Combined uncertainty and scenario analysis within Life Cycle Assessment of waste management systems

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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?
Roger Strand, University of Bergen, Centre for the Study of the Sciences and the Humanities, Norway
Responsible Research and Innovation (RRI) is a cross-cutting principle of EU’s research funding programme “Horizon 2020”. Indeed, in Rome 2014, scientists and policy-makers jointly produced the “Rome Declaration on RRI in Europe”, that states that “excellence today is about more than ground-breaking discoveries – it includes openness, responsibility and the co-production of knowledge”. The principle of RRI acknowledges that civil society is entitled to “speak back” to science and help shape the knowledge and technology of tomorrow in an ethically acceptable and sustainable direction.

What does RRI entail in practice, for researchers, innovators and policy-makers? How could RRI principles and practices help to pick up more early warnings to avoid costly late lessons from unfortunate impacts of science and technology? The lecture will present the conceptual basis of EU’s RRI policy. Specifically, a full appreciation of RRI depends on a theoretical understanding not only of risk, but also of decision-making under uncertainty, ignorance and indeterminacy.

Keynote Monday
Food Safety in a Complex Changing World
Bernhard Urf, 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. Effects on the environment are also considered as they may pose an indirect risk to food and feed. 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 on 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 freshwaterwaters 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 (ASRT), 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 environmental 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 standardised protocols for drift characterization in the field Develop an enhance 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. Beside 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 future 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 Arable 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

C. Mackay, BASF SE; Z. Alonso, Bayer Crop Science Division; M. Lamshoef, Bayer CropScience AG / R&D; M. Reitz, H. Resseler, Syngenta Agro GmbH; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; P. Sweeney, Syngenta; P. Volz, BASF SE; S. Webb, Syngenta Ltd; B. Zillgens, Dupont GmbH

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 with different levels of experience with uptake testing participated in a round robin test and studied uptake of [14C]-1,2,4-triazole by wheat plants. Afterwards, uptake of ten radiolabelled 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 compounds/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: applying the TSCF value from the appropriate soil (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 EurPUGF workshop (York, 2015) 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 the academia and authorities facilitated optimisation 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 has been provided to date on study design. 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 general study designs 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

Although used in the European leaching assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a first-order (SFO) degradation of the pesticide concentration in total soil. Thus, this is one of the cornerstones 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 passes. Simulations of MON 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.
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. 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 relevant exposure model by evaluating several established exposure models. For this we tested their performance with peak concentration data monitored in small agricultural streams in central Germany. These field data comprised of event-driven samples of 46 active substances from field-campaigns performed in 1998, 1999, 2000, and 2013. The highest agreement of measured and modelled peak concentration was yielded by the risk indicator EXPOSIT/EVA (R²: 0.38), followed by the more complex model FOCUS STEP 2 (R²: 0.36), SYNONPS-TREND (R²: 0.24), and GERDA (R²: 0.24). (ii) The translation from toxin pressure to pesticide risk was implemented by applying the field based and validated exposure – response relationship SPARE_solution. Based on these information and models, we calculated the trend of toxin pressure and pesticide risk in Germany from 1996 to 2016 for the 500 substances authorized in this period. The method presented here requires only few input data, is based on validated models and can be adapted to regional conditions around the world.

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

7 The hydrophobicity delay: symptoms and solutions
A. Celisie, Queens University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemetry

The objective of this presentation is to set out the conditions under which chemicals of high hydrophobicity experience significant delays in approaching equilibration 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 Cwater and fish concentration Cfish is kfish/kwater times delay. The characteristic time for uptake and loss t is L²/kW/kf. Slower uptake and loss will occur if the partition ratio kW is large, and the fish must contact kfish·L its own volume to approach equilibrium. Very hydrophobic 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 biouptake model for fish. Due to the very high hydrophobicity (log kW≈10 for D5) and very low water solubilities Cw must be very low, which results in a very long equilibration time. Uptake time to equilibrium for D5 was estimated to be ~2000 days, to get Cw=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/aerogel partitioning data in which the onset of a hydrophobic delay (HD) is approximated when log kwater=kd[4]. Development of this delay can be used 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 kW≈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 validated the use of passive dosing for the study of chlorinated paraffin (CP) 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 (Kow,water). Inoculation of D. magna was observed after 48 hours under different exposure concentrations. APCLI-QTOF-MS was used for CP quantification. Both silicone-water and organic carbon-water partition coefficients overlap between different categories of CP technical mixtures. CP-52, labelled as a MCCP, had a similar silicone-water partitioning coefficient as a restricted SCCP – Huels 70C. We demonstrate that increasing average chlorine content of each CP mixture significantly increases the log Kow,water and Log Kow,organic. These results could have implications on the study of environmental fate of CPs: in-use CPs (MCCPs and LCCPs) might be equally or more bioaccumulative as restricted SCCCPs. Kow,water is particularly helpful at predicting bioaccumulation of chemicals into biota. The next step is to quantify the bioaccumulation potential of CPs. With the use of the passive dosing approach, we are producing laboratory experimental data that can be used to help in the on-going regulatory discussion on MCCPs and aid their risk assessment.

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 of these compounds. The effects of the specific compounds, octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5), and dodecamethylcyclohexasiloxane (D6) was determined for the Lake Pepin, Minnesota (USA) food web. The objective of this work was to determine if cVMS materials are biomagnified in this freshwater ecosystem. To determine whether the benthic influence in the Lake Pepin aquatic food web affected the trophic magnification factor (TMF) values for the cVMS compounds, a companion study was conducted to determine the biomagnification and TMF value of a reference material, 2,3,4,4',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 level. The TMFs measured for the three cVMS materials were all99% of the uncertainty for cVMS TFM 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 TMF of 2.2 in the evaluated food web, indicating biomagnification. TMFs 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, Saitama University Research Institute; 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 Dianshan (China), and their bioaccumulation in the San Francisco Bay estuary system. A total of 11 halogenated carbazoles, including 3-chloro, 3,6-dichloro, 1,3,6,8-tetrachloro, 2,3,6,7-tetrachloro, 3-bromo, 2,7-dibromo, 3,6-dibromo, 1,3,6-tribromo, 1,3,6,8-tetrabromo, 1-bromo-3,6-dichloro, and 1,8-dibromo-3,6-dichlorocarbazole 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 pg/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. In most of these species samples, PHCZ concentrations exceeded those of polychlorinated brominated biphenyls, polybrominated biphenyl ethers (PBDEs), and polychlorinated biphenyls (PCBs). 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 (REP) 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 studies systems and potentially in global 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 constituents of essential oils in fish determined in an in-vivo benchmarked dietary exposure study: A case study for pine oil

C.L. Chen, Stockholm University / Department of Environmental Science and Analytical Chemistry; M. McLachlan, Stockholm University / Environmental Science and Analytical Chemistry (ACES); M. MacLeod, ITM - Stockholm University / Department of Environmental Science and Analytical Chemistry. Essential oils are fragrance materials that are registered as natural complex substances (NCS) under the European REACH legislation. One of the categories of information required in a REACH registration is information about the potential for bioaccumulation of NCS by fish. Determining the bioconcentration factor (BCF) of essential oils can be challenging in a standard flow-through uptake/depletion experiment. Previously, we demonstrated that a single dietary exposure coupled to the benchmarking technique could be applied to an artificial mixture for measuring the in vivo BCF. Here, we report an application of our proposed BCF-determination methodology on a real essential oil – pine oil. Fish (rainbow trout) were dosed with a mixture of the pine oil and a suite of benchmark chemicals and a single dose of 2,4-dichlorophenoxyacetic acid (2,4-D) to the reference chemicals. The test compounds deposed faster from the soma than the GIT, making estimated whole-body depletion slower (conservative) compared to the soma only. HCB was the chemical most resistant to depuration via all the test compounds. Benchmarking to HCB reduced the standard error of measured k12,SMTP from the soma for most of the chemicals, with k12,SMTP ranging from 0.001 d−1 (PCB52) to 2.98 d−1 (BAc). The apparent BCF (BCFacc) values in soma for the key components in pine oil and the reference chemicals were in the range of 98.2 L kg−1 (BAc) – 1030 L kg−1 (BCP7) – and 267 L kg−1 (DiCB) – 1730 L kg−1 (HCB), respectively; while for the benchmarked BCF (BCFbioass) in soma, they are 46.3 L kg−1 (BAc) – 2570 L kg−1 (BCP), and 208 L kg−1 (DiCB) – 197000 L kg−1 (PCB52) respectively. We conclude that a single dietary exposure coupled with the benchmarking technique is a feasible experimental approach for measuring the BCF of NCS in fish.

12 ROLE OF ADIPOSE TISSUE RESPONSIBLE FOR ECHOLOCATION IN THE BIOACUMULATION PROCESS OF POLYPHILE COMPOUNDS IN HARBOUR PORPOISES

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Previous studies have suggested that persistent organic pollutants (POP) can lead to adverse effects in marine mammals, including harbour porpoises, exposing them to health risks. 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 Dianshan (China), and their bioaccumulation. The median concentrations of PHCZs by species ranged from 33.7 to 164 ng/g lipid weight. In most of these species samples, PHCZ concentrations exceeded those of polychlorinated flame retardants (PBDEs) and polychlorinated biphenyls (PCBs). 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 (REP) 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 studies systems and potentially in global aquatic systems. These findings raise the need of additional research to better elucidate their sources, environmental behavior, and fate in global environments.

13 Interpretation and uncertainty - overcoming challenges of translating LCA results into reliable information

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LCA: everything is relative and nothing is certain. Over the past five years, we have published several approaches to deal with data and uncertainties. In addition, LCA involves making methodological choices. Over the past five years, we have published several approaches to deal with data and uncertainties. In addition, LCA is a methodological framework that integrates knowledge from almost all environmental scientific disciplines, in particular immunology. Interpretation and uncertainty: a corollary for Risk Assessment. Correlation of process emissions: a corollary for Risk Assessment.

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Keywords: Echolocation, life time bioaccumulation, biomonitoring, PBTK modelling, POP

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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 (EPISuite, 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 ChF’s 95% CI was primarily attributable to fragrances (61%), surfactants (20%), and the scenario of products used (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. A more long-term 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 wastewater 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 (or parametric 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 LCI analyses are 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 hypothetic 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 hypothetic 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 condition considered, and of the scenario most sensitive for carrying out discernibility analyses across background conditions, allowing obtained 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 to be compared can be made. 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 R² 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 investigating 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. Regionalization characterizes the spatial variability of the 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 uncertainty. This research work proposes a procedure to prioritize regionalization efforts based on global sensitivity analysis (GSA) to reduce the 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 World+ is used to assess environmental impacts. Statistical tests are then used to derive sectorial recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. These recommendations mean 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 is performed.

17 Reduce the uncertainty of LCA results by prioritizing the regionalization effort: a sectorial meta-analysis

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Uncertainty in Life Cycle Assessment (LCA) can limit the results interpretation. Regionalization is one of the ways to reduce the uncertainty due to spatial variability. Life Cycle Inventory (LCI) regionalization deals with investigating 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 World+ is used to assess environmental impacts. Statistical tests are then used to derive sectorial recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. These recommendations mean 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 is performed.

18 Poster spotlight: MO387, MO388, MO389

Poster spotlight: MO387, MO388, MO389

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

Unravelling longitudinal pollution patterns in freshwaters 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 (QExactive™ Plus, Thermo Scientific) with a heated electrospary 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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Pharmaceuticals and personal care products (PPCPs) and artificial sweeteners (ASWs) have been detected in environmental media and their byproducts (e.g., DATS) and metabolites (e.g., NPEC), polymers (PEG, PPG and many ethoxylated derivatives), pharmaceuticals (e.g., valsartan, diclofenac, carbamazepine, etc.), personal care products (UV stabilizers) and food additives (e.g., sucralose), some of them (e.g., sulfon) identified in the environment for the first time. The list of compounds reflected here not only shows many of the substances that can potentially escape from wastewater treatment but also constitutes a first step towards a more detailed characterization of the chemical exoscape in the marine environment.

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Pharmaceuticals, personal care products (PPCPs), and artificial sweeteners (ASWs) in river and groundwater from the Ganges River Basin, India

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Emerging organic contaminants (EOCs) have 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 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, cyclamonte and sucralose. 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 then that EOCs and ASWs have been isolated and in some cases isolated 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 plausibe 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 bioisoderegeneration 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 environment of the river water. This work was possible due to support from EU-EPF programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

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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 “hiding” 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 consideration of reactivity to CBZ-10,11-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 reconstituted in 100 µL of ELISA buffer. The TOP-EASI-MS applied on a specifically “positive” fraction revealed an exact mass of m/z = 389.168 and a chloride pattern. The compound is cetizine, an antihistaminic. It appeared in our samples from spring on and was responsible for 20% of the overestimation we found initially with the CBZ antibiotic. 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-acetyl-sulfamethoxazole, 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
R. Sjers, KWR Watercycle Research Institute / Chemical Water Quality and Health; A. Brunner, B. Hajema, Vitens; P. Bauerlein, KWR / Analytical and Environmental Chemistry; M. de Jonge, Vitens; Y. Fujita, M. Schirks, KWR Watercycle Research Institute; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health

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 anorganic chemical parameters. However, most drinking water utilities monitor a broad set of parent chemicals and their transformation products, using both target, non-target and bioanalytical methods. The EU DWD stipulates 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 Vitens 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 present here the results of a risk-based monitoring program for all 26 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
L. Welge, P. Janz, BASF SE, Crop Protection - Ecotoxicology; P. Sowig, Bayer CropScience / Ecotoxicology

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 LD50) for fish and bioconcentration factors (BCF) in fish. Where possible, fish BCF values were correlated to 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. Adriaanse, Alterra Wageningen University and Research Centre; A. Aitch, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, 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 Santaliatea, Institute for Game and Wildlife Research (IERC) UCLM-CSIC-JCCM; C. Topping, University of Aarhus; S.M. Weir, Queens University of Charlott / 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 2009; 7(11):1-27. The purpose of the risk assessment for amphibians and reptiles is to ensure the safety of these organisms and risk mitigation options are needed if unacceptable, adverse effects on their populations may occur. It was concluded that the current risk assessment scheme does not fully cover all relevant life stages and thus might not protect the persistence of amphibian and reptilian populations in the long term. The EFSA working group proposes a general risk assessment framework based on a tiered approach and adapted to assess local and landscape-scale risks for amphibian and reptilian populations. Identified knowledge gaps regarding amphibians and reptiles concern on the one side the exposure assessment, with e.g. a lack in data about size and location of ponds inhabited by amphibians. On the other side, central issues are missing links in the risk assessment framework, especially concerning the impact of oral and dermal exposure routes. Invasive field studies are very difficult to perform with these organisms and risk mitigation options – if available - could usefully be included in risk assessment as an alternative to full-scale field studies. Practical mitigation options would need to be developed and adapted for local environments to be most effective. [1] EFSA PPR. 2017 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.20YY. [2] EF. 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 309/1-726 Ecotoxicological assessment of Caretta caretta (Linneaus, 1758) in the Mediterranean Sea using an integrated non-invasive-protocol
S. Casini, University of Siena / Scienze Fisiche della Terra e dellAmbiente; I. Caliani, M. Giannetti, L. Marsile, D. Coppola, N. Bianchi, T. Campiani, University of Siena / Department of Physical Sciences, Earth and Environmental Sciences; S. Ancora, University of Siena / Physical sciences, Earth and environment; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment

Caretta caretta is the most common sea turtle in the Mediterranean Sea. The IUCN 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 on the impact of plant protection products on marine turtles. 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 non-intervention positive way in Invasive Rescue Center of the Mediterranean Sea. Blood, skin and carapace samples were used to test biomarker responses and contaminant (OCs, PAHs, Ph, 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 CYPIA1, 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 alterations can be potentially related to their coastal habits. Older specimens showed the highest levels of cytochrome P450 in skin, which may indicate a higher oxidative 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 seals - 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 their 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 at 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 blubber were positively related to age in this species. Hilaric 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 T4 were negatively related to contaminant exposure. We also 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 Trichlosan-induced embryotoxicity in the yellow-legged gull

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Trichlosan (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, information 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 mg/g body 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 assessed effects on embryo body mass, tarsus length and head size, as well as liver and brain mass. The amount of oxidant species (i.e. ROS), enzymatic activities (SOD, CAT, GST) and the levels of lipid peroxidation (LPO) were measured as biomarkers of oxidative stress, while levels of DNA fragmentation were measured as genetic damage endpoint. To check for the reliability of the injection method, we quantified TCS concentration in the yolk of unincubated eggs, while to assess its transfer to the embryo, we measured TCS in residual yolk and in the liver and brain. TCS concentrations in yolk from unincubated eggs were similar to the nominal ones (158.9±35.3 ng/g wet weight), while lower concentrations were found in residual 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 limitedly in the brain (0.2±0.1 ng/g wet weight). TCS concentration did not significantly affect embryo morphological 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 both experiments, we sprayed the emergence site with tepucanozole on embryonic development and post-hatching survival. Chicks were weighted 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 (Walld’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 tepucanozole 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 (Walld’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 may affect reproduction in birds. Likewise, potentials of 2,4-D and tepucanozole in the overlap of egg laying and incubation period with a pesticide application may result in direct effects on chick survival. These results demonstrate the need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines from a European regulatory perspective. There is a need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines within the EU, is the responsibility of the European Medicines Agency (EMA); however, developed best practices are shared by all member states. The EMA also aids in coordinating other European procedures with several member states involved. EMA frequently authorises and takes advice from specialist working parties aligned to the specific provision or modification of regulatory guidelines or procedures within the committee for veterinary medicine products (CVMP). One such group focuses on the improvement of the guidance to industry and other stakeholders on environmental risk assessment alongside the provision of reflection documents that aid understanding or address specific areas for clarification in regulatory procedures. The overview will highlight some of these recent developments, in improved regulatory advice for current or future procedures. It will summarily cover issues around assessing and limiting veterinary medicines in groundwater, the use of higher tier testing of dung fauna, the use of higher tier plant testing, improvements in PBT assessments, future plans during developing improved guidance for the assessment of risks from aquaculture.

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

L. Weeks, Joint Nature Conservation Committee

This presentation will focus on the developments in the environmental risk assessment of veterinary medicines from a European regulatory perspective. There is a need to continuously develop and react to changing requirements to perform more sophisticated, quantitative or robust environmental risk assessments for veterinary medicine products. The centralised approval of new veterinary medicines within the EU, is the responsibility of the European Medicines Agency (EMA); however, developed best practices are shared by all member states. The EMA also aids in coordinating other European procedures with several member states involved. EMA frequently authorises and takes advice from specialist working parties aligned to the specific provision or modification of regulatory guidelines or procedures within the committee for veterinary medicine products (CVMP). One such group focuses on the improvement of the guidance to industry and other stakeholders on environmental risk assessment alongside the provision of reflection documents that aid understanding or address specific areas for clarification in regulatory procedures. The overview will highlight some of these recent developments, in improved regulatory advice for current or future procedures. It will summarily cover issues around assessing and limiting veterinary medicines in groundwater, the use of higher tier testing of dung fauna, the use of higher tier plant testing, improvements in PBT assessments, future plans during developing improved guidance for the assessment of risks from aquaculture.
They are an important link from laboratory to field. Mesocosms provide the environment 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 studies are used to evaluate the potential impact of pharmaceuticals on aquatic ecosystems in the context of PPP risk assessment and will provide important aspects for assessing the environmental concentration of biocides, veterinary medicines and chemicals in the context of REACH.

35 Estimation of insecticides in run off in farm waters - what product groups are the sources? S. Wreck, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; O. Olsson, Leuphana University of Lüneburg / Institute for Sustainable and Environmental Chemistry; K. Kümmerer, Leuphana University of Lüneburg / Institute of Sustainable and Environmental Chemistry

The emission sources of biocidal active substances in households have been under discussion since these substances have been detected frequently in municipal wastewater. The emissions from certain households, e.g. facing factories, 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 year for one household sewage. The 14 substances analysed with an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMIT, DCOIT, DEET, diuron, icaridine, OIT, piperonyl butoxide (PBO), triclosan, tetrachloroethylene, terbutryn and tetramethrin. In comparison, the levels of products applied at this household were in the range of 1-5 kg/year. The results from the analysis of these compounds showed that C12-benzalkonium chloride and carbendazim were the main contributors to the emissions from this household, with concentrations of 15 kg/year and 10 kg/year, respectively. These results underline the importance of considering household product inventories when investigating emissions from households, especially for biocides.
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 icaridin 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 carbamazepine 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 in 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 (NM3001K 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 treatment with TiO₂-NPs the 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 meaningful 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

N. Chau, School of Biological Sciences, Plymouth University; D. Boyle, Plymouth University; R. Handy, University of Plymouth

Bioaccumulation is one of the key triggers of concern for environmental risk assessment that has 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 addressability of an ex vivo gut sac technique to reproduce 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 Ag-S 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 Ag-S 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, gillbladder, kidney, spleen, gills and carcasses were dissected. Tissues from both experiments were analyzed 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 muscularis of the mid and hind intestine after exposure to Ag NP and Ag-S NP compared to AgNO₃, but no difference between ENM treatments. The in vivo experiment demonstrated significantly more Ag in the mid and hind intestine of Ag NP and AgNO₃-treatments compared to Ag-S NPs. Silver 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 Ag-S 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


Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics etc. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the wastewater are 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 Onchorhynchus 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 [liver and kidney glutathione S-transferase (GST)], lactate 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 ICP-OES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into untransformed effluents with raw wastewater, the amended AgNPs per adult daphnid showed a concentration 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 trout 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 (MNMs) are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the wastewater are 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 Onchorhynchus 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 [liver and kidney glutathione S-transferase (GST)], lactate 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 ICP-OES analysis. No chronic effects were found in D. magna after exposure to effluents with transformed AgNPs. However, when supplemented into untransformed effluents with raw wastewater, the amended AgNPs per adult daphnid showed a concentration 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 trout 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.
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, nanocomposite) and 100 µg TiO₂ 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 long-term bioaccumulation. Samples and aqueous effluents 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 NPs 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 for terrestrial microbial experiments, giving 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)

43 Optimization of Oil Spill Response Planning and Preparedness Using Spill Mitigation Impact Assessment (SIMA)

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Oil spill emergency response plans (OSRP) are required as part of permitting for offshore operations. An OSRP typically includes risk assessment and detailed plans for responding to different types of oil spill accidents involving shipping, pipelines, platforms, and/or subsea wells. The owner/operator must demonstrate to state and federal regulatory authorities that the company’s OSRP for offshore exploration and production operations conform to all applicable regulations and international standards and practices, and further demonstrate that the necessary equipment and trained personnel are in place to respond quickly and effectively to an oil spill accident. In the event of an oil spill accident, the priorities for oil spill response (OSR) are to protect people, prevent or mitigate environmental damages, and prevent impact to affected communities. Spill Impact Mitigation Assessment (SIMA) is a science-based framework evolved from Net Environmental Benefits Analysis (NEBA) to broaden the focus from consideration of mitigation of ecological impact to include mitigation of socioeconomic and cultural impacts, as well. SIMA is a method for identifying and comparing the socio-environmental and -economic benefits of alternative OSR options, with the goal of selecting options that best mitigate the consequences of spilled oil and impose the lowest additional negative consequences on environmental and social resources. SIMA is both site- and spill- specific, and is particularly useful during the initial planning and preparedness period for oil and gas exploration and when new technologies and best practices emerge that need to be adopted into safety, health and environmental operational programs. This paper describes a spill impact mitigation assessment framework using recent examples of OSRP work conducted for the Arctic Oil Spill Response Technology Joint Industry Project, American Petroleum Institute Gulf of Mexico Deepwater Project, and several companies working in tropical marine environments. The applicability of SIMA to marine resources and habitats is also discussed. The SIMA framework typically includes (a) assessment of initial impacts and potential consequences in the marine environment, and (b) effectiveness and consequences of deploying different spill response strategies.

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 Benefits Analysis (NEBA) approach for oil spill response contingency planning. Recently, IPIECA-API-IOGP published guidelines on the implementation of NEBA, using a novel process known as Spill Impact Mitigation Assessment (SIMA). When applied, the objective of SIMA is to conduct an evaluation that will enable decision-makers to choose response options that will result in the best overall recovery of the ecological, socio-economic and cultural resources. One of the key advantages to the SIMA process is its transparency – it clearly shows and documents the assumptions and decisions that were used to arrive at the conclusions. In most spill scenarios, no single response option is likely to be completely effective; often, the best approach to minimize the ecological impacts is to employ multiple response options. This will require consensus between key stakeholders and the various decision-makers on the benefits and
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 regulators, thus 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 G. Lassalle, ONERA; A. Chateauneuf, ONERA; J.-C. Quesnel, ONERA / Optics and Associated Technics; A. Credoz, R. Hédacq, TOTAL SA / Environment; P. Borderies, ONERA / DEMR; G. Bertoni, INRA / Dynafor; D. Dubucq, TOTAL SA; A. Elger, University of Toulouse in L'ecolab

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 J. Beyer, NIVA - Norwegian Institute for Water Research; H.C. Trannum, T. Bakke, Norwegian Institute for Water Research; P.V. Hodson, Queens University / School of Environmental Studies; T.K. Collier, Delta Independent Science Board NINA, Street Suite 121-201

47 Oil spill combat and effects in the Arctic coastal environment; selfcleaning potential and in situ burning S. Wegeberg, Aarhus University / Department of Bioscience; J. Fritt-Rasmussen, Aarhus University / Department of Bioscience - Arctic Environment; O. Geer Hansen, M.B. Larsen, Greenland Institute of Natural Resources; K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

48 How are our indices? - differentiating between sources in a weathering environment S.M. Mudee - NILU - Norwegian Institute for Air Research / IMPACT

49 Exposure to bisphenol S alters microRNA expression in male zebrafish (Danio rerio) J. Lee, J. Ji, Yongin University

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. Qualitative real-time qPCR was used to confirm 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 miRNAs were involved in the regulation of BPS-induced toxicity via the interaction 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.

51 Toxicity and neurotic profiling of sediments from Gulf of Bothnia with Danio rerio embryos

R. Massag, Helmholtz Centre for Environmental Research, UFZ; H. Hohert, 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. Haglund, C. Galampaos, Umea University; M. Tysklin, Umea University / Department of Chemistry, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

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 exposome methods. 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 test fish 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) 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 aromatization inhibition

S. U. Ayobahan, IME Fraunhofer / Department of Aquatic Ecotoxicology; E. Eidebrecht, 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 VGT 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). Through identification of the biological endpoints preceding to apical endpoints have become crucial for analyzing, accessing and determining chemical effects. Proteomics, therefore, show appreciable promise as a molecular screening tool for identifying specific alterations between exposures and controls, which is therefore imperative in discriminating endocrine disruptors from substances with a non-endocrine MoA. Such tool was freezes the need for longed higher-tier testing. The study successfully identified alternative diagnostic and regulatory endpoints 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 25-26°C on a 16:8 h light:dark cycle for 21 days were exposed to various concentrations of fadrozole (0.0, 0.1, 1, 10 µg/L) and analyzed for plasma vittellogenin 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 stimulation 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 trigger 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 immunoprocident 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 biotransformation processes and activation 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; B. Seiwert, Helmholtz Centre for Environmental Research/ UFZ / Department Analytical Chemistry; T. Reemtsma, Helmholtz Centre for Environmental Research / Department Analytical Chemistry

There has been concern that they may exhibit a limited biotransformation 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 for a proof of concept for activation in fish embryos as in many cases compounds for a proof of concept for activation in fish embryos as in many cases produces more toxic substances. Organophosphates (OP) can serve as a model suitable for high-resolution (30 µm) ultrasound biomicroscopy. Whole-body energy stores (triglycerides and glycogen) and mRNA transcript abundance of selected genes of interest were determined. Compared to controls, adult zebrafish exposed to elevated dietary SeMet exhibited impaired swimming performance (lower fatigue velocity or Ucr). It 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 transcript abundance of several genes involved in lipoid 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 ecophysiologica effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the model organism leads to the investigation of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the model organism leads to the investigation of metabolic, energetic, and cardiovascular toxicities caused by excess dietary Se in contaminated ecosystems.
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. Roer, 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 / Sinhhuber 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). However, research groups use 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 hi-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=32/treatment) were treated with controls (DMSO, blank filter portions) and treatments (PM2.5, filter portions 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 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 compounds that are relevant 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. Sabioni, 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 this heritage we received from the past to the future generations. It is urgent to include 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 been very limited until now and it has not yet generated policies designed to mitigate the impact and to develop preventive adaptation strategies. The presentation will be focused on future scenario on the effects of climate variability on the vulnerability of cultural heritage at European level. Recommendations on the inclusion of cultural heritage in the national adaptation strategies and plans to climate change will also be discussed.

56 Nanotechnologies for the conservation and connected risks

M.J. Mosquera, University of Cadiz

Most products commonly employed in the restoration and conservation of cultural heritage materials have not been specifically developed to preserve such elements. In addition, they are plagued by limited performance and structural drawbacks such as low adhesion, poor penetration, and cracking. Another disadvantage is the requirement for most products to be dissolved in volatile organic compounds (VOCs), which produce environmental and human health risks in their use. 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 “InnovacConcrete”.

57 Towards the European Research Infrastructure in Heritage Science: E-RHISH

L. Pezzati, CNR-Istituto Nazionale di Ottica

The European Research Infrastructure for Heritage Science (E-RHISH) entered the European strategic roadmap owning PM4 - treatment in all extraction methods to preserve such elements. Another disadvantage is the requirement for most products to be dissolved in volatile organic compounds. 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. Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses C. Roer, 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 / Sinhhuber Aquatic Research Laboratory and the Environmental Molecular Toxicology

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

59 Scenario Development for Off-field Soil Exposure and Risk Assessment M. Wang, WSC Scientific GmbH / Dept Efate Modelling; J. Kleinnmann, WSC Scientific GmbH; T. Schad, Bayer Ag / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer Ag / Ecotoxicology; G. Goehret, Bayer CropScience AG / Environmental Safety; P. Neumann, Buyer Ag; S. Bub, Tier3 Solutions GmbH

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 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/off-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 scenarios 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 specific crops.

60 Biogenic residues formation from pesticides - an overview

K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); A. Miltner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; M. Kästner, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology

Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in environmental matrices. Hence, they have the potential to contaminate the environment and pose a risk to human health. In order to assess the environmental fate and exposure of pesticides, it is essential to understand the processes that govern their behavior in the environment. One such process is the formation of biogenic residues, which are the result of biological, chemical, and physical degradation pathways. The formation of biogenic residues can be influenced by various factors, including the chemical structure of the pesticide, environmental conditions, and the presence of microorganisms. In this presentation, we will discuss the formation of biogenic residues from pesticides, with a focus on the factors that influence their formation and the potential implications for environmental fate and exposure.
nitrogen) source and the NER were mainly biogenic. The major formation of biogenic residues is supposed to be relevant for easily biodegradable contaminants under significant CO₂ formation. However, in the case of more recalcitrant pesticides like bentazone, the incorporation of C into microbial biomass, although reported to be very low, cannot be completely excluded.

61 Derivation of a wash-off factor for FOCUS modelling based on literature research S. Singt, DR. KNOELL CONSULT GmbH / E-Fate Modelling; C. Wollmann, Dr Knoell Consult GmbH; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety

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, PELOMO, 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 EFSA 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 acetone/IR/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 pertinent 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.


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 active substance in the organism 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 and 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 logKow 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 models developed for time-varying conditions and the multi-scale dynamic of agricultural settings. 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 M. Morfessi, University of Insubria / Department of Science and High Technology; E. Terraighi, University of Insubria (Como) / Department of Science and High Technology; Como; A. Di Guardo, University of Insubria / Department of Science and High Technology

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 case of extreme 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 Institute of Biological Research of Norway, Julius Kühn Institute, Dr. Schumelow, Julius Kühn-Institute / Institute for Strategies and Technology Assessment; B. Golla, Julius Kühn Institute / Institute for Strategies and Technology Assessment; J. Strassemeyer, ral Research Centre for Cultivated Plants / Institute for Strategies and Technology Assessment

In response to the implementation of the EU-directive on sustainable pesticide use by Norway, 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, SYNOPS, 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-EPA PRZMS and VFSMDO have been incorporated in SYNOPS for a more realistic modelling of the runoff/erosion modules and the functioning of the vegetated filter strip. The Norwegian tool, SYNOPS-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-based climate data. Data are classified out for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tilage/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 SYNOPS-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.

Hydrophobic Chemicals and Mixtures: Reliable Investigations
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Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna
H. Lin, X. Xia, S. Bi, X. Jiang, H. Wang, W. Wen, School of Environment, Beijing Normal University

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 HOC and five dissolved organic matter containing pyrene (C_{DOM}) was managed 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) > higher molecular weight (HMW, > 100K Da) > DOM M < molecular weight (MW, < 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 forms of DOM silicone rod has successfully been used in 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.

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Passive dosing for constant concentration and defined composition of hydrophobic organic mixtures
K. Hannenskjøg, Technical University of Denmark / Department of Environmental Engineering; H. Birch, DTU Environment / Department of Environmental Engineering; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; P. Mayer, Technical University of Denmark / Department of Environmental Engineering

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 (UVCBs). 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 UVCBs (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 UVCB 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.

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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 Tetralin and Decane was conducted on 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 Tetralin 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.

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Untangling the biodegradation of hydrophobic chemicals in OECD and novel tests using a unified modelling approach
F. Pohle, Technical University of Denmark / DTU Environment; A. Brock, DTU Environment / DTU Environment; F. Sibany, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; M. Kästner, Helmholtz centre for environmental research – UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark / DTU Environment

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 modelling approach across the spectrum of OECD degradation tests and 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, propargite and pyriproxyfen). Model predictions were fit to experimental results obtained elsewhere in conventional degradation tests activated sludge or soil or in novel passive dosing setups, in the absence of a single degradation pathway. A high agreement between model predictions and empirical data was shown by adjusting only the ratio v_{biodegr}/K_w, which describes biodegradation kinetics according to the Michaelis Menten equation. Overall, a high range of v_{biodegr}/K_w values was shown for the selected substances (0–55 mg g^{-1} d^{-1}), indicating that both limited bioavailability and intrinsic recalcitrance can explain HOC persistence. This study represents a first attempt of using a unified modelling approach for predicting biodegradation of HOCs across a variety of tests, showing promising results towards persistence prediction of organic chemicals during regulatory screening. Ongoing research is focusing on extending the model applicability by (i) including 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.

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History of polychlorinated biphenyl deposition to snow and ice from the Lomonosovfonna glacier, Svalbard
M. Ramann, Hermann-Gmeiner Associates LLC / Environmental Chemistry; O. Garmash, University of Helsinki; E. Iaksoin, Norwegian Polar Institute; C. Teixeira, D.C. Muir, Environment and Climate Change Canada / Aquatic Contaminants Research Division

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 spring 2010. Lomonosovfonna is the highest-elevation ice on Svalbard at 1250 masl. It is above the tropospheric boundary layer at all times of year (maximum ~1000 masl), so all of the contaminant inputs have sources 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 pm 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 60° 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 concentration profile is dominated by PCB 110, 70, 74, 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, 70,74, 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 Acorol products, and apparently is not found in other PCB parent mixtures. Its source is often considered to dairylead 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; C. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry; K. Liu, Jilin University. Environmental monitoring data from 110 locations in the Bohai and Yellow Seas, China, were used for environmental occurrence and distribution studies of UV stabilizers. 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 reviewed. Due to their chemical properties, most UV stabilizers accumulate in sediments and soils. The current study shows levels of organic UV stabilizers in sediment from surface to bottom in sediments of the Bohai and Yellow Seas. The presence of UV stabilizers in sediments can be indicative for potential exposure to aquatic organisms and human beings.

71 Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia

M. Owsianiak, Technical University of Denmark; G. Cornelissen, S. Hale, Norwegian Geotechnical Institute; H. Lindhjem, Menon Economic Research, CAS; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry; K. Liu, Jilin University. Biochar production from biomass residues and its use as soil conditioner in 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, regionalization of biochar impacts shows similar scores. This is mainly because 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 a significant impact of spatial differentiation 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 Kom 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 site-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, ArianeGroup / 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 Create-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. Consequentially, considering end-of-life management during the design of the space projects becomes a subject of interest.

This study shows levels of organic UV stabilizers in 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.

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

P. Verschuelen, Radboud University; R. Kranenburg, 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 is a key contributor to photochemical smog formation. Considering generation of debris in operating orbits with a resource depletion perspective allows us to address the environmental footprint of the spacecraft’s design and operations. Volume occupance by debris and dead space 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.

Implementing ozone formation effects due to poplar plantations for biomass production in Europe (LCIA perspective)

P. Vercauteren, Radboud University; R. Kranenburg, 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 bioenergy generation. 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, yr/km²hectare) 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.
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (II)

77 Review on removal and reactions of micropollutants in biofilms under growth and non-growth conditions

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 biofilms. In this contribution it is highlighted which ecological conditions (aerated versus denitrifying; high and low BOD loads) have been found to favor degradation. 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 are believed 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. Importantly enough, it was 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. Caraeng, 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 anticonvulsant using lacticase enzyme, extracted from a white-rot fungi Trametes Versicolor, in the presence of 2,2’-azino-bis(3-ethylbenzthiazoline-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 irradiation 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 can be done 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 macrolide antibiotic transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays

S. Terzić, Rudjer Boskovski Institute / Division for Marine and Environmental Research; P. Kostanjevecki, Faculty of Food Technology and Biotechnology; N. Udiković-Kolic, Rudjer Boskovski Institute; J. Ćurko, Faculty of Food Technology and ERY TPs assay; M. Matosić, Faculty for Food Technology and Biotechnology; J. Lončar, I. Mihalićević, T. Smital, Rudjer Boskovski Institute; M. Ahel, Rudjer Boskovski Institute / Division for Marine and Environmental Research

The aim of the present study was to investigate the transformation of three prominent representatives of macrolide antibiotics (azithromycin - AZI, clarithromycin - CLA and erythromycin - ERY) in model biodegradation and ozonation experiments. The study included determination of the transformation kinetics of the parent compounds, identification of transformation products and ecotoxicological evaluation of transformation processes using two different end-points. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of 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 very limited. Under the present conditions, the results of similar ozonation experiments carried out in the laboratory bioreactor and abiotic 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 photobioreactor

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 emerging concern (CECs) in environmental matrices is a reality today. However, the combination of two quantification approaches, i.e., matrix derivatization and high resolution mass spectrometry, as well as sensitive (LODs below 20 ng L⁻¹) and/or specific TPs quantification (based on UHPLC-MS/MS) are very often only available in high-tech laboratories. The cost-competitive methodology presented here, successfully developed and validated, intends to fill the existing gap between current environmental needs and analytical capacities. It consists of an innovative method for CECs and TPs analysis. Two experimental conditions were tested: transformation products (TPs), in sewage and sludge using a fully automated on-line DI-SPME - On-fiber Derivatization – GC-MS. The validated method was proven to be reliable, thanks to the combination of two quantification approaches, i.e., matrix-matched and internal standard, as well as sensitive (LODs below 20 ng L⁻¹) for most of the target compounds in sewage and 30 ng g⁻¹ sludge), versatile and green. The method was successfully applied to real samples from a novel pilot scale anoxic-anerobic photobioreactor, where the influence of the organic load on the removal efficiencies (REs) of the CECs was evaluated. The three operational stages, at three different concentrations of chemical oxygen demand (COD) (690±6 mg L⁻¹, 493±11 mg L⁻¹ and 434±11 mg L⁻¹), were maintained for 40 d (<4 times the SRT) to achieve representative steady states. The maximum REs of ibuprofen, naproxen, salicylic acid, triclosan and propylparaben were 91±1%, 28±7%, 83±5%, 85±0% and 82±5%, respectively. COD concentration only affected clearly ibuprofen and naproxen REs. This pointed out oxidation as an important removal mechanism for those compounds. In contrast, salicylic acid and triclosan REs slightly increased at lower COD loads. For the propylparabens, high elimination rates (above 80%) were observed regardless the COD concentration. Oxidation, biodegradation, sorption, photolysis and quantification and photo degradation were discussed as the possible removal mechanisms of the tested contaminants. This constituted the first evaluation of CECs removal by a synergetic interaction between algae and bacteria depending on the organic carbon load.

81 Abatement of amoxicillin, ampicillin and chloramphenicol from aqueous solutions using activated carbons prepared from grape slurry

R. Chitongo, Cape Peninsula University of Technology Cape Town South Africa / Chemistry; B. Oseodu, Cape Peninsula University of Technology / Faculty of Applied Sciences; O.S. Olatunji, Cape Peninsula University of Technology / Chemistry

There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The capability of activated carbons produced from grape slurry to adsorb amoxicillin, ampicillin and chloramphenicol was determined. The purpose of this study was to assess using the grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHL). This study therefore aimed at monitoring of the three antibiotic residues in selected surface water samples. Activated carbons produced from grape slurry were prepared and explored for abatement of the antibiotics’ residues from aqueous solutions. An UHPLC-UV-DAD was optimized for the separation, detection and quantification of antibiotics in aqueous matrix. Solid Phase Extraction (SPE) procedure was optimized for recovery studies. Surface water samples were collected along the mainstream and a number of sampling points were measured in over two seasons. The removal of antibiotics from aqueous solutions using activated carbons produced from grape slurry was also studied. Activated carbons were characterized using FTIR, SEM and EDX in order to understand the structural and functional properties of the activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate the antibiotic residues using activated carbons produced from grape slurry waste. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing adsorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherms studied. The biodegradation efficiency was studied using the sludge culture enriched in the presence of AZI (10 mg/L) over a period of 4 months while the ozonation experiments were performed in different matrices by applying selected pH conditions and ozone concentrations. The dissipation kinetics of 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 very limited. Under the present conditions, the results of similar ozonation experiments carried out in the laboratory bioreactor 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.

82 Biodegradation of organic micropollutants in constructed wetlands: comparison of design and operational parameters

P. Carvalho, Aarhus University, Department of Environmental Science / Department of Environmental Science; Y. Zhang, Southern University of Science and Technology / School of Environmental Science and Engineering; L. Tao, Nottingham Trent University / School of Animal, Rural and Environmental Sciences; L. Zhang, C.A. Arias, Aarhus University / Department of Bioscience; K. Bester, Aarhus University / Department of Environmental Science; H. Brix, Aarhus University / Department of Bioscience

Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove all micropollutants in the treated effluents. Constructed wetlands (CWs) have 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 closed. Organic micropollutants 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 nitrification activity and
with the biofilm activity, suggesting that bacterial processes play an active role in
the micropollutants biodegradation. The removal of the organic micropollutants 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.

PFAAs levels in the eggs and reproductive parameters, including the total hatching
success, eggshell thickness or the total breeding success. PFAAs 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 PFAAs in wild bird populations. [1] Buck RC, Franklin J, Berger
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environment: terminology, classification, and origins. Integr Environ Asses 7:
Environ Sci Technol 36: 146-152.

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

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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-know. The
objective of the present study is to improve our knowledge on the exposure to Pb in
birds of prey in Spain by means the integration of active and passive monitoring
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 (n=27) and liver (n=685) lead
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)
of 9 species trapped alive in the field. Adverse effects of lead exposure on heme
biosynthesis, P/Ca 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 (1/6) and red kite (1/18) presented
abnormal blood Pb exposure levels (>200 ng/ml). Passive monitoring revealed that
the species with lead levels in liver associated with clinical poisoning (18-30 µg/g
d.w.) were cinereous vulture (1/39), Eurasian griffon vulture (2/228) and western
marsh-harrier (1/32); and the species with clinical severe poisoning (>30 µg/g d.w.
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
δ-ALAD activity in blood and blood Pb concentration. Ca/P homeostasis was also
affected by Pb exposure, because elevated blood Pb levels were associated with
lower Pb levels 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
perspective of the risk that Pb represents for raptors. Here we confirm with 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 >30 µg/g d.w.) in Eurasian griffons and golden
eagles with the passive monitoring.

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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 at ecologically relevant concentrations (0, 12.6, 126, and
1260 μg PAH/kg body weight/day). We found that EROD activity 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 serum 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
PFAAs levels, oxidative status and reproductive success in great tits (Parus
major) inhabiting a contamination hot-spot.
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Physiological and Ecotoxicological Research (SPHERE), University of Antwerp /
Biology; L. Bervoets, Universiteit Antwerpen; R. Lasters, E. Prinsen, H. Abd
Elgawad, University Antwerp; M. Eens, University of Antwerp / Department of
Biology
Perfluoroalkyl acids (PFAAs) are substances which have been produced for more
than five decades. 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 about their effects on organisms. We report here PFAAs 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

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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 Investigación en Recursos Cinegéticos IREC
CSICUCLMJCCM / Wildlife 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’-DDT, 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 Island were one of the
Spanish regions with the highest use of OC pesticides due to the intensity of its
agriculture. A previous study performed between 1988 and 1994 with 14 unhatched
eggs of West Canarian common kestrel (Falco tinnunculus canariensis) from
Tenerife Island showed elevated concentrations of p,p’-DDE (17.9 µg/g dw;
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 kestrels from Tenerife Island collected between 2009 and 2016. We have
also measured the porphyrin composition of the eggshells to explore the use of
these pigments as biomarkers of organochlorine pollution in birds. Biometry, status
of embryo development and eggshell thickness were recorded from each egg and
information about habitat characteristics 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:dichloromethane (4:1), 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:HCl 3N (2:1) and then

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analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; μg/g dw): p,p′-DDE, 152.5 ± 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 altitude (+). The shell index was not affected by p,p′-DDE levels, but decreased with embryo development. Propotophyrin IX was the only pigment in eggshells and its concentration was negatively affected by HCB levels in egg content.

87 Long-term increase in secondary exposure to anticoagulant rodenticides in European polecat in Britain K.A. Samsbury, University of Exeter / Environment and Sustainability Institute; R. Shore, Centre for Ecology & Hydrology (NERC); H. Schofield, L. Croese, The Vincent Wildlife Trust; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; D. Sleep, NERC Centre for Ecology & Hydrology; A.C. Kitchener, G. Hankte, 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 polecat traits (age, sex, provenance), to potential exposure pathways by analysing stable isotopes of carbon (δ13C) and nitrogen (δ15N) in whiskers, and to data collected from polecats in the period 1992-99. In all, 54 of 66 (80%) polecats from 2013-16 had detectable liver residues of at least one SGAR. Bromadiolone (73%) 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 polecat 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 regions although the reason for this is unclear. Both number of compounds and total SGAR concentrations were positively associated with age, presumably due to 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-established areas and suggests an increase in the risk to polecats from SGARs throughout their range.

88 Poster spotlight: M0035, M0036, M0083

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 delivery of 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-established 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

90 Understanding risk - a better approach to reduce uncertainty M. Wang, WSC Scientific Gmbh / Dept Efate 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 (focal 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 for answering questions on relative effectiveness of different risk assessment tools. The present presentation results from two case-studies which are given in this presentation. In these case studies the risk assessment is performed using a new approach in which the relative toxicity to different species is taken into account.

91 Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms E. Zielińska, 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 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 risk to non-target species in agro-ecosystems 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.

92 Where are the Springtails? A vertical distribution model for Collombolans V. Roehe, 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. Schaefer, 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 collobenland 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 and effect. We will present the individual-based model of the soil-dwelling collobenland *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 pesticides. 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 experiment we assessed the vertical dispersal of *F. candida* in OECD soil in relation to food concentration 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: 0-1 cm, 1-2.5 cm, 2-5 cm, 5-10 cm, 10-15 cm and 15-20 cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (24°C, 12h photoperiod). The dispersal of individuals, food and F. **candida** was monitored by means of simulation and simulation results of the vertical dispersal of collobenlands 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. Mintran, University of Exeter / Biosciences; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences; S. Maynard, AstraZeneca / Safety Health and the Environment; A. Brown, Exeter University / Biosciences; C. Liu, Syngenta / Environmental Safety; S. Parker, Cefas Weymouth Laboratory; P. Throbe, Syngenta / Environmental Safety; S. Parker, Cefas Weymouth Laboratory

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 in population-level interactions and specific behaviors. IBMs can therefore be used to extrapolate from a large number of individual-level 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 parameterized from field and laboratory obtained data. 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. Stangel, Wageningen University / Institute of Environmental Toxicology; J.D. Stark, Washington State University / Dept of Entomology; K. von Stackelberg, 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, timescales 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 model 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, Victoria, and 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 in terms of 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 Chinko salmon, the specific economic ecosystem services provide by the endpoint and the watersheds, and finally demonstrate the risk 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 / Toxicology Department; D. Hermans, L. Sloat, Wageningen University and Research; N. van den Brink, Wageningen University / Dept of Toxicology

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 surface of 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±0.4 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 addition 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 the environment**

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, decompostation 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_{dried}) 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 1% of the Ag_{dried} concentrations in the soil columns. The correlation between remobilized Ag_{dried} and Ag_{undist} 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 retention. 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_{undist} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Au_{dried} release to the percolate water (t= 480 d, control= 24 ng l^{-1}, Lysimeter (7 mg kg^{-1}) = 56 ng l^{-1}, DIN 38402-11) was obtained for the lysimeter with the highest Ag ENP application. 

The aim of this work is to study the effect of soil composition, flow velocity, initial ENP concentration, and the specific ENP. The columns were packed with an excess of rainwatered canola, barley) showed a low uptake of 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 experiments
K. Norrills, SLU Uppsula / Soil and environment; G. Cornelis, Swedish University of Agricultural Sciences / Soil and environment
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 system, adsorption and desorption of nanoparticles (ENPs) on the soil surface is involved in the biogeochemical cycle. The selection of the appropriate laboratory column experiment to determine the sorption efficiency (α) can affect the outcome of the column experiment. 

Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver
J. Merten, Precious Metals and Rhenium Consortium c/o EPMF; K. Arijs, ARCHE; E. Smolders, Katholieke Universiteit Leuven; D. Leverett, wca; K. Oorts, ARCHE
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/nm^2). A nanosilver product (AgNP) and commercial silver nitrate were used as controls.

The transformation of copper and zinc (-nanoparticles) during sewage sludge composting
J.J. Wielsinski, ETH Zürich/Eawag / Process Engineering; A. Gogos, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Process Engineering, Particle Lab; A. Voegelin, Eawag Swiss federal Institute of Aquatic Science and Technology; E. Morgenroth, Eawag Swiss federal Institute of Aquatic Science and Technology / Process Engineering; R. Kaegi, Eawag - Swiss federal Institute of Aquatic Science and Technology 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 phosphorous 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^{+2} and Zn^{+2} to four aliquots of sewage sludge, subsequently digested and combusted under different 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 copper and silver uptake was calculated from the spiked fraction of Cu and Zn. For control sludge and sludge spiked with Zn^{+2}, 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 concurrently high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a spectrum of Zn 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 results were obtained for CuO-NP and ‘truly’ dissolved Cu ions (LAF 1). A nanosilver product (AgNP) and commercial silver nitrate were used as controls.
controlled by the intrinsic particle properties and modified by the hydrochemical conditions (pH, electrolytes, NOM). Distinct from homogenisation is the complexity added to the system by SPM in the case of heteroggregation. In this contribution we therefore propose an approach to develop a heteroggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogue selection. The development of such a protocol requires (1) selecting SPM analogues and homogenization conditions complex enough to represent relevant environmental characteristics, and simple enough for routine testing, (2) a novel, easy-to-handle experimental setup to estimate a heteroggregation 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 homogenisation in the OECD TG 318 and will also apply for heteroggregation. 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 heteroggregation.

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**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

L.M. Basirico, Louisiana State University; R.J. Portier, Louisiana State University / Environmental Sciences

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 associate 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 hopane/sterane biomarker families. The presence of biomarkers in the sediments allows for the identification of MC-252 containing sediments via 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 shaling 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 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 sampling transect. A partial effects-model was used to control for 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 origination 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 intermoult 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 oil, we tested a restraint-induced 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 in dispersed crude oil but not oil alone. This suggests that dispersed oil interferes with either the pre-mRNA transcription of hsp90 or potentially causes alternative splicing of pre-mRNA.

hsp90 expression in crabs exposed to oil alone was slightly elevated, although not significantly. However, the intermoult duration of crabs exposed to oil increased, meaning that exposure to oil results in delayed molting 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 (sponge 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-hycyclic aromatic hydrocarbon (PAH) or a complex of organic contaminants composed of two or more fused carbon rings and are a major constituent of crude oil. Exposure to ultraviolet radiation (UV) can exponentially increase the toxicity 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 potentiation 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 latent mortality was observed in daphnia tests overall whenchronological correlation 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

SETAC Europe 28th Annual Meeting Abstract Book
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. Photoxototoxicity 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). Wild-type zebrafish embryos (Danio rerio) and weathered mid-distillates, crude and heavy oils can exhibit photoenhanced toxicity. These same products do not exhibit photoxototoxicity 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 photoxotoxic toxicity, and a diversity of aquatic invertebrate and fish species can exhibit photoenhanced toxicity when exposed to combinations of oil and UV. Risks of photoxototoxic 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.

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

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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 ISD-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 throughout 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 treatments, no statistically significant differences in key parameters (e.g., total phytoplankton biomass or chlorophyll-a concentrations) were observed across microcosm treatment groups. This suggests that the dilbit may not be having a significant impact on the primary producers as the oil slick sink 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)

107 Life-stage, and species-specific effects of dietary methylmercury exposure

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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 amino acid transporters with the potential to cause severe, irreversible effects on developing organisms. Here, we describe the development in effects of dietary MeHg in a model fish species (Pimephales promelas). Exposure to environmentally relevant concentrations of MeHg during development led to alterations in the dopaminergic system, metabolome, 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 brain 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 midbrain 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 telosts as a surrogate model species for studies assessing effects of MeHg on highly conserved systems in higher vertebrates.

108 Characterization of molecular toxicity pathways of Fluoxetine in rainbow trout and white sturgeon using RNA-Seq whole transcriptome analyses

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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 life-history traits and vulnerabilities. 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 development of objective endpoints. The Putative Toxicity Pathway 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 96th static renewal system, and sequence-by-synthesis whole transcriptome analysis was used to determine unique differential 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. This study coupled transcriptome analysis using ontologies based on zebrafish 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.

109 Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish

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Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in adult life as well as in early life stages of aquatic organisms. A diversity of studies exist of model fish species, such as Menidia beryllina, a euryhaline fish with short generation time that is found throughout North America and is demonstrated to be sensitive to contaminants. As such, we exposed Menidia beryllina embryos (8 hpf) until 21 dph to environmentally relevant of an androgenic or estrogenic EDC of emerging concern: levonorgestrel (Levo) (10 ng/L), bifenirin (Bfn) (5 ng/L), respectively, and coupled this exposure with testing of an established androgenic or estrogenic EDC: trenbolone (TB) (10 ng/L), and ethinylestradiol (EE2) (5 ng/L). We are now evaluating the potential for transgenerational EDC 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 show increased atelic 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

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Polycyclic aromatic hydrocarbons (PAHs) are ubiquitous contaminants in the environment. Many of them cause developmental defects in fish, and cardiovascular tissue seems to be the most sensitive tissue. The mechanisms of toxicity remain largely unresolved for many PAHs, though partial adverse outcome pathways (AOPs) exist for those that are aryl hydrocarbon receptor (AhR) agonists. Rainwater trout (Oncorhynchus mykiss) yolk sac larvae were exposed to sublethal concentrations of PAHs that act via different mechanisms of toxicity: Retene, an AhR agonist causing dioxin-like toxicity; pyrene and phenanthrene, weak AhR agonists causing toxicity independently of AhR; and fluoranthene, a CYP1A inhibitor interfering with PAH metabolism. Also the effects of a mixture of retene and fluoranthene were studied. Information was gathered at multiple levels of biological organization to reveal the mechanisms of toxic action. Changes in cardiac transcriptome, proteome and metabolome were explored over time. Physiology and function of the heart were also studied. At the whole organism level, growth, yolk consumption, and developmental defects and abnormalities were monitored. Each PAH caused a unique pattern in OMICS analyses, and the mixtures of retene and fluoranthene caused a different transcriptomic profile from that of each of the single compounds. Retene differentially regulated genes involved e.g. in muscle contraction and ion metabolism (ion channels). Retene and phenanthrene impaired cardiac function in larval rainbow trout. Both caused bradycardia, and phenanthrene caused also arrhythmias. Phenanthrene affected cardiomyocyte electrical characteristics. As cardiovascular development is modulated by the beating heart and blood flow, alterations in cardiac function during development may have long-lasting impacts in cardiovascular tissues. Different PAHs clearly have different mechanisms of toxicity. The transcriptomic changes can at least partly account for the cardiotoxicity of retene, but the cardiotoxicity of phenanthrene seems to involve a direct effect on cardiac ion channels.

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

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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 biodiversity and the use of water resources for various industrial, agricultural and urban activities, with many focal places of point and diffuse contamination along its main axis, in addition to a high degree of modification of land use associated with the basin. The high degree of intervention and fragmentation of this river has affected the biota and water quality mainly in its lower third, due to the convergence of complex chemical mixture and antrhopic interventions in the main course. The objective of this study is to determine how the development associated with 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 Poster spotlight: MO248, MO249, MO256

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

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

E. Giovannini, ASviS

114 How the SDGs are being addressed in Horizon 2020

M. Tamborra, European Commission - DG Research and Innovation

115 Examples of EU projects related to SDGs

M. Recchiuti, European Commission - EASME

116 Why SDGs are relevant for a large enterprise

A. Valcaldia, ENEL

117 Conclusions

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

118 Questions and answers

119 Rethinking Atmospheric Mercury Chemistry

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. 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 (Hg(I) or 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-RMA), and an Hg calibrator system (Utah State University) have demonstrated that the standard measurement method for GOM –collection on a KC1 denuder- results in underestimation of GOM concentrations by 2 to 13 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

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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 antagonist effects of Se against Hg has been suggested to have antagonistic effects. Due to interactions between Se and Hg, observations in different studies indicate that mercury methylation is impeded in seawater under probable nutrient limitation compared to those found under phosphorus limitation (P-limitation) conditions.

We used two published studies that have examined the interaction of Hg and Se in both multicellular organisms and environmental media containing microbes (sediment, water). In this study, we seek to better understand the uptake of Hg and Se into biota, as well as the biochemical conditions that promote this pathway and evidence for antagonistic effects. We use samples collected from the mountain- and NEAO-feeding populations of the Atlantic mackerel (Scomber scombrus) and Atlantic herring (Clupea harengus) species. We determined total mercury (THg), MeHg and selenium (TSe) in coastal and marine 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 wolfishes (Anarhichas spp.), respectively. The mean Hg levels ranged from 0.40 to 0.77 mg kg⁻¹ ww with the lowest level in Atlantic mackerel (Scomber scombrus) samples. 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 (P>0-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 nuclear acid bacteria seems responsible for most of Hg methylation in seawater under P-limitation. Under 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 microesten to mesozooplankton was observed through an increased biomagnification factor. In contrast, MeHg fractionation and uptake are probably enhanced under P-limitation, which emphasizes its impact on Hg transfer to higher trophic levels. In order to test our nutrient-limitation hypothesis, we have performed statistical analysis on previously published data from the Southern Atlantic Ocean. We found similar correlations between MeHg (DGM) and physico-chemical characteristics of seawater under probable nitrogen limitation compared to those found under P-limitation in our study. These results indicate that mercury methylation is impeded in seawater under probable nutrient limitations.

124 Poster spotlight: MO333, MO334, MO335

Bioavailability and realistic risk assessment of organic
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in stagnant 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 method. This method is based on anisotropic exchange kinetics and therefore allows for reliable estimates of nonpolar organic chemicals in sediment porewater. For deducing truly free 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 spiked PRC concentrations. For the field study, we immersed low-density polyethylene (PE) and silicone thin sheet passive samplers of multiple thicknesses and spiked with PRCs 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 the in-situ data 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 series of studies in our group on whole sediment-epipolarized 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 bioassay 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 polyacrylate 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 0.02-0.1 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 development 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 their 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 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 carried out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of slow degradation PRCs) were taken. The Tenax, soil, and resulting soil PAHs concentrations were in the range of 0.02-0.4 µg/L. This study suggests that the 4d ESR dosing assay is a rapid and reliable method to determine bioavailable concentrations in a wide set of operational conditions ranging from a different time scale to dissimilar treatments (planting, biosurfactant application, etc.).

128 Prediction of very slow biodegradation of PAHs in soil and validation in a pilot of 25 years
R. Rietra, Akerra and Wageningen University / sustainable soil management; J. Harmens, Wageningen Environmental Research / CALM

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) and mineral has been followed during periods up to 25 years. Biodegradation took place on real scale fields (six landfills and one depot) within the Netherlands. On these fields dredged sediments were applied and PAHs were measured in the original sediment and resulting soil. PAHs were present in concentrations up to 550 mg/kg d.m (Dutch list). The objective of the investigation was to find experimental prove on the existence of long term biodegradation in field conditions. The measured data showed continuation of PAH degradation and this could be distinguished in 1) fast degradation in the first year 2) slow degradation in the following 6 years and 3) very slow degradation of PAHs from 6 years until at least 25 years. Knowing the long time necessary for biodegradation, it will be necessary to supply regulators with data and prediction to convince them that biodegradation will be a safe option to remediate the contaminated soil or sediment Bioavailability as measured with Tenax can be used to explain and predict the rate of biodegradation of PAHs. Three desorption fractions can be measured. Tenax applied at 20°C gives the fast desorbing fraction; at 60°C the slow desorbing fraction is measured. The slow desorbing fraction in the residue represents the very slow desorbing fraction. These are the same fractions as considered in the approach of Ortega-Calvo et al., (2015). In the soil, desorption makes the PAHs bioavailable and if conditions allow biodegradation (sufficient oxygen and water), this will occur. Using results measured in stored original sediment the different bioavailable fractions were measured and a model with three first order degradations (fast, slow and very slow) the really observed degradation curve could be predicted. Moreover, the fractions measured in present soils, shows that biodegradation will continue, however with a very small slow rate. Experiments applied in the nineties of last century had already shown that risks measured with biosolids were already not measurable after 6 years of landfarming. After 25 years the PAHs concentrations were 10 mg/kg d.m. or lower which made the soil usable within the Dutch legislation.

129 Linking bioavailability of complex mixture to toxicity changes to assess recovery of contaminated soils

A six-month laboratory scale experiment was carried out to assess the effect of biobar and compost amendment on the behaviour and toxicity of tar mixtures in
130 Impact of Biochar Additions to Soil on Contaminant Sorption and Plant Bioavailability

W.J. Doucette, Utah State University; Y. Water Research Laboratory; J. Flitjawski, D. McAvoy, Utah State University

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. Biochar is biologically inactive, and does not participate in plant metabolism. It undergoes 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 often 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 triclosan (TRI)), an anticonvulsant that prevents seizures and relieves nerve pain (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihyperlipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinya Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they were produced from tree species that often require removal because they are considered invasive or due to insect infestations. Corn was used as the test plant because of its commercial value and has been grown with reclaimed water in the past. After the 28 day growing period, it was found that there was no negative impact of the biochars on corn growth. Once the plant tissue was analyzed and sorption experiments are completed, the impact of biochars on corn growth. Once the plant tissue analysis and sorption experiments are completed, the impact of biochars on corn growth. Once the plant tissue analysis and sorption experiments are completed, the impact of biochars on corn growth. Once the plant tissue analysis and sorption experiments are completed, the impact of biochars on corn growth. 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quantify 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 framework for LCIA based on freshwater fish 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 Condition Potential (HCP) indicator for river fish species is developed and invertebrates is proposed and applied in France at Q50 (wet season) and Q90 (dry season) flows. HCP represents the change of available habitat area deriving from river discharge alteration. At the river reach scale, HCPs from different taxa have been aggregated under different perspectives in order to test the results’ sensitivity to negative and positive effects of hydrological alteration. A spatial aggregation has been also performed on the waterbodies and sub-watershed. Subsequently, 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 aventered by the marginale quality where this model is used for quantifying and assessing species loss. HCP is also useful to find critical points and extra-European species habitat preferences. The proposed model is a promising effect factor for mechanistic impact characterisation which should be integrated with fate model factors describing hydrological alteration at a computable spatial resolution. Since habitat models are based on species abundance, HCP represents the first step towards developing biodiversity damage indicators complementary to species loss.

134 The use of dynamic stock model to the definition of characteristic factors for biotic resources depletion
A. Hidalgo Montpellier SupAgro / LBE ELSA; J. Langlois, Université Paul-Valéry Montpellier 3 / CEFE UMR CNRS Université de Montpellier Université Paul-Valéry Montpellier

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 impact of biotic resources depletion. Subsequently, the global stock depletion impact according to a marginal change in inventory. Here, the Depleted Stock Fraction (DSF) is considered to be the assessed impact while the elemental flow of the inventory is a mass of fish removed from the biomass stock. The marginal approach is applied to the Schafer model, a commonly used model in fisheries representing the dynamics of the biotic stocks. It combines catch, consumption 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
B. Lieselot, R.A. Alvarenga, Ghent University / Department of Sustainable Organic Chemistry and Technology; V. Van Linden, Flanders research institute for agriculture, fisheries and food / Technology and Food Science Unit; I. Roldán Ruiz, Flanders research institute for agriculture, fisheries and food; J. Dewulf, Ghent University / Department of Sustainable Organic Chemistry and Technology

The growing demand for food and feed has put a pressure on the agricultural sector, which resulted in agricultural intensification. This entails many adverse environmental impacts and takes a huge toll on land resources; which can result in land degradation. Especially farm management can affect soil quality (e.g. soil organic carbon, SOC) by for instance the choice of crop rotations. The agricultural sector is therefore forced into a more sustainable approach. To assess the environmental sustainability, life cycle analysis (LCA) is a powerful tool. As 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 (AoPs). Although soil quality changes are often related to the AoP ecosystem health, we focus on the AuP 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) are used to indicate the long-term effect of agricultural land use. 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 calculate characterization 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

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

137 Full-scale WWTP balancing with passive samplers offers new insights in xenobiotic elimination processes
T. Galle, Luxembourg Institute of Science and Technology; C. Koehler, M. Bayerle, D. Pittois, Luxembourg Institute of Science and Technology LIST; A. Christen, J. Hansen, University of Luxembourg / Faculty of Science, Technology and Communication

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 an inventory-based framework in line with the simple concept of using recalcitrant compounds like carbamazepine to normalize sampling rates from in-and 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. Normalization with carbamazepine and lisdexamfetamine 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
S. Schüpp, N. Montemmuro, DIAEA-CSIC / Environmental Chemistry; D. Barceló, IQAB-CSIC / Department of Environmental Chemistry

Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Hundreds of wastewater-borne pharmaceuticals 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 photocatalysis involving reactive oxygen (O3, ?OH), peroxy radicals (HO2, ?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 processes. Following the identification of photo-TPs, a list of suspect TP s was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstituted 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 IRR-MS/MS, l-generation co-extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, the polymers (free and non-attached counter part) was dominated by Sphingobacteriia (a class of Bacteroidia, Spirochaetes and unclassified bacteria from water surrounding territoriali; S. Pérez, A. Martínez-Varela, IDAEA-CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry. 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 (AER) and in the anaerobic digester (ANA) (a class of Polypropionactonolenoïd (PCLD); average MW=1250) was selected as suitable candidate polymer probe. The method was tested in four WWTPs by exposing the polymer probes in situ at the secondary and nitrifying/denitrifying conditions. The progress of biodegradation after several days of exposure was reflected on changes in the MALDI-TOF MS/MS spectra obtained across the sample’s surface. Peaks were identified using liquid chromatography coupled to high-resolution mass spectrometry (QExactive, Thermo Scientific), which evidenced the occurrence of three different degradation pathways (Fig. 1). Results were further examined using different image processing tools enabling to observe differences between degraded and non-degraded areas. Microbial biomass was collected from water surrounding the polymers (free-living communities) while communities attached to the polymers were collected scratching the surface of the polymer with a sterile spatula. The nucleic acids were extracted by phenolization process. One microtitre of the extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, composition of free-living bacteria was significantly different than polymer-attached microbial. Bacteroidia, Spirochaetes and unclassified bacteria co-dominated the free-living communities in AER and ANA, although metabolisms under oxic and anoxic/nitrifying conditions differ quite dramatically. Polymer-attached in the same waters were dominated by deltaproteobacteria, a class of proteobacteria characterized by sulfate-reducing bacteria although also harbors aerobic phylotypes. Free-living microbial communities in IN were dominated by Bacteriodia, belonging to the phylum Bacteoidetes whereas their potential attached was dominated by Spirochaetes (a class of Bacteroidetes). Results suggest that polymers select specific microbial groups that benefit from consumption of PCLD that can be used as carbon and energy source.

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

A. Martínez-Varela, CSIC - Spanish National Research Council / Environmental Chemistry; M. Vila-Costa, B. Zonja, IDAEA-CSIC / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agroambientali e territoriali; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry, D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry. 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 (AER) and in the anaerobic digester (ANA) (a class of Polypropionactonolenoïd (PCLD); average MW=1250) was selected as suitable candidate polymer probe. The method was tested in four WWTPs by exposing the polymer probes in situ at the secondary and nitrifying/denitrifying conditions. The progress of biodegradation after several days of exposure was reflected on changes in the MALDI-TOF MS/MS spectra obtained across the sample’s surface. Peaks were identified using liquid chromatography coupled to high-resolution mass spectrometry (QExactive, Thermo Scientific), which evidenced the occurrence of three different degradation pathways (Fig. 1). Results were further examined using different image processing tools enabling to observe differences between degraded and non-degraded areas. Microbial biomass was collected from water surrounding the polymers (free-living communities) while communities attached to the polymers were collected scratching the surface of the polymer with a sterile spatula. The nucleic acids were extracted by phenolization process. One microtitre of the extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, composition of free-living bacteria was significantly different than polymer-attached microbial. Bacteroidia, Spirochaetes and unclassified bacteria co-dominated the free-living communities in AER and ANA, although metabolisms under oxic and anoxic/nitrifying conditions differ quite dramatically. Polymer-attached in the same waters were dominated by deltaproteobacteria, a class of proteobacteria characterized by sulfate-reducing bacteria although also harbors aerobic phylotypes. Free-living microbial communities in IN were dominated by Bacteriodia, belonging to the phylum Bacteoidetes whereas their potential attached was dominated by Spirochaetes (a class of Bacteroidetes). Results suggest that polymers select specific microbial groups that benefit from consumption of PCLD that can be used as carbon and energy source.

140 Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant

g. Šuksek, Université de Sherbrooke / Civil Engineering In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problem which 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 unreactive 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 acetylpheneone and phenolic organic contaminant acetalaminophen 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. Microbial iodine synthesis is investigated with different KI (0.5, 1.0 and 2.5 mM) concentrations and different laccase activities (5, 10, 30 and 40 U/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 HRMS/MS and LC-MS/MS. I generationphoto transformations and disinfection effect of iodine measured by fecal coliform tests. 0.35 maximum mM/L iodine concentration could be synthesized during experiments. During iodine production, while phenolic compounds’ concentrations were decreased (50% acetalaminaphen 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 I was possible using laccase-system. Iodine production was affected by the initial laccase activity and mediator concentration. Laccase catalyzed bacterial activity in municipal wastewater was also assayed without the addition of any mediator assuming that wastewater already contains mediators such as acetalaminophen. Using that system, non-fecoliforms present in the tested wastewater were removed.

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

D. Zahn, Hochschule Fresenius / Chemistry and Biology; A. Harloff, Hochschule Fresenius, University of Applied Sciences; R. Meusinger, TU Darmstadt / Chemistry; T. Fönnel, Hochschule Fresenius, University of Applied Sciences; T.P. Knepper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology 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. PMT substances, like the halogenated methanesulfonic acids (MSAs) found in drinking water consumption might be a major human exposure pathway for PMT substances. While environmental contaminants of low and intermediate polarity have been thoroughly investigated, so far only little is known about the most polar, and thus potentially most mobile, water contaminants. This gap in knowledge might be caused by difficulties in the analysis of very polar organic chemicals, especially in their enrichment from aqueous matrices. PMT substances might be, among others, pharmaceuticals, personal care products, or industrial chemicals, however, a significant fraction may also be (dead-end) transformation products (TPs), and thus a substantial share of them might still be unknown. In a non-target screening approach dedicated to the identification of mobile, potentially drinking water relevant organic contaminants, we identified chlorinated and brominated methanesulfonic acids (MSAs) as novel water contaminants and estimated the concentrations of the most prevalent congeners to be in the 100 ng/L range for some drinking water samples. Accurate quantification, however, was hindered by the lack of commercially available reference materials. Thus, we synthesised chloromethanesulfonic acid, dichloromethanesulfonic acid, bromomethanesulfonic acid and bromochloromethanesulfonic acid as well as 1,3,5-trifluoromethanesulfonic acid (as internal standard) and included these analytes in a sample pre-treatment and hydrophilic interaction liquid chromatography – tandem mass spectrometry (HILIC-MS/MS) method dedicated to the analysis of very polar water samples taken from high population areas in different countries.

142 Poster spotlight: MO272, MO273, MO274

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

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European Commission Joint Research Centre / Bioeconomy unit; A. Laurent, DTU / Division for Quantitative Sustainability Assessment DTU Management Engineering

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 were assessed in life cycle impact assessment (LCIA) 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 inherent 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 LCIA methods such as the consensus model USEtox.

144 Combining economic modelling and LCA to assess regional policies: key learnings from a case study on the French forestry sector

T.B. Beussier, INRA; E. Loiseau, Irstea; S. Caurla, INRA

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 of system aggregation and disaggregation are different and the two tools are not compatible. Therefore, the socio-economic and environmental impacts must be calculated separately and the economic model must be adjusted to the system boundaries of the LCA model in order to ensure a consistent combination. This paper presents a case study on the regional bio-economy in the French East Region. The case study aims to illustrate how economic and environmental models can be used in combination to assess the socio-economic and environmental impacts of a regional policy. For this purpose, a structural economic model of the French forest sector, including the wood-energy sub-sector, is coupled with an LCA model of the regional bio-economy. The economic model is used to study the competitiveness of the regional bio-economy and to explore economic scenarios that influence the optimal use of forest resources. The LCA model is used to assess the environmental impacts of the different scenarios, including emissions of greenhouse gases and other pollutants. The results show that the use of forest resources for bio-energy production has a significant impact on the environmental performance of the sector. The economic model can therefore provide valuable insights for policy makers when trying to assess the socio-economic and environmental impacts of regional policies.

146 LCA_WIND_DK: temporarily, 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 associated with the manufacturing of the machine to the energy it produces during the use phase. The modelling of the life cycle inventory in each phase should ideally cover the temporal, geographical and technological dimensions of the product system under study. Assumptions are commonly used to simplify and handle variable aspects of the inventory. While this approach provides generic one-size-fit-all inventories, it may disregard important characteristics of the wind turbine leading to biased end-results. As these assumptions are prone to differ from one study to another, the results become hardly comparable. With more than 1,500 wind turbine models on the market and a high variability of sites and manufacture periods of the different installations, it makes the environmental assessment of wind turbines a daunting task. LCA_WIND_DK is an on-demand tool that provides the environmental footprint of Danish wind turbines based on systematic individual cradle-to-grave life cycle inventories using manufacturer’s data. The temporal context is considered through the evolution of the electricity mix used for manufacturing wind turbines as well as the evolution of recycled content in materials over time. The spatial dimension is also accounted with geographical parameters determining the amount of material required, such as the distance from shore and sea depth for offshore installations. Additionally, the supply chain is adapted to select the relevant origin of the material and energy suppliers. Finally, the approach considers the registered electricity production for past and present wind turbines and assesses the future production from site-specific weather re-analysis data and power curves. Denmark, where wind power contributed to 45% of the total annual electricity production in 2016, is a prominent choice to demonstrate the benefits of such comprehensive modelling based on spatial, technological and site specific LCAs. The approach generates a life cycle assessment for each of the 11,000 wind turbines that compose the Danish national fleet over the 1980-2030 period. The results, through the on-line tool, are showcased as a map, where the individual performance of each of the past, present and future wind turbines can be consulted, as well as the performance of the whole fleet at a given year.

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 a product and service. Therefore, assessing environmental footprints of households is of great importance 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 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 or region, and different consumption 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 building refurbishment programs to future mobility solutions such as autonomous vehicle systems.

148 Poster spotlight: MO109, MO110, MO113

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

149 Modelling ecological scenarios for the assessment of chemical effects on stream communities
A. Gergs, Bayer AG - Crop Science Division / Department of Environmental, Social and Spatial Change; S. Classen, K. Ladermann, Research Institute gaiac; T. Strauss, M. Hammers-Wirtz, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment

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 extent 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.

150 Robust implementation of TKTD models with Bayesian inference
V. Budroit, Université Lyon 1; S. Charles, Université Lyon 1 / Laboratoire de Biometry and Evolutionary Biology

The application of toxicokinetic-toxicodynamic (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. Unintergovernmental institutions as the OECD have acknowledge 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 (R software). To soft to software, we have recently been modelled using toxicokinetic (TK) and toxicodynamic (TD) models in order to describe the underlying mechanisms for the enhanced toxicity. The purpose of the current study was to test if the same C. riparius 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 17 day exposure period followed by six days of recovery in clean water. To assess the combined toxicity 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-model before applying the internal metabolism to the observed TKTD kinetics. 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 EC\(_{50}\) values for the 24 h pulse exposure of 1.06 ± 0.27 and 0.28 ± 0.10 µmol 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 further wish to hope that many of the compounds could be investigated in the laboratory with exposed to azole and pyrethroid pulses with varying time intervals between the pulses.

152 Integration of temperature-dependent TKTD kinetics in individual-based population modelling - A case study with Chaoborus crystallinus
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The toxicokinetic-toxicodynamic (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. But the temperature exposure seems to be particularly relevant 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 applied to the TKTD framework GUTS, which has been 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.
Using temperature dependencies for the relevant biological and toxicological processes, this modelling approach allows a more realistic risk assessment of pesticides for populations in the field.

153 Assessing lethal and sublethal effects from time variable exposure for different life stages with the DEB model: an example for a Pythroid in rainbow trout
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Ecotoxicology
The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-TD modelling. As part of this 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 provided mechanistic fromation for the growth 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 metabolised from the mussel tissue and the fry have enough reserves 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.

154 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 toxipants on populations such as individual-based models (IBMs) was suggested as relevant tools. Furthermore, IBMs can be coupled with DEB models which describe physiological processes of an organism. However, the development of DEB-IBMs requires a large number of data for the organism and population dynamics 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 teleost fish is relatively well known and a DEB model for this organism 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 the effects 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.

New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment

155 Atmospheric Microplastic’s: A novel method for the identification of microplastics in the inhalable size range.
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Microplastics (microP) are a class of persistent omnipresent contaminants found in aquatic, atmospheric and terrestrial environments. Current investigations focusing on atmospheric microP have identified microP fibre >50µm in size. For atmospheric microP to have the potential to directly impact human health, research must now focus on the presence of microP in the inhalable size range (<10µm). We present a novel analytical method compatible with the Multi-vial cyclone sampler (MVCS), for assessing whether microP down to an inhalable size range are airborne. An automated Raman Spectral Imaging (RSI) protocol has been developed for chemical analysis sampled from the inhalable size (PM). This approach removes operator bias allowing for the chemical identification of all microP >3µm in size in a sample. To validate RSI for the identification of microplastics (RSI analysis was conducted using an in-house program developed by Dr. Frederic Festy (KCL). Pre-identified features unique to polystyrene (1000.9 cm^-1, 1030.7 cm^-1 and 1602.1 cm^-1) were fit to the dataset using a Pearson-based cluster analysis to indicate spatial feature intensity (ImageJ). The identification of 4 and 10µm beads was successful and an operator based particle count detected 163 particles per 100 µL; this resulted in an 85% recovery rate. However, 2µm polystyrene beads were not identified as they were found to be below the limit of detection. This automated RSI protocol facilitates the identification of microP >3µm in size in atmospheric samples.

156 Analysis of polystyrene based microplastics in the environment
G.F. Schirrinzi, IDAEA-CSIC / IDAEA; M. Farre, IDAEA-CSIC / Environmental Chemistry; m. farre-urgell, IDAEA-CSIC; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry
Marine anthropogenic litter is a severe environmental problem. Wastes discarded or deposited in aquatic environments (including rivers, estuaries and coastal 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 nanoplastics (NPLs) and microplastics (MPLs), respectively. The quantitative analysis of these plastic waste 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 protocols 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 Infrared 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), Ambient 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 allowed obtaining qualitative and quantitative information about the whole spectrum of polymers, which may be present in the environment.

157 Uptake, excretion and accumulation of microplastic in mussel after an experimental exposure
B. Fernández, Instituto Español de Oceanografía / Marine Pollution and Biological Effects Department; M. Albentosa, Instituto Español de Oceanografía / Marine Environment and Environmental Protection Area. Fisiología y Ecotoxicología de Bivalve Moluscos Department
Filter feeding invertebrates such as mussels are especially susceptible target species to microplastic (MP) ingestion. Field and laboratory studies have reported that MP are ingested by mussel. Once ingested, MP may be egested through defecation,
158 Analysis of tire wear particles in environmental samples using TED-GC-MS

P. Eisenraut, Bundesanstalt für Materialforschung und -prüfung; E. Dümichen, Bundesanstalt für Materialforschung und -prüfung / Germany and various stages of a filter system receiving street runoff. Various environmental samples with expected contaminant concentration were chosen. Environmental samples with expected contaminant concentration were analyzed. Results showed that after 120 hours of the exposure, the amount of solids in the water samples was analyzed after filtration only, since the amount of solids was too low for the density separation procedure. Acknowledgement - The authors thank the BMBF 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.

In this context, a laboratory experiment was conducted to investigate the uptake kinetic of MP and MA, indicating a similar capture efficiency of environmental plastic debris. In addition, the platform will host a scale survey on a consensus definition/categorisation framework. To get immediate feedback by the community, we will use online polling asking specific questions to the audience and the wider community to further discuss the implications we give and share their opinions 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/categorisation 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 limiting 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 implications 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 olfactory cues following crude oil exposure

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In fishes, olfactory cues provide information about predators, prey, and conspecífics that is crucial to survival; however, olfactory sensory neurons are purged with nitrogen through a heated coupling device to a solid phase adsorber. After the adsorber is loaded, an asphalt material, provided by BAM were analyzed. As tire wear particles by density separation was achieved by use of a heavy liquid, sodium polytungstate mixed with MilliQ water. Separated fractions were 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 BMBF for funding the MiWa project (reference number 02WRS1378H) and BWB for provision of samples.

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

In fishes, olfactory cues provide information about predators, prey, and conspecifics that is crucial to survival; however, olfactory sensory neurons are purged with nitrogen through a heated coupling device to a solid phase adsorber. After the adsorber is loaded, an asphalt material, provided by BAM were analyzed. As tire wear particles by density separation was achieved by use of a heavy liquid, sodium polytungstate mixed with MilliQ water. Separated fractions were 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 BMBF for funding the MiWa project (reference number 02WRS1378H) and BWB for provision of samples.
pelagic and reef fishes, including mahi-mahi (Coryphaena hippurus) and bicolour 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 bicolour 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 detection system, changes in the damselfish avoided a chemical alarm cue, whereas the exposed conspecifics did not avoid the cue (p < 0.001). Control mahi-mahi did not distinguish between seawater and crude oil, however oil exposed mahi-mahi spent a greater proportion of time in 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 bicolour 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 Ecological Risk (RECOVER).

162 A wide range of endpoints are impacted by oil exposure in early and later life stages of marine fish

M. Groselli, J.D. Stieglitz, 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. Schneider, RST, GA, exposed fish. Such reductions in cardiac output 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

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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 low-level oil exposures, showing reduced aerobic 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 sarcomere shortening upon electrical stimulation is reduced by acute oil exposure which likely explains the reduced stroke volume observed in fish. Such reductions in cardiac output 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

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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 maintenance of embryo buoyancy 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, 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).

165 Crude oil impairs heart cell function in the pelagic mahi-mahi (Coryphaena hippurus)

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Crude oil from the Deepwater Horizon spill of 2010 has been shown to have a number of cardiovascular effects across life stages, species, and levels of organization in marine fish. Over the last decade, the use of the mahi-mahi (Coryphaena hippurus) to study these cardiovascular impairments has been particularly important, since this pelagic species is both ecologically and economically important in the Gulf of Mexico. Mahi exposed to environmentally-relevant crude oil concentrations have shown compromised intact animal performance, including reductions to maximal swimming speed and maximal cardiac output. In addition, additional sublethal effects may have imparted more subtle yet ecologically significant consequences on populations of pelagic fishes as a whole. The maintenance of embryo buoyancy 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.

Furthemore, pronounced 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).
166 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 cardiopathy in a common species, a teleost, was observed in a number of fish species following exposure to 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 of 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 number of diverse 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 miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-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 miR-34 and miR-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-1529; 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
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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 flatten 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 indirectly changing abiotic conditions, such as ultraviolet (UV) radiation. Therefore, in this work we aim to understand the effects of different stressors to early life stages of S. senegalensis, namely of UV radiation and of the organic compounds 4MBC, Carbendazim, Linuron and Triichloro, which have potential estrogenic and larval stages of development. While functional inhibition of the chemicals 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 number of diverse 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 miR-133a, miR-34, and miR-15b (Figure 2). Enhanced expression of miR-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 miR-34 and miR-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-1529; Name: Relationship of Effects of Cardiac Outcomes in fish for Validation of Ecological Risk (RECOVER).

168 Predicting in vivo toxicity from in vitro transcriptional responses following chemical exposure
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Alternatives to in vivo animal testing in ecotoxicology 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 where alternative 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 (Oncorhynchus 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 gill 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. Schoenenberger, 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. Within this 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 vivo and performed a residual analysis. In the second phase we have upgraded this approach so 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 assumptions 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; S. Chang, United States Environmental Protection Agency / National Exposure Research Laboratory; K.A. Connors, The Procter & Gamble Company / TERC; F. Falciani, University of Liverpool / Institute of Integrative Biology; M.G. Hill, U.S. EPA / Gulf Ecology Division; R.R. Otter, Middle Tennessee State University / Department of System Biology; J. Herbert, P. Antczak, University of Liverpool / Institute of Integrative Biology; H. Sanderson, Aarhus University; P. Wilson, SANOFI Aventis / Institute for 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 Research; T.J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; R.R. Otter, Middle Tennessee State University / Biology; H. Sanderson, Aarhus University; P. Wilson, SANOFI Aventis / Institute for Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; S.A. Hughes, Shell Health - Americas / Shell Health Risk Science Team
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

wealth of ecotoxicological information as Predicted No-Observed Effect Concentrations (PNECs) on diverse chemical substances in the form of probability distributions. These enable the prediction of untested chemicals based on a structural attribute, mode of action, or functional use. The approach may be useful for assessing chemicals at early tiers of the risk assessment process, providing hazard perspective on chemicals that lack QSARs, guiding product development discussions, and assisting read across or category justifications. An ecotoxicological database of approximately 120,000 records was developed based on recent assessments of published data and international chemical management programs. This ecotoxicity data is associated with physical chemistry data and curated taxonomic information for the organisms tested, including a process to conclude acute and chronic effects as well as identify the PNEC for exposed ecosystems based on depth and breadth of data. Several modes of action schemes are also included to facilitate development of a best approach for grouping compounds. To make these data accessible and useful to stakeholders, the dataset was transitioned from Microsoft Excel and Access into a modern MySQL format, allowing for a for format that is relational and scalable, facilitating easy access, sharing, and integration with other datasets and tools. The dataset is accessed via a web-based query system that is integrated with PNEC calculator and probability distribution tools. The novel interface allows users to explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecoTIC concept. An international workshop was held to discuss and evaluate the feasibility of the eco-TIC approach, which included evaluation of several case-studies based on particular decision-contexts (e.g., regulatory decision-making, chemical risk MoA. Int. 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.

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. Kiellöf, 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 (ZFET) extended by various endpoints using chemical risk MoA.

172 Poster spotlight: MO158, MO159, MO190

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 - POSTER SPOTLIGHT MO456
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 - POSTER SPOTLIGHT MO457
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 - POSTER SPOTLIGHT MO458
R. Croning, Wildfowl & Wetlands Trust

177 Main scientific gaps on knowledge of NSAIDs [migratory] wildlife globally, and potential contribution of WTIG to CMS questions - POSTER SPOTLIGHT MO459
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 MO460
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 country/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. Dobmen, 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 sufficient local food production with an 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 manageable concepts allowing an overall consideration of the environmental impact. 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, we need to cover all aspects of ‘stress ecology’ (impact of humans on ecosystems) beyond the impact of chemicals. Therefore this call for a more holistic environmental risk assessment approach.

183 Identifying ecosystem services-based protection goals.

J. Malby, Y. Pan, The University of Sheffield / Dpt of Animal Plant Sciences

There is an increasing interest in the use of ecosystem service-based approaches for assessing the risk of environmental contaminants to ecological systems. Ecosystem functions become ecosystem services when they are utilized and valued by people. Therefore, the first step in implementing an ecosystem service approach to ecological risk assessment is to identify what portfolio of services are required, by whom and where they should be protected. But how do you 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 prioritized 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 recommended 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 % 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 impacts of human activities on bee colonies to. To avoid the difficulty of selecting a specific hard numerical SPG value upon which consensus between different scientists and stakeholders is to be based, it is recommended to follow 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. key species, generic 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 (NTTPs) 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 and those growing in the crop would be considered as non-target. The Opinions provision for setting SPGs going forward, the experience with the EFSA Bee Guidance Document is in itself surprising for a biological system particularly one with complex feedback systems and processes. 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 prioritized for protection.

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; D. Clunn, 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 be on specific Protection Goals. Specific Protection Goals are defined for surface water and Ecosystem Services. Biodiversity is a common and important General Protection Goal, and Ecosystem Services, as they pertain to human health and welfare, are comprised of ‘provisioning services’ (e.g. drinking water), ‘regulating services’ (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape that conserve species and promote wellbeing). To this aim, this presentation 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?

F.M. Bakker, Eurofin-IBT

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 diversity. In principle, this is not a call for ignoring the impact of crop protection products. However, for achieving our targets and maintaining sufficient local food production with an 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 manageable concepts allowing an overall consideration of the environmental impact. 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.

188 Protection goals for non-target terrestrial plants: Is in-field protection of beneficial weeds achievable?

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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)habits, which seems a promising lead to assessing effects on biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects on the structure and functioning of 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 biostimulation of the soil bacterial communities, potentiating their degradation capacity and, consequently, sustaining rhizoremediation. Aiming to select bacterial strains to be exploited for autochthonous bioaugmentation coupled to rhizoremediation, we established a collection of isolates from the soil biostimulated by Phialitis arundinacea. This species cultivated in communities of redox cycle showed to stimulate the highest integrated activity after 3 months from planting. Moreover, with the 18-month biostimulated 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-degradation through a site-tailored bioaugmentation approach.

181 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; S. Rosati, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria / 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 biostimulation effectiveness of plant species and their treatments for the development of a suitable rhizoremediation strategy, an experimental trial including ten vegetated treatments and their non-plant-controlled plants 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 biostimulation of the soil bacterial communities, potentiating their degradation capacity and, consequently, sustaining rhizoremediation. Aiming to select bacterial strains to be exploited for autochthonous bioaugmentation coupled to rhizoremediation, we established a collection of isolates from the soil biostimulated by Phialitis arundinacea. This species cultivated in communities of redox cycle showed to stimulate the highest integrated activity after 3 months from planting. Moreover, with the 18-month biostimulated 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 Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites

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Thus, the possibility to use a new dispersed colloidal activated carbon technology (Plunestop®), Regenesis together with an electron donor to create an in-situ adsorption/biologically-reactive zone was deeply investigated and finally adopted as the site-specific remediation approach. The full-scale remediation plan was approved by the local authorities and completed by the end of 2016. This was the first example of a completed full-scale application of this approach in Europe and the monitoring results after more than one year appear particularly encouraging. A very good reduction rate of contaminants was observed in all the treated zones. Together with classical chemical analyses, microbiological tools, such as qPCR and CARD-FISH, were used to verify the enhancement of the biological reductive activities induced by the simultaneous injection of activated carbon and electron donor.

190 An innovative bioelectrochemical reactor for in-situ treatment of groundwater contaminated by monoaromatic petroleum hydrocarbons E. PALMA, CNR-IRSA, M. Daglio, A. Franzetti, University of Milano - Bicocca / Department of Earth and Environmental Sciences; M.P. Papini, Università La Sapienza / Chemistry; E. Auletta, National Research Council / Water Research Institute (IRSA)


191 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated J. Vila, Instituto de Recursos Naturales y Agrobiologia; M. Grifoll, Universitat de Barcelona / Dept. Genetica, Microbiologia i Estadistica; M. Aiten, University of North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiologia / Agroquimica y Conservacion del Suelo

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a renewed interest on unpolluted soils of industrial PAH-contaminated sites, with a major composition in high molecular weight (HMW) compounds (four or more rings), was analyzed. We identified 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 (93%) of the total PAH concentration. Low molecular weight (LMW) compounds (2 and 3-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 10² to 10⁹ copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rDNA gene sequencing revealed distinct gene profiles for each and diverse communities 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 *Immobilineformibacteriales* and members of *Sphingobium* as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of *Sphingobium* and *Immobilineformibacterium* expressed a major phylotypes in the subsurface soil with a large number of *Immobilineformibacterium* species and genera. Interests, 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. Niessen, 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


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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, Versals; R. Baciocchi, University of Rome Tor Vergata

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microorganisms has been recognized during the last decade and indicates the potential use of petroleum hydrocarbon vapours from contaminated soil or groundwater on indoor and outdoor air quality. The occurrence of natural attenuation in the subsurface is generally evaluated by employing multi-level soil gas sampling through the installation of sturdy probes, by applying the so-called “gradient method”. In this way, it is possible to assess the vertical concentration profiles of vapors and oxygen across the source area and then estimate attenuation rates in terms of soil gas fluxes through the subsurface. In this work, we propose a novel approach based on the combination of the data obtained from standard source characterization with dynamic flux chambers measurements. The natural attenuation rates are calculated as difference between the flux of contaminants estimated with a non-reactive diffusive model starting from the concentrations of the contaminants detected in the source (soil and/or groundwater) and the effective emission rate of the contaminants measured using dynamic flux chambers installed at ground level. The reliability of this approach was tested in a versails 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” 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 chamber volumes by an inert gas. The measurements sampling points were repeated in 4 seasonal campaigns. The obtained results highlight 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?

M. Vieira, PRe Sustainability; K. Cenian, PRe Consultants; A. de Schryver, European Commission; A. Genet, ifi Hamburg; L. Zampoti, European Commission / Joint Research Centre; C. Wolf, Tier3 Solutions GmbH; M. Dupriez, RDC Environment; S. Horlacher, thinkstep; E. Mieras, PRe Sustainability

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 Product Life Cycle Environmental Footprint (PEFCR) and organization environmental footprint sector rules (OEFs). They use the prescribed EF-compliant secondary datasets, and can be made available for free to any user applying a PEFCR/EF/ESFR 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 improve the process were reported. 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-system related issues and makes it easier to detect and prevent mistakes. Most importantly, now there is the commitment of the 5 tool developers to make available to all users in the course of 2018 a compliant import and export interface for the eILCD format. We believe this is a crucial step towards the exchange of data and models across software tools 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 new era: the larger and larger availability of on-line measurements 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

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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 (LUC) 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. Differentiation 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 a market of products and define land uses trends. The agricultural and land use module in EXIOBASE make use of FAOSTATData, 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, NH₃ and resources of accelerated denaturation caused by transformation of land. The iLUC model can been combined with any life cycle impact assessment model. 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

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Fertilizer water comes from different sources that are unevenly distributed in the world and different water users (e.g. domestic, agriculture, industry) need different water quality profiles 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. The work aims to develop WSmix framework for modelling current and prospective 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 technologic mix has been established to link water sources to water production technologies and energy use. To develop the P-WSmix, a methodology based on algorithms allowing 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 technologic mix. 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 highly relevant for a more consistent water-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, TU099

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

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. Alaniärä, 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 Science

Concern over the impact that pharmaceuticals can 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 irbesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L; 200 ng/L, 20000 ng/L, for temazepam and irbesartan, 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 the high and low doses of temazepam dispersed faster downstream when compared to control fish. Irbesartan 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 tissue of fish in our study. Our results emphasize the importance of measuring how pollutants affect ecologically relevant behaviours in the wild alongside standard and efficient laboratory assays.

201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish

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The iLUC model can been combined with any life cycle impact assessment model. 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.

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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 ecosystems worldwide. However, despite being shown to cause altered development, reproduction and morphology in various non-target species, relatively little is known about the potential of HPGs to alter ecologically important behaviours, especially across multiple contexts. Here, we investigated the effects of short-term (24 h) exposure to field-detected levels (average measured concentration: 16 ng/L) of 17β-trenbolone—a potent growth-promoting veterinary pharmaceutical repeatedly 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 shoal 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 surprising effect of trenbolone was observed on the feeding rate of exposed fish; exposed fish fed more often and at even higher rates than control, despite being less adaptive in terms of nutrient content. Although treatment-induced increases in foraging behaviour were dependent 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.

202 Selective grazing behaviour of chironomids between three microalgal species under pesticide pressure J.N. Henry-Ormanni, Irseta / EABX-CARMA; C.N. Doose, INRS - Centre Eau Terre Environnement; B. CHAUMET, Irseta; N. Mazellier, Irsete Bordeaux / UR EABX; N. Majdi, Ecolab / UMR 5245 CNRS; J. Vedrenne, S. Morin, Irseta Bordeaux / UR EABX; W. Traunspurger, Bielefeld University / Animal Ecology. The herbicide diuron and the insecticide imidacloprid are amongst the most frequently detected pesticides in French rivers, and each is known to affect many aquatic organisms. However, it is less examined whether and how both pesticides together might impact feeding. Therefore, this study focused on the effects of diuron and imidacloprid, alone and in combination, on feeding behaviour of chironomids. A first experiment measured the impact of the different contamination conditions at environmental concentrations (5µg L⁻¹ for each pesticide) on the grazing rate of chironomids on three microalgal species, independently. Therefore, two diatom species, *Gomphomena gracile* (two different morphotype: normal (GG) and teratogen (GT)) and *Planolithium lanceolatum* (PL), and one green algae *Pseudokirchneriella subcapitata* (PS) were offered as food, during 24h. Protein and lipid contents in microalgae were analysed subsequently. Each pesticide condition elicited a different grazing rate in chironomids with regards to algal species and their nutritional quality, with a general preference for *Gomphomena gracile* with teratogen shape and *Pseudokirchneriella subcapitata*. In a second experiment (cafeteria), food selectivity of chironomids was determined under similar contamination conditions during 4h: Under diuron, larvae switched equally among microalgae, then were as mobile as in the control without pesticide. However, imidacloprid and the pesticide mixture condition altered chironomids’ movements and grazing behaviour. In this experiment, we highlighted that chironomids feeding behaviour and food preferences are impacted by pesticides. Herbicide and insecticide exposure, alone or in combination, had contrasting effects on grazing, both directly on the larvae or indirectly (food selectivity according to its quality). Our study illustrates the value of considering the impacts of toxicants on target and non-target species across trophic levels to improve ecotoxicological risk assessment in an ecosystem perspective.

203 Environmental levels of anxiolytic pharmaceuticals alter migration of Atlantic salmon in both lab and field Tamara J. C., Irseta / EABX-CARMA; T. Dallinger, LFV; K. Birgersson, Umea University / Department of Ecology and Environmental Science; B. Furtsch, Umea University; A. Piraux, Umea University / Department of Ecology and Environmental Science; M. Jonsson, Irseta; J. Fick, Umea University / Department of Chemistry. Humans consume more pharmaceuticals than ever and consumption is set to rise. As a consequence, increasing amounts of pharmaceuticals are released into waterways worldwide with virtually no knowledge of how they might affect aquatic ecosystems. Some conspicuous effects of these emerging contaminants are already evident including the feminization of fish by contraceptive residue. However, recent work suggests that important effects of pharmaceuticals in aquatic environments are much more widespread than currently believed, and that these effects may result in major changes in species interactions, population survival and ecosystem functioning. In several earlier laboratory studies, we have shown that concentrations of pharmaceuticals presently found in waterways alter important behavioural traits in both aquatic macroinvertebrates and fish, and that this in turn affects both feeding efficiency and predation risk. These results suggest that pharmaceutical contamination of aquatic environments may change species interactions, in particular predator-prey interactions, with severe ecosystem-effects as potential consequence. Recently our research focus has turned towards realistic large-scale studies in lakes and rivers using acoustic telemetry to test if findings from the lab also hold in natural settings. Here we present results from one such study comparing effects of environmental levels of the anxiolytic pharmaceutical Oxazepam on migration pattern of Atlantic salmon (Salmo salar) in the lab and the field. In the lab, salmon exposed to the drug migrated approximately twice as fast as unexposed salmon and the subsequent field-study generated similar results, validating the results found in the lab. This pharmaceutically induced change in migration-intensity has the potential to be a key determinant between survival and mortality of salmon individuals and as such important for population persistence since migration intensity is believed to be adapted to the environmental conditions of the river in question. The overall finding of recent studies suggests that effects of pharmaceutical contamination of natural systems might be much more widespread than we predicted based on conventional ecotoxicological tests.

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 environmental stressors? In this research, we sought to understand how differences in personality (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 shoal 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 surprising effect of trenbolone was observed on the feeding rate of exposed fish; exposed fish fed more often and at even higher rates than control, despite being less adaptive in terms of nutrient content. Although treatment-induced increases in foraging behaviour were dependent 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.

205 Effects of fluoxetine on anxiety-related behaviours and physiology in a songbird S.E. Whitlock, Environment Department, University of York / Environment; R. Shore, Centre for Ecology & Hydrology (NERC); J. Lane, Animal and Plant Health Agency; K. Herborn, Newcastle University / Centre for Behaviour and Evolution; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; K. Arnold, University of York / Environment. Several species of bird are known to forage directly on invertebrates at wastewater treatment plants (WWTs), representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine, which is also used as an antidepressant, is known to affect many aspects of animal behaviour, including the individual to respond appropriately. Contaminants with the potential to alter anxiety-related behaviours and physiology in a songbird, the Eurasian starling (Sturnus vulgaris). We used a combination of behavioural and physiological endpoints to assess the effects of fluoxetine, specifically: 1) object neophobia, 2) exploration in a novel environment into shy and bold individuals, and subsequently exposed during 9th to carbamazepine, a human pharmaceutical, suggested as a marker of anthropogenic pollution. Assessed responses included behaviour (distance swan, position in the tank and time spent swimming) and biochemical markers associated with oxidative stress, neurotransmission and energy metabolism. Overall, our results showed significant differences between control shy and bold organism with behaviour endpoints demonstrating to be very sensitive to stressor conditions. Although carbamazepine alone did not show considerable effects in the assessed endpoints, strong interactions were found between personality and pharmaceuticals, supporting further studies.

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indicating increased lethargy in the fluoxetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that fluoxetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, fluoxetine causes vasoconstriction, 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 predicted 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 Danish Environment Agency (DEA). For the DEA monitoring sites that exceed 50% of the German national loadings of the investigated compounds, a weighted average impact of NPES was calculated. A potential for species loss via Species Sensitivity Distribution modelling (SSD) is estimated. SSD 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 Ecotoxic / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Zijp, RIVM / Centre for Sustainability, Environment and Health

“Big data” are a potential goldmine for studying and contextualising the impact of chemicals and their mixtures 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 Danish Environment Agency (DEA). For the DEA monitoring sites that exceed 50% of the German national loadings of the investigated compounds, a weighted average impact of NPES was calculated. A potential for species loss via Species Sensitivity Distribution modelling (SSD) is estimated. SSD 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.

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

A. Johnson, CEH 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 differences between the treated and untreated sections of the river, however it is clear that improvements in wastewater treatment have contributed to the observed improvements in macroinvertebrate diversity.

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. No 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 90th percentile BOD below 5 mg/L and NH4 below 0.6 mg/L, we would expect an improvement in 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 5EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

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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. This also essentially relies on 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-state models and fish length trends with quantile 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 analyses. 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-species trends were observed after 1970s. We did not detect PBDEs before 1970 in the Swedish or Norwegian time series of Ni in marine water. Funding was provided by Natural Sciences and Engineering Research Council of Canada (NSERC), Vale Canada and NiPera Inc. nickel risk in seawater is of increasing concern because of coastal Ni pollution, and this work used a retrospective examination of Mercury (Hg) and several criteria to interpret how dietary habits (using isotopic analysis of biota) and anthropogenic contaminant sources. Further attention will be paid to discuss conservation measures and life stages which should be protected in priority to favor 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, Toxico logical Center / Toxicological Centre Dep of Pharmaceutical Sciences; B. Hjeppe, Swedish white-tailed eagle ringing 1975-1998; E. W. Chen, Antwerp University / Department of Biology; G. Eens, 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 pattern 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 static ontogenetic 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 (Hunting 1975-1998; median = 3.299 ng g⁻¹). Clear declining trends were observed for both the Swedish and Norwegian time series after 1970s. We did not detect PBDEs before 1970 in the Swedish or Norwegian time series, although concentrations increased steeply during the 1980s, decreasing trends were observed afterwards. Hg concentrations in the Greenlandic time series were stable before 1940, but showed an increasing trend from 1980 to 2013. These results suggest that changes in historical and recent anthropogenic emissions strongly shape temporal changes of persistent contaminants in avian top predators. In addition, the relative interplay between local versus long range transport have likely affected the spatial pattern of contamination levels. The here presented 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. Stubblefield, 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 metal risk. The aim of the workshop was to review 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, Develop the extent to which available biotic ligand models (BLM/multi-linear regression (MLR)-based models/other alternative methods) offer a means to model the toxicity associated with metals, and on methods to model bioavailability under a range of environmental conditions. 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. McGeer, 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 pollution, and this work used 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 static ontogenetic 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 (Hunting 1975-1998; median = 3.299 ng g⁻¹). Clear declining trends were observed for both the Swedish and Norwegian time series after 1970s. We did not detect PBDEs before 1970 in the Swedish or Norwegian time series, although concentrations increased steeply during the 1980s, decreasing trends were observed afterwards. Hg concentrations in the Greenlandic time series were stable before 1940, but showed an increasing trend from 1980 to 2013. These results suggest that changes in historical and recent anthropogenic emissions strongly shape temporal changes of persistent contaminants in avian top predators. In addition, the relative interplay between local versus long range transport have likely affected the spatial pattern of contamination levels. The here presented 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. Stubblefield, 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 metal risk. The aim of the workshop was to review the current 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, Develop the extent to which available biotic ligand models (BLM/multi-linear regression (MLR)-based models/other alternative methods) offer a means to model the toxicity associated with metals, and on methods to model bioavailability under a range of environmental conditions. 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.
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 crustaceans 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 crustaceans very well, an “average crustacean” model was developed. This model was 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. Hassan, Mines ParisTech / Hydrodynamics and reactions team (HR); M. Lemeanders, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry; M. Descotes, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University / CTU (Laboratoire d'écologie, de systémique et d’aménagement des milieux terrestres et aquatiques) (HS); M. Chiabal, KWR Watercycle Research Institute / Chemical Water Quality and Health; M. de Vaulx, Université libre de Bruxelles / Department of Biology and Environmental Sciences (HS); J. Van Stappen, Leermakers, Vrije universiteit Brussel / Department Analytical, Environmental and Geochemistry (HS); B. Ceusters, University of Liege / Department of Earth and Environmental Sciences (HS); and D. Van Hoorebeke, University of Antwerp / Department of Chemistry and Materials Science (HS). 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 geochemical conditions of the aquatic system, which define the chemical speciation. For several elements, Environmental Quality Standards (EQS) and Sediment Quality Standards (SQS) 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 nonbiting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz (Q), 10% Kaolin/90% Q, 10% Sillimanite/90% Q, 10% Ferrihydrite (FOH)/90% Q and a mixture of the 4 mineral phases (3.3% Kaolin/3.3% Sillimanite/3.3% (FOH) and 90% Quartz) 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 chironomid larvae Sediment to porewater partition coefficients ($\text{K}_{\text{d}}$) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Accumulation Factor ($\text{BSAFA}$) was found for uranium (10), followed by Ferrihydrite (9) and Sillimanite (8) and is the lowest for the mixed composite sediment (1). DGT labelable uranium porewater concentrations account for 70-100% of the uranium in porewater for all mineral phases except the quartz, where $\text{C}_{\text{DGT}}$ 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 batch experiments are the same as for the continuous supply model, with only $\text{BSAFA}$ accounting for 100% of uranium uptake. The results are also compared with the proposed regulations by IRSN on uranium bioavailable chemical species.

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

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 Design; R. E. Santore, Windward Environmental, LLC; E. Nordheim, Alumínium 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 aquatic toxicity. To address possible data gaps in the Al database, a series of chronic toxicity tests conducted predictive models based on decision trees, to discriminate the 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 to model the pressure impact on the ecosystem (eg extraction, cyanation, ammoniation) The identification of these 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 determine the those environmental factors responsible for the environmental degradation of aquatic ecosystems and the ecosystem services they provide. The main threats of the deterioration of the ecological quality of the rivers studied are calcium, copper, the total suspended solids and the modification of the hydraulic bed of the river. The impacts of mineralogy, 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)

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. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; H. M. Ohlendorf, CH2M$. Detection of microplastics and determining actual concentrations and sizes of plastic particles present in the environment is essential to assess the risks that are posed by plastic particles. Microplastics have been detected globally in various aquatic ecosystems. The determination of microplastics is hampered by 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 aquatic 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 nanoparticles from 100 into 0.5 L and yields in a reproducible particle recovery of 54.2 ± 2 %. Microplastics are detected using FTIR-microscopy which is limited to a minimum particle size of 28 µm. For nanoparticles 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 nanoparticles. 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 size estimation that takes 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 metal and microplastic particles and microplastics in urban waste water

F. Schmidt, M. Schmiederbuhr, 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/mt) 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 three orders of magnitude lower than concentrations of 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 matrix leech 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 quantitation methods, even at the bench scale, have remained elusive in part due to the 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. Altmann, Bundesanstalt für Materialforschung und prüfung; C. Bannick, Umweltbundesamt; E. Kober, Technische Universität Berlin; M. Ricking, UBANRW; T. Schmitz, Berliner Wasserbetriebe; U. Braun, BAM- Forschungszentrum, Institute of Testing / 5.3 Mechanics of Polymers

The presence of large quantities of plastic waste and its fragmentation in various environmental compartments are an important subject of current research. In the environment, (photo-)oxidation processes and mechanical abrasion lead to the formation of microplastics. However, until now, there are no established quality assurance concepts for the analysis of microplastic (<5 mm) in environmental compartments, including sampling, processing and analysis [1-4]. The aim of the present work is the development of suitable examination methods and protocols (sampling, sample preparation and detection) to qualify and quantify microplastic in urban water management systems. At first a fractional filtration system for sampling and the analytical tool, the so-called TED-GC-MS (thermal desorption gas chromatography mass spectrometry) for removing the analytes, is developed. This method is a two-step analytical procedure which consists of a thermal extraction where the sample is annealed and characteristic decomposition products of the polymers are collected on a solid phase. Afterwards these products are analysed using GC-MS [5]. The developed fractional filtration for sampling and the TED-GC-MS for detection were used for quantitative analysis to screen the waste water influent and effluent of a Berlin waste water treatment plant for the most relevant polymers, polystyrene (PE), polypropylene (PP), polyethylene (PE), polystyrene terephthalate (PET) and polyamide (PA). The results of the study revealed that the polymers PE, PS and PP were detected in the effluent, and PE and PS were found in the raw waste water of the sewage treatment plant in Ruhleben, Berlin. Differences in polymer types and amounts were detected at different sampling dates and within different sieve fractions. Much higher amounts of polymers were observed in the raw waste water. The peak areas of the decomposition products, used for quantification of the polymers, were adjusted using so-called response factors since the TED-GC-MS method is more sensitive for PE and PS than for PE. It has been shown that PE is the most dominant polymer 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].

221 Soil and sludge: A time and cost-effective method for extracting microplastics from 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, Telermark University College; L. Nizzetto, NIVA

There is very little existing work on the analysis of 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. Extraction efficiency and compositional analysis of the tested 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 new approach is 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 plants

A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, Norwegian 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 nationwide survey investigating the incorporation of microplastics into sludge from domestic wastewater treatment plants which operate different waste treatment technologies. The main objective of this project was to characterize, map and compare results between different types of wastewater treatment plants. Particles 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 average overall microplastics concentration was 6.077 particles kg⁻¹ (d.w.) (1701 – 8387) or 1.176 889 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. Polystyrene 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 the results and details on the application of sewage sludge in Norway, it can be estimated that approximately 446 million microplastic particles are spread on agricultural soils, 27 billion microplastic particles are added to green areas and 112 billion microplastic particles are sent to soil producers per year. This equates to over 584 billion microplastics that are released into the environment via sewage sludge application each year in Norway.

223 The Influence of Weathering on the Sinking Behavior of Microplastic in Freshwater and all Surface Waters

H. Arg, NGO / Environmental Technology; L.B. Olsen, D. Issler, NGI; N. Berrogaibuz, NGI / Environmental Chemistry; S. Wongsorejodo, X. Shen, E. Toormann, 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
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/particulates, like phytoplankton and sedimentary material. Herein we present the results of linking experiments done on microplastic, covering different shapes (spheres, cubes and circular), microplastic in situ 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 microplastic.

**Air Pollution, Biomonitoring and Human Health (I)**

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**Particulate matter in indoor academic environments: chemical composition, sources, infiltration from outdoor**  
L. Tofoli, CNR / Institute of Atmospheric Pollution Research; S. Canepari, Sapienza University of Rome / Chemistry; M. Catrambone, F. Marcovecchio, M. Giusto, CNR / Institute of Atmospheric Pollution Research; S. Paret, CNR / institute of atmospheric pollution research; T. Sargolini, CNR / Institute of Atmospheric Pollution Research; G. Perrino, 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 (PM0 and PM1.5) 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 weekends 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 PM1.5 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). The Long-Term Sampling was carried out during the winter SOP and during the winter part of the Long-Term Sampling. The composition of PM in the indoor environments was dominated by the organic fraction, with a relevant contribution of the bioaerosol, mainly in the coarse fraction. The infiltration of particles from outside constituted a significant source of inorganic species. A vertical gradient was observed for soil components. A relationship of the concentration and composition of indoor PM with the volume of the classroom, height from the ground, presence/absence of the students and distance from the street has been highlighted.

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**Source apportionment of major species and metals in PM2.5 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. Kfouri, University of Balamand / Department of Environmental Sciences; G. Delnaire, University of Littoral Côte d'Opale / Laboratoire Informatique Signal de la Côte d'Opale LISIC EA4491; G. Rousseau, University of Littoral Côte d'Opale / Unité de Chimie Environnementale et Interactions sur le Vivant UCEIV EA4492  
PM2.5 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 city of Dunkirk is one of the most densely populated area in Europe and is known as an industrialized region especially in the field of metalurgy, 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 PM2.5 and on the identification of their sources in urban sites influenced by particulate emissions from anthropogenic sources. Sampling was performed using Digitel® DAA80 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). PM2.5 composition was analyzed for major elements, trace metals, non-ferrous elements and some aromatic hydrocarbons, 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 PM2.5 was then quantified using a weighted non-negative matrix factorization based receptor model that considers constraints on chemical profiles (CW-NMF). NO2, SO2, NH3 and TC were found as the major constituents of PM2.5 (behind 95% and 95%) and temporal 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 PM2.5 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 associated with industrial emissions and sintering stack of an integrated steelworks, electric steelmaking and glassmaking activities. Despite their low contribution to PM2.5, such industrial sources were the main contributors of metals at the two sites.

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**Estimating the contribution of deposition in the total exposure to PAH’s in order to derive save 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 atmosphere 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 (PM10) 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. Save 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]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)

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**A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air mass contribution**  
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Air quality is currently assessed by monitoring a few pollutants involved in the development of several health problems. It is more difficult to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposure to many bioactive micropollutants, 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

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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 care center during cold season (winter 2018) 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 a statistical comparison of the target EDCs in the 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.

228 The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health H. W. Collinge, A. M. Bilec, University of Pittsburgh / Civil and Environmental Engineering 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, inversely, envelope improvements (airtightness) can result in increased 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 health impact 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 represented the energy conservation design districts, which is situated downhill of major industrial point sources. Indoor and ambient measurements of particulate matter (PM_10, PM_2.5), black carbon, ozone (O_3), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO_2), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of deficient heating and aged mechanical systems had indoor air quality levels 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 CO_2 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., PM_10, O_3, NO_2) before increasing outdoor air volume. Natural ventilation systems can 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 recommendations are simply to ensure proper ventilation and HCHO levels overnight. In this given case, the use of occupancy sensors did not allow proper flush-out of indoor environments and interior finishing prior to the building being opened for operations, and as a result, increases exposure over the lifetime of the building.

229 INNOVATIVE AND LOW-COST MONITORING TECHNIQUES FOR EVALUATING THE SPATIAL VARIABILITY OF PM COMPONENTS: VALIDATION AND FIELD APPLICATION L. Massimi, Sapienza University of Rome / Environmental Biology; c. perrino, Cnr Institute of Atmospheric Pollution Research / Institute of Atmospheric Pollution Research; M. Cossali, Sapienza University of Rome; S. Canepari, Sapienza University of Rome / Chemistry A new very-low volume sampler has been developed with the purpose of allowing spatially-resolved determination of atmospheric particulate matter (PM) and 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 analysis. The device was validated during a 2-month study focused on the concentration of PM_10 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 PM_10 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 biomonitors 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.

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 P. Cribi, ENTEF, IRSTEA LYON; A. Devaux, INRA-CNRS / UMR LEHNA USC INRA IGH ENTEF; K. Abbacci, H. Queau, N. Delorome, L. Gambero, IRSTEA LYON; UR MALY Laboratoire Ecotoxicologie; S. Bony, INRA - CNRS / UMR LEHNA USC INRA IGH ENTEF; a. chaumot, IRSTEA / UR MALY Laboratoire Ecotoxicologie Since the 80s, the development of molecular biomarkers is an important component of ecotoxicology. Unfortunately, field studies that uniquely 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 at 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 unrecontaminated 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 is currently in progress. References (1) Forbes VE, Calow P, Silby RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994. (2) Lacaze E, Geffard O, Geyot D, Bony S, Devaux A. 2011. Linking genotoxic responses in Gammarus fossarum germ cell 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 Q. Fu, Eawag. Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; A. Rösch, Eawag / Environmental Chemistry; C. Vignet, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; D. Fedrizzi, Eawag / Swiss Federal Institute of Aquatic Science and Technology; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry Numerous micropollutants have been 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 and may affect 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 strebliuran fungicides in non-target organisms. Therefore, we determined the toxicokinetics of a strebliuran fungicide azoxytrobin and an azole fungicide prochloraz in two aquatic invertebrate species Gammarus pulex and Hyalella azteca. Furthermore, we explored median lethal concentrations (LC_50) of azoxytrobin in the presence and absence of prochloraz, the inhibition strength (IC_50) of prochloraz, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxytrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg_\text{-1}, while bioaccumulation of prochloraz was different in two species, with BAFs 57 and 110 L kg_\text{-1} in G. pulex and H. azteca, respectively. Many biotransformation products were found for azoxytrobin in both species, of which caurine and azoxytrobin were identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl β-methoxyacrylate group of azoxytrobin and imidazole ring of prochloraz. Prochloraz inhibited the CYP-catalyzed biotransformation of azoxytrobin in both species, leading to higher internal azoxytrobin concentrations and suggesting synergistic effects. The half maximal inhibition concentration of prochloraz IC_{50, w_2, z_2} was 0.1 and 0.02 μM in G. pulex

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and *H. azteca*, respectively. The LC$_{50}$ of azoxystrbin alone were 157 and 200 µg L$^{-1}$ in *G. pulex* and *H. azteca*, respectively. Prochloraz significantly decreased the LC$_{50}$ of azoxystrbin 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, H. Aramburo, Istrea Lyon / Freshwater system, Ecology and Pollution Research Unit, Istrea / UR MALY Laboratoire Ecotoxicologie; N. Delorme, K. Abbaci, Istrea Lyon / UR MALY Laboratoire Ecotoxicologie; P. NOURY, Istrea Lyon / Ecotoxicology; R. Tutundjian, Irstea Lyon; E. Vulliet, Institute of Analytical Sciences; G. Daniele, ISA / Biology; C. Barata, CSIC / Environmental Chemistry; I. Fuertes, Institute of Environmental Assessment and Water Research IDAEA CSIC. V. Debat, MNHN / Institute of Systematics, Evolution and Biodiversity 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 embryos geneseis' sensitive period, iii) we evaluated the sensitivity of the reproductive period and iv) we compared the response to fenoxycarb exposure among three Gammarus garrard 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. fossarium*. The gastrulation phase was particularly sensitive. Moreover, exposure to 5 and 50 µg L$^{-1}$ fenoxycarb strongly altered the pre-copulatory behavior in *G. fossarium* 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
N. Shahid, Helmholtz Centre for Environmental Research UFZ; J.M. Becker, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology Exposure to pesticides affects non-target aquatic communities, with substantial consequences on ecosystem services. Adaptation of exposed populations may reduce the toxic effects of pesticides. 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 recolonization from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below considered acute effects showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC$_{50}$ = 218 µg L$^{-1}$) compared with non-exposed populations (mean EC$_{50}$ = 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 affecting sensitive test organisms and also lower than those predicted to be safe by governmental risk assessment frameworks.

234 The use of antifouling biocides in a changing world: combined impacts of marine and coastal environment systems. M. Coelho, University of Aveiro / Biology and CESAM; A. Loureiro, University of Aveiro / Department of Biology; M. Monteiro, Aveiro University / Biology; F. Maia, Smallmatek - Small Materials and Technologies, Lda.; R. Martins, Department of Biology, University of Aveiro / Department of Biology and CESAM; J. Tedit, University of Aveiro / Department of Materials and Ceramic Engineering; D. Espichel, A.M. Soares, University of Aveiro / Department of Biology & CESAM; A. Loureiro, Universidade de Aveiro / Biology. The use of antifouling agents to prevent organism’s 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 Saccharomyces 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 monocular coral 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$^{-1}$ (nanocontainer control). A negative control was added for each experiment. 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 microalgal fractions) being determined by measured enzyme 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 °C (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 °C, whereas at 30.5 °C they were closed. Regarding enzymatic activities, significant increase on the GST of both animal and microalgae fractions was found in 30.5 °C groups. On the controls, the raise of 4.5 °C 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 warmer oceans.

235 Assessing interspecific variation in Imidacloprid toxicity in earthworms
A. Robinson, Centre for Ecology & Hydrology; E. Lahive, Centre for Ecology and Hydrology; S. Short, P. Kille, Cardiff University; D. Spurgeon, Centre for Ecology & Hydrology; C. Barata, CSIC / Environmental Hydrology; M. Abbaci, Irstea Lyon / UR MALY  Laboratoire Ecotoxicologie; P. NOURY, Irstea Lyon / Freshwater system, Ecology and Pollution Research Unit, Istrea / UR MALY Laboratoire Ecotoxicologie; N. Shahid, Helmholtz Centre for Environmental Research UFZ; J.M. Becker, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; M. Krauss, W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology Exposure to pesticides doesn't come without consequences. The impacts of industrial activity. In the past decades Greenpeace did several investigations on persistent industrial pollution is a severe threat to water resources around the world, and our precious water resources cannot be protected without strong actions. Assessing interspecific variation in Imidacloprid toxicity in earthworms is needed. In this study a 10 fold difference in the EC50 reproduction values of imidacloprid was observed across 5 species of earthworm (Eisenia fetida, Lumbricus rubellus, Dendrobena octaedra, Apporectodea caliginosa and Aynmythus 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 biological 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
M. Santen, G. Ungherese, Greppance
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. The need to protect our water systems is of critical importance. In the past decades Greppance 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 bees 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 expert panel meeting in Europe where 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 analyses in wastewater, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountains. It is not too late to act – but new rules and regulations 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 hand in hand with an increasing need to search for ecologically 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://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Vienna_EU_27-10-28-2011.pdf [1] http://www.greenpeace.org/international/Global/international/publications/toxics/Water%202011/dirty-laundry-12pages.pdf [1] https://www.greenpeace.de/sites/www.greenpeace.de/files/20121203-Toxic-Threa ts-China-eng.pdf [1] http://www.greenpeace.org/italy/global/italy/report/2017/Inquinamento/PFAS-in-Veneto.pdf [1] http://www.greenpeace.org/italy/global/italy/report/2017/Inquinamento/Report_N on_ce_la_beviamo.pdf

237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework

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Bioanalytical tools hold great promise as an additional tool of our current water monitoring strategies. In vitro bioassays, which are increasingly being applied in water quality assessment, provide relevant and robust predictive biosytems able to specifically and quantitatively measure early adverse effects of contaminants in water, including providing a measure of mixture effect, even in low doses, where in vivo tests do not have such a potential. The Evolution of NTS. Using a variety of case studies from Europe, this talk will highlight how open science activities such as MassBank.EU (https://massbank.eu), the NORMAN Suspect database (http://www.norman-network.eu/?q=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 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 research 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 assays

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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

M. Blank, Bayer AG Crop Science Division / Environmental Safety; B. Harvey, Syngenta; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; D. Liss, SGS Institut Fresenius GmbH / Agro

1H-1,2,4-Triazole (124T) is a key structural component of azole fungicides, one of the world's most widely used fungicide classes in agriculture. Its use has led to a need for improved crop protection industry toolkits (Triazole Derivative Metabolite Group, TDMG) and improved approaches such as stressing scientific and regulatory topics, covering the environmental fate, metabolism, ecotoxicology, 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 learning and actual contamination in groundwater. The TDMG 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 TDMG 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 shows 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

M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, A. Chevalle, Bayer Crop Science AG; J. Telschel, Bayer AG Division, CropScience/Environmental Fate / Development Environmental Safety; O. Heinemann, Bayer Crop Science Division 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 season 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 detected in all forest top soils. However, origins of 124T were not ascertained due to the large number and widespread use in the EU of registered azole products. Information about the background abundance of 124T in non-agricultural environments and residues in different matrices 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 shows 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.

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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 nitration 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 reaching 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 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 practice. 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 growth regulators used in agriculture. Leaching of 1,2,4-triazole began 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 by degradation in soil. These pesticides together with other triazole-fungicides have been applied to the PLAP fields several times since 1999. The applications of tebuconazole and epoxiconazole have not resulted in unacceptable leaching of the active substances to the groundwater. Monitoring of 1,2,4-triazole in PLAP showed detections in groundwater, and some of the detections exceeded 0.1 µg L⁻¹ (max. 0.26 µg L⁻¹). Due to the high background levels of 1,2,4-triazole before application of these triazole-fungicides, it was not possible to fully relate the detections to the specific application of fungicides, as there may be unknown sources like other triazole-fungicides used before 2014. A general decrease in the concentration of 1,2,4-triazole with depth, however, indicates a surface applied source.

246 The triazole story: Differentiation between 1,2,4,1-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 DegTBZ50 data for 124T and TBZ while differentiating between different 124T sources. In the study 13C labelled TBZ (13C-TBZ) and non-labelled TBZ were 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 15 sampling times from 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 out 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/kg. 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-fungicides 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 trifluoroacetate 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, TFAA is found in the biodegradation product of several pesticides. During a screening of surface waters in south-western Germany, high concentrations of TFAA (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 contributing still supplies 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 wastewater-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 hold 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.

Perspective & 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, including 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 Texan or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 1C-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. 48:10869-10877, 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 radiorespirometry and dual 1Cresideanalysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability assessment 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 physicochemical 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

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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 the assessment of biodegradation of these substances. It has compared 24 methods of improving bioavailability methods (BIM) and initiated the revision of the international standard ISO 10634.

250 Impact of temperature on micropollutants removal in an activated sludge system

P. Meynet, Newnwick University / CEGS; R.J. Davenport, Newnwick University / School of Engineering; K. Fenner, ETH Zürich/Eawag

The investigation of the environmental fate of pollutants is essential for evaluating their ecological impact and human exposure, and is a priority for the European water framework. In particular, the high variability of micropollutants removal efficiency in biodegradation systems requires a better 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 Arthenius-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 micropollutant 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 (68g/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 in biotransformation rate. These findings may be linked to basic living cell function and high sensitivity 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

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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 prioritisation 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 false positives, 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 centrifugal 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 polycyclic amide), 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 intra-laboratory variation in biodegradation test outcome will also be discussed.

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

D. Hennecke, Fraunhofer IHE - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IHE - Institute for Molecular Biology and Applied Ecology; J. Hassink, BASF SE / Environmental Fate OECD TG 309 "Aerobic Mineralisation in Surface Water" is currently used under different regulatory frameworks for the persistence assessment of chemicals in surface water. The test is performed in batch to measure biodegradation at defined conditions. Other processes which might be relevant for the fate of a chemical in the environment like direct and indirect photolysis are not addressed. Since biodegradation is limited in the OECD 309 study, the consequences are critical for substances which are hydrolytically stable but sensitive to light. Within pesticide regulation direct photolysis studies are mandatory, indirect photolysis studies optional. In natural waters, which have to be used for OECD 309, both processes are relevant for photolytically stable compounds. Hence, beside direct photolysis in the upper layer of a water column, it is interesting to know until which water depth indirect photolysis might contribute to degradation since the light intensity decreases with increasing water depth. A simulation approach has been performed considering the major conditions required in OECD 309 but at a much larger scale. Stainless steel containers of 900 liter volume are filled with surface water taken from a natural lake and maintained at 20°C. The geometry of the water column was simulated as screens for persistence. They are prone to high levels of variation and produce a large number of false positives, 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 centrifugal 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 polycyclic amide), 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 intra-laboratory variation in biodegradation test outcome will also be discussed.

253 Poster spotlight: TU267, TU268, TU269
Integrating life cycle approaches towards a sustainable circular economy (I)

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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 common terminology and analysis framework that is interpreted 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.

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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 beer in different contexts and calculated the following indicators to assess product-level circularity: i) the Material Reutilization Score (MRS) and 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) is used 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 MCDAs is applied to process the indicator scores and subsequently obtain the ranking. Specifically, the compensatory approach based on the MCDa method TOPSIS (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 MCT 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 the identification of the best alternative from a CE perspective.

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Consistent allocation using archetypes of LCA Goal and Scope definitions

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Identifying a suitable allocation procedure is always a challenge in the modelling of life cycle assessment (LCA). This is mostly because LCA are often modelled for different products 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 allocation procedure of a product LCA study, the LCA goal and 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 obvious. The production phase of a laptop is modified to reflect a closed loop for 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.

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Sustainability assessment of product lifetime extension through increased repair and reuse

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The concept of circular economy is characterized by an economy that aims to keep products, components and materials at their highest utility and value at all times. Based on data collected by a reuse organisation, computers are often considered 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 assumed 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. If the product is not to be recycled, 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, steel production site and cement kiln and used for remelting defining. 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.

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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 automatized 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 i-RTG systems. Hence, different nutrient classes can be optimized. In this sense, different literature evidence shows that 30% of the currently available chemical 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 treated 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 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 PFOF 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 deadline to evaluate these uses at regular intervals 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 bait for control of leaf-cutting ants from Atta spp. and Acromyrmex spp. and insecticides for control of red imported fire ants and termite species. Data on the use of these applications will update in 2020. The evaluation 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 conclusion 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 SUPPES (Substitution of per Fluorinated compounds to eliminate diffuse Sources) our 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. The SUPPES SIP model includes 1) characterisation of PFAS in use and for high selected consumer products 2) initial alternative selection based on matching function criteria and toxicity and exposure assessment and 3) final selection of alternatives underlying global environmental impact and technical performance assessment for specific scenarios. The SUPPES 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 reduction and substitution of hazardous chemicals, its potential, and challenges are discussed in this session. Struvite as a virtual TVP and as a fertilizer/biofertilizer is reviewed and two total environmental life cycle assessments for an improved product has been performed in the Dutch case study. Sustainable economic performance is facilitated in the context of a circular economy for PET recycling. The Dutch case study demonstrates that a substitution model, and more from a sustainable point of view, is needed to optimize the P cycle, struvite has been defined as a potential source of this nutrient. With a circular economy perspective, wastewater treatment plant treated 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 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.

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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 consider when deciding on the substitution. While the availability of such alternative ammunition can however turn out to be difficult, especially for 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 (SPFs) based on long perfluoroalkyl moieties that were associated with the release of persistent, biaccumulative and toxic perfluoroalkyl acids (PFAA), a variety of new DWRs have been developed including biodegradable materials that are based on more sustainable renewable resources to their unique properties to provide substances and oleophobic fibre modifications. SPFs 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 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. This was provided by 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 evoking a hydrophilic surface repellency, but no penetration, 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 shotgun

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An analysis of the technical and economic feasibility of alternatives to lead shot 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 shot (soft iron) is by far the most used alternative; often it is used in combination with barium and tungsten. The alternatives have a somewhat different ballistic behaviour, but they are still technically and economically suitable alternatives to lead shot. 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 short-range weapon will also influence 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 gunshot. 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 alternative leads to lead gunshot for hunting and shooting in wetlands is technically and economically feasible. While the availability of such alternative ammunition 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 in functionality and safety in a given adaptation. Application 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 relevant applications is a long-term study. The case studies 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 database 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 14000 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 database is planned. The focus of the presentation will address (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 world.
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


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. This data includes all the physico-chemical properties (166’926 test results), ecotoxicity (305’068 test results) and human toxicity data (41’381 test results) available in the IUCLID 5.5 database (as of May 2020). Data van den Brink, Alterra Wageningen / European Commission, A. Focks, Alterra Wageningen / European Commission, P. Karametzian, European Commission; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology, A. Gissi, 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 proven difficult to implement. The paper will allow 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 UVVC (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

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New approach facing new challenges in Ecotoxicology: D counter

S. Abreu, University of Aveiro / Dep. Biology & CESAM; A.M. Soares, University of Aveiro / department of Biology & 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 method 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 chromatic 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 bioassays using for example, the brine shrimp Artemia salina nauplii (within within48 h of hatching) or nauplii (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 species sensitivity modelling. 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 bioassays 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 bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.

270 Ceriodaphnia is equesitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements

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The OECD 202 Acute and Chronic Toxicity Test and its Alternative: The Toxicity Test for Freshwater Invertebrates - D. magna and D. pulex. For many years, the zooplankton Ceriodaphnia dubia was considered a standard test species for chemical regulation 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 assay conducted with C. dubia submitted to fulfill REACH dossier can only be used as supporting or weight of evidence studies and not as key studies. Then, simply present the battery of exposures (mixed species or single) to the device by just pouring the (tens of) flasks to the sequential 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 bioassays 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 bioassays involving a single or several species, being tested independently or in mixed sets of organisms from more than one species.
Assessment and management of stormwater on sediment recontamination due to metal contaminants

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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. Porewater (Pw) and THg are also considered as particles that present the percentages of clay, fine silt, coarse silt and sand, which represent particles that could be most directly related to recontamination potential. The results show that over the time the contaminant loadings decreased due to reduction in particulate contaminants while the concentrations in finer, and dissolved fractions remained relatively constant. Cu and Pb were associated with the largest particles in stormwater, but only Cd is strongly associated with sediment recontamination. Cu, Pb, and Ni are associated with the dissolved phase, fine silt and clay in stormwater and present moderate impact on sediment recontamination. In addition to showing a greater dissolved fraction it appears that the depositing loads are more influenced by resuspension and redistribution of sediment than stormwater. The THg load is relatively small and stormwater recontamination does not add appreciably to sediment THg loads. The particle associations in stormwater along with spatial distribution in sediment traps can identify sources, contributing locations and effective remedial approaches. The implications of the study, can be the development of identification tools that give information about the potential mobility-transport of the metals during storm events, identification of contributing locations, effective remedial approaches, and thus, help to propose best practices for stormwater and sediment management.

The effect of percolation and form on lead bioavailability and toxicity to Enchytraeus crypticus

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Soil moisture properties, such as soil water holding capacity (WHC), affect the bioavailability of metals to soil organisms. In this study, the effect of WHC on the bioavailability of lead was assessed using Enchytraeus crypticus. Three soils with different WHC (30%, 50%, and 70%) were used. The soils were spiked with PbO and Pb(NO3)2 and leached with artificial rainwater for 60 days. The samples were analyzed for metal concentrations in the soil, porewater, and the worms. The results showed that leaching significantly reduced the bioavailability of PbO, while Pb(NO3)2 was more toxic. The study also compared the effects of the two forms of Pb on soil enzymes, such as acid phosphatases, arylsulfatases, and glucosidases. The results showed that the two forms of Pb had different effects on soil enzymes, with PbO being less toxic. The study also showed that the bioavailability of Pb was affected by soil moisture, with higher bioavailability at lower WHC. The results of this study are important for understanding the bioavailability of Pb in soils and for developing strategies to reduce Pb bioavailability in the environment.

Soil moisture influences the avoidance behaviour of Folsomia candida and Enchytraeus crypticus in metal(loid)-contaminated soils

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Presentation Type: Presentation preferred. Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awua1, B. Hale2 & S. Siciliano3, 1University of Saskatchewan, Toxilogical Center. 2University 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 salt. 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 mixtures, and five metal(loid) concentrations at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucoisidases, 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 was hermetic toxicity for the 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

Soil moisture influences the avoidance behaviour of Folsomia candida and Enchytraeus crypticus in metal(loid)-contaminated soils

M. Alcaraz, University of Guelph / School of Environmental Science; Z. Xu, University of Guelph / School of Environmental Science; F. Awuah, University of Saskatchewan / Toxilogical Centre. Abstract: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awua1, B. Hale2 & S. Siciliano3, 1University of Saskatchewan, Toxilogical Center; 2University of Guelph, School of Environmental Sciences. Presentation Type: Preferred. Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awuah1, B. Hale2 & S. Siciliano3, 1University of Saskatchewan, Toxilogical Center. 2University 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 salt. 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 mixtures, and five metal(loid) concentrations at one dose. The activity of the soil enzymes ammonia monoxygenases, beta-glucoisidases, 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 was hermetic toxicity for the 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
metallurgical wastes

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Inorganic compounds from smelting activities are strongly influenced by metal resources through mining and metallurgical activities, for instance, of 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 Burgundy Franche-Comté (eastern France), iron mining and metallurgical activities were dominant over the Middle Age period, especially in the ancient district of Beaunage. 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 (identification and mapping of their composition by XRD and SEM-EDS); ii) chemical extractions for the assessment of total and available Mn concentrations in soils and iii) environmental bioavailability of Mn using toxicokineticons (28 days) in Contaureas asparagus 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 4.5−6 wt% MnO. With time, slag weathering, as testified by the formation of a smoky layer on the surface of the slag, increases the bioavailable Mn in soils 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 3,000 mgMn 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 exposure to soil invertebrates, raising the question of Mn bioavailability in soils and slag fragments. The modelling of Mn accumulation kinetics in C. asparagus snails tissues allowed to show i) the first-order elimination of Mn from the bioavailable Mn in soil invertebrates and ii) the Mn 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 3,000 mgMn kg−1. Hence, in slags, 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).

Chemical and eco-toxicological 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 consisted i) the characterization of slag and sludge in soil; ii) the redissolution of soil invertebrates and iii) the bioavailability of within soil invertebrates and itii) 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 3,000 mgMn kg−1. Hence, in slags, 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).

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

278 Profile of microplastics in water and sediments of Antàu 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 very high densities, derive from a variety of sources and can interact with biotic and abiotic environment. These micromaterials (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 MPs contamination in Antàu river in to 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 Agueicheira, 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) underline 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 fibres were the most abundant type in São João da Madeira, while fibres and fragments are the most abundant in Agueicheira and Estareja 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 carriage systems 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


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 MP occurrence and their concentrations in water and sediment samples with the greatest evidences. 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. More than 1,000,000 MPs were identified out of which >20% 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
University of Bayreuth represents one of the most comprehensive measuring programs in fluvial systems regarding the number of sample sites and the analytical accuracy. Exceptions of the study, focusing on particle number, distribution of size classes, particle shapes and polymer types at the water surface of rivers in western and southern Germany will be presented.

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) from March (P1) and December (P2) of an inflow and two different discharge conditions during 17 campaigns each for 24 h. Plastic material was extracted and quantified in the suspended matter using particle size pre-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 of plastic input in both subcatchments 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 in the rural 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

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Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally and have been 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 (sub)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 that do not receive wastewater treatment effluent 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 influe 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 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 1% SDS. Inorganic materials were reduced 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 nano-Fourier Transformed Infrared Spectroscopy measuring an Agilent Cary 620/670 system with a 128x128 pixel FPA. The software WinIR was used to interpret spectra. 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 0.245 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 retain 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

T. Menkhaus, The University of Bayreuth represents one of the most comprehensive measuring systems regarding the number of sample sites and the analytical accuracy. Exceptions of the study, focusing on particle number, distribution of size classes, particle shapes and polymer types at the water surface of rivers in western and southern Germany will be presented.

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
sites are located in the area surrounding the “Federico II” coal-fired power plant. The studied area included the territory of the Province of Brindisi, close to the coal-fired power plant “Federico II”, and in the territory of the Province of Lecce at about 26 km SSE of the power plant. The Lecce site was included to assess the impact of the power plant emissions at middle distances. The measuring sites are Lendinisco (LN), Cisternino (CL), Torchiarolo (TR) and Lecce (LE). The Lecce site is one of the 10 stations for observation integrated in the network of the Global Atmospheric Watch (GAW-WMO) program. Daily PM$_{10}$ samples were collected at different sites during measurement campaigns in different seasons (summer, autumn and winter) between 2013 and 2016. Specifically, three measurement campaigns were performed simultaneously at the four sites in 2016 and the dataset was enriched with previously available data collected in 2013 and 2015 at the sites in the province of Brindisi (LN, CL, TR) and for a total of 457 daily samples. Collected samples were chemically analysed to determine 19 species: the carbonaceous components (EC and OC); the water soluble ions Cl$^-$, NO$_2^-$, SO$_4^{2-}$, Na$^+$, NH$_4^+$, K$^+$, Mg$^{2+}$, Ca$^{2+}$; the elements Al, Si, Ti, V, Mn, Fe, Ni, Cu and Zn. Measured data was used for source apportionment of PM$_{10}$ based on a receptor-oriented model approach that integrates the results obtained using two receptor models (Positive Matrix Factorization - PMF and Multivariate Mass Balance - CMB), with those obtained using the CALPUFF dispersion model. This approach allows to estimate the primary contribution of the power plant to PM$_{10}$ and to obtain an estimation of its contribution to secondary sulphate.

285 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 mutagenic and genotoxic effects of air pollutants and the role of particle size and particle elemental content on 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 thanks 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 studies we have obtained by the use of two different air exposure systems, one 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 changes in airway epithelial cell morphology 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 changes in airway epithelial cell morphology. Outcomes from these studies are focused 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 pollutants.

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 (industry, agriculture, traffic, living, recreation) can impact the atmosphere (and vice versa), and some contaminants can be transported over long distances. The natural cycles (e.g., vegetation, soil, human bodies) can also transport substances present in the atmosphere to different places. The concentrations of contaminants can be strongly dependent on human activities and can lead to toxic effects on human health. The indoor air is exposed to many different contaminants (e.g., particulate matter, radon, and volatile organic compounds) from different sources (e.g., building materials, furnishings, and appliances). The indoor air quality is closely related to the concentration of pollutants in the outdoor air, which is affected by many factors such as meteorological conditions, the location of the building, and the emission sources outside the building. The indoor air quality can be affected by many factors such as the building design, the ventilation system, the presence of indoor pollutants, and the presence of outdoor pollutants. The indoor air quality can be affected by many factors such as the building design, the ventilation system, the presence of indoor pollutants, and the presence of outdoor pollutants.
implementing policies of public health protection.

288 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-dispersive 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 reach 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 led to the dimensional and mass distribution of the sources in PM10-2.5, PM2.5-1, PM1 fractions, showing that the antropic sources are mainly present in the fine and ultrafine particles, while the natural sources are characterized by coarse dimension.

289 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 particle matter (PM2.5) remains a global health concern as transport models continue to fall 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, Di benzo[ghi]fluoranthene (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)

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

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Autophagy is a ‘self-eating’ system that regulates the degradation of cellular components and organelles, whereas the activated process is typically accompanied by the production of ATP and the uptake of nutrients. Despite its crucial role in organisms the regulatory mechanism of autophagy remains largely unclear, particularly in invertebrates. In this study, conserved autophagy in the rotifer Brachionus koreanus in response to cadmium (Cd) exposure was verified by measuring acidic vesicle organelles using acridine orange (AO) and neutral red (NR) staining, and by detecting LC3 II/I on Western blot and immunofluorescence. We also demonstrated activation of mitogen-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.

291 Effects of trielosan (TCS) on antioxidant system and oxidative stress-mediated gene expression in the copepod Tigrigopus japonicus

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Trielosan (TCS) is an antibiotic 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 300 μg/L and 437.47 μg/L, respectively, while in the nauplius stages the corresponding values were 20 μg/L and 51.76 μg/L, respectively. Fecundity was significantly reduced (P < 0.05) in response to TCS at 100 μg/L. Concentration and time-dependent analysis of ROS, GSH content (%), and antioxidant enzymatic expression (e.g., GSH, GST, GPx, and SOD) 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 (CYP3026A3 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 copepods.

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

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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 xenobiotic exposure in aquatic organisms. GST, GSH, and transporters such as 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 roles of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chlorpyrifos, endosulfan, and molinate) 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, the current results demonstrate a protective 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.

293 CRISPR/Cas9 genome editing generates Daphnia magna (loss of function) mutants for TRH and ABCB1 genes. Implications for (eco)toxicological testing.

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Unravel the toxicological mode of action of pollutants to non-target keystone species may allow us to model and predict environmental risks of similar acting chemicals. OMICs technologies approaches developed in model
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 del ABCB1 mutants had lower transcript activity. Chronic toxicity tests with the selective serotonin reuptake inhibitor fluoxetine 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 ivernectin and its total or partial knockout dramatically increased its toxicity. These results provide the first evidence over 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.)

294 Assessment of Effects and Recovery of Chaoborus Populations in a Novel-Concept Microcosm Experiment  
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Larvae of *Chaoborus asp.* (phantom midges) which inhabit water bodies in the agricultural landscape are very sensitive to synthetic pyrethroid insecticides and are known to often populations were impacted by pesticides. Chaoborus are holometabolous dipterans and from egg hatch, larvae develop through four aquatic instars before pupation and adult emergence. A concurrent study conducted on the same site (unpublished) elucidated that the species used in the study were multivoltine so *Chaoborus* have an almost all-year-round potential for re-colonisation. A new type of microcosm study was conducted to assess the extent and rate of recovery of *Chaoborus* populations in microcosms treated with a synthetic pyrethroid. Novel elements included spatial separation of treated and control 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* are more susceptible to pesticides when compared to later instars and are 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.

295 Poster spotlight: TU108, TU109, TU110  

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

**296 Linking chemical pollution and effects – How to identify drivers of toxicity?**

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European water resources are contaminated with complex mixtures of ten 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, Meckle 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.

297 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. However, it turns out that there exist mixtures (for example pyrethroids and polychlorinated biphenyls (PCBs), or non-PCBs) which produce toxicodynamic recovery, which can be fast or slow. We tested four combinations of substances and found a clear difference in toxicity when the exposure order of two toxicants was reversed, while maintaining the same dose. When toxicodynamic recovery of the organism was slow relative to the interval between exposures it resulted in carry-over toxicity and so caused this sequence effect. We provide evidence for carry-over toxicity amongst chemicals acting on different targets and when exposure is several days apart. It is therefore not only the dose that makes the poison but also the exposure sequence.

298 How to deal with mixtures of pollutants in water resource management? R. Achtenburger, 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 Emerging effects of carry-over toxicity amongst chemicals acting on different targets when exposure is several days apart. It is therefore not only the dose that makes the poison but also the exposure sequence.  

299 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 poly-chlorinated dioxins (PCDD) or polybrominated 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

M. Faust, Faust & Backhaus Environmental Consulting; R. Altenburger, UBC
Centre for Environmental Research / Department Biocatalytic Ecotoxicology; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; V. Dulio, INERIS; J. van Gils, DELTARES; A. Ginebreta, CSIC - Spanish National Research Council / Environmental Chemistry; A. Kortenkamp, Brunel University London; J. Munthe, IVL Swedish Environmental Research Institute Ltd; J. Slobodnik, Environmental Institute; K. Tollefsen, NIVA / Hydroecology and Risk Assessment; A. van Welzel, KWR Watercycle Research Institute / Chemical Water Quality and Health

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). Although data gaps exist, a research gap is more a consequence of the current prioritisation process than a lack of available data. Hence, a research case for 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, thresholds be developed for so-called biological quality elements to reduce the risk of exposure. 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 somewhat blocked by significant data or knowledge gaps, mixture components of potential impact may be prioritised for future 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 pinpoints 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 potentiate 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 and for potential toxic synergies. 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 active 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 effect 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

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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’s be exceeded by the Annual Average concentration. While these definitions allow for a risk calculation for a single substance, the AA-EQS is based on chronic eco-toxicity 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 prospective 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 of water fleas and growth and development in duckweed and algae. These results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time-proportional 3-day mixed samples is inappropriate.
substances, the number of AA-EQs and MAC-EQs derived using Species Sensitivity Distributions (SSDs) increased from 2 to 5 and from 7 to 11, respectively. For AA-EQs derivation, AFs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQs derivation, AF were reduced in 5 cases and increased only in one case. Our study demonstrates that EQs derived on small data sets are more prone to large numerical changes when revised. Hence, an update often results in discrepancies with the derived EQs, as evident from application of lower AFs and more frequent EQS derivations based on SSDs. This is likely to make EQSs more robust against 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, crustaceans, and insects. The focus on the elicitation of action of a substance, this factor alone prevented the use of lower AFs. 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 A. JAMES-CASAS, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances ETES; A. BOTHAMY, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances TIA; J. VON DSMANN, A. PROCTOR, wca; R. A. VAN DAM, A. JAMES, B. WATT, CSIRO / CSIRO Land and Water; M.S. WARNE, Coventry University / Centre for Antarctic D

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 derive 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 water quality status, classification and also as a starting point for setting 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 WQGs 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 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 “toothbrush wars” 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 variable list of issues associated with WQB derivation in the derivation and implementation of WQGs. What research efforts 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 methods and, if so, what are the policies that will have the biggest impact, and the criteria that would make new approaches amenable for adoption?
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 stations, while Bacteroidetes were more pronounced in some of the stations. Rare phyla were higher in Echinadhes and Patraikois 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{3}, NO\textsubscript{2}, NH\textsubscript{4}, PO\textsubscript{4}, SiO\textsubscript{2} and chlorophyll 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 lysozyme (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 85:236-244. [2] Pavlidou A, Simboura N, Rousselaki E, Tsapakis M, Pagou K, Drakopoulou P, Assimakopoulou G, Kontoyiannis H, Panayotidis P. 2015. Methods of etiopathogenesis 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. Haffman, Macquarie University / Evolution and Ecology Researcher Centre; P. Steinberg, University of New South Wales / Centre of Marine BioInnovation; 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. Swarup, 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 Researcher 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 flushed open channels. Sediment was 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 study the 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 micrometazoan communities in a multistressors scenario. An experimental approach

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Climate change will affect agriculture practices and productivity because increased insolation frequency and intensity will stress crops and increase evapotranspiration, 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 micrometazoa 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 as a whole reduction in the diversity was the most important 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 ciliates 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 polyunsaturated 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 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 of high quality 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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streams might be toxic for periphyton (i.e. inhibiting the photosynthetic activity), being herbicides the driving chemical stressors. Results from the field, indicate that when the levels of pesticide pollution are low and co-occur with high levels of nutrients pollution, nutrients might mask pesticides effects on periphyton quantity and quality because compensatory effects from nutrients.

312 Estrone and triolosan mixture alters soil metagenomics during degradation
D.L. Carg, Texas Tech University / Biological Sciences; E. Osuji, 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 could have profound consequences for soil microbial community processes are poorly understood. Estrone and triolosan 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 triolosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrone, triolosan, and a 1:1 mixture of estrone: triolosan, and incubated for 90 days in the dark at 27°C. We examined soil microbial function dynamics using commercial Biolog EcoPlatesTM. 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 triolosan as single compound treatments exhibited half-lives of 6.8 days (estrone) and 26.7 days (triolosan). The rate of degradation of the binary estrone:triolosan mixture was the same as the individual compounds. There was a decrease in species diversity between control at day 1 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 triolosan in this soil whether occurring singly or as a binary mixture thus preventing accumulation in soil and subsequent contamination of ground water.

313 Poster spotlight: TU014, TU015, TU016

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

314 Region-specific life cycle inventories for tailings disposal in ecoinvent v3
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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 dammed 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 – since 2009 and the release of version 2.1 – a global average life cycle inventory (LCI) dataset for sulphidic tailings disposal, developed using a dedicated tailings emissions model. 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 inventories. Based on an exhaustive literature survey and 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.

315 Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction
L. Passarini, 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 current pattern of copper production 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 function in order to evaluate 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.

316 Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piecewise Linear Functions
C. Lee, L. Papageorgiou, University College London / Department of Chemical Engineering; N. Shah, Imperial College London / Department of Chemical Engineering
In this study, a reverse supply chain model has been developed to support strategic decisions making problems and associated with its reverse logistics chain design and less operation. The examined networks comprise multi-echelons, including disposer 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 indicators calculated to total cost the resulting production savings. Total cost includes capital and operation costs required to operate the supply chain network. The production saving is the revenue obtained from selling secondary products. In contrast, the ecological objective function is based upon net environmental value. This is achieved by adopting the principles of LCA, expanding the network boundaries to incorporate a set of life cycle stages and using the Korean Eco-indicator 99 method to assess the environmental impact of the network and avoided burdens. In addition, the environmental and economic performances of reverse supply chain networks are assessed through the development of a spatially explicit model that combines logistics and Geographic Information Systems. The model is used to address strategic decisions involving the location, number and capacity of collection and recycling facilities; selection of recycling technologies; and assignment of transportation links required to satisfy returns and demand at the markets. At the operational level, optimal recycling profiles and flows of material between various components within the supply chain are determined. Furthermore, the model considers the economies of scale (large, medium and small) of collection & recycling facilities and transportation links, and explores whether decentralised recycling is favoured over decentralised recycling. The performance of the proposed models is explored within a South Korea context in order to determine the optimal reverse supply chain configuration of fluorescent lamps.

317 The use of Life Cycle Assessment to adjust consumption taxes: The concept of a Damage and Value Added Tax
B. Timmermans, Alma Mater Studiorum - University of Bologna / Dept. of Industrial Chemistry
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 LCA. 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 ethical concerns specific to a country, another damage tax termed 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 impossibility 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. calculate changes in 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. Sonderregger, ETH Zurich; M. Berger, Technische Universitaet 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. Helbig, University of Augsburg; O. Jolliet, University of Michigan; M. MOTOSHITA, National Institute of Advanced Industrial Sci. and; S. Northey, Monash University, another damage tax termed ISM; L. Tikana, DKI Copper Alliance / Life Cycle; A. Valero, Universidad de Zaragoza; M. Vieira, PRe Sustainability; S. Young, University of Waterloo Primary mineral resources are of great relevance for industry and society. The environmental impacts caused by emissions to air, water, and soil resulting from mining and refining processes to produce usable materials are considered in relatively recent or specific impact categories (e.g. calculate changes in 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. However, the assessment of impacts resulting from resource use on resource availability is still controversial – even though a wide range of methods and models are available. Therefore, this task force – comprising 48 experts from different fields and working under the umbrella of the UN Environment Life Cycle Initiative – focuses on methods assessing these impacts and works towards consensus guidance for method users and developers on what method type is best suited depending on the goal and scope of a particular LCA study. In a comprehensive literature review, more than 20 methods assessing impacts of resource use in LC($A) have been identified. These methods have been clustered into four categories: methods assessing depletion of stocks, methods assessing “future efforts” resulting from ore grade decline as an (assumed) consequence of current extraction, methods using thermodynamic accounting (exergy and emergy approaches), and methods assessing supply risk of raw materials based on socio-economic aspects (like country concentration, political stability, etc.). Within the four clusters of methods, key axioms and methodological choices, like the resource stocks used in depletion methods, the reference environment used in exergy methods, or the socioeconomic aspects considered in methods addressing supply risk are discussed. Furthermore, methods are evaluated based on a comprehensive evaluation scheme developed within the Life Cycle Initiative that has been customized to the primary mineral resource context in an iterative process in the task force. The overall aim is to provide clear guidance on best practice for each method type. Furthermore, the review process includes a debate about what the newly established within LCA method should be and how problems related to resource use (provisioning capacity, availability for future generations, etc.) can best be assessed. Especially supply risk methods cover perspectives beyond “environmental” impacts and the task force keeps discussing how to map these methods in the framework of LCIA or how to use them complementary to “traditional” LCA.

319 Poster spotlight: TU214, TU215, TU237

Safe by Design: responsible and innovative research for safe and sustainable chemistry

320 Silica coating for the control of nano-reactivity
S. Ortelli, CNR ISTEC; M. Blosi, CNR; D. Gardini, CNR ISTEC; A. Costa, CNR Nano-titanium dioxide (TiO2) and nano-silver (Ag) and are among the materials most investigated for their technological importance and consequent interest in terms of their environment, health and safety (EHS) issues. In particular these particles cause alert for their capacity to generate, transport and release potentially toxicants such as metal ions and reactive oxygen species that can induce several negative effects, responsible for cytotoxicity. In this study we investigated silica coating as technique for control two recognised toxicity drivers for nano TiO2 and Ag that are the exogenous production of ROS and the Ag+/Ag total distribution. We evaluated the effect that silica coating had on physicochemical properties (size, shape and zeta potential) outcomes from the evaluation of nano TiO2 and Ag nanoparticles was formed, even by simply playing with colloidal attraction between the two hetero-phases. The presence of silica coating seems to have two important effects for the control of ROS and Ag+ toxicants, representing a safe by molecular design solution for the control of nano-reactivity. 1) Silica acts as dispersion/dilution matrix for decreasing the production of ROS, but improving the photocatalytic performances of pristine sample; 2) Silica act as reservoir for Ag+ ions, decreasing the amount of immediately available fraction and so improving the range of concentration where the sample shows antibacterial properties despite to negligible cytotoxicity.

321 Framework for the optimal design of sustainable chemical processes
A. Gonzalez Garay, R. Calvo-Serrano, G. Guillén Gosalbez, Imperial College London / Chemical Engineering
Given its natural link between fundamental science, engineering and industrial practice, the chemical industry plays a key role in meeting the challenges of sustainable development. In particular, the use of computer aided tools for the generation of sustainable processes is essential to facilitate the transition towards a more sustainable chemical industry. In this work, we present a framework that incorporates sustainability principles in the design of chemical processes. The methodology proposed uses life cycle assessment to assess the sustainability of the processes; surrogate modeling and objective-reduction techniques to enhance the optimization of the processes; and data envelopment analysis (DEA) as multi-criteria analysis tool. The use of DEA facilitates the post-optimal analysis of the Pareto front by filtering and ranking the optimal designs that conform the Pareto frontier without the need to define explicit weights. In addition, DEA provides improvement targets for suboptimal alternatives that if attained would make them optimal. The key advantages of this approach is its capability to incorporate several criteria into a single index and to use the information from the standard DEA approach to evaluate the optimal analysis of the processes; and data envelopment analysis (DEA) as multi-criteria analysis tool. The use of DEA facilitates the post-optimal analysis of the Pareto front by ranking and filtering the optimal designs that conform the Pareto frontier without the need to define explicit weights. In addition, DEA provides improvement targets for suboptimal alternatives that if attained would make them optimal. The key advantages of this approach is its capability to incorporate several criteria into a single index and to use the information from the standard DEA approach to evaluate the optimal analysis of the processes; and data envelopment analysis (DEA) as multi-criteria analysis tool.
licensing authorities. Furthermore, it is advised to develop a broader decision scheme that besides SVHCs also considers and weighs other risk and benefit factors of recycling, like the risk of pathogens and medicine residues and the benefits with respect to sustainability (e.g. carbon footprint). Such a development will further stimulate the transition towards a safe and sustainable economy.

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

Ly Veen, Institute for Environmental Studies (IVM) VU University Amsterdam / Chemistry and Biology; A. Hanning, Swerea IVF AB; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, VU University Amsterdam Department Environment & Health / Environment and Health; J. Weiss, Stockholm University, ACES / Department of Aquatic Sciences and Assessment; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health

In the durable water repellence (DWR) layer of textiles of outdoor clothing, PFAFs have been used because their perfluoralkyl chains have the ability to repel liquids of a wide range of polarities (DFW, hydrophobic and hydrophilic) and DWR compounds, like PFASs and silicones, are emitted to air, water and soil. Weather conditions, like sunlight, high temperature, or humidity can have a strong effect on the emission of PFAFs from textiles. 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. 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 rainout and windout. 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.

324 Chemicals in plastic packaging: Prioritization of hazardous substances

K. Groth, Food Packaging Forum Foundation; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences; B. Geuweke, Food Packaging Forum Foundation; A. Lennquist, Chemsec; H. Leslie, VU University Amsterdam / Environment&Health; J. Vromans, Food Packaging Forum Foundation / General Management

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 use 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 a Classification and Packaging (CPP) hazard assessment categories, and also including endpoint disruptive properties and PBT (persistence, bioaccumulative and toxic) characteristics. Due to the lack of empirical hazard data for many of the substances in the CPP-DB, we also used in-silico tools to bridge data gaps. In this presentation we will use the CPP-DB to present an overview of chemicals associated with plastic packaging, their hazards for human health and soil contamination, and we will highlight priority hazardous chemicals for substitution. Finally, we will discuss the research needed to allow for a more robust hazard characterization and ranking.

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

E. Giubbioli, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; E. Semenzin, Ca Foscari University of Venice / Department of Environmental Sciences Informatics and Statistics; E. Badetti, University Ca Foscari Venice / Department of Environmental Sciences Informatics and Statistics; M. Picone, D. Hristozov, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Brunelli, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; J. Muncke, University Ca Foscari Venice / Department of Environmental Sciences Informatics and Statistics; V. Cazzagon, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics; A. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences; B. Carney Almroth, University of Gothenburg / Department of Biological and Environmental Sciences; A. Hanning, Swerea IVF AB; S. Schellenberger, Stockholm University / Department of Applied Environmental Science (ITM); J. de Boer, VU University Amsterdam Department Environment & Health / Environment and Health; J. Weiss, Stockholm University, ACES / Department of Aquatic Sciences and Assessment; P. Leonards, VU University, Institute for Environmental Studies / Department of Environment and Health

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326 Recent developments in environmental risk assessment for pollinators

Z. Browning, Brownings Honey Co., Inc.

In the USA, beekeeping is a hobby, a sidelined 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 honey producti. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial bee have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture endures, 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 have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture endures, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their honey producti. Commercial beekeepers migrate with their tens of thousands of colonies to pollinate the nation’s food supply. Once commercial bee have pollinated the majority of specialty crops they head to summer forage areas for a honey crop. The areas of conflict for bees in agriculture endures, and crop pollination may have hundreds of hives serving not just their local communities, but their state or regions of the country renting their honey producti.
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. Inviting beekeepers in risk assessment and research design is key to ensuring the research premise 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. Pollinating 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 an results)

327 A new multi-dimensional method for evidence synthesis and weighting in bee risk assessment A. Ippolito, 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, but the method proposed is applicable and consistent guidance document within the regulatory framework 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 analyzing of existing data generated thus far on honeybees Using the existing laboratory chronic data, EFSA’s Bee Guidance Tier 1 assessment showed the following: • Almost all substances and uses fail the screening step for chronic risk to larvae and chronic risk to adult honey bees for both spray and solid application types. • For solitary bees very few substances pass the acute screening step and none pass for chronic risk assessments. • Even known low-bee-toxic substances fail the risk assessment and would need higher tier refinement. In order to pass the assessment, the required doses that would have to be tested would be so high that they would not be technically (solubility) or practically (consumption by the bee) achievable. Results of the Tier 1 assessment following an industry proposed approach will be presented, together with a comparison of existing honeybee and bumblebee data, proposals for protection goals and higher tier testing methodology. 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.

330 Standardization of an in vitro larval rearing method for stingless bee species Melipona scutellaris for use in toxicological bioassay studies. A.S. Dorigo, Universidade Estadual Paulista Júlio de Mesquita Filho Unesp Rio Claro / Departamento de Ciências Exatas / Instituto de ciências da Natureza e do Meio Ambiente; A. Rosa-Fonseca, Unesp - Instituto de Biologia / Departamento de Biologia, Centro de Estudos de Insetos Sociais; R. Cornelio Ferreira Nocelli, Universidade Federal de São Carlos USFCar Araras / Ciências Biológicas Departamento de Ciências da Natureza Matemática e Educação; O. Malaspina, Unesp Universidade Estadual Paulista Júlio de Mesquita Filho / Departamento De Biologia, Centro de Estudos de Insetos Sociais. We believe that for effective risk assessment, risk assessors need to be informed about 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), analyzing the amount of food consumed by larvae. Before the experiments, the acrylic plates with larvae food cells were pre-weighed. The Petri dishes were filled with water to keep the humidity around 95% within the Petri dishes during the first five days of rearing. Each artificial cell received 130µl of larval food and, afterwards, 24-hour-old larvae were placed in the food. Then, the plates were kept in an incubator at 30°C and 75% of relative humidity. After the total consumption of the food, the humidity within the Petri dishes was reduced to 75%, adding NaCl. This technique was carried out five times sequentially, evaluating parameters such as defecation rate, pupation, emergence, and mortality and morphometry of newly emerged workers. For the morphometric analysis we also evaluated newly emerged work from natural brood combs. The survival rates increased gradually according to the larval food level.
the progress of the experiments, increasing from 67.1% in the first to 87.8% in the latter, and the morphometric analyses indicated newly emerged workers in vitro with similar sizes to in vivo. The in vitro rearing method described showed a satisfactory survival rate, as well as produced newly emerged workers with similar to those from natural conditions, allowing its use in toxicity tests.

331 Poster spotlight: TU038, TU048, TU052

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?

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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 used 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 exposures 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 product use, i.e the fraction of a chemical in product that is cumulatively taken in by the users. Based on the building materials Pharoas 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 VOCs, 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 time. The total 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. Jiang, Environment and Climate Change Canada; M.L. Diamantidis, University of Toronto / Department of Earth Sciences

Organophosphorus 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 10^3 ng/m^3 in air. Concentrations are also relatively high in urban media (e.g., low µg/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 levels. “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 related to PCB 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” estimations, which could be caused by higher emissions from commercial buildings or single source emissions from OPEs 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. Emission 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; 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. Pharmaceutics can be related to PCB and TPhP, respectively. The relevance of these estimates in comparison to real world temporal variations in pharmaceutical exposure has yet to be determined. In this study we attempt to quantify and understand the drivers behind spatiotemporal fluctuations in the concentrations of pharmaceuticals in a city system. Monitoring data for 33 pharmaceuticals were obtained monthly at 11 sites in two rivers that run through the City of York, UK. This data was compared with local monthly prescription, tourism and flow data. In the smaller River Foss, a strong relationship was found between measured concentrations and prescription amounts divided by flow. This trend was not replicated in the larger more urbanised River Ouse. Analysis of pharmaceutical loads indicates that seasonal differences exist in the Ouse, but not in the Foss. Seasonal variability in WWTP removal efficiency is expected to be a factor. In-stream losses of up to 75% were found in the River Foss during summer months and all pharmaceuticals studied followed a sinusoidal loss pattern through time. Significant losses were not identified in the River Ouse. Finally a risk assessment indicated that seasonal differences exist in the Ouse, but not in the Foss. Significant losses were not identified in the River Ouse. Finally a risk assessment indicated that seasonal differences exist in the Ouse, but not in the Foss. Significant losses were not identified in the River Ouse. Finally a risk assessment indicated that seasonal differences exist in the Ouse, but not in the Foss.
Microplastics in freshwater and terrestrial systems - fate, monitoring and biological interactions (III)

337 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. Arnott, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology; F. Wania, University of Toronto at Scarborough / Physical and Environmental Chemistry.
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 of 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, when 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.

338 Modelling of the environmental release of macro- and microplastics for seven different polymers
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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 using a Probabilistic Material Flow Analysis (PMFA). The environmental flows of seven different commodity thermoplastics are estimated based on societal data. The polymers are chosen for their popularity of use and the frequency at which they are reported in the environment: low-density polyethylene (LDPE), high-density polyethylene, polypropylene (PP), polystyrene (PS), expanded polystyrene (EPS), polyvinyl chloride (PVC), and polyethylene terephthalate (PET). 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 polymer consumptions. 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 sources and the possibilities for pollution mitigation.

339 Modelling Microplastics in Rivers in the US
A. Koelmans, Wageningen University / Aquatic Ecology and Water Quality Management; C.M. Holmes, Waterborne Environmental Solutions
Pollution with nano- and microplastics (MPs; particles < 5 mm) is a topic of emerging concern and as such receives growing interest. Although measurement and monitoring data are indispensable, there also is a need for estimated concentrations to enable prospective assessments and to guide analysis of retrospective ecological analyses. Besseling et al (2017) provided the NanoDUFLOW model, a detailed MP aggregation-sedimentation model integrated in a hydrological and particle transport model. A much larger scale model potentially suitable to simulate MPs originating from WWTPs is the iSTREEM® model, which has been developed to estimate chemical concentration distributions for all rivers and streams of the USA receiving WWTP discharges. Here we merge these two riverine modeling worlds: NanoDUFLOW with iSTREEM for MPs, to simulate the routing of MPs from WWTP point sources in US waterways and to assess export to the Great Lakes for a range of particle sizes. This combines the mechanistic realism of NanoDUFLOW, accounting for formation and settling of heteroaggregates, with the US well-established iSTREEM implementation. We modeled floating as well as non-buoyant MP, for diverse sizes, from 100 nm to 10 mm, a range that incorporates the theoretical parabolic size-setting relationship reported by Besseling et al (2017). Depth dependent in-stream first order removal rate constants simulated with NanoDUFLOW were combined with standard iSTREEM output (which was used to simulate the emission, transport and water column concentrations of MP) in an Excel-based post-processing phase, without modifying the iSTREEM model directly. Simulations were spatially explicit with MP concentrations being modeled for the Sandusky River watershed in Ohio (~3500 km²). Emissions were based on per capita usage and population served for the past usage of these chemicals in the US and microplastics for seven

405 The routes to uptake and bioaccumulation of nanoplastics in freshwater sediments
R. Cross, C. Liddle, University of Exeter; T.S. Galloway, University of Exeter / Biosciences
Plastic contamination of freshwater sediments is well documented, and whilst quantitative measurement of PET routes to uptake and bioaccumulation in sediments are be low. However, assessing their potential uptake and transfer through food chains can contribute towards the data required to inform decisions as to the suitability of classifying nanoplastics as POPs. This study provides initial insights to address this question in

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an ecologically relevant system, using the freshwater aquatic worm Lumbriculus variegatus, representing an entry point for nanoparticles from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluorescently dyed nano-poly styrene (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 worm. Associations of nanoparticles to the surface are examined in waterborne exposures, whilst dietary uptake is tested using nanoparticles associated with an algae food source. The accumulation of nanoparticles directly from contaminated sediments is also investigated, alongside the fate of these particles in sediments to assess the relationship between nanoplastic mobility and accumulation. Results indicate that pristine nanoplastics are less bioaccumulated upon feeding and waterborne exposures and from dietary uptake of a nanoplastic associated algal food source, with carboxylated and amminated plastics experiencing greater uptake than non-functionalised particles. Sediments on the other hand, reduced the availability of these particles for uptake into the worms, potentially though strong associations of the nanoplastics to solid constituents of the sediment. Ongoing work addresses the potential for formation of an “ecocorna” to alter the bioaccessibility of nanoparticles for the worms. These results will also be presented during the platform presentation.

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 riversbanks) 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 (ACH-E); antioxidant defences and biotransformation (CAT, GST total glutathione levels); oxidative damage (LPO); cellular energy allocation (CEA) and immune response (phenoilxidase). Exposure to PE 40–48 µm caused deleterious effects at lower concentrations in comparison with larger particles in several parameters: larval growth and development time of both male and female imagos and on emergence rate. PE 40–48 µm were then selected to assess effects on physiological homeostasis. Acute exposures to PE 40–48 µm generated alterations in C. riparius larvae antioxidant 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 effect 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. Foster, University of Bayreuth / Animal Ecology I; I. Schrank, J. Dummert, A. Wieg, 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 leach 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, as the insight desorb from the polymer matrix. With our transcriptome analysis, which was conducted via the use of a microarray, we showed that Daphnia magna reacts substantially different to the chronic (31 days) exposure to rigid PVC or flexible PVC (with diisononyl phthalate (DINP) as plasticizer) with changes in gene expression. Rigid PVC caused a fivefold up regulations in a total of 19 genes (15 up-regulated and 4 down-regulated) related to stress and detoxification processes (e.g. increased mortality and reduced growth) whereas the associated ecosystem processes (reduced leaf decomposition). The effects can propagate through food chains and result in indirect effects in predators. Future studies should elucidate the spatiotemporal dynamics of exposure and uptake given that imidacloprid leaches from plant material and may influence downstream food webs directly and indirectly.

343 Accounting for trophic relationships in fish bioconcentration models applied with emergent-pollutants risk-assessment tools

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Pollution is a major driver of ecosystem change resulting in alterations in food webs and their food web interactions. As a result, 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. Thereby, 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 mesocosm setting. Therefore, decomposers fed on control or contaminated leaves for 3 days on the microcosm. 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 unpolluted 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 and growth rates of decomposers in contaminated microcosms compared to the control. Furthermore, decomposer’s biomass and length decreased in the contaminated but not in the control microcosms. Predators hunting decomposers from contaminated microcosms decreased in body size compared to the control. Systemic insecticides in plant materials can be a relevant source of exposure for decomposers with consequences for their population dynamics and leaf decomposition. The model food chain can be applied 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 insight in 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 variability 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. Wold, 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 Kow 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 from six Canadian lakes (Lake Slave, Lake Ontario, Source Lake, Happy Isle Lake, Lake Opeongo, and Lake Mephemagog) 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, diet 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 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 Mephemagog 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 and diets for lake trout systems and linked to streams (Stave Lake, Lake Ontario, Source Lake, Happy Isle Lake, Lake Opeongo, and Lake Mephemagog) 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, diet 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 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 Mephemagog feeding on less lipid rich rainbow smelt.

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

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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 gosseled s flyway. Resightings 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 perfluoralkyl substances (PFAs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be correlated with PCBs and DDEs, but emerged to PODs like perfluorinated sources due to overlapping signal, but stable isotopes of nitrogen appeared to be fuelled by distant resources in United Kingdom and Northern Norway. When examining pollutants individually, there was no relationship found between stable isotopes and pollutant concentrations. However, when combining pollutants together as part of a multivariate analysis, it was found that egg laying date contributed to the variation in PFAS levels across eggs. Large eggs are formed for PCBs. Protein associated pollutants (PFAS) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

349 Trophic Magnification of Persistent Organic Pollutants Within A Terrestrial Food-Web of An Avian Top Predator, the Cooper's Hawk (Accipiter cooperii)

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Several types of legacy persistent organic pollutants (POPs), such as PCBs and DDEs, but not for PCBs. Protien associated pollutants (PFAS) may be more influenced by migration strategy than lipid soluble contaminants (PCBs and HCB), due to protein stores being a more limiting energy source during migration than lipids. This knowledge furthers our understanding on how pollutants operate within Arctic terrestrial ecosystems, and the interaction between climate and pollutant bioaccumulation in highly seasonal environments.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling

SETAC Europe 28th Annual Meeting Abstract Book
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 complex situations (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/ECx, for arbitrary effect strength x 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 very often. In order to make 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 ‘morex’ 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 of any size and complexity 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-pesticides on the energy budgets of an estuarine amphipod
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Estuaries are major recipients of runoff 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 insects in vitro, further investigation is needed to allow modeling. Understanding the availability of nano-based copper formulations for regulatory risk assessments is particularly pertinent, as these new copper formulations are likely used on coastal agricultural fields. In this study, we report the first measurements of copper in the marine invertebrate Leptocheirus plumulosus. The copper accumulation was monitored over 1 day. The copper accumulation was found to vary with the concentration of copper, with the highest uptake of copper observed at the highest concentration of copper used. The copper accumulation was found to vary with the concentration of copper, with the highest uptake of copper observed at the highest concentration of copper used.

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 susceptibility 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 oxychloride), on different endpoints, including growth, for the earthworm species Apooretoidea 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 over R15 (i.e., young individuals (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 toxicodynamic model (cytochrome P450 activation & transcriptomics) along with effects on development, growth, and reproduction. The model predictions were compared to experimental data to assess the predictive power of the model. The model was able to accurately predict the growth and survival of earthworms exposed to copper at different development stages, providing insights into the mechanisms underlying copper toxicity in earthworm growth, development, and reproduction. The conclusion of our study is that the DEB model is a promising tool for assessing the impact of copper on earthworm populations, and could be further developed to include other metals and to assess long-term effects.
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 hypothalamic-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 oocyte 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/kg 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.

355 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 might have effects on the response of fish to the other. Some effects of Pb have previously been developed in kinetic models for predicting metal accumulation in fish-parasite systems. Our review-based 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 non-specific distribution 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 terecicottis. 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 diffusion 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 change of metal 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)

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

J. van Gils, DELTARES; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; h. baveco, Wageningen Environmental Research; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; I. Cousens, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); C. Lindström, Stockholm University; S.S. Kutsarova, University of Zlatarow / Laboratory of Mathematical Chemistry; S.D. Dimitrov, University of Zlatarow / Dept of Comp Inform Technologies

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 presents the advantage of being a "truly "chemically unbiased"" approach 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 EH-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 multiple uses. The predict chemical and biological monitoring results, based on a correlation with 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.

357 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 needed to be developed to link chemical monitoring results, derived 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 "The Solution" (SOLUTIONS). The methods approaches are applied to link exposure dynamics of a number of chemical compounds to parasinomous 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 partes 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.

358 Eco-epidemiology of aquatic ecosystems: aligning chemical and ecological studies

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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. Sudbrock, who famously provided a solution to a cholera outbreak in Soho, London, 1854, by epidemiological reasoning. So, this paper presents 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 guidelines such as the EU Water Framework 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 staging and risk. The presentation highlights MARS (Mixing Aquatic stress 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: toxins 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 thus the EU project MARS (Mixing Aquatic stress 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.

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. Levels of currently used additives such as phthalates, PFCs, flame retardants or nanomaterials 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 resulting 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: where the same approaches, evaluation options for minimising risks as to quantifying risks for new substances under introduction or development; (2) Transparency and openness of information and knowledge: Current applied research aimed at providing solutions to identified problems of chemical contamination in e.g. water ecosystems is severely limited by a lack of information on the production and use of chemicals in society as well as emissions to water. Linkage of national databases on use volumes of industrial chemicals such as SPIN (Substances in Preparations in Nordic Countries) would allow tracking quantitatively substitution of the most problematic substances; (3) Increased international cooperation and strengthened global agreements. The world is globalised and the transport of chemicals is transboundary – both via the atmosphere and via global trade.

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

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

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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 ecosystems 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) Update the framework and develop a starting point.

363 Predicting the response of ditch ecosystems to multiple stressors
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Until recently, our knowledge of the net effects of multiple stressors was limited. We still lack a general framework that can integrate known effects of individual stressors on organisms and predict how these effects propagate through higher levels of biological organisation. In light of this, a workshop was held at Wageningen University and Research, the Netherlands, (September 2017) to determine the current state of knowledge of multiple stressor effects on aquatic ecosystems and to assess how these effects can be better predicted. The workshop was attended by experts from the Netherlands, Australia, Germany, and Canada and covered a range of ecosystem types considered to be at high risk from multiple stressors. The workshop resulted in a “best-approach” conceptual framework for assessing multiple stressor effects on aquatic ecosystems. The framework was subsequently applied to three case studies: harbours, agricultural drainage ditches, and floodplains. Here, we present the application of this framework to agricultural drainage ditches. Agricultural drainage ditches are an under-appreciated and undervalued habitat for a range of aquatic and terrestrial organisms. Although these man-made features can maintain high biodiversity in agriculture landscapes, they are often ignored for their effects on aquatic communities. They provide a strong linkage between agricultural fields and adjacent water bodies as they are a common sink for agricultural chemicals such as neonicotinoid insecticides and fertilizers. As these agrochemicals are bound to co-occur with the ditches, we aimed to study the effects of thiacloprid on invertebrate population and community responses. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted outdoors. We found that the effects of thiacloprid on several population responses at concentrations that were comparable or far lower than laboratory derived LOECs as obtained from literature. These effects were less pronounced when organisms were exposed under nutrient enriched conditions. In addition, we observed significant dissimilarity between the naturally assembled communities under the influence of both thiacloprid and nutrients. These shifts were largely represented by a severe decrease in insect abundance under thiacloprid exposure. This decrease was not observed in ditches that received both thiacloprid and nutrient application. Thus, we showed the importance of nutrient enrichment (and the resulting increase in primary production) for coping with thiacloprid induced toxicity. This might explain the difficulties as often faced when extrapolating lab to field data and the other way around.

365 Macroinvertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams
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Ditches are commonly used to control for fluctuating groundwater tables in agricultural landscapes. They provide a strong linkage between agricultural fields and adjacent water bodies as they are a common sink for agricultural chemicals such as neonicotinoid insecticides and fertilizers. As these agrochemicals are bound to co-occur with the ditches, we aimed to study the effects of thiacloprid on invertebrate population and community responses. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted outdoors. We found that the effects of thiacloprid on several population responses at concentrations that were comparable or far lower than laboratory derived LOECs as obtained from literature. These effects were less pronounced when organisms were exposed under nutrient enriched conditions. In addition, we observed significant dissimilarity between the naturally assembled communities under the influence of both thiacloprid and nutrients. These shifts were largely represented by a severe decrease in insect abundance under thiacloprid exposure. This decrease was not observed in ditches that received both thiacloprid and nutrient application. Thus, we showed the importance of nutrient enrichment (and the resulting increase in primary production) for coping with thiacloprid induced toxicity. This might explain the difficulties as often faced when extrapolating lab to field data and the other way around.

366 Daily temperature variation determines the toxicity of a pesticide mixture
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Pesticides from agricultural usage are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide use in agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in Eastern Europe (Romania), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on animal labour (e.g. horse ploughs). We assessed that, in contrast, to pesticide toxicity, excessive nutrient and sediment input would be unrelated to agricultural intensity. Consequently, this would allow distinguishing effects from pesticides and these other stressors. We analysed the relationships between pesticide toxicity and other agricultural stressors. Additionally, we analysed combined and individual effects of these variables on the biodiversity, as well as on the composition of stream macroinvertebrate communities. We examined 19 low-order streams across a gradient of agricultural intensity in terms of average field sizes. Pesticide concentrations were investigated using two different passive sampling methods. Firstly, we used styrene-divinylbenzene (SDB) disks to sample hydrophilic compounds, which enabled the determination of approximate time-weighted pesticide concentrations in streams during heavy rainfall events. Secondly, we used polydimethylsiloxane sheets (PDMS) focused on the detection of lipophilic pyrethroids and organophosphates. The toxicity of the 88 detected pesticides was assessed using the sum toxic unit (sumTU). Stream macroinvertebrate communities were sampled twice, using a quantitative multi-habitat-sampling. This allowed the analysis of relationships between the community composition and diversity with a gradient of pesticide toxicity in interaction with additional agricultural stressors. The toxicity gradient originated from pesticides and nutrients (NH₄⁺) showed no relationship to the intensity of agriculture expressed as the average size of the adjacent fields. This indicates that pesticides and nutrients co-occur independently of agricultural intensity. How and to which extent, in terms of effect size, the communities are affected by the pesticide gradient and the additional presence of other stressors originating from agricultural land use will be presented during the conference.

364 The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses
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Synergistic interactions between pesticides in mixtures and between pesticides and warming may improve the efficacy of vector control. Particularly, synergistic interactions between biopesticides and chemical pesticides would be promising as these could potentially result in the combination of efficacy of control, slowdown of resistance build-up and lower ecological damage. One understudied aspect of global warming is the increase in daily temperature variation (DTV). While DTV may increase the toxicity of chemical pesticides, it is unknown whether it also interacts synergistically with biopesticides, and magnifies the toxicity of pesticide mixtures. We tested whether DTV influences the toxicity of pesticides with a
different mode of action (the chemical pesticide Chlorpyrifos, 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 measured effects on gaseous and extractable 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 small DTV changed the toxicity 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 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.

367 Widening 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. 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-factorior 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 (CPF). 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 fitness of these insects in more extreme 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 ecotox testing will increase the realism of the risk assessment of pesticides under global warming.

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

368 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 volatile from non-volatile compounds. 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) -2.5 to +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 example like “hidden-target screening” in complex environmental matrices (such as wastewater treatment plants) or in the pharmaceutical industry. Both techniques are complementary and useful for all types of molecules polarity. In this study, more than 80 percent of the compounds found in wastewater treatment plant effluent samples possessed a negative log D (pH 7) value. This result highlights the basic necessity to include “very polar” compounds in water monitoring techniques and protocols [1]. S. Bieber, G. Groe, S. Grosse, T. Letzel: RPLC-HILIC and SFC 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).

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

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Polar organic matter (POM) is ubiquitous in natural waters and can be classified into two main groups: non-volatile, non-polar 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 and fate of micropollutants in drinking water was studied at lab-scale for their removal by different options including powdered activated carbon (PAC), high pressure membrane processes and transformation of these compounds. Chlorinated and hydroxylated analogues, and products of cleavage and cyclization were identified. US EPA toxicity prediction tool showed that common micropollutants like natural and synthetic pesticides and veterinary drugs, are 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⁻¹ s⁻¹ and thus will not be transformed during ozonation of drinking water. Two aromatic guanidines, the 1,3-diarylguanidine and the 1,3-di-o-tolyguanidine, an olefinic sulfonate and an amine compound, the N-benzylidemethylamine, 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 chloride and hydroxylated analogues of MOCs are more toxic than the parent compound, which was confirmed by Microtox acute toxicity test for Cl₃guanidine 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 halogenated methanesulfonates, adamantan-1-amine and triazine compounds will neither be removed by adsorption on activated carbon nor by ozonation. The removal by ozonation of drinking water was studied under lab-scale and field conditions. 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 example like “hidden-target screening” in complex environmental matrices (such as wastewater treatment plants) or in the pharmaceutical industry. Both techniques are complementary and useful for all types of molecules polarity. In this study, more than 80 percent of the compounds found in wastewater treatment plant effluent samples possessed a negative log D (pH 7) value. This result highlights the basic necessity to include “very polar” compounds in water monitoring techniques and protocols [1]. S. Bieber, G. Groe, S. Grosse, T. Letzel: RPLC-HILIC and SFC 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).

370 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 preferentially remain in the water phase during environmental and water treatment processes, potentially reaching finished drinking water and thus raising concern over adverse effects to human health. In The Netherlands reverse osmosis (RO) has been proposed as a stand-alone treatment capable of producing impeccably drinking water. However, riverbank filtration (RBF) is still considered the most economic solution to retaining organic compounds depending on physicochemical properties such as size, charge and polarity. The aim of this study was to assess whether riverbank filtration followed by RO can provide sufficient removal of MPs and thus be considered for further implementation. We also aimed to elucidate the transport of organic solutes through RO membranes by relating solute physicochemical properties to solute passage. A novel pilot-scale RO system capable of operating in anaerobic conditions was built for this study. Raw anaerobic riverbank filtrate was used as feed water. The feed was spiked with 30 target polar MPs selected from scientific literature and considered relevant for the quality of source waters and critical for...
RO. Feed water samples were analysed by direct injection, whereas RO permeate samples were 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 benzozytrazole, tolytriazole and phenyurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that retention of neutral polar MP s is mainly governed by size exclusion. For neutral and moderate polar MPs the inverse was observed. Passage in RO permeate was well below 1% for bisphenol A, which displayed 4% passage. The higher passage of moderately polar and hydrophobic MPs could be attributed to solute-membrane hydrophobic interactions followed by diffusion. All anionic MPs displayed less than 1% passage, opposed to cations for which up to 10% passage was observed. The negative charge of the membrane surface explained the results. Overall this study showed that high chemical removal rates can be achieved by RO. Tighter membranes 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.1 If these mobile organic contaminants (MOCs) are persistent (POMCs) against microbial and chemical degradation, their removal during water and wastewater treatment and drinking water purification may prove difficult. Toxic POMCs may be classified as PMCs (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 often only (e.g. acetaldehyde, glycol) have been extensively studied and monitored2. POMCs 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 pollutants. Many POMCs derived 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.3 and Schulec et al.4 we selected 15 industrial chemicals with a high expected potential to form subsequent transformation and study their behavior during hydrolysis, biotransformation, oxidation with MnO2, and photolysis 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 water surfaces for the presence of these TPs. While some TPs were not detected, others were detected by the majority of the 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 application domain, i.e. 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 in 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 octamethylene cycloctetrasiloxane (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 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/vPvB 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 vPvB 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 haunting 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 all 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 production systems. These damages are conventionally characterized per so called functional unit. In practice, however, these functional units are partially descriptive, e.g. white light from a point source with 1500 lumen, and not well assessed. In the first part of this study we therefore further elaborate the functional unit towards product benefit. When taking a closer look at the concept of functional unit, it is imperative to define what functionality implies. Products have been created to fulfil human needs, e.g. the need for light at night provided by a light bulb. Through fulfilment of needs, human well-being is induced. The characterisation of the actual functionality hence boils down to the assessment of this well-being effect. In consequential LCA, not only the consequences related to the needed activities associated to the functional unit life cycle should after all be considered, but also those associated with the benefit induced by the product. In the second part, we specify how a better product benefit characterisation could improve life cycle assessment 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. Using a respective product benefit, the different products will treat the same. 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 develop a holistic sustainability system in which the benefits are not only subtracted. Third, when an additional amount of byproduct is created by a production system, this may also induce a byproduct benefit, which can be
accounted for as such, in fact, when a byproduct enters the market, a share of it can lead to a decrease in supply (substitution approach) but another share can also lead to an increased demand and thus consumption, which satisfies needs that were previously unsatisfied (production benefit approach). A consideration of both effects is needed in CLCA.

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, polyunsaturated 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 μDALY/Y. We also develop a profiling system for 6000+ food items consumed 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 trend range between -8 avoided μDALY/Y for sodium, up to 57 avoided μDALY/Y for omega-3 from seafood. HENI score typically ranges from -80 avoided μDALY/serving for Frankfurter sandwiches to 50 avoided μDALY/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 increasing demands of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, 70% 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 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 inequalities 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 reliable evidence as to what people today eat. Our study looks into the meat and 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 and allow for a better comparison of strategies. Our 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

380 The Assessment of Human Health Benefits and Risks of Contaminated Sediment Remediation
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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 also create negative health impacts 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 DALYs per day for the AC and reference site, respectively. 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. For this study, the method was retrospectively, inter realistically, with conditions that appear in the field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg AC/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 sediments, 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. 

381 Six inches under: Remediation efficiency of activated carbon caps buried by dynamic sediment movement

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The application of 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. For this study, the method was retrospectively, inter realistically, with conditions that appear in the field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg AC/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 sediments, 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 amounts of sediment (thicknesses of the overlying sediment layer ranged from 1 - 40 cm). Endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. 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 Ecosafe nanotechnologies 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 and an adequate assessment of potential adverse effects. These 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. The No Action scenario, the health impacts are 11 and 78 DALYs per day for the AC and reference site, respectively. 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. For this study, the method was retrospectively, inter realistically, with conditions that appear in the field trial on AC based sediment remediation in Finland. At the test site in the PCB-contaminated Lake Kernaalanjärvi, a 300 m² plot was amended with an AC thin layer cap (1.6 kg AC/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 sediments, 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 amounts of sediment (thicknesses of the overlying sediment layer ranged from 1 - 40 cm). Endpoints were the growth and PCB bioaccumulation in Lumbriculus variegatus and Chironomus riparius. 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).

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 sites are rich in organic amendments. This is one of the main reason why many scientists are interested in the bioremediation with using various methods are justified and necessary. Potential health impacts created by the selected remedy are within the same order of magnitude as potential benefits. Occupational fatal incidents are comparable to the combined benefits of MNA 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.

384 Sorption of pharmaceuticals in soil systems

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Pharmaceuticals in soil systems

L. de Vries, Environmental Department University of York / Environment Department

Pharmaceuticals in soil systems
been detected at fairly high levels in aquatic systems (0.33-611 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 (Drilla 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 (neutals, 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. Fewer ACs were selected by alcoholic 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 transtent (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)

386 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 used samples of landfills, the boundary of which were located near lands or water basins near some settlements of Armenia. The following 14 dioxin-like polychlorinated biphenyls (PCBs) were determined in soil samples: congeners NN 77, 81, 105, 114, 118, 123, 126, 157, 167, 169, 170, 180, 189; 200. Quantitative determination was carried out using chromatograph 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 i. d., 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 is 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.

387 Associated Health Effects of Veterinary Pharmaceutical Residues in Livestock farmers 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 validated and optimized 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 acetaminophen (AC), dichlofenac(DP), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHR), ciprofloxacin(CP), bupivacaine(E3), lidocaine(E3), vermiculin(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, 76.62 – 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.

388 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 preoccupant 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 groundwater. Therefore, treatment of pesticides can be quite expensive and inputs may not be clearly identified or collected. Effluent 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 also 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
389 Study of bioconcentration of benzophene-3 in gilt-head bream and characteristic... H. Ziarrustria, 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. 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; N. Etxebarria, M. Olivares, O. Zuloaga, University of the Basque Country UPV/EHU / Plant Science; A. Gonzalez, University of the Basque Country 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, biocumulation 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 gill-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 significantly higher in comparison to the rest of tissues/fluids. Since BP-3 is hydrophobic and non-ionizable 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 metabolism 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 several water 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 (ED431C1017/36) and FEDER/ERDF. H. Ziarrustria is grateful to the Spanish Ministry for 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. Villanueva, Notting Research Centre for 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 Biociences; 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 20-L column 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 transformation products (TPs) in both hydroponic growth solutions and plant tissues were measured by HPLC-QqTOF-MS. The uptake, translocation and metabolism of tebuconazole and imazalil 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 imazalil concentrations inside Phragmites showed a maximum level day at 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 imazalil 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 antiinflammatory 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. Alfarhan, A. Maleymeni, King Saud University; D. Barcelo, IQAB-CSIC / 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-QqTOF-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 Gizaan area of Saudi Arabia, were germinated in Petri 'plates or sown on commercial soil. After 3 and 6 days of germination and at a concentration level of 10 µg/mL of ibuprofen. Seeds and plants were incubated in a growth chamber 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 chemical structures 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; E. 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 the cases where an active pharmaceutical ingredient (API), or substance, is used, it is treated multiple clinical diseases, there is the potential to under-estimate environmental impacts. 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-infective 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 concentration (PEC) and predicted environmental concentration (PEC/E)) and (iv) calculated 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 discharge site. Investigation in the wastewater network identified uses responsible...
Estimation and prioritization of hospital API emissions

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Hospitals constitute an important source of APIs, particularly for substances like antineoplastics and contrast agents. Measuring these emissions and their impacts is possible, but is very time-consuming and costly. The main aim of the present study was to develop an approach for estimating hospital API emissions based on hospital purchase data and to prioritize these emissions based on potential environmental impact. A model was developed to estimate the API loads reaching the hospital sewer system. The model accounts for the return of unused APIs, route-specific excretion by patients, non-patient API use (e.g., personnel) and off-site emissions. The model was operationalized for 16 APIs emitted by two academic hospitals in the Netherlands. Model predictions were validated based on measurements of APIs in the sewer system using passive samplers with speedi®k 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 isoprotanol also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

Development and validation of a model to predict concentrations of human APIs in surface water

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Active Pharmaceutical Ingredients (APIs) are consumed in large quantities, and end up in the environment as a result of not being degraded completely during passage through the human body and wastewater treatment plants (WWTPs). Although reported concentrations are generally low, adverse ecological effects caused by some human APIs are plausible considering their specific modes of action and high potency. Consequently, the issue of human APIs in the environment has been acknowledged as an emerging environmental problem requiring scientific and regulatory attention. A crucial step in environmental risk assessment of APIs is the prioritization of APIs based on environmental impact. Five datasets with data for the total elimination half lives in humans (HT), the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewerage 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.

Occurrence and fate of the antidepressant metformin and its transformation products

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Effluents of municipal wastewater treatment are major entry pathways for pharmaceuticals and their transformation products (TPs). A wide-spread compound is the antidepressant 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 WWT and surface water. Analysis was performed by LC-high-resolution-mass-spectrometry (HRMS) using HILIC (hydrophilic interaction chromatography) in 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-aminoo-1-methyl-1,2-dihydro-1,3,5-triazine (4,2,1-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 ranges of 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 spectra to verify if a PEP-ingredient no TPs, 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 90 and 100 ng/L. In addition, 2,4-DAT was detected. Its response was in all three samples about 40 % of the response in the WWT ef fluent samples. The study is performed within the project “Effect-Net”, funded by the Ministry for Science, Research and Art, Baden-Wuerttemberg.
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
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When results of standard laboratory tests show an unavoidable 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 the most suitable for adaptation to non-standard species. Most tests were performed based on the Leucaena 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 (Aquatic Macrophyte Risk Assessment) Panel. Even though the model underestimated the internal concentrations by a factor of 2-4, the model is able to reasonably represent intra-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 EFSAs are on population and community level. Reuter and Siemoneit-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 Siemoneit-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 adequate in the community setup. The plant interest group of SETAC has a committee working on the topic of risk assessment of recovery in plants from exposure to chemicals and after several days, the growth rates of the affected groups may approach that of the controls indicating recovery.

399 Applying the EFSA Scientific Opinion on NTTP: 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 guidelines 208 and 227. The number of numbers 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). 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 Ouse (which had a concentration range of 0.5-2.2 pmol/g) with a pH range of 7.6-8.45) than the river Ouse (which had a concentration range of 0.2-2.95 pmol/g and a pH range of 7.4-8.84) 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.
Mapping percentile statistics of element concentrations in moss collected from 1990 to 2015 in forests throughout Germany
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Monitoring and mapping of atmospheric deposition can be achieved by use of chemical transport models, sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss samples from about 7300 sites in the EEA countries have been collected, chemical determination of heavy metals (since 1990), nitrogen (since 2005), and persistent organic pollutants (since 2010) in moss specimens, quality control and statistical evaluation was conducted according an harmonized methodology [1].

Mapping the percentile statistics of heavy metals and nitrogen concentration in moss sampled in forests across Germany is in the focus of this paper. Therefore, 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 monitoring. References are cited in the presentation.

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Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochemistry
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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. Some effects of this are observed on food chains. 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 conifers which are of importance to Mediterranean countries. Needles were sampled at different locations in the Mount Amiata and Colline Metallifere region 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, Si, Al, Ca, Cr, Ni, V, Fe, Hg, P, K, Mg, As, Pb, Cd, Zn, 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 were 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 element concentrations between different age classes which relate to the availability, transformation, accumulation or overcompensation 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 nature.

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Examining historical trends in diet and contaminant exposure in bats using buccal groove deposits from Jamaica
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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 are of particular use as they may serve as archives for the cave environment and preserve stable isotope and metal data 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 exploitation or exploration. The objective of this research is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activities affect these high trophic level mammals. We constructed the 210Pb, 10Cs, and 14C dating profiles in both bat guano deposits: this revealed that one of the deposits is over 3,000-years-old. We constructed the δ34S, δ33S, and δ30S profiles in order to determine the long-term dietary trends in the bat guano deposits.

Preliminary results suggest that the 3,000-year-old bat guano deposit is tracking a change in stable isotopes associated with the agricultural history of Jamaica, specifically, the introduction of: nitrogen fertilizers, the Bordeaux mixture, and sugarcane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholesterol and stigmastanol, for example, could be evidence of fluctuations in foraging habits (0.3 ng/g dry wt for South) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the 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 222Rn within the bat guano deposit in association with the introduction of leaded gasoline.

408 Perfluoroalkyl substances and metallic elements in South African dragonflies

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Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metal contamination is present. In this study, we present (i) perfluorooctanesulfonic acid (PFOS) concentrations and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult dragonflies were collected and analysed for PFASs and metallic elements. The results indicated that dragonflies from farming areas had significantly lower EPFAS concentrations than sites located closer to industrial areas (median 2PFASs of 0.32 ng/g wm (wet mass) for North Heidelberg (0.3 ng/g for South) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the 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 222Rn within the bat guano deposit in association with the introduction of leaded gasoline.

409 Bioavailability of Arsenic and Antimony co-contamination to vegetable crops in agricultural soils

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Antimony (Sb) is an emerging contaminant that is associated with human and industrial activities. Sites located near wastewater treatment plants had elevated concentrations associated with mining and industries. Dragonflies from sampling sites near potential pollution sources that seemed to have the highest PFAS concentrations than sites located closer to industrial areas (median 2PFASs of 0.32 ng/g wm (wet mass) for North Heidelberg (0.3 ng/g for South) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the 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 222Rn within the bat guano deposit in association with the introduction of leaded gasoline.

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

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The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bivalves worldwide. In this study, we aimed (i) to study the processes by which water quality might affect freshwater mussels in situ and (ii) to provide insights into the ecotoxicological significance of water pollution to natural populations in order to provide necessary information to enhance conservation strategies. M. 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 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, Cr, Zn, Cd and Ni were the main factors correlated with transcription levels, with effects on translation, apoptosis, immune response, response to stimulus 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, we separated mussels into three age classes (young, middle-aged and old animals). The 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 LC-HRMS based-metabolomics to highlight biodiversity products and effects of dicyflocen in Mytilus galloprovincialis

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Dicoflocen (DCF) has become a major contaminant of interest as shown by its inclusion in the EU Water Framework Directive (2015/495/EU). 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 relates essentially to (i) the “endometabolome”, compounds 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 to dicyflocen. The metabolome investigation in a panel of mussel species has the co-contamination of As and Sb on alteration of crops. Our study evaluated the potential use of vegetable crops to identify and assess the bioavailability and toxicity of As and Sb in co-contaminated soils using bioassays. Water spinach and choy sum are herbaceous leafy vegetable belonging to the morning glory (Convolvulaceae) and mustard (Brassicaceae) families, respectively. Our study compares the soil characteristics in terms of total and bioavailable metal fractions with plant accumulation and toxicity data. Plant toxicity parameters (tissue biomass and lengths) were used to evaluate impacts of contaminant exposure on plant productivity. This information was used to understand the tolerance of plants grown in As-only contaminated soils, and the risks associated with As and Sb co-contaminated soils. This was done as single element and mixed metal exposures. Test soils were silty sand and slightly acidic. Bioavailable As and Sb in soils increased proportionally with total metal concentration. A clear increase in the tissue accumulation of As and Sb was observed with increasing bioavailable metal fraction for both individual (As and Sb) and combined (As+Sb) treatments. Vegetable productivity decreased when grown in As only and As+Sb combined contaminated soils. Sb contamination in agricultural soils poses a greater human health risk and hazard than As only and As+Sb co-contamination, because Sb accumulates in edible crops with no observed phytotoxicity or reduction in the vegetable productivity.

Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (I)

411 LC-HRMS based-metabolomics to highlight biodiversity products and effects of dicyflocen in Mytilus galloprovincialis

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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, as catecholamines and serotonin are involved in osmoregulation, and in gamma 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].


4.12 Metabolomics used to link affected molecular pathways with behaviour outcomes after a single dose of pesticide exposure in mussels

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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 biologically 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 in vitro, 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.

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

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Metabolomics profiles are comprised of targeted endogenous metabolites (< 1 kDa) such as amino acids (AAs), fatty acids (FAs), and membrane lipids such as phosphatidylcholines (PCs) to identify how changes in the metabolome relates to extrinsic factors, including e.g. exposure to persistent organic pollutants (POPs) and metals. Polar bears (Ursus maritimus) from Hudson Bay (Canada) are differentially exposed to complex mixtures of POPs and metals including total mercury (THg = inorganic + methyl-mercury), and legacy and new POPs. In the present study, quantifiable profiles of 295 organic POPs and THg in fat and liver (respectively) assemble a dataset which liberates 2415 SHB; n = 14) and Western Hudson Bay (WHB; n = 15) male polar bears were combined for multivariate and univariate statistical analyses. Correlated compounds and significantly different or impacted physiological pathways were identified that may be related to differences in POP exposure or other environmental factors. Partial least squares discriminant analysis (PLS-DA) and variable importance in projection (VIP) were applied to the combined metabolite-contaminant profiles of these polar bears, and Spearman correlation analyses were used to establish relationships between metabolites and contaminants, as well as with other biological factors. Forty-one metabolites [membrane lipids, acylcarnitines (ACs), and symmetric dimethyl arginine (SDMA)], and 21 POP discriminated the subpopulations. Perfluorinated alkyl substances (PFASs), polybrominated diphenyl ethers (PBDEs), p,p'-dichlorodiphenyldichloroethylene (DDE) and some ortho-polychlorinated biphenyls (PCBs) were greater in the SHB bears and changes in the metabolite concentrations had some consistency with previous laboratory studies. Arachidonic acid (ARA), glycerophospholipid and amino acid pathways were identified as being differently enriched or impacted between the subpopulations. Greater ARA in SHB bears may be related to differences in chronic exposure to POPs such as the hepatotoxic PFASs, as ARA is part of the inflammatory response in liver. SDMA and most legacy organochlorine compounds were greater in the WHB bears, which may be indicative of differences in renal function. Consistency of relationships between metabolites, POPs and biomarkers from laboratory studies suggests linkages between POP concentrations and differences in the hepatic metabolome of SHB and WHB polar bears.

4.14 Integrative Omics linkage to reproduction effects of a fungicide in the soil invertebrate Folsomia candida

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Due to high complexity of ecosystems, environmental risk assessment can be a challenging task and there is the need to develop and validate innovative and reliable tools and integrated approaches for fast detection of changes in population and community structures that can be applied by regulatory agencies. Folsomia candida is among the most sensitive species and the toxicity and chemistry of its habitat has been selected as a genomic model organism for soil toxicology studies on non-target soil arthropods. This work aimed to determine the toxicity mechanisms of a widely applied fungicide formulation (Braov5000®), with active compound chlorothalonil (CHT), in F. candida, by linking effects at different levels of biological organization like reproduction, gene expression and protein levels, following a time series exposure. Therefore, Folsomia candida was exposed to CHT formulation and its metabolome and effects were studied at the different time points (2, 4, 7, and 10 days). Four replicates per treatment and time point were used (32 in total). CHT exerts its toxic effects primarily through binding to thiol-rich molecules (ex. glutathione), exhibiting often a multi-site activity and the results with the formulation were very indicative of these mechanism of toxic activity. Also in this study, results point for similar effects of the fungicide formulation mechanism of action involved in detoxification and excretion (also involving glutathione), normal cellular respiration and protein metabolism, leading to impairment in development and reproduction. The datasets presented highly significant positive correlations between the gene expression levels at a certain time-point and the correspondent protein products from the consecutive time-point, thus highlighting the importance of considering a time series when identifying components of toxicity and also having the capacity to provide useful insights, exhibiting their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

4.15 Using functional genomics to find mechanisms of herbicide toxicity in Chlamydomonas reinhardtii

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At present, environmental risk assessment of chemicals is limited to measuring physiological 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 method for gene function discovery is functional genomics based on high throughput screening of single-genome knockout strains under different conditions (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 pooled library of loss-of-function mutants of Chlamydomonas reinhardtii to three herbicides that target photosynthesis: atrazine and diuron which target photosystem II, and which disrupts the transition of electrons from photosystem I to photosystem II 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 mutants of genes involved in the photosynthesis. The profiles of paraquat also included photosynthetic genes, but also several genes involved in defence against oxidative
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?**

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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: environments, 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 long-term 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 obtained 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. Giliberti, IFREMER

Periodic 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 species affected by 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.”

418 **Addressing the growing threat of marine litter: NGOs essential role in strengthening the science-policy-society interface**

T. Vlashogianni, Mediterranean Information Office for Environment, Culture and Sustainable Development (MIO-ECSD)

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 sustainability and their 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-ECSD, 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 Interreg 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-ECSD 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 the 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 these findings have already been 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. Delegi Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and improper investments in prevention, and recovery programs. Bioplastics can be the right solution for specific products, if properly applied. For instance, biodegradable plastics hold promise for aquaculture professional applications (e.g. biodegradable mulch films used in agriculture, tests specific to the marine environment are different from composting. Similarly, tests specific to the marine environment are now under development at ASTM and ISO level. Some biodegradable plastics showed biodegradation levels (as CO2 evolution) comparable to cellulose in less than 1 year using these test methods. Generally speaking, the environmental risk depends on the concentration of the environmental stressor and on its residence time in the environment. The lower the concentration and the shorter the residence time, the better. Bioplastics do not immediately disappear upon exposure to the sea. However, biodegradability reduces the risk by reducing the stressor’s residence time. Concluding, the idea of solving the problem of plastics in the ocean just by shifting to bioplastics is groundless (bioplastics does not disappear “by magic”). However, for those applications where accidents are improbable and unlikely to happen, biodegradability decreases the environmental risk. Materials that show full and relatively fast biodegradation may be suitable for plastic products known to wear down or become stranded (for example, fishing gear) and scatter into the sea. Bioplastics hold promise for aquaculture professional applications (e.g. nets for mussel farming) where the disposal of plastic waste is an inevitable outcome. Bioplastics can be the right solution for specific products, if properly applied.
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/MAP 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 in the cooperation with the RPML and its latest developments, 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.

241 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 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, carrying 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.

242 Discussion

243 Final Remarks

G. Leone, UNEP/Mediterranean Action Plan

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

244 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 specific losses may reduce the capacity response 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 macroalgae, algae, macroinvertebrate and fish communities related to environmental pressures. The data obtained from the field work conducted in three of the Globaqua 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.

245 Changes in pCO2 after the reproductive toxicity of common active pharmaceutical ingredients

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Increasing pCO2 in aquatic environments is occurring as a consequence of the release of anthropogenic carbon dioxide in to 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 in 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 them 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 determining the 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 pCO2 conditions when accurately assessing the environmental risks of such compounds.

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

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Phytoplankton are crucial for lentic ecosystems productivity and foodwebs, but facing multiple anthropic 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 ones. We carried out a field experiment, using a non-invasive mesocosm approach, to study the response of phytoplankton communities to combined physical and chemical anthropogenic stressors. We aimed at investigating if chemical pollution can prevent the ecosystem to promptly re-gain structures and functions after extreme events. An extreme temporal 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 EC10 of individual species). This 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 (biomass, functional diversity, species composition and photosynthetic efficiency), chemical concentrations and nutrients were routinely monitored during the 3-weeks experiment. Our results, showed that contaminant information on how fish will cope with the presence of chemical contaminants in the future is still extremely limited. Emerging and non-registered 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 first aims of the study was to evaluate for the first time the effect 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. Assunçao, Céfas Lowestoft Laboratory; P.E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M.G. Hutchins, 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 (QUESTOR) that simulates the spatial extent and a baseline generated for the period of 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, corresponded 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, however, more work is required to identify 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 vPvB substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH S. Houbertz, Wageningen University / Social Sciences; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; 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 or non-use, and for comparing these impacts across different scenarios. Impacts arising from chemicals’ use, impacts of PBT/vPvB, are use-specific. Furthermore, due to stock pollution properties of PBTs/vPVBs, 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/vPvB substances, the evaluation of PBT/vPvB 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 analyzed with a multimedia exposure simulation 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 production of multisubstances and to benchmarking against 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. Nedzda, Analytisches Laboratorium; S. Hahn, Fraunhofer IFT / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environment and Sustainability; R. Hornek, Analytisches Laboratorium; S. Hahn, Fraunhofer ITEM / Chemical Risk Assessment

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 and relative ranking is to classify a chemical with respect to its 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 PBTs/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-phrases), 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 possibilities and limitations of the grouping and relative ranking and the resulting fingerprints are observed for two chemicals with the same use, but different emission patterns (in the context of socio-economic analysis (SEA)). The purpose is to identify chemicals with known impacts, serving as points of reference for the impact evaluation.

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

U. Johnke, Federal Environment Agency (UBA) / IV.2.3 Chemicals; V. Bonnomet, European Chemicals Agency; I. Doyle, Environment Agency / Evidence Directorate; R. Hornek-Gausterer, Environment Agency Austria; A. Kapanen, European Chemicals Agency - ECHA; M. Kästner, Helmholtz centre for environmental research - UFZ; J. Reis, Environment Agency Austria; R. Kummerer, University of Freiburg; J.R. Peltoła-Thies, ECHA-European Chemicals Agency; L. Ribeiro; A. Schäffer, Institute for Environmental Research RWTH Aachen University; M. Telscher, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; F. Schmidt, C. Leake, Bayer Ag Non extractable residues (NER) so called “bound residues” of plant protection products are formed in soil as a result of degradation processes. Due to their inherent nature, analysis and further assessments of bound residues are challenging. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main part of biogenic residues in soil. The amino acids were liberated via a digestion of the soil with 6 N HCl at 110°C. Within this presentation we focus on the utility and validity of this analytical method using 14C bromoxynil and an agricultural soil from Germany as an example. As a result 55% of the 14C label was lost. The residues could not be liberated and remained bound to the soil even after such a harsh digestion step. During further clean-up of amino acids further losses of radioactivity of approximately 40% of those liberated bound residues has been observed. Further analyses elucidated up to 50% of those unidentified losses, however, in total approximately 75% of bound residues stuck to the soil and therefore could not be identified or unambiguously assigned. However, 16% of the generated NER was extractable and could be assigned to amino acids. Both results indicate that bound residues will not contribute to future risks or hazards because they are on one hand not bioavailable or on the other hand they have been converted to natural biogenic residues like natural amino acids.

433 A tool to establish the role of Non-Extractable Residues (NER) in soil on toxicity

J. Harsen, Wageningen Environmental Research / CALM; D. Hennecke, SETAC Europe 28th Annual Meeting Abstract Book
Developments in the Biopharmaceutical 
Using Life Cycle Assessment (LCA) to Evaluate Global Sustainability Assessment; examples of how a harmonized approach, speaks to their heart and mind and that is relevant for their job at hand. This requires insights are accessible for developed a too and thus the criteria will also be different. In other words: the context of the situation, it is interesting to investigate, for a given issue, the ideal portfolio of tools. There is already a long discussion 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 and carboxylation processes ask for understanding of the different non-measurable 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 14C chemicals. In first experiments formation of Non-Extractable 14C was observed for all chemicals. For the chemical Tri-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 TNT 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 Carbazin 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 Carbazin. 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**

**436 How to make LCA fit for purpose as decision making tool**
E. Mieras, PRe Sustainability; A. Gassebek, PRe Consultants / Consultancy; J. Coustillas, 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 quite irrational, as also Daniel Kahnemann, the Nobel Prize Winner, argues in his book “Thinking Fast and Slow”. The first tries to define how to come to the best option, assuming that decision makers are fully rational and that the world can be modeled accurately. These are quite opposite ways of how decisions are made. The second distinction to be made is between what type of decisions are made, by whom and what the objectives are. It’s a big difference if you want to make a decision about different options for new products, determine the long term company strategy or select the most sustainable supplier. Even more so, the objectives will differ per organisation or even situation and thus the criteria will also be different. In other words: the context of the decision determines what support is needed and what’s the relevance of the outcomes. Results can have a different meaning in different context. Therefore, it’s important to assess first which methods are fit for purpose to support decisions in a specific context. To enable this, we want to introduce an intermediate step to determine whether LCA, LCT or any other assessment is best suited to answer the questions that are relevant in a specific decision making situation. For this goal we developed a tool with the working phase: (Research ITO 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 14C chemicals. In first experiments formation of Non-Extractable 14C was observed for all chemicals. For the chemical Tri-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 TNT 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 Carbazin 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 Carbazin. 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.

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

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6-Aminopenicillanic acid (6-APA) is the beta-lactam nuclei of penicillin and is the intermediate to most semisynthetic antibiotics. Manufacturing of the nuclei represents one of the largest production scale processes within the biopharmaceutical industry. Many of the environmental impacts associated with 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. Necessary is water intensive due to high volume required for fermentation media and cleaning. 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**
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The importance of sustainability in transportation infrastructure has raised in recent years due to the link between transportation activity and global 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 address 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.superitin.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 sustainable pavement and railway transport solutions 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.

**439 Influence diagrams and scoping for Life Cycle and Sustainability Assessment, an example from sustainable mining**
A. Ciroth, GreenDelta; C. Di Noi, GreenDelta GmbH; D. Bizarro, GreenDelta; H. Wessman-Jääskeläinen, VTT Technical Research Centre of Finland
Life Cycle Assessment is a technique typically intended to provide a holistic assessment of environmental and possibly also social impacts over the entire supply chain and life cycle. However, LCA has limitations, for a variety of reasons. In this situation, it is interesting to investigate, for a given issue, the ideal portfolio of tools...
to be used, including LCA, but not necessarily limited to it. Moreover, in every LCA, it is in a first step important to specify goal and scope for the further analysis, and it is worthwhile to be aware of aspects which have an influence on the overall environmental impacts of an investigated product. So far, goal and scope in LCA is conducted typically without a diagram or visualization of relations between different aspects to be decided about in goal and scope. We introduce influence diagrams and advanced hot spot analysis, meaning to both "tailor" the approaches to be applied for the description of sustainability of a given situation: A) to shape goal and scope of an LCA, where LCA is part of said portfolio. As an application, we develop and present a causal loop diagram for sustainability assessment of mining in general, and apply this to specific mine sites in Finland, Portugal, and South Africa, where this approach is currently applied, led by GreenDelta, in the European H2020 research project ITERAMS. In the presentation, the developed causal loop diagram and the approach for obtaining the diagram for the case will be explained, with results from the ITERAMS project. Results are quite promising and we believe that using causal loop diagrams in sustainability and life cycle assessments helps to clarify selection of the (combination of appropriate tools for the assessment, and help to structure the goal and scope setting in LCA.

440 Life Cycle Sustainability Assessment for Improved Space Mission Design

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The advent of the Paris Agreement and Sustainable Development Goals in 2015 has been the driver for a more coordinated global approach towards achieving environmental sustainability. However, to be successful, this vision must run through every sector of society and the space industry is no exception. In the context of renewed global awareness on environmental sustainability, Life Cycle Assessment (LCA) is an important environmental management technique allowing for the most complete and consistent assessment that, in some cases, can be used to assess the environmental impacts of products over their entire life cycle. The European Space Agency (ESA) began work on this topic in 2009, employing an internal concurrent design study called ECOSAT to consider the life cycle impact of the design, manufacturing, launch and operations of a satellite. Since then ESA has continued to develop LCA methodology for the space sector, creating the first set of LCA guidelines for space systems in 2016 and now working to integrate LCA into the concurrent design process. Whilst space-based LCA is still in its early stages, its further development relies on it being increasingly employed within the broader space sector to give parity across the industries. For this reason, moving towards space-based Life Cycle Sustainability Assessment (LCSA) is a logical next step which allows for the third pillar of sustainability (environment, society, economy) to be addressed within one assessment. Tailoring this integration for space systems will allow the industry to become more accountable and responsible for their operations by taking into account the full spectrum of life cycle sustainability issues associated with the operation of space systems. This paper will present the LCSA methodology used in an open-source platform under development at the University of Strathclyde, outlining the requirements and taking into account the interface between LCSA and environmental LCA to evaluate the life cycle impacts of space systems. As adverse impacts are more difficult to modify the later into the design process that they are identified, the integration of LCSA into the concurrent design process is essential for the early mitigation of sustainability issues. As such, the intention of this platform is to help decision-makers choose sustainable technologies and products at the design stage by determining those that are not only cost-efficient, eco-efficient or socially responsible, but also ones that can easily justify and evidence their sustainability.

441 How can Agent-based Modeling improve decision making in Life Cycle Assessment?

A. Sciotti, F. Martelli, Italferr S.p.A.

Having those who carry out public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and if produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.

442 Characterization and management of excavated soil and rock

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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 and management effort, including but not limited to characterization, alternative treatments and disposal. The regulatory framework tends to be dynamic on the inventory phase. Future research in this field should now address temporal dynamics in the life cycle impact assessment.

Environmental risk assessment and management of the material produced in tunnelling excavation

443 REALIZATION OF ROAD GALLERY: ADVANTAGES, CRITICITY AND FUTURE PERSPECTIVES

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When choosing a public works at the service of the territory, which are the motorway routes, it is essential that in all phases, from approval to the realization of the work, the respect of the pre-established times in the project and the relevant regulations is guaranteed. In fact, time is a factor that directly affects the costs of execution and, above all, the costs borne by the community, which, in the event of bureaucratic red tape, cannot benefit from the availability of a more efficient, safer and less impactful service. Even though the regulatory framework tends to introduce simplifications in procedures with the latest updates, there are rare cases where there are no burdens that often negate the positive effects of investments in technologies put in place to improve construction techniques and increase the speed of completion. To the complexity inherent in the realization of linear works, which involve the excavation of tunnels and the consequent management of the excavated soil, is added the paradox that, at equal environmental conditions, the same lands can be considered by-products or waste, even if deriving from the same pile and if produced with the same excavation system within the same work. A case that represents this situation well is the mechanized excavation technique, whose adoption often involves an excess of provisions that substantially increase the size of the characterization areas inside the building sites, and the observation times, against a null environmental advantage.
The increasing use of Earth Pressure Balanced Shields (EPB-TPMs) 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-TPMs 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 from excavation processes can be re-used by producing 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 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.

447 Mineral-based soil conditioner for EPB TBMs: An environmentally friendly alternative
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A novel product, based on a natural mineral has been developed for use as a foaming agent and soil conditioning agent with earth pressure balance (EPB) tunnel boring 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 investments. The product is a 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 is very compatible with the product and deposition 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 solutions. At an independent laboratory we have demonstrated the good stability of the foams produced using the product (half-life measurements of water drainage), 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 amount of chemical treatment required for the excavation material. The use of foaming agents and additives is one of the fundamental factors allowing the correct use of the EPB-TPM (Earth Pressure Balance-Tunnel 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 aims 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 testing, it is possible to hypothesize 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-TPM 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 activity feasible tests. 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-TPM. 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 ecocompatibility of the conditioned soils through biodegradation and ecotoxicological studies of the foaming agents.

445 Environmental effect of chemicals injected into the soil in mechanized tunnelling 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 of large amount of chemicals used for the soil conditioning, the treatment of activities that 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, vapors and/or fumes may be released, and the soil may be conditioned as aggregate for concrete, for filling in civil engineering, fills for road, railway embankments or breakwater harbour dam. Stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil material, and their potential toxicity to the environment. Some of the most important studies have 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, vapors and/or fumes may be released, and the soil may be conditioned as aggregate for concrete, for filling in civil engineering, fills for road, railway embankments or breakwater harbour dam. Stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil material, and their potential toxicity to the environment. Some of the most important studies have 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, vapors and/or fumes may be released, and the soil may be conditioned as aggregate for concrete, for filling in civil engineering, fills for road, railway embankments or breakwater harbour dam. Stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil material, and their potential toxicity to the environment. Some of the most important studies have 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, vapors and/or fumes may be released, and the soil may be conditioned as aggregate for concrete, for filling in civil engineering, fills for road, railway embankments or breakwater harbour dam. Stabilization of slopes affected by landslide phenomena or through projects of landscape management. The lack of information about the environmental impact of these chemicals, introduced during the tunnelling process, may lead to remarkable economical impact of the spoil material, and their potential toxicity to the environment. Some of the most important studies have lead companies, governments and research groups to face economical, technical, logistical and environmental issues.
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 emersion 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 [1]. At least 15 individual CNTs were counted for each sample. The number of CNTs was 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 μg L^{-1} – 100 μg L^{-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 mg kg^{-1}) 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. Khan, National Institute of Environmental Research (NIER) / Geum River environment 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 – 37 ng/L, and 5.1 – 11.7 ng/L, respectively while limit of quantitations (LOQs) were 0.9 – 21.1 ng/L (Insecticides) and 15.4 – 35.0 ng/L (BFRs). 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, Chenniang Sun 1, John Trumble 1, Jay Gan 1 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 resources, it is expected to play an increasingly important role in meeting the environmental and social 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 ability to be transmitted to the environment through mass spectrometry. 14C tracing, enzyme extraction and Illumina sequencing techniques were evaluated to 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 (Eisenia fetida), a model plant (Arabidopsis thaliana) and cucumbers (Cucumis sativus), radishes (Raphanus raphanistrum 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

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The presence of pharmaceuticals in surface waters 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 selective 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, Cartagena and Ceuta were selected as study areas. In total, 27 bile 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 absolute concentrations in the fish samples.

452 Accumulation and fate of 12 human drugs through the soil-root-leaf system

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Crop irrigation with reclaimed water has become an extended practice in many countries worldwide where the water scarcity and excessive exploitation of agriculture are forcing local authorities to look for alternative resources. Despite this, these practices increase bioavailability and consumption of products and contribute to nutrient recycling, using reclaimed water for irrigation, however, represents a primary source of emerging organic contaminants resilient to wastewater treatment processes, such as some pharmaceuticals and personal care products [1]. These pollutants can be retained in the soil, directly uptake by crops or translocated from soil to plant tissues above the ground [2,3]. The present work aimed to evaluate the transfer and the bioaccumulation of organic contaminants of emerging concern (mainly pharmaceuticals) in lettuce tissues and soil. The distribution of twelve relevant wastewater-derived pollutants was evaluated in lettuce tissues (leaves and root system) and soil. This list included nine prescription drugs (dichlofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, trandolapril, midazolam, methadone, and diltiazem) and two transformation products (acidronate and valsalartan acid). Lettuce plants were grown in pots in a controlled environment and irrigated with artificial spiked water containing the 12 compounds during the entire growing period (60 days). Control was irrigated with tap water. Afterwards, a set of new lettuce plants were grown in the same soil pots and irrigated with rainwater or with tap water, if necessary. At the end of each cycle, leaves, roots, and plant tissue (lettuce and fish) were harvested, frozen (and desorbed, if necessary). GC-MS analysis of tissue and fish extracts were performed using liquid chromatography coupled to tandem mass spectrometry (LC-MS/MS). The results from the first growing season evidenced the presence of all analytes in all investigated matrices. Carbamazepine was the analyte that accumulated the most in lettuce tissues (73.0 ppm in leaves and 13.3 ppm in roots), whereas cis-diltiazem, methadone, and midazolam were preferential accumulated in the plant root system and the soil. Concentrations of the target analytes in the plant-root-soil system after the second growing season were significantly lower than those measured after the first growing season.
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: Haplic Chernozem, Haplic Cambisol and Arenosol Epiaquic. 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 (radish). These results suggest type of pharmaceuticals for all tested plants. The impact of application (single compound versus compounds' mixture) differed for different plants. Antibiotic sulfamethoxazole likely reduced 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 solute divided by a dry mass of soil).

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 fish. We quantified plasma prostaglandin (PG) and plasma NSAID concentrations at measured environmental concentrations. Here we seek to refine the understanding of how NSAIDs affect fish at measured environmental concentrations. We quantified plasma prostaglandin (PG) and plasma NSAID concentrations within 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, whereas low-level exposures were detectable for much longer hours. High level exposures, due in part to considerable inter-individual variation in fish, 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 measured co-reactive protein concentration quantifying baseline immune system status, and plasma cortisone 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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Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/4447/00 corr 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. Because of owner protection, most of the data set is anonymous and encoded form. One discussion point will be the question whether the current base of data is sufficient to draw general conclusions. Although the results are based on more than 10 years of experience with environmental risk assessment within the authorization of new human medicinal products, the data basis is still lower than desired. So for some pharmaceutical ingredients detected in surface waters environmental effect data are lacking, because they entered the market before implementation of the EMA guideline. Furthermore, the tailored assessment approach for substances with very specific mode of action will be addressed, especially regarding the remaining uncertainties for protection of biodiversity and the environment. This does apply e.g. for endocrine active substances, like anti-cancer drugs. Furthermore, the evaluated data allow discussion about effect sensitivity of several taxonomic groups, as well as about the PEC action limit (10 mg/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 50% of the cases. In this context, the proposed approach to replace long-term acute data couples with both increased test 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 new fertility risk assessment. To address this need, the following study was performed to estimate PPCP use in Nigerian households to prioritise the potential for PPCPs to enter source water. Using questionnaires as the survey instrument, we elicited information from 350 participants, concerning the most frequently used PPCPs, duration and amount of use in households. Drug usage was limited to over-the-counter(OTC) medicines and was estimated by application of questionnaires. The Health Organisation and Personal Care Products consumption of personal care products (PCPs) was calculated by multiplying the quantity of products used by the frequency of their use. To prioritise PPCPs, a risk index was developed to rank chemicals according to their potential to enter source water. Consumption of PPCPs varied considerably. Analgesics were the most consumed OTC medicines and highest use was observed for decongestants and cold medicines. Detergents were the most consumed PCPs and highest use was observed for detergent washing liquids. Overall, 12 PPCPs were identified as having the greatest potential to reach source water and pose adverse effects to human health. These include 8 active pharmaceutical ingredients (acetaminophen, tetracycline,
ciprofloxacin, ampicillin, clexacinil, sulfamethoxazole, trimethoprim and pseudoephedrine) and 4 PCP ingredients (sodium lauryl ether sulphate, alcohol ethoxylates, ammonium thioglycolate and dichlorvos). 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

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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-specific baseline toxicity such as cancer 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 explored this hypothesis testing anti-histamines as model substances in Daphnia magna and the green alga Raphidiocelis subcapitata.

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458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and behavioral profiles in zebrafish embryos and larvae

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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 investigating molecular (transcriptomics) and behavioral endpoints with behavioural alterations in zebrafish embryos and larvae exposed to neuroactive pharmaceuticals. *Danio rerio* up to 5 days post fertilization (dpf) were statically exposed to venlafaxine (serotonin norepinephrine reuptake inhibitor antidepressant) or oxazepam (benzodiazepine derivative anxiolytic) at the µg/L range (1 µm to 10 or 100 µm). Solution concentrations were measured at the start and end of exposures by LC-HRMS. Assessed behavioral endpoints were embryonic spontaneous movement (1 dpf), touch-evoked escape response (3 dpf), and phototaxis and thigmotaxis reactions (5 dpf). RNA was extracted from pooled embryos or larvae (n=20-50) and submitted either to RNA sequencing with Illumina Next Generation Sequencing System (RNAseq) or Sybr Green based quantitative real-time PCR (qPCR). qPCR target genes were selected with basis on RNAseq results, but also a few targets proposed as markers of exposure or modulation by neuroactive compounds were selected from literature studies (eg. fkbp5, cfos, per2). Reference genes were ef-1a, rpl13, rpl8. Chemical analysis indicated that solution concentrations were stable along exposure periods and in general accordance with nominal values. Oxazepam caused behavioral alterations mainly at 1 and 10 µm Oxages, while venlafaxine affected prevalently larvae behavioral endpoints. RNAseq of embryos exposed to 100 µm oxazepam indicated gene ontology enrichment for notochord morphogenesis. Larvae exposed to 1 µm venlafaxine presented differential modulation of response to abiotic stimuli, while 100 µm venlafaxine affected mainly muscle processes and to a minor extent circadian rhythm modulation. Confirmatory qPCR is being conducted. Zebrafish embryo-larval assays supported the elucidation of molecular mechanisms at the transcriptome level that occured concurrently with organism-level behavioral effects. Our results are expected to contribute in the future for AOP annotation and for the setup of a regulatory assessment approach to evaluate neurotoxic environmental contaminants.

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 1995. 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 numerous 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 iPiE project (IM grant no. 115735—IP5). Those *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-organs (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 (BBSRC/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 toxicity**

460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations

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Little is known about the effects at cellular, tissue and individual levels of emergent materials such as fullerenes and nanomaterials. In particular, the mechanism of action of fullerene C60 (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 cytoskeleton reorganization. Mussels were exposed to C60 (0.01, 0.1 and 1 mg/L) for 72h. Tissue C60 accumulation was evaluated by immunofluorescence using a specific antibody as well as by nuclear magnetic resonance. mTORC1 revealed the presence and cellular distribution of C60 in mussel tissues, already at the lowest concentration. Our data demonstrated that the changes of the phosphorylation of mTORC1 and mTORC2 may explain most of C60 effects studied at cellular and tissue level. Indeed, the C60 induced dephosphorylation of mTORC1 contributed to increase autophagy and to decrease protein synthesis as mediated by the reduction in lysosomal membrane stability and the enhancement of lysosomal/cytosplasmic volume ratio of the digestive gland cells; and mTORC2 to affect cytoskeleton organisation as revealed by the changes of actin/tubulin structures. Transcriptomic data are important to understand the cellular adaptive responses to the chemical. For this purpose, a novel low density oligo microarray (470 genes, suitable to follow 15 stress response pathways) was used. Transmission of toxic effects identified a number of DEGs showing a bell-shape trend with a maximum in animals exposed to 0.1 mg/L C60. In terms of processes related to the DEGs depicted in all conditions, the most affected are associated to...
461 Protonic responses to nanoparticulate and ionic silver in freshwater microbes with different background

D. Barros, Universidade do Minho / Centre of Molecular and Environmental Biology, Department of Biology; A. 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 silver (AgNPs) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics 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 EC20 (effective concentration) were assessed based on the variations in the overall proteome in two aquatic fungal strains of *Articulospora tenuidudia*, one isolated from a non-polluted stream (ArT2) and the other from a metal-polluted stream (ArT61), and ii) the bacterial strain *Pseudomonas* sp. M1 (PsM1) isolated from a metal-polluted stream. ArT2 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 ArT2 while for ArT61 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%). ArT2 and ArT61 shared only 20% of the proteins suggesting that the biological pathways involved in Ag+ and AgNPs exposure were different. ArT61 had ~25% more proteins induced by both Ag forms (compared to ArT2), 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 ArT2, 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 ArT61, 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 proteomics 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. Souza, University of Minho / Centre of Molecular and Environmental Sciences; J. Sturve, Goteborg 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 not negligible. This has raised serious concern 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 destruents, 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 (No/L) and surface area (m²/L) against the observed toxicity. The results show that cell line were the most sensitive test model with the lowest reported EC20 value of 5.1μg/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 dependant, except for particles coated with ethoxy 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. Palani, Birla Institute of Technology & Science, Hyderabad Campus / Biological Sciences. Titanium dioxide engineered nanoparticles (TiO₂-ENP) are extensively employed in manufacturing of cosmeticsceuticals, 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 nanoparticle 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. Hackenberg, Department f Biology, University of Osijek / Department of Biology; L. Primork, University of Osijek / Department of Biology; D. Markovska, University of Rijeka / Department of Biotechnology; I. ObodDzaz, Radjer Boskovic Institute; B. Hackenberg, Department f 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 that have different modes of action and potentially can interact with each other. The aim of this research was to investigate the effects of a mixture 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 (EDXR). 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, 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 znZnO/CHP 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 was observed depending on ZnO concentration and characteristics of the soil in which the earthworms were exposed. More biomarkers should be employed to elucidate which low-level biomarker can be linked with the effects on the higher (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. Lilliecrap, 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 particular set of natural, social and economic resources which must be used wisely if the development of the sector is to be sustainable. Appropriate environmental characteristics, good water quality, well-understood social interactions and use of 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 micropolutants in offshore seawater and fish farm

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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 micropolutants (MPs). In this study, the presence and distribution of multifunctional organic micropolutants were investigated to 14 different groups were investigated in offshore seawaters and fish farms of Singapore. The sampling area is affected by various anthropongenic 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 cyclamate, salicylic acid and sucralose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality

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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 fish 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, acute chemical products is occurring faster than public health interventions and environmental management systems are being implemented. Unfortunately, 80% of the global sewage production 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 antifoulant discharges of marginal quality, in Hong Kong. Our findings from a 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 to support bioaccumulation assessments for chemicals falling outside of applicability

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

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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 azathiopeh. 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 mussel samples into clean flowing seawater during the 7 to 14 day depuration phase. The effects of salinity on the bioaccumulation of teflubenzuron also indicated that other mussels in brackish waters show different bioaccumulation dynamics. So far, the results have shown a clear uptake of teflubenzuron over 14 days, reaching maximum concentrations (~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, deltamethrin showed lower bioaccumulation, with maximum concentrations of 45 ng/g after 6 days. No significant depuration of deltamethrin 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

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Environmental pollution from aquaculture is often seen as a major concern, but today, increasingly is the potential exposure of aquaculture to contaminants. In order to fully understand the contamination risk of farm-raised species, nuclear applications can be used. This is a very powerful approach that allows identifying the susceptibility of economically important species (fish and seafood) to be contaminated. Marine fish farming is regarded as the future of aquaculture and thus, the safety of these farm-raised fish is paramount especially as 50% of fish consumed are now farm-raised. Therefore, a better understanding bioaccumulation processes of such contaminants with current aquaculture practices is essential. Such work will attempt to better understand the role the fish food or key environmental parameters on contamination of fish that may affect the health of the farm-raised species and/or the human consumer. This has been commonly done in a natural setting but is now beginning to be examined for fish farming practices. Major advantages of radiotracer techniques over conventional techniques are their very high sensitivity and discrimination capacity: it permits the measurement of bioaccumulation kinetics of several elements at realistic (viz. low) environmental concentrations in a single experiment. Furthermore, some radiotracer permits the non-destructive analyses of contaminant levels in living organisms. This paper identifies present and future threats on farm-raised fish from a contamination point of view, and presents a synthesis of experimental results completely on farm-raised fish exposed to contaminants in realistic environmental conditions. It revealed, for example, the various effects that food, water salinity and temperature can have on the Assimilation efficiencies of trace elements and radionuclides in farmed fish. Such findings paving the way for further investigations on the potential use of nuclear techniques in aquaculture and food safety.

471 Effects of antibiotic’s medicated fish feed in the marine environment

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Intensive aquaculture is considered to be an important source of antibiotics into the marine environment. Antibiotics used in aquaculture have been reported to accumulate on sediments and non target aquatic organisms, modifying the biodiversity and the environmental conditions in areas close to fish farms. Moreover, recent studies show an increasing emergence of resistance genes in environmental bacteria next to fish farms, which indicates the assembly, selection and dissemination of antimicrobial resistance through open aquaculture installations and might thereby compromise environmental and human health. A field experiment was performed in a moderately impacted bay in the south east coast of Spain (Aguilas, Murcia), which consisted of a series of sediment traps (covered and non-covered traps) by a net vs. without local feed. Each treatment was medicated or medicated with three antibiotics (oxytetracycline, florfenicol and flumequine). Fish feeds were applied simulating fish farm losses for a period of 3 weeks. Measured antibiotic concentrations in the sediment were 2700 – 8000 ng/g (average 1% of the applied ammount) for oxytetracycline, and 19000 – 54000 ng/g (average 10% of applied amount) for flumequine. Florfenicol was not detected. Different accumulation rates were found in covered/uncovered traps due to wild fish influences in the availability of feed and bioturbation. Physico-chemical characteristics of the sediment also changed; with a higher S and lower N content and a larger percentage of fine material in feed affected treatments. Invertebrate
presence was also correlated with the food availability, although no evident effects of the antibiotics were found over the analyzed samples. Bioaccumulation of the target antibiotics in the invertebrate community and evaluation of the antibiotic impacts over the microbiome and resistome of the sediment bacteria is still ongoing. This is one of the first studies describing fish feed and antibiotic impacts produced by aquaculture under Mediterranean conditions.

**Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (II)**

472 Systems toxicology approach for the assessment of zebrafish cardiac and neurotoxicity


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 humans 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 cardiotoxicity 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 apter 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.

473 Time response relationship between gene expression and life history in a Daphnia population exposed to heavy metals

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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 avoiding focusing on gene expression patterns that are the cause of clonal or interindividual variation. Furthermore, most studies select an arbitrary time point in the time course of a stressor’s concentration response curves and lengths of time required for recovery. Here, we focus on population level responses of a Daphnia magna population to arsenic and copper and their binary mixture. The population was exposed to low chronic toxicity concentrations of arsenic and copper resulting primarily in effects on reproduction rather than survival. Rather than focusing on a single arbitrary timepoint, gene expression data and life history data were both recorded at multiple time points. As such, these datasets will provide a first basis on how exposure duration may affect the conclusions and decisions made about the toxicity of chemicals. In addition, by collecting both molecular data and life history data, we will be able to better understand the time response relationship in populations under stress both at the life history level and the molecular level. This will allow us to better integrate these two data types and identify potential causal relationships between the molecular level and the life history level. The identification of such causal relationships will play an integral part of incorporating omics data in environmental risk assessment.

474 How to implement functional responses of microalgae in risk assessment processing?

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Microalgae (e.g. bacteria, fungi and algae) are involved in various ecosystem functions such as biogeochemical cycles or pollutants degradation meaning that they are crucial for ecosystem functioning. In the environment, organisms are exposed to anthropogenic pressures which are known to potentially induce structural and functional changes. If such causal links are identified, little is known about the involved biochemical pathways supporting specific functions. Moreover, most of a priori ecological risk assessment (ERA) tools are based on structural endpoints and do not necessarily ensure the protection of these functions. The recent raise of OMICs approaches (e.g. transcriptomics and metabolomics) opens the perspective in ecotoxicology to explore pathways involved in ecological functions. The main aim of this study was to provide a new and innovative risk assessment tool based on functional responses (captured via OMICs approaches) of microalgae. A highly novel approach that allows a more accurate prediction of microalgae toxicity response to triclosan were exposed 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 items (metabolites/transcripts) and we built 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-sigmoid 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 functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

475 Sex, drugs and Daphnia magna. A multi-omics approach suggests conserved mechanisms of interaction between metalloalloxazines and endocrine disruptors

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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 ecotoxicological methods of assessing endpoints are limited to single chemicals 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 bait 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 endocrine disruptors (AChE inhibitors in the Cd), while others are closer to metals with unclassified MoA. The estrogen 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 one or several toxicogenics like tool based on functional responses captured at the community level in order to protect functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.
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 Toxictology; E. Foeckema, Wageningen IMARES; R. van der Oost, Waterent / Onderzoek en Advies; K. Chipman, University of Birmingham; F. Falciari, University of Liverpool / Institute of Integrative Biology

Introduction. Increasing population and industrial production put strain on clean water resources. Even in highly developed countries 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. Waterharmonica 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 (alidarb, chlorpyrifos, fluoroanthen, pirimiphyl 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 or the other sex. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCBs 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 triclosan 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 shown 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. Deglì in post, Istrea / UR RIVERLY Labortatoire Ecotoxicology; C. ALMUNIA, CEA Paris-Saclay; D.D. Gouveia, Istrea Lyon / UR MALY Labortatoire Ecotoxicology; J. Trapp, Istrea Lyon; J. Gaillard, CEA / Laboratoire de Biochimie des Systemes Perturbés; O. Pible, CEA; a. chaumot, O. Geffard, Istrea / UR MALY Labortatoire Ecotoxicology; J. Armengaud, CEA / Laboratory Innovative technologies for Detection and Diagnostics  
Detection and profiling of potential risk factors in test species under contaminant 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 Gammarus fossarum in this crustacean, stickleback proteins were 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 crustacean. We identify 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. Vanhoeﬂout, 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 intellectualism – 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 debate.

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. Becker, 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). Under 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 Hecker

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 stressors

A. Schäffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; W. Amelung, 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. Pugel, 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. Streck, 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 desaturation and elongation of rainbow trout

M. Fadhloua, 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 (Pimephales 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 (fad2, desg2, scd2) and elongases (elov2, elov5, elov6). Both yellow perch and fathead minnows 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 was more pronounced for yellow perch. We observed a mismatch between desaturation and elongation 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. Voit, 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 environmentally-relevant concentrations. As metal toxicity varies with water chemistry in a predictable manner, modelling approaches, such as the Biotic Ligand Model (BLM), are powerful tools to predict site-specific effect concentrations. To date, the BLM used in risk assessment for fish only predicts gill toxicity. However, 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 was more pronounced for yellow perch. We observed a mismatch between desaturation and elongation 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.
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 parameterized 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 / Departamento de Biologia - 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 therefore can lead to a decrease in bioturbation activity in marine communities, mainly on those organisms living in sediments, such as polychaetes, which also support much of the diversity at higher trophic levels. So, this work examines the interactions of elements contamination and change in salinity and polychaetes performance, highlighting modifications that coastal systems may undergo due to alterations driven by salinity change. Polychaetes were exposed to elements 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 (regenerative capacity of Diopatra nepolitania), 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. neapolitania. Although polychaetes were able to increase the activity of SOD, CAT and GSTs, these defense mechanisms were not sufficiently efficient 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 to fine sand at salinity 40 led to a decrease in bioturbation activity in marine neapolitania individuals exposed 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 parasitism infestation influence the activity of the bioturbator Upogebia pusilla? A. daírin, EPOC, University of Bordeaux / UMR EPOC CNRS 5805; X. de Montaudouin, A. Cluet, P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; D. Bandimont, Université de Bordeaux / UMR EPOC CNRS 5805; G. Maire, P. Gourves, G. Daffe, 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 seston and porewater exchanges, habitat structuration 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 on ecosystems. 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 activity was determined by evaluating sediment reworking rates of the mud shrimp after 3, 7 and 14 days to trace metal exposure. 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.

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 require understanding the individual and joint action of these factors to enable identification of management measures. 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 applicability to a range of multiple stressor situations. Moving forward, ecotoxicology 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. Fathbender, PETA International Science Consortium Ltd.; M. Halder, 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 expressed 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. Elston, Syngenta Ltd; C. Mayer, BASF SE / Ecotoxicology; E. Pilling, Dow Agrosciences / Regulatory Sciences; G. Weyman, ADAMA; P. Neumann, Bayer AG

A range of factors can be used to calibrate 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 were calibrated for calibration 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 analyzed separately, but as no differences in
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
eliminated 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 values of 0-1, 1-2, 2-6, 6-12 and 12 months were delimited by
HQ values of 40, 375, 620 and 2500. Tier 2 studies could have lethal and non-labile
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
(MOEGR) biological validity criteria E. Salinas, BASF SE / Experimental Toxicology and Ecology; L. Weltje, BASF SE / Crop Protection Ecotoxicology
The Medaka Extended One Generation Reproduction Test (MOEGR) was established in 2015 as OECD test guideline (TG) 240; a level 5 investigation under the OECD conceptual framework for endocrine disruption assessment. The MOEGR 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 allow relevant effects of a test chemical to be detectable. Validity 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
quality of validity criteria in the MOEGR TG 240 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, data is available for the MOEGR and currently very few laboratories can implement this highly complex TG. The MOEGR 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 MOEGR 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 MOEGR fecundity validity criteria 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 MOEGR. 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
Inherent variability in Non-Target Terrestrial Plant (NTTP) guideline testing of pest-kill toxicity studies is an inherent and unavoidable component affecting these data for TP assessments. Standardized NTTP testing protocols were initially designed to calculate the application rate causing a 25% effect (ER25, used in the U.S.) or a 50% effect (ER50, used in Europe) for various growth measures based on an observed dose-response relationship. The requirement to generate a no-observed-effect rate (NOER), or, in the absence of a NOER, the rate causing a 5% effect (ER05) requires that the test chemicals be very toxic and very variable in, and statistical detectability of, these tests. Statistically significant differences observed between test and control groups may be a product of inherent variability and may not represent biological relevance. Attempting to derive an ER05 and the associated risk assessment conclusions drawn from these values can overestimate risk. To address these concerns, we evaluated historical data from approximately 100 field emergence and vegetative vigor guideline studies on pesticides to assess the variability of control results across studies for each plant species, examine potential causes for the variation in control results, and define the percent effect that can be estimated or the minimum percent effect that can be reliably detected statistically. The results indicate that with current test design and implementation, the ER05 cannot be reliably estimated.

497 An avian reproduction study historical control database: A tool for data
interpretation J. Wheeler, Dow AgroSciences; P. Valverde-Garcia, Dow AgroSciences LLC; T.A. Spade, Watt EAG Laboratories / Specialist Projects & Histology; V.J. Kramer, Dow AgroSciences LLC / Ecotoxicology; M. Fouldoulakis, 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 historical database of 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 Ecotoxic 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 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 control, and the εi are independent random errors, usually assumed to be identically distributed. Which 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. Huysveld, 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 generation of innovative and efficient treatment processes. Despite the fact that wood waste from, for example, may contain high concentrations of heavy metals such as arsenic and copper. Heavy metal toxicity is a threat to the environment and is associated with adverse health effects. In the particleboard industry, heavy metals may be discharged into the air when dust from wood waste is incinerated to supply heat for dryers. Moreover, downstream industrial customers of particleboard (e.g. furniture manufacturers) who incinerate wood waste dust from particleboards for internal heat supply, are of concern as well. Local human health effects due to reduced local air quality may question the overall benefit of recycling contaminated wood waste
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.

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Development of non-conventional LCA indicators for circular characteristics of bio-based products
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This paper 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 limited 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 analysis tool, has been shown to manage these issues via holistic indicator also 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.

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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 waste streams such as 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 idsos biggest hot-spots 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 that requires external application of nutrients and intensity of chemical pretreatment. Today decisions on new chemicals are further developed companies mostly 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.

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A risk evaluation approach for indirect land use change associated to biobased products
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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 climactic 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 can lead to severe negative economic and environmental impacts. 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.

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How to find sustainable applications for new materials and how to overcome the relativity of LCA
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The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to assess the most 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 for the early stage of development of a new material. 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 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

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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 array 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 a 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 allows assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/recovery 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 this BoP, consumption-related water quantities have been simulated in order to identify 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, by 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.

### 505 Environmental Risk Assessment in Sediments

Assessment of risk from historic contaminants in sediments of the Elbe flood plain, using a multiple line of evidence approach

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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 Germany, water quality has 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 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 long term to sediments in those areas. 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 14C 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 analysed contaminants 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

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An old ilmenite mine deposit disposed up to 3.0 million 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 deposits 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. Anilvibrio fischeri and freshwater bivalves in laboratory and field set-ups. Differences in the bacterial sediment contact test (Arthrobacter globiformis), the Allivibrio fischeri, Arthrobacter globiformis, the bacterial sediment contact test (Arthrobacter globiformis), the

### 507 In situ metal fluxes for the assessment of metal bioavailability in sediments

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Analysis of pore waters, dilute-acid extractable metal (AEM), acid volatile sulfide (AVS), and organics (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 from these analyses may be based on relatively narrow ranges 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 flux and measured acute and chronic 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

SETAC Europe 28th Annual Meeting Abstract Book
Spatio more sensitive than length and survival endpoints. Using either field confidence limit was present, indicating a high associated uncertainty. The animals was better here, allowing for a better expression of effects. Sometimes a field criteria of less than 20 percent control mortality or more than 70 percent emergence, Chironomus worms comprised surviving animals and their weight, including yield and growth of the midge experiment with fludioxonil the most sensitive sediment testing included. In a previously performed spiked sediment 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 DT50water/sediment) 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 measured 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

Effects of untreated wastewater dilution in surface waters on pharmaceuticals natural attenuation and on the community genomics: Implications for ERA S. Bagnis, M. Fitzsimons, Plymouth University; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; A. Tappin, Plymouth University; S. Comber, Plymouth University / Environmental Science

The decreasing consumption and production of active pharmaceutical ingredients (APIs) in low and low-middle income countries (LLMICs) 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 exposure of the organisms. Permeability is consistent 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 attempt to expand this area of study within the ERA. The bioavailability of a set of APIs was 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 previous reported studies as the biodegradation at no dilution shows a behaviour consistent with previous reported studies. The bioavailability is measured by the water/sediment partitioning but the sorption 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.

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 the addition of an activated carbon step to eliminate toxic and endocrine active chemicals from the effluent can plausibly be related to the distinctly after the upgrade of the WWTP with the additional activated carbon step. Further collected upstream of the WWTP with respect to the investigated health parameters. The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WWTW in the UK (approximately 13% of all WWTW) may cause exceedances of estimated riverine PNECs after mixing of their effluents with receiving waters. The overall degree of risk is driven by the toxicity value selected, which in itself is controlled by the availability of reliable and relevant data. For our project, the aim was to identify: 1) the potential facts and sources of these types of chemicals. 2) The removal of pharmaceuticals in WWTPs is to add a tertiary treatment step based on the addition of ozone. Ozonation is a cost efficient and effective 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 is largely unknown. The aim of this study was to investigated the health status of gammarids as well as the integrity of the macrozoobenthic community using impact data and consequently the possible effects of pharmaceuticals in exposed biota (n=5) at each site and sampling occasion will also be presented. Several additional methods to evaluate the impact of ozonation was using including impact on microbial community composition, presence of antibiotic resistance genes as well as studies to detect endocrine, reproductive and behavioral effects in fish and its progeny.

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 freshwater 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 DROPP (The dreissen as purifier to remove pharmaceuticals in wastewater effluent) project aims to test the depurative capacity of the zebra mussel in terms of pharmaceutic contaminants 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 biological techniques. The results indicate that the variable load remains stable during the 21 days of depuration, suggesting that the zebra mussel could be a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

Aqueous macrophytes potential for the removal of water contaminants - The Green Liver Application

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Reservoirs are aquatic environments that are impacted by anthropogenic activities. The main activities around reservoirs in Brazil are agriculture and settlement. Agriculture and 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
used to water supply and has been reported as contaminated by cyanotoxins 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

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**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 AMR is the high cost and organization 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.

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**Urban and rural antibiotic resistance**

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Soils are both a source and a sink for antimicrobial resistance (AMR). Despite growing awareness of AMR in the soil resistome, debate continues over the 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, multi-contaminated sites. This study focusses on 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.

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**Dissemination of extending-spectra β-lactamase E. coli carrying multidrug resistance and virulence factors in tropical rivers receiving hospital effluents**

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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, due to the occurrence of resistance in 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 resistance and the carriage 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 genetically distinct E. coli, 1st and 2nd detected, were 1.3%, 5.4%, 2.7% and 6.8% 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, tetracyclins, quinolones and phenicol classes) and may also carry virulence genes factors. The proportion of multi-drug resistant E. coli and not inherently linked to untreated hospital wastewater discharge in urban receiving system are widely distributed along the river, thus highlighting the risk of surface water use.

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**Methods for determining selective endpoints of antimicrobials**

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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 aquaculture result 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 target each selective endpoint. 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 PNEC6 (PNECs for resistance) published previously and PNEC6 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.

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**Determining the minimal selective concentrations of macrolides in a complex microbial community**

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Antibiotic resistant bacteria, especially those resistant to macrolides, are present in hospital effluents. Continuous release of antibiotics from human activity can and does lead to measurable concentrations 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 2012 by Guindon et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotic, 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 resistant genes (ermF, ermB, mefA, mcrA, mcrB, msdE and mefE families) 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 high 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 macrolides 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 (e.g. 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 a diverse group 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 MPs 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 than for fibres. There was no apparent trend of spatial distribution. Although a spike in MP particulate activity was observed between May2015 and May2016, there was 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 microplastic contamination issue, more standardized sampling and extraction procedures need to be developed.

526 Interactive effects of carbon 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 over their 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 polyacrylate 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 benzo(a)pyrene (BaP) and two different types of carbon nanoparticles, [C60 fullerene and multi-walled carbon nanotubes (MWNt)], 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 GCMs. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technologies targeting 15 stress response pathways. Contrasting results were obtained between BaP and BaP + CNPs of the same type. The CNPs used were: co-dissolved as mussels to MWNt and BaP seemed to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to C60 and BaP does not seem 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 response). In order to have a better understanding of the effects of these CNPs, further biological analysis (e.g. DNA oxidation and proteomics) are currently in progress. This study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

527 Trophic transfer of CuO NPs and Aqueous Cu: from worms to fish - a proof of concept study
T. Lammel, University of Gothenburg / Dep of Biological and Environmental Sciences; A. Thit Jensen, Roskilde University / ENSPAC; A. Thit Jensen, Roskilde University / ENSPAC; C. Mouneyrac, T. Lammel, University of Gothenburg / Dep of Biological and Environmental Sciences; A. Thit Jensen, Roskilde University / ENSPAC; A. Mouneyrac, University of Gothenburg / Dep of Biological and Environmental Sciences; H. Selek, Roskilde University / Dept Science and Environment Nanoparticles (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 as transfer of C60 to the upper part of the food web may occur. In order to better understand the effects of these CNPs, further biological analysis (e.g. DNA oxidation and proteomics) are currently in progress. This study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

528 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study
V. V. de Dié, V. Louër, University of Lorraine - CNRS / LIEC; C. Mouneyrac, T. Lammel, University of Lorraine - CNRS / LIEC; C. Mouneyrac, T. Lammel, University of Lorraine - CNRS / LIEC; C. Mouneyrac, T. Lammel, University of Lorraine - CNRS / LIEC; C. Mouneyrac, T. Lammel, University of Lorraine - CNRS / LIEC; L. N. Arlt, University of Plymouth / Biogeochemistry Research Centre; A. N. Jha, Plymouth University / Biological Sciences
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 behavior, encephalitides, gill and liver functions, suggesting an avoidance reaction. CuO ENP also induced significant impacts at the biochemical and molecular levels. However, the detected changes were low and did not show a clear and constant pattern. Further studies are needed to better understand whether detected effects may induce other effects at higher biological level (such as affecting behavior) or whether the avoidance behavior may have protected organisms from exposure, then lowering the effects that we were able to measure.

529 Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins
V. Kratayuk, Siberian Federal University / Biophysical; E. Simbeka, Siberian Federal University / Biophysics
A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to thin, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)H:FMN-oxidoreductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymolusum was used to facilitate and accelerate the development of the bioluminescent enzymatic matrix compared to the classical physiological bioassays for environmental toxicology assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

530 Toxic and adaptive effects via luminescent assay systems of different complexity - from cells trough enzyme reactions to proteins
V. Kratayuk, Siberian Federal University / Biophysical; E. Simbeka, Siberian Federal University / Biophysics
A new approach in developing bacterial bioluminescent enzymatic biosensors, application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to thin, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)H:FMN-oxidoreductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymolusum was used to facilitate and accelerate the development of the bioluminescent enzymatic matrix compared to the classical physiological bioassays for environmental toxicology assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).
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 biogeosciences is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogeosciences is explained by the diversity of reactions to external stimuli, their physiological 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 fulmantous 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 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 luminescence spectrometer Solar CM2203 at several wavelengths of the exciting radiation (250, 300, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spore suspensions and supernatant liquids) with the UV excitation consist of two 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 chromophores like NADH and or melanins. We suggest using the intensity of the first fluorescence band in the fungal samples for rapid evaluation of spore biomass. Measured fluorescence characteristics were found correlating with saturation of growth medium by source of bioavailable and nor readily bioavailable carbon. Therefore, we consider this research as promising on the way of using fungal fluorophores to assess responses of filamentous fungi to external stimuli.
Lipidomics profiling of wild fish to identify patterns associated with pollution exposure
C. Porte, IDAEA-CSIC / Department of Environmental Chemistry; M. Blanco, IDAEA-CSIC; A. Maceda-Veiga, University of Barcelona / Department of Animal Biology
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 lipidome of 235 fish species (Barbus meridionalis, Squalius laetanus) 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), phosphatidylplasmons (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 CEs (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. laetanus from polluted areas was characterized by a significant increase of TAGs and PC- 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. laetanus living in polluted sites together with a concomitant increase in neutral lipids (TGs, CEs), possibly due to an increase in the energy demand to respond to stress in polluted sites.

539 Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes
N.D. Denslowski, M. Nouri, University of Florida / Physiological Sciences; K.J. Kroll, University of Florida / Physiological Science; C.J. Martynik, University of Florida / Physiological Sciences; V. Dang, Iowa State University
The organochlorine pesticide (OCP) contamination of two lake (Lake Apopka) 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 Apopka 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 Apopka 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 Apopka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol is decreased and cholesterol esters are elevated in the livers of fish from Lake Apopka 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 Apopka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylethanolamines. 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.

540 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
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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 nanomaterials under investigation did not directly affect the algal 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, Likhele 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.lifegen.de/newsip/shownews.php4?getnews=n2011-11-09-3109&pєs02. 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. Oberg, UBC / IRES; 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 misunderstood 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 found in seafood, honey and even drinks. It was at this point that many of the presented articles did not have proper controls. And if they did, it became apparent that many of the plastic fibres observed in the samples were a result of cross contamination by air. Secondly, while plastic particles do not behave very differently from other particulate matter with respect to absorption of organic contaminants, all known equilibrium processes of contaminants between particulate matter, biota and water were blatantly ignored. Contaminants in open seas would first sorb strongly to plastics, to desorb readily in the gastrointestinal tract of fish, leading to higher bioaccumulation of pollutants like PCBs in the food chain. The fact that the amount of ingested plastic is still almost negligible compared to the natural food intake makes these claims even more difficult to uphold. Therefore, it was disappointing that even Science published an article about the dangers of plastic microplastics for fish larvae, while the manuscript did not comply to the journals own quality standards. As and it seems now, the described research has not even been performed. So, besides the obvious and clear detrimental effects of plastic debris in the environment, an important concern of plastic may be that research on the environmental impact of plastics is not always conducted following proper scientific guidelines. In this presentation I will also discuss shortly the more recent progress in plastic research, such as the exposure of humans to plastic particles.

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, Arts- Tecnamia / Marine and Coastal Environmental Management
The H2020 project ResponSEable (www.responseable.eu) is trying to raise awareness around 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, P. van den Brink, ScienceWageningen UR / Ass. Ecology and Water Quality Management Group b Alterra; B. Deutschmann, RWTH Aachen University

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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 model the ecological 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, transparent and formulative assessment method (model) with a risk quotient (RQ) approach. The developed toolbox was applied to the Danube case study, to facilitate evaluation of the very comprehensive data set from Joint Danube Survey 3. The toolbox concept proved to be practical, simple and promising for further studies, with fairly high diagnostic power.

551 How can we identify “drivers of mixture risks”? T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences; R. Altenburger, UEC Centre for Environmental Research / Department Bioanalytical Ecotoxicology; W. Brack, Helmholz centre for Environmental Research UFZ / Effect-Directed Analysis; M. Faust, Faust & Backhaus Environmental Consulting; A. Kortenkamp, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health Mixtures 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 overall toxicity, as there is no generally accepted rule that often only a very few chemicals dominate the mixture risk. The European Commission has therefore 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 risk” can be established. Therefore, 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 will conclude that, although the identification of 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; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermler, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences; I. Teodorovic, University of Novi Sad / Department of Biology and Environmental Sciences

Wildlife is exposed to an infinite number of different combinations of chemicals. There is evidence that single substances that are present below their threshold of effects can still be of concern and contribute to combined effects. A framework for environmental mixture risk assessment (MRA) has been suggested by Backhaus and Faust (2012), however MRA is often hampered by limited data availability. An ecological Threshold for Toxicological Concern (eToT) approach has been recently developed based on a database of more than 100 000 acute and chronic aquatic toxicity data. The tool allows for the calculation of predicted no effect concentrations (PNEC) derived from the underlying data to which an assessment factor (AF) is applied depending on the comprehensiveness of the available data set and the geographical area considered. A PNEC distribution, from which the eToT value is derived by calculating the fifth percentile. Other types of chemical toxicity distributions (CTD) are also possible i.e. distribution of acute (LC50) or chronic (NOEC) ecotoxicological data without applying any AF. It is common practice to predict combined effects and risks based on information of the mixture components, most of the time based on the concept of concentration addition (CA). For this case study the sum of risk quotients has been used as a surrogate for CA based predictions. The risk quotient for the mixture (RQmix) is based on the summation of the risk quotients of the individual substances. This approach is conceptually different from CA because the involved PNECs might be based on different groups of species and using different AF. However, it can be used as a screening level approach. If a RQmix>1 is identified, the MRA can be refined by using the sum of toxic units, based on LC50 data. The case study is based on chemical monitoring data in European rivers, which give realistic environmental concentrations and co-exposure scenarios to a relevant number of chemicals. Available ecotoxicological values have been gathered for the identified chemicals from regulatory sources when available, or from the literature and existing database. The possible use of the eToT approach and other type of acute to chronic conversion factors (F3) for screening for the appropriate use of NTA data within exposure assessment. Recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.

554 A common framework for the assessment of human and ecological risks from pollutant mixtures in European surface waters - case study with > 300 chemicals co-occurring in the Danube A. Kortenkamp, Brunel University London; M. Faust, Faust & Backhaus Environmental Consulting; S. Ermler, Brunel University London / Institute of Environment, Health, and Societies; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences

Experimental mixture studies have shown that the toxicity of a mixture is usually greater than that of the active substance and that the individual mixture effects can often even though all components in the mixture are present at levels that individually are without observable effects. These observations have lent urgency to the need of evaluating the risks from multiple pollutants both to humans and wildlife. Here, we present a common decision tree and tiered workflow scheme for performing human and ecological mixture risk assessments (MRA) in the context of the EU Mixture Risk Assessment (MRA) processes on MRAs for humans and aquatic species groups. It uses measured concentrations of chemicals co-occurring in water and builds on the principle of a tiered approach, where unnecessary expenditure of resources is avoided by discontinuing the analysis when cumulative exposures are judged to be acceptable on the basis of crude and simple worst-case assumptions. The analysis is refined when previous tiers reveal clearly unacceptable exposures, with refinements based on best-case assumptions of minimum expectable risks. The workflow is divided into three main tiers in which the distorting influence of different assessment factors present in regulatory values is successively removed, and increasingly sophisticated
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.

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Pesticides do rarely come alone, except in risk assessment - Risk indices of ranked spray series of the project COMBITOX
B. Scholz-Staver, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research; S. Bär, German Federal Environment Agency UBA / Section Plant Protection Products; B. Daniels, RWTH Aachen University / Institute for Environmental Research; T. Firsche, Federal Environment Agency UBA / Section Plant Protection Products; M. Liess, UFZ Center for Environmental Research / System-Ecotoxicology; R. Ottermanns, M. Roli-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. Ulrich, 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 spray series by typical mixture patterns, sequences and toxic potencies. 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 (PPDB 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-values). Next, risk indices were calculated based on the concept of a concentration addition from single-substance TER and summed up per application date. In general, patterns of pesticide use showed that tank mixtures 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 mixtures for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimes 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)

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Time-dependent effects of two fungicides and their mixture on enchytraeid and earthworm communities under field conditions
J. Anoss, S. Bart, INRAAgroParisTech; C. PELOSI, INRA (Institut National de la Recherche Agronomique); S. Knillmann, Helmholtz Centre for Environmental Research UFZ / Environmental Research; R. Ottermanns, M. Roli-Nickoll, RWTH Aachen University / Institute for Environmental Research.

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 300 g l⁻¹ of oxiconazole and 250 g l⁻¹ of epoxiconazole), and Swing Gold® (composed of 133 g l⁻¹ of diminosystrobin), and the mixture of both on two groups of terrestrial oligochaetes (Lumbricidae and Enchytraeidae) after 1, 6 and 12 months (i.e., t1, t6, t12) of exposure under field conditions. We also assessed the feeding activity of soil organisms using the bait lamina 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 4.76 kg ha⁻¹ of copper) and in the treatment with the Swing Gold® at ten times the recommended dose (i.e., 15.1 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 earthworms at t12 could only be observed later at t12. We showed no overall significant difference in total feeding activity, enchytraeid diversity and between treatments with or without pesticide at different sampling periods. In the Swing Gold® treatment, earthworm community did not recover twelve months after pesticide application. We suggest thus going beyond the ISO norm 11268-3 (2014) - for the study of the effects of pollutants on earthworm under field conditions. Organisms such as Lumbricus terrestris and Enchytraeus fedrens are considered as an indicator species for wetland quality. In the study of the effects of pesticides on earthworms, these species are often used for the assessment of pesticide contamination due to the number of species, their abundance, and their sensitivity to the chemicals used. In our study, we wanted to elucidate the possible effects of fungicides and copper used in agriculture under field conditions on terrestrial oligochaetes (Lumbricidae and Enchytraeidae) and earthworms (Lumbricus terrestris and Enchytraeus fedrens) in our study site, a floodplain in the Danube.

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Toxicity of imidacloprid and thiadiazuron towards four Colembolan species C. Lima, Vrije Universiteit Amsterdam / Animal Ecology; C. van Haren, G. Mainardi, Vrije Universiteit Amsterdam / Department of Biological and Environmental Sciences; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Sciences

Folsomia candida has been used for assessing the toxicity towards non-target soil invertebrates since the 1960s, but only in the 1990s a standard reproduction test was developed. In 2009, after a ring test, OECD also accepted Folsomia candidata as a model organism The first species, has been transported all over the world, therefore being considered a tramp species, having a parthenogenetic mode of reproduction. F. candida is present in most of natural and agricultural soils worldwide, and has a sexual mode of reproduction. Following a suggestion of the ring test to use different species as test organisms to assess the toxicity of contaminants, in this study two additional species, Heteromurus nitidus and Sinella curvisetosa, were used together with F. candida and F. jenneti to determine the toxicity of imidacloprid and thiadiazuron in Lura 2.2 soil. The tests aimed at answering 2 main questions: (i) Is there a difference in the sensitivity to neonicotinoids between the different species? (ii) Are these species suitable for assessing the toxicity of neonicotinoids?. Imidacloprid was most toxic, with F. jenneti presenting around the same sensitivity as F. candida for survival (LC50 0.56 mg/kg dry Lura 2.2 soil), and a slight difference in the sensitivity for reproduction, with EC50 for F. jenneti of 0.10 mg/kg dry soil and for F. candida of 0.26 mg/kg dry soil. H. nitidus was slightly less sensitive with an LC50 of 1.6 mg/kg dry soil and an EC50 of 0.40 mg/kg dry soil. Thiadiazuron was tested on S. curviseta, F. candida and H. nitidus, with survival of the first one being least sensitive (LC50 27 mg/kg dry soil), followed by F. candida (LC50 5.2 mg/kg dry soil) and H. nitidus being the most sensitive with an LC50 of 2.3 mg/kg dry soil. Thiadiazuron was more toxic to the reproduction of S. curviseta (EC50 2.6 mg/kg dry soil) followed by F. candida (EC50 1.5 mg/kg dry soil) and H. nitidus (EC50 1.3 mg/kg dry soil). The different species tested presented similar sensitivity towards the neonicotinoids for both endpoints, with the exception of S. curviseta. The results suggest a specific action mode of thiadiazuron towards reproduction, a trend that has been found in all tests, except for H. nitidus that presented around the same sensitivity to both survival and reproduction. The species tested presented good control performance and consistency in the results, pointing towards a possibility to be used in toxicity tests.

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Dirty dancing: measuring mito movement responses to pesticide residues J. Witton, 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, ADAMA; 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 – where individuals display avoidance or significant separation 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 a natural predator found in fruit orchards throughout Europe. 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 l⁻¹ deltamethrin, and that 54% of individuals exhibited avoidance behaviour when exposed to 1.0 µg l⁻¹ acetamiprid, where 0.5 µg l⁻¹ acetamiprid mean distance covered fell by 34%; however, when exposed to 0.45 µg l⁻¹ dimethoate the mean distance covered increased by 11%. No individuals Sheet SETAC Europe 28th Annual Meeting Abstract Book 119
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 attempts to escape the arena. Our results complement existing knowledge of sublethal pesticide effects in NTAs by quantifying movement behaviour changes in T. pyri. We are also contributing to the knowledge base relating to T. pyri avoidance 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.

560 Plant protection products in agricultural soils - Do active ingredients show a comparable pattern in worms and in soil? T. Schmidt, IES Ltd / Ecotoxicology; H. Viric Gasparic, University of Zagreb Faculty of Agriculture / Department for Agricultural Zoology; R. Bazok, University of Zagreb Faculty of Agriculture / Department of Agricultural Zoology; S. Kimmel, Innovative Environmental Services (IES) Ltd / Ecotoxicology; S. Heger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology The environmental risk assessment of plant protection products on soil organisms is mainly based on the outcome of laboratory and extended laboratory studies (EFSA 2017). However, the link from the laboratory to realistic field conditions over several seasons is not well established. Currently no validated trigger for bioaccumulation in terrestrial organisms is available (EFSA 2017). One available approach for filling this gap is proposed by combining experimentally determined residue data from earthworms and data from degradation studies in the field. Earthworms were sampled at different seasons from eight fields in Croatia and analysed for 26 active ingredients. The concentrations of 26 analysed active ingredients were 0.000-0.247 mg/kg worm fresh weight with a mean of 0.005 mg/kg. The percentage of samples with values below the limit of detection (LOD), values below the limit of quantification (LOQ) = 0.001 mg/kg) and values above LOQ was 29, 42 and 29 %, respectively. Based on publicly available draft assessment reports from EC and EFSA, degradation parameters (DT90, DT100) were used to calculate degradation curves and the current concentration in soil at the date of worm sampling. By comparing analysed residues in worms and calculated concentrations in soil, a substance-specific bioaccumulation factor could be calculated. In the case of imidacloprid, the analysed residue levels in earthworm samples from the fields tended to increase with time whereas the calculated concentrations in soil decreased with time as expected, resulting in a supposed increasing bioaccumulation potential of imidacloprid under field conditions. The procedure proposed here – in the absence of analysed soil data – is a simple estimation which combines field history data with data from publicly available draft assessment reports. This approach may be useful for the assessment of the bioaccumulation potential of an active ingredient from a plant protection product under realistic field conditions.

561 PBT assessment of substances - Proposal of a trigger value for bioaccumulation in terrestrial oligochaetes M. Simon, Fraunhofer IME / Applied Ecology; C. Schlechtriem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; P. Egeler, ECT Oekotoxikologie GmbH / Nature Protection, ECT Oekotoxikologie GmbH / Institute for Technology Assessment and System Analysis ITAS; J. Römcke, ECT Oekotoxikologie GmbH; B. Karaoğlan, German Environment Agency UBA; A. Wiemann, UBA Umweltbundesamt; W. Drost, Federal Environment Agency (UBA) / Chemicals Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances, are necessary to ensure a high level of protection of human and animal health, and of the environment. In aquatic organisms, trigger values for the identification of bioaccumulative (“B”) and very bioaccumulative (“vB”) substances are bioconcentration factors (BCF) of >2000 and >5000, respectively, obtained from fish flow-through studies according to OECD 305. However, Annex XIII of the REACH regulation does not define similar trigger values for bioaccumulation in terrestrial organisms. The objective of this project is to provide a suitable data basis which will help to clarify how to address terrestrial bioaccumulation in the B assessment and to define trigger values for the bioaccumulation factor (BAF) obtained from bioaccumulation studies with terrestrial oligochaetes according to OECD 317 that are comparable to the B/vB criteria in the scope of the PBT guidance revision. For this aim, the study comprised the following steps: 1) Literature research on available bioaccumulation factors (BAFs) both in open scientific literature and in regulatory data from several OECD 317 studies and performance of correlation analysis between soil/substance-properties, BCF and BAF values. 2) Performance of bioaccumulation studies according to OECD 317 with the earthworm Eisenia fetida using the four model substances endosulfan, methoxychlor, o-tolylphenyl and PCB153. 3) Proposal of a trigger value for identification of bioaccumulative substances in terrestrial organisms based on the literature research and the performed experimental results. The results clearly showed that organic carbon content of the test matrix used in the tests influences the BAF, whereas no clear correlations between log Kow, log KOC or similar substance properties and the BAF were observed. Additional confirmation was obtained by measuring substance-specific BCF from fish studies and BAF determined with earthworms. Therefore, lipid- and C-pe normalized BSAF should be used for the assessment of terrestrial BAF. Kinetic BSAF from both experimental studies and literature-derived values ranged from 0.21 to 14.8. Based on the data evaluated in the present work, a BSAF trigger value of 1.00 is proposed as a general trigger to identify bioaccumulative substances in terrestrial oligochaetes. Other effects like non-deuterated residues at the end of the elimination phase are discussed.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy 562 Developments and recommendations on the practical use of Social LCA S. Di Cesare, CRAD / Department of Economic Studies; A. Zamagni, Ecoinnovazione / LCA and Ecodesign Laboratory; J. Garcia, SCORE LCA; F. Silveri, University of Chieti-Pescara / Department of Economic Studies; A. Lanfranconi, Ecoaat; L. Petti, University of Chieti-Pescara / Department of Economic Studies S-LCA is a multi-criteria, multi-stakeholder and multi-step methodology that provides useful, transparent and science-based information on social and socioeconomic performance of a product throughout its entire life cycle. In this study, a systematic literature review was carried out dealt with within these aspects: the scope of S-LCA, its purpose, the social dimension outside S-LCA (i.e., analytical tools, procedural and managerial tools, currently used for monitoring, assessing, reporting and communicating social aspects, and their main differences with respect to S-LCA); impact assessment methods; users and uses of S-LCA. In addition, an experimentation was conducted through a practical case study based on literature, with the following goals: (1) to test the applicability and practicability of S-LCA to the case study of the methodology to identify social hotspots along the whole life cycle, and in particular in the remote phases of the life cycle, such as raw material production and end-of-life; (3) to show how those results may complete environmental LCA and other social approaches. The product chosen is a Photovoltaic (PV) Module. The analysis carried out clearly pointed out that S-LCA is an evolving field, and main developments are envisaged, both at the level of methodology and results interpretation and communication. More in detail, the main limits of the S-LCA methodology identified in this analysis are
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 the results along the value chain. On the basis of the main challenges for S-LCA identified in this study, recommendations were identified, for a further 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
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Globally, the textile and especially leather industries face different challenges 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 implementers 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 cycles 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 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 up-to-date inventory data and integrating 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
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The iron and steel industry is both a large contributor to greenhouse gases emissions and a provider of 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 the importance of the iron and steel industry for 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 throughout its life cycle. In order to promote sustainable development, 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
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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. (2011) is an example of how they sum up social costs of 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 internalized. The social footprint of an activity can be defined as $SF = IR + PG$. 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 was 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 transport). This study is an example of how the sum up 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
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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 (EOP) 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 polar organic 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_80hr_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 the prediction of endpoint concentrations for static ecosystems. 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) compared to automated semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, the pipetting system can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has made automation technology accessible to a much higher number of laboratories around the world.

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An intestinal fish cell barrier model to assess absorption of poorly soluble organic chemicals in vitro

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Permeation of organic chemicals from the aquatic environment across cellular barriers is a critical step for accumulation in organisms, such as fish. To better understand the underlying processes, we aim to study the role of the fish intestinal barrier for hydrophobic and volatile chemicals. The function of the intestine in these processes is experimentally impractical to assess on a routine basis. Additionally, hydrophobic and volatile chemicals are difficult to work with, due to their low water solubility and high volatility. Therefore, we here combine a recently developed in vitro epithelial barrier model using the rainbow trout (Oncorhynchus mykiss) intestinal cell line RTgutGC, and a newly constructed chamber that enables stable chemical exposure concentrations. In this setup, we measured the permeation of 10 fragrance compounds with a range of volatility (logHLC = -5.8 to -2.2) and hydrophobicity (logKOW = 3.6 to 5.7). The RTgutGC monolayer partly presented a physical barrier for the permeation restricting the fragrance transfer from the apical to the basolateral compartment. The calculated permeation rates across the cell layer combined diffusion controlled permeation and intestinal biotransformation. In the RTgutGC model, the involvement of biotransformation within the cell monolayer was further supported by experiments at 4°C and the measurement of cell associated chemical concentration. We determined the chemical distribution in all different compartments of this model, which correlated with the logKOW. The chamber enabled stable exposure concentrations and close to full recovery at the basolateral side, which precludes a direct comparison of the in vitro measured rates with in vivo observation. However, this exact unavailability of data highlights the importance of the development of such an in vitro system for understanding the chemical permeation time in 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.

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A new paradigm in water sampling - how can we challenge the needs of effect-based monitoring?

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In vivo 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 (LVSPSE) 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 LSPE approach and apparatus. It brings the SPE onshore, allows for field sampling and avoids processing and ensures the transport of larger water volumes to laboratory for filtration and extraction. LSPE was comprehensively assessed with respect to recovery and carry-over of effects. It has been shown that LSPE 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, LSPE is a promising technology for the implementation of EBM for water quality monitoring in European and worldwide water quality monitoring. LSPE 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 or 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 Zwitterionic, Cationic, and Anionic Perfluoroalkyl and Polyfluoroalkyl 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 perfluoroalkyl and polyfluoroalkyl 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 cannot be compensated by some degree of dilution to the lack of matching internal standards. If consistent “one-method recovery” 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., FTOH partitioning coefficients, dissolved organic carbon bioconcentration 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 assayed to recover PFASs from AFFF-impacted soils and 28 industrial textiles have been analyzed 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., PFHxSAm) 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

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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 water, dirt and moisture repelling properties, PFASs are suitable for a variety of applications and possess a lot of possible entry pathways that were identified in prior studies. Although, advertisement and material safety data sheets indicate a rather extensive use of PFASs in building materials and industrial textiles, only few studies dealt with investigation of these materials. A total of 23 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 perfluorooalky 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 FTOH 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 thus important for mitigating future exposure. The concentrations of 19 PFASs (SPFAS) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faroe Islands) where pilot whale is part of the traditional diet. Median SPFAS concentrations in children (ages 5 to 13 years) peaked in 2000 (47.7 ng mL⁻¹) and declined significantly by 14.4% yr⁻¹ to 8.7 ng mL⁻¹ in 2012. Perfluorooacrylic acids (PFCAs) with nine or more carbons (C≥9) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PFUnDA, r = 0.72). Toxicogetic modeling revealed PFAS exposures from seafood have become increasingly important (53%) of perfluorooctane sulfonate (PFOS) in 2012, despite a decline in whale consumption in recent years. A previous study reports PFASs in Faroese drinking water were below detection. We thus infer that even in a major seafood consuming population, declines in SPFAS exposure after 2000 were achieved by a rapid phase out of PFOS and its precursors in consumer products.
Membrane-water partition coefficients to aid PFAS risk assessment.
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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 experimental calibration data but 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 $pK_a$ of alternative PFASs, e.g. GenX. The negative charge on the negatively charged phospholipid head groups on electrons 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
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Concerns over the persistence, bioaccumulation potential and toxicity in organisms prompted the inclusion of perfluorooctane sulfonate (PFOS) in the Stockholm Convention in 2009. The ocean is thought to be the terminal sink for most PFOS released into the environment, and simply taken 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 $pK_a$ of alternative PFASs, e.g. GenX. The negative charge on the negatively charged phospholipid head groups on electrons 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
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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 PFASs (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 aquous firefighting foams (AFFF) containing PFASs 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 presented. 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: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (I)

580 Environmental fate and exposure models: Advances and challenges in 21st century chemical risk assessment
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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 identification needs for research in the field of multimedia fate models. Considerable efforts were devoted to their improvement in the last 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 injecting more ecological realism in exposure predictions to account for the variety of ecosystem structures and functions in risk assessment. Finally, to transfer new scientific developments into the realm of regulatory risk assessment, we propose the formation of expert groups that compare, discuss and recommend model modifications and updates and help develop practical tools for risk assessment.

581 Development and update of environmental exposure assessment tool EUSES for REACH and BPR Regulations
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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 assessment 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 efficiently, both for applicants/registrants, MScAs and ECHA. EUSES has several modules (release estimation, fate and distribution and exposure assessment) 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 authorisation 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 prioritisation of the most important issues to be dealt with. 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

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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 TERA, CHESAR), no local scenarios for direct application to 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 constituents 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 and allows for information 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 under the FARM REACH legislation. Further information on the project, including downloads of the FEE tool and SPERC factsheets can be found via www.fertilizers-europe.com.

583 Bioaccessibility of grease thickeners and the implications for REACH registration

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An intrinsic component of greases are the grease thickeners which include a diverse range of substances including metal soaps, metal-complex soaps and polyureas. These different thickeners impart different technical properties on the final grease. Although individually registered under REACH as isolated substances (i.e. extracted from base oil), grease thickeners are typically manufactured in situ in base oil and seldom exist except within a grease base. Under normal environmental conditions, grease thickeners would be expected to remain within the grease base because they are incorporated as manufacturing process, unique physical properties (or matrix effects) occur between the grease thickener and the base oil. These interactions are important because, to be effective, the grease thickener matrix has to keep the lubricating base oil entrained. It is proposed that these matrix effects have a significant impact on the bioaccessibility of the grease thickener substances in situ in base oil in comparison to their isolated form. These matrix effects are expected to decrease the bioaccessibility of the grease thickener as it is not available to cross an organism’s cellular membrane. The European REACH Grease Thickeners Consortium (ERGTC) have characterised the bioaccessibility of their grease thickeners by conducting leaching studies based on a Water Available Fraction” (WAF) approach, but using relevant media i.e. deionised water for the environment or synthetic fed state intestinal fluid (FeSSIF – Biorelevant, Switzerland) to assess exposure route via the gut (human health). Data is presented for different types of thicker substance which shows that most thickeners will not be bioaccessible and therefore, there will be minimal exposure to these substances. As the main form in which grease thickeners are manufactured and used, is

entrained in a grease base, it is proposed that a lack of exposure based on low-solubilities and/or 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

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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 (pendimethalin–nanocarrier complex) was considered to test and the framework proposed for 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.

585 Can we model emissions, fate and exposure on a global scale? A case study of PCB 153 in human milk

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One of the grand challenges of environmental chemistry is to be able to predict the environmental fate and exposure of chemicals on a global scale. A global scale based on the human diet, was considered in this study. We used LC/MS analysis of PCB 153 in human milk in Africa, with data from studies published since 1970, in order to emulate the global exposure of a POP. The methodological framework was set up by Koo et al. (2010), who developed the Global Assessment of Exposure to POPs (GLOPEX) platform. The main conclusions of this study are that a global scale approach is feasible, and that PCB 153 is a suitable POP for this type of study. In order to model global human exposures, we applied a robust statistical method, a random forest prediction model. The random forest models of PCB 153 were compared to the measured concentrations in the WHO/UNEP global monitoring program for POPs. The predicted and observed concentrations were highly correlated, with a correlation coefficient of 0.76. For 49 out of 78 data points, the predictions and observations agreed within a factor of 4. The model over-predicted the concentrations in central Europe and under-predicted the concentrations in much of Africa, in particular West Africa. Potential weaknesses identified in the chain of models include an under-prediction of the rate of decrease in PCB concentrations in air since the 1980s and inadequate treatment of food sourcing. We conclude that we have come a long way towards meeting this grand challenge for PCB 153, but there remains room for improvement! References U. Schenker et al. Environ. Sci. Technol., 2005, 39, 8434-8441. K. Breivik et al., Environ. Sci. Technol., 2016, 50, 798-805. M. MacLeod, et al., Environ. Pollut., 2011, 159, 1442–1445. G. Czab and M. S. McLachlan, Environ. Toxicol. Chem., 2004, 23, 2356–2366. https://undatalist.org/dataset/gmsoff-consumption-database M. van den
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. Deyderly Stephan, European Chemicals Agency / Evaluation Directorate; V. Rodriguez Unamuno, A. Karjalainen, J. Holinqvist, European Chemicals Agency ECHA European Chemicals Agency (ECHA) implements the REACH Regulation (EC) No 1907/2006 (Registration, Concentration 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)(c). It states that the approval of an active substance does not cover nanomaterials explicitly or 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 Registries, 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 with 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

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Despite the potential benefits associated with the use of nanomaterials, concerns also exist regarding possible ecological and 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

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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 or sort searches based on exemplar criteria. This inventory that approved the standard (and thereby indirectly the procedures followed to come to a standard), the level of evaluation and validation of the resources or the acceptance of the resource in view of the reach REACH legislation. During the project and after the duration of the project this overview will be updated when new information or updated versions of resources become available or when new resources are introduced. 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 be useful for those interested. One of the most important issues is the lack of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 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

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OECD test guidelines using aquatic organisms have been identified as suitable starting points for identifying risk that engaged nanomaterials (ENMs) risk represent for the environment. However, standardized testing (mainly relevant for free nanomaterials) may not adequately capture the risk and dynamic behavior of ENMs in the environment, in particular for aquatic regions like coastal areas which are the ultimate sink for all land based contaminants. As a result, the addition of less conventional organisms to regulatory projects can promote the characterization of environmental risk nanomaterials pose. Mytilus species have a long history of being used as sentinel organisms to characterize ecosystem health and can be a powerful tool to understand the movement of environmental risk into emerging contaminants like ENMs pose. This information can be particularly useful for the development of safer-by-design strategies as implementation in risk characterization can promote the identification of which products an industry creates pose the lowest environmental risk. In this context, under project the Horizon 2020 project NanoReg2, the aim of this study was to demonstrate the implementation of a safer-by-design strategy for ENM development. Three carbon nanofibers (CNFs) were provided by an industrial partner in order to characterize the potential environmental risk their products posed. The aim of the study was to compare the original product (GANF) to a new scaled up production process for the CNF (GATAm) as well a graphitized version of the product (GANFg). The study implemented regulatory testing using Daphnia magna and Pseudokirchneriella subcapitata as well as hemocytos from the marine mussel Mytilus edulis (M. edulis) following in vitro and in vivo testing on subcellular endpoints. The testing strategy was conducted in order to demonstrate the suitability of both regulatory testing (OECD tests) as well an in vitro screening strategy on M. edulis hemocytes to characterize the environmental risk posed by ENMs in the context of safer-by-design and its application to industry. In addition, recommendation and discussion on protocols used to test this CNF are provided.

590 Minimising the risk posed by TiO2 nanomaterials used in sunscreen throughout the entire product lifecycle

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nanomaterials contained in the sunscreen 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 aquatic 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 dermal 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
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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 freshwaters 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 parameterization, 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.

Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (I)

592 Occurrence of cyanotoxins in Greek lakes
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Thanks to their adaptation cyanobacteria are anificient in aquatic, marine and terrestrial environments. Eutrophication of waters has promoted and still increases 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 planktonivorous 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 has the question, if 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 P. nostocoides Laug. D. magna were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 μm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10^6 cells/mL, reduced feeding and survival, modified haemolysis, altered detoxication and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy-d are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 exposed to 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.

593 Interactions between cyanobacteria and daphnia
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Thanks to their adaptation cyanobacteria are anificient in aquatic, marine and terrestrial environments. Eutrophication of waters has promoted and still increases 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 planktonivorous 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 has the question, if 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 P. nostocoides Laug. D. magna were employed. In order to disentangle mutual interactions between both organisms, a co-culture chamber was designed, where two chambers are physically separated by a 0.2 μm cellulose nitrate membrane filter, preventing the grazing effect but allowing exchange of chemical compounds released into the medium. Exposures lasted one week. First results confirmed the detrimental impact of cyanobacterial metabolites released into their culture medium on D. magna. Cyanobacterial culture medium of M. aeruginosa PCC7806 obtained after 2 weeks culture, equivalent to 10^6 cells/mL, reduced feeding and survival, modified haemolysis, altered detoxication and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy-d are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 exposed to 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.

594 Teratogenic retinoid-like compounds produced by cyanobacteria into surface water
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Cyanobacte...
595 (Co-)Production Dynamics of Cyanobacterial Peptides
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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 toxicogenic compounds. Information on formation and degradation 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 counting, and biomass was simultaneously measured; 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.

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 from Cyanobacteria, Prymnesium parvum (Prymnessis), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsin, anatoxin-a, prymnessins and euglenophycin. The objective of the first phase of this research was to spike experimental fish, cell cultures, and biomass with 3 algal congeners (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 research will provide for development of procedures for plankton, periphyton, and macroinvertebrates. Ten and 100 mg of fish homogenates from fishcontaining 1, 4 and 14% lipids were spiked with 4 and 40 ng of each of the microcystin congeners, LR, LA and RR. Various extraction techniques and conditions were tested to optimize recovery and simplify the procedure. Overall toxin recoveries were found to range from 30 to 50%. The lipid content was found to not interfere with generation of MMPB; however, it did impact the workup/extraction procedure in ways that were accountable through the use of a surrogate standard. The MMPB technique can be reliably employed for microcystin quantification in fish tissue. Detections in non-spiked samples (10-20 ug/kg) are comparable to literature precedent. For tissue quantification the MMPB method provides considerable improvements over extraction of individual toxin congeners and is consistent even with very polar or hydrophobic MCs.

597 Saponins in the aquatic environment: hydrolysis 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. Cedergreen, 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 up to 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 hydrolysis 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 (HC5) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinoa seed coat were 2.91 ±0.00, 0.22 ±0.11 and 22.9 ±8.54 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 originates 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
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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 exercise 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, 6% regulatory, and 4% other. For the ranking exercise, over 800 respondents were involved in proposing question solicitation, questions were separated into broad topic areas including, AOP networks, quantitative AOPs, collaboration and communication on AOPs, AOP discovery and development, extrapolation, exposure/toxicokinetics considerations, and AOP application. An expert-ranking exercise was then conducted to identify high-priority questions for each category and from this, four key themes emerged including further AOP research and regulatory initiatives. These themes were used as workgroup topics for a Pelliston™ Workshop, including: AOP networks and their applications; quantitative AOPs and...
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, expert council exercise, and charging exercise were 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 D. Knapp, University of Antwerp / Zebrafish Dept Veterinary Sciences; M. Angrish, US EPA; National Center for Environmental Assessment; M.C. Fortin, Alcami / Environmental and Occupational Health Sciences Institute; I. Katsiadaki, Cefas / Environmental and Atmospheric Health; M. Leonard, IOREAL SA; U. Margiotta-Casaluci, Brunel University London / Institute of Environment, Health and Societies; S. Munn, European Commission; J. O'Brien, Environment and Climate Change Canada / National Wildlife Research Centre; N. Pollesch, US EPA / ORD NHEERL Mid Continum Ecology Division; L. Smith, University of Florida / Physiological Sciences; X. Zhang, Nanjing University / Environmental Science; D. Dugan, U.S. EPA / National Health and Environmental Effects Research Laboratory 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 disciplines and different life stages. 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. This report expands on that exercise, and answers 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 development of individual AOPs. 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 those 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. Landesmann, JRC, European Commission; C. Mackay, Unilever; C. Murphy, Michigan State University / Department of Fisheries and Wildlife; N. Pollesch, US EPA / ORD NHEERL Mid Continum 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 Quantitative precipitation and developmental impacts on ecological health are 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 and fundamental guiding concepts 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 stoeatosis, 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 Technology 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™, “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 explication 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 conceptually coherent 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. Ankney, 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 Assurance Centre; K. Leeming, 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 framework 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 Scanning” 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) Pellanum™ Workshop comprised of international participants representing industry, government, academia, and NGOs was held in Cornell, Ontario, in April 2017. This presentation will provide an overview of the overall outcomes and common themes that emerged during this Pellanum 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 toxicologists to related professional organizations. 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, pine, 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, DDTs, 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, DDTs 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 Gothenburg environmental specimen bank

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In the last century, conventional brominated flame retardants (FR) 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 time and their accumulation. One substance series going back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree lichens 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 Ecosystems Specimen Bank (Mes in the SB). Hollings Marine Laboratory, in Charleston, South Carolina, USA, using standardized protocols for collecting, processing, and cryogenic storage. The protocols ensure a high quality sample is provided for downstream analysis that is fit-for-purpose and that homogeneous aliquots are uniform, reproducible, and stable over time. New investigations exploring if the standardized protocols, 1) affect the quality and suitability of RNA for downstream expression studies, 2) reveal feasible methods 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-sliced genome, and 2) the discovery of using total mercury as an alternate method 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. Rostkowi, NLU 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 handle the samples in 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 enhance 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-sliced genome, and 2) the discovery of using total mercury as an alternate method to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Aastron, 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 genomes 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 ESB samples should be deposited in dedicated DNA banks in order to make this resource available to the scientific community and the developing DNA analysis methodsologies (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 ESB 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

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Increased focus on cumulative effects of pollutants in the environment has led to 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 account for 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 ERICA tool for ERA of 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 valuation 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. Levi, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRSEE Suez Environment; a. guillon, Suez / CIRSEE; m. favier, INSERM Institut Cochin; v. dormeau dupont, Université Paris Sud; M. Bimbot, V. Huteau, Univ. Paris-Sud / UMR ESE; m. plewa, 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, reverse osmosis-filtered water and bomb mineral water. 2 generations of mice (10 males, 10 females for each type of water) were fed with contaminated 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 OC-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 procedural and results. In vivo tests on mammals (Phaenocoelis antarctica and Cyprinidomus antarcticus) allowed 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 individual contaminants), and synergism (more toxicity 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 Chlex1-100 resin) to assess the toxicity of Cd, Cu, Ni, Pb, and Zn in mixtures, to two common Antarctic marine microalgae, Phaeocystis antarctica and Cyanobium antarcticum. 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 detected 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?

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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 Zeelbregte (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 analysis was performed on identified contaminants including metals such as Cd, Cu, Pb, Zn, and 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 multivariable 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. Napierska, 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. Potential, ISPRA Institute for Environmental Protection and Research; R. Looi, European Commission Joint Research Centre; D. Marinov, T. Lettieri, 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 evental 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 Diuron and Isoproturon. Signatures induced by the Cadmium 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, Umweltpolitikamt / Federal Agency of Environment / Risk assessment for plant protection products; J. Roembke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Luz and C. Belo, University of Coimbra; S. Chehino, 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 proposals on terminology and nomenclature, 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 current risk assessment may lead to field studies that might be underestimation of the toxicity of test chemicals for soil 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 Lufa 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 properties 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 higher tier conceptual models allowing the extrapolation from the lab towards the field situation.


For Plant Protection Products (PPP), regulatory risk assessment for soil organisms followed the Tiered Procedure approach. It covers worst-case situations (i.e conservative estimates and toxicity laboratory studies) to the most realistic assessment (i.e. Field studies). The recent EFSA opinion proposed a framework for risk assessment of soil organisms and definition of protection goals. Still, no statistical tool was proposed when dealing with field studies as higher tier. The aim of this communication is to test tools routinely used for regulatory risk assessment of communities. The tools for the ecological communities were mostly developed for aquatic organisms risk assessment. The multivariate analysis (PCA) is used for the community comparison. Individual populations are compared date-by-date using various statistical analysis commonly including Dunnett test and Wilcoxon test. The main objective of this exercise was to test and validate statistical methods (e.g. DCA, PCA) not used in environmental risk assessment in the context of this communication is to test tools routinely used for regulatory risk assessment of communities for earthworm and soil communities.

618 Metal soil threshold calculator tool: use of available data for derivation of metal soil quality standards for different scenarios and protection goals K. Cicin-Sain, T. Lettieri, European. Commission Joint Research Project -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 protection goals (PG) for soil quality standards. To provide some lead and improvements for the soil community risk assessment, from the experimental design to the sampling choice and statistical analysis in the context of this communication is to test tools routinely used for regulatory risk assessment of chemicals for earthworm and soil communities.

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effect levels from the original dose-response curves (ECs), selection of protection level (probability level in SSD), bioavailability models to be included etc. The advantages of this approach are the maximal use of available toxicity data and bioavailability corrections and the enhanced transparency in the derivation of ecological quality standards for metals in soil for different goals and different scenarios.

619 Assessment of pesticides on a landscape level - What is basically needed? 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 currently 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. To face this loss it 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 independently individual of the current status of biodiversity in the field and possible effects of the combined or sequential use. Additionally there is no trace upon the consumption 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 thresholds for 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? J. Roembke, ECT Ökotoxikologie GmbH, J. Sousa, University of Coimbra / Department of Life Sciences

In February 2017, the 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 document is to provide a recommendation on the use of pesticides 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

Wood-fibres composite in substitution of a synthetic material to enhance sustainability purposes for automotive sector S. Maltese, Magneti Marelli Spa / Powertrain Division; a. bonoli, DICAM- Alma Mater Studiorum - University of Bologna / DICAM; L. Zanchi, M. Delogu, University of Florence / Department of Industrial Engineering

Nowaday bio-composite materials have increased automotive market penetration, which intend is to produce environmental friendly products while maintaining their competitive edge [1]. In particular wood-fibers is considered a more environmental friendly alternative to the synthetic reinforcements as talcum, glass and carbon fibers. The reason behind is due to their less impact on production issues (sharp reduction of toxic and fossil materials as well as for the energy expenditure, light-weight profile and more energy credit through their incineration [2-4]. This study presents the application of a new industrial engineered wood-based product, called Woodforce® , for the production of an automotive PedalBox Support (PBS); in particular, the environmental advantages/disadvantages are presented and discussed when such material is thought to substitute the glass fibers. At this scope, a comparative environmental analysis has been performed between two materials - a standard material (with glass-fibres content) and an innovative (with woodchip content) – which perform the same function. 1. References [1] Platenen A., Curis M. 2016. Wood and natural fiber composites current trend in consumer goods and automotive parts. Reinforced Plastics 60: (3) 170-173. [2] Joshi S.V., Drzal L.T., Mohanty A.K., Arora S. 2003. Are natural fiber composites environmentally superior to glass fiber reinforced composites? Composites: Part A 35 (2004) 371- 376. [3] Boland S. Claire, De Kleine R., Keoleian G.A., Lee E.C., Kim H.C. Waste Strateg. Plan. 2015. 5. [4] J. Holbery J., Houston D. 2006. Natural-Fiber-Reinforced Polymer Composites in Automotive Applications. Low-Cost Composites in Vehicle Manufacture.

623 Resource depletion of a Lithium ion battery cell technology M. Cussenza, Università degli Studi di Palermo; S. Bobba, G.A. Blengini, Politecnico di Torino; M. Cellura, M. Mistrutta, University of Palermo Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode and anode materials, are available in the market, such as LiMnO₂, Li(Ni₀.₅Co₀.₅Mnₓ)O₂. The cathode contains a wide range of raw materials (RMs), among which e.g. cobalt is in the 2017 list of CRMs for the Europe Union (EU). CRMs are both of high economic importance, for the EU, and vulnerable to supply security. In the last years, the increasing demand of LIBs has triggered a growing interest in the need to ensure the security and the sustainability of the availability of the raw materials used in LIBs and in general in EVs. In this context, lithium rich layered oxides from the class xLiMnO₂-(1-x)Li₂MnO₃ (M=Ni, Co, Mn, known as LMO – NCM, have drawn attention as cathode material due to their high discharge capacity and lower cobalt content, compared with the Ni-Co-Mn cathodes (NCM). In this context, the authors carried out a Life Cycle Assessment of an 11.4 kWh LMO-NMC battery cells usable in Plug-in EVs with the objective of assessing the impact on the mineral, fossil and renewable resources depletion (MFRRD); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRRD; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRRD and CRMs requirement. The LMO-NMC battery cell technology is modelled as 0.5LiMnO₂ – (0.5Ni₀.₅Co₀.₅Mn₀.₃)O₂, using both primary and secondary data. The cells of the 11.4 kWh LMO-NMC battery are selected as functional unit. The system boundaries include RMs supply, manufacturing, transports and infrastructures. The results show that the LMO-NMC cells have an impact on MFRRD of 0.34 kg Sb eq. The relevant share of MFRRD (34%) is caused by the cobalt sulphate production used in the cathode. Of the 27 CRMs for the EU, the analysis shows the relevance of only two of them: cobalt and barite. From the comparison with the NMC cells, the carried out with reference to 1 kWh of nominal capacity, results that the MFRRD impact and the cobalt requirement of the LMO-NMC technology is lower, respectively, of a percentage equal to -4.4% and -29% than those of the NMC. The results indicate that the LMO-NMC cell could be a suitable technology to meet the demand of the EV market as it involves a lower impact on MFRRD and a lower consume of CRMs compared to the NMC cell.

624 Analysing the environmental impacts of alternative solutions for passenger transportation: LCA of a charging station for e-bicycles G. Bartellone, University of Roma Tre / Department of Business Studies; R. Salomone, L. Giuttari, G. Saija, G. Ioppolo, University of Messina / Department of Economics; M.C. Lucchetti, University of Roma Tre / Department of Business Studies

The transport sector causes environmental impacts that are mainly connected to the passenger car activities. In this context, strategies for reducing the environmental impacts related to the transport sector are required moving from cars to alternative transport vehicles, such as electric bicycles. Although many studies have been focused on the application of the Life Cycle Assessment (LCA) method for assessing the environmental impacts of electric vehicles (EVs), there are

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fe 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 stations 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 utilization in Italy with a lifetime of 15 years. The investigated station 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, realized 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 demonstrate 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. Cutia, C. Chialvo, P. Porta, ENEA; M. La Monica, C. Scaglari, CINEO

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 the penetration scenarios of 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 highligh 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. Albesc, P. Collet, D. Lorne, IFPEN / Economics & Technology Intelligence; A. Benoist, CIABD / UPR BioWooEELS 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 differently enforced by energy policies (e.g. the French Transition Plan 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 CO2 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 Chio accounting models towards dynamic LCA. The former—a prospective techno-economic partial-equilibrium model covering the French energy-transport sector—represents scenario-dependent outputs over a long timeframes (2007 to 2050), exploring optimisation options under no-policy and policy-driven constraints. The latter assesses biomass growth and alloometric relations representing the Chio fixation of a vegetation species per hectare on an annual basis, and thus the time-dynamic Chio flows between the atmosphere and the technosphere. The assessed Chio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Chio 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 Chio sequestration potentials and climate benefits of lignocellulosic biofuels. The consideration 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 (Chio 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

R. van der Oost, Wateren / Onderzoek en Advies; G. Sileno, Wateren / Research and Development; M. Thao Nguyen, Waterproof, L. Moria, Wateren / Water Systems

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 cycle 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 bioanalytical 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 of the SIMONI strategy for identifying hot-spots of chemical pollution. If appropriate, ecotoxicologically generalised at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wtp 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 msPAP determination (potentially affected fraction of water organisms due to multiple substances). Anyway, these sites 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 Speedik passive sampler extracts

M. de Baat, University of Amsterdam / IBE-FAME; M. Thao Nguyen, Waterproof; R. van der Oost, Wateren / Onderzoek en Advies; W. van den Berg, Waterproof Laboratory, Research and Validation; P. de Voogt, University of Amsterdam / IBED; M. Kraak, University of Amsterdam / IBE-FAME

A large portion of the toxic effects observed in surface waters cannot be explained by conventional 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 water bodies. Effects observed in surface waters cannot be explained by compounds that water authorities regularly monitor. Since chemical analysis of the chemicals in water is expensive, it is not always performed and the resulting data is not always available. This paper focuses on the environmental risk assessment (II)
630 Endocrine modulation and toxic effects of sunscreen chemicals, Octocrylene and Benzophenone, 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, octocrylene (OC) and benzophenone-3 (BP-3), benzophenone-3-p-coumarate, ketomedrine, 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 BP-3 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 endocrine disrupting chemicals and individual organic contaminants M. Machala, Veterinary Research Institute / Chemistry and Toxicology; K. Pencíková, S. Strápacová, Veterinary Research Institute, Brno / Chemistry and Toxicology; L. Svržková, 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; O. Křížová, J. Tomáš, Faculty of Veterinary Medicine, CAS, Prague; J. Vondráček, Institute of Biophysics, CAS, Brno
Since 2001, our laboratory has continuously employed an ever growing set of in vitro bioassays combined with a detailed chromatographic analysis, and in some cases the effect-directed analysis, in order to identify principle 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) for a large number of poly cyclic aromatic compounds, including PAHs, methyl-, nitro- and oxy-PAHs, thiophenes, dibenzothiophenes, benzazulenes and carbazoles, which complemented the available data on polychlorinated biphenyls, dibenzo-p-dioxins and dibenzofurans. Recently, we also developed REP values in human AhR-dependent reporter gene assays, in order to compare the potencies in rodent and human models. Using a set of various CALUX assays, we used systematic and directed analyses by the toxicity profiling approach, 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-cell communication, we further studied toxicity profiles of both mixtures and selected individual compounds to induce (anti)estrogenic, (anti)androgenic, TRα1/2-, CAR-, PPAR- 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. P303-12-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) impacted locations. The extracts of the passive samplers were subjected to a battery of bioassays, specifically responsive to polar compounds, including ERα, anti-AR and GR chemical activated luciferase gene expression (CALUX) bioassays, as well as the RIKILT WaterSCAN for antibiotics activity. In addition, the Microtox 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 values exceedences and thereby to the detection of ectotoxically risks. Hence, POCIS outperformed Speedisk 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.
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. Shekhter, Saskatchewan Water Authority; J. Eilertson, Department of Environment & Sustainability and Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre Nechako white sturgeon (Acipenser transmontanus) is 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 anthropogenic activities. In the 1980s the Community of Rivers First Nation 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 CWG 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 governments, industry, 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 project 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 A. Farenhorst, University of Manitoba / Soil Science; W. Ross, University of Manitoba / Centre for Human Rights Research; R. Me, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amaraawansa, K. Anderson, University of Manitoba / Department of Soil Science; E. Khafipour, University of Manitoba / Department of Animal Science; A. Kumar, University of Manitoba / Department of Microbiology 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, Indigenizing 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 G. B. Millan, Centre détudes nordiques, Université de Montréal / Department of Biological Sciences; J. Gérin-Lajoie, Université du Québec à Trois-Rivières / Centre détudes nordiques, Département des sciences de lenvironnement; J. Chetelat, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health; E. Hébert-Houle, Université du Québec à Trois-Rivières / Département des sciences de lenvironnement; J. Rowell, University of Montreal / Department of Chemistry; J. Heath, The Arctic Elder Society; H. Snowball, The Nunnivik Village of Kangisualuqjuajuaq, R. Mickpegak, Sakkull Landholding Corporation Kuujjuaarapik; M. Amyot, Université de Montréal / Département de sciences biologiques Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and insects important on both biotic and abiotic levels. One such concern is the potential contamination of First Nations 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 Kuujjuaarapik-Whapmagoostui (K-W) and Kangisualuqjuajuaq 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 describe perspectives from the community who are engaged in the Nunnivik Village of Kangisualuqjuajuaq: 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 important for both biomonitoring and country food. 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 Papatāunu: A Collective Response to Healing T. Godfrey, H. Hirire, Te Whare Whananga O Awanuiarangi / School of Undergraduate Studies The use of pentachlorophenol (PCP) as an anti-stain 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 stain 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 contaminants upon both human and environmental health has led to the formation of the Upper Whakatane River Catchment Trust (UWRCT). The Trust partnered with indigenous communities for emerging contaminants.

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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 depend on 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 in the NT as part of visits for informal forums 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 by 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 perfluoroalkyl 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 Oviedo / 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=642) of matched 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 is modulated by up to a factor of 2-3. We will next 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 freshwaters 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 Directive environmental quality standards for lead and nickel according to Directive 2000/60/EC 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” (#2011-060-1600).
Age-Based and Time Trends of Exposure Chemical Biomarkers in the US Population 1999-2014

V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; J.A. Arnot, ARC Arnott Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Ecology, University of Victoria / Department of Environmental Health Sciences; O. Jolliet, University of Michigan

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 studying 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 attracted a great deal of interest. The principle of the biomonitoring 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 (Microgonias furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments 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 hepatopancreas and AChE inhibition in copepod whole-body, crabs hepatopancreas and fish muscle and brain. 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 spatial and temporal changes. However, analyzing all biomarkers studied, regardless of organ/tissue, 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 distinguish the main characteristics (pollutants and contaminant sources) that are affecting the estuaries along different seasons and year as well as the effects on local species. Regards test organisms, estuarine fish (Microgonias 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.

Ecotoxicology of micro and nanoparticles: Mechanistic

643 Biomarkers for the assessment of water quality in tropical estuarine environments in northeast Brazil

M. Jorge, Universidade Federal Maranhão / UFMF / Oceanografia e Linhologia; A. Bianchini, Universidade Federal do Rio Grande - FURG / Instituto de Ciências Biológicas

In attempting to measure and characterize the effects of pollutants in the aquatic ecosystem, biomarkers have been a valuable tool for a long time. The principle of the biomonitoring 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 (Microgonias furnieri), copepod (Acartia tonsa) and crabs (Callinectes spp) as bioindicators to evaluate the environmental quality assessment in tropical estuarine environments 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 hepatopancreas and AChE inhibition in copepod whole-body, crabs hepatopancreas and fish muscle and brain. 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 spatial and temporal changes. However, analyzing all biomarkers studied, regardless of organ/tissue, 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 distinguish the main characteristics (pollutants and contaminant sources) that are affecting the estuaries along different seasons and year as well as the effects on local species. Regards test organisms, estuarine fish (Microgonias 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 chemicals with the help of 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 provide data that would allow for 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 carasses, which were processed separately. Biometric data (e.g. fish size, weight, sex) were documented. Age was determined by ear marks. Since many decades, but the legacy of these extraction processes remains apparent 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 200000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which five fish species are most appropriate? Which age/size class is appropriate? Which tissue should be chosen? Fish of which trophic level should be caught? In this contribution, influences of these factors on fish levels of PS (e.g., mercury, PFOS, HCB, HBCDD) will be evaluated. It will also be assessed whether the data allow deriving factors for the conversion of whole body to fillet monitoring data and vice versa. Another aspect is to test whether the normalization of biota monitoring data (e.g., lipid normalization, trophic level normalization) enhances comparability.

645 Using Paleoenecotoxicology to Assess the Toxicity of Lake Sediments Impacted by Legacy Gold Mining in Yellowknife, NT, Canada

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Natural resource extraction has supported the development of Canada’s far north for many decades, but the legacy of these extraction processes remains apparent 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 200000 tonnes of particulate arsenic trioxide, which was deposited to the surrounding landscape. Which five fish species are most appropriate? Which age/size class is appropriate? Which tissue should be chosen? Fish of which trophic level should be caught? In this contribution, influences of these factors on fish levels of PS (e.g., mercury, PFOS, HCB, HBCDD) will be evaluated. It will also be assessed whether the data allow deriving factors for the conversion of whole body to fillet monitoring data and vice versa. Another aspect is to test whether the normalization of biota monitoring data (e.g., lipid normalization, trophic level normalization) enhances comparability.
approaches to understand their risk for the environment and human health

646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms
S. Neale, Griffith University / Smart Water Research Centre / Griffith School of Environment; P.A. Neale, Griffith University / School of Environment; A. Kumar, CSIRO / Center for Environmental Contaminants Research; L. Rintoul, Queensland University of Technology; F.D. Leusch, Griffith University / Australian Rivers Institute

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 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 (Daphnia magna) and a sediment-dwelling midge larvae (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 environmentally relevant 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
L. Zimmermann, Goethe University Frankfurt am Main; C. Völker, Institute for Social-Ecological Research; M. Wagner, Norwegian University of Science and Technology / Department of Biology

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. impurities and byproducts, are almost unknown. Furthermore, although 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.

648 Microplastic size-dependent toxicity, oxidative stress induction, and multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus korenasus)
C. Jeong, J. Lee, Sangkyunkwan University

Plastics are in marine ecosystems like a 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 korenasus) on particle size was investigated by studying the ingestion and egestion of microplastics. Our results showed that particle size affects the oxidative stress and MXR activity. 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. korenasus 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. korenasus in response to microplastics and their potential impacts on the aquatic ecosystem.

649 Sorption of model pollutants on microparticles and toxicity assessment using early life stage of zebrafish (Danio rerio)
B. Cormier, EPOC University of Bordeaux; M. Larsson, Orebro University / Marine Pollution-Environment research centre (MTM); L.W. Yeung, University of Orebro / Department of Chemistry; C. Clerendeau, EPOC University of Bordeaux; A. Karman, Orebro University / MTM Research Centre; B. Morin, University of Bordeaux; EPOC; M. Engwall, Orebro University / Man-Technology-Environment research centre (MTM); M. Bégout, X. Cousin, IFREMER / Laboratoire de Recherches Halieutiques de La Rochelle; J. Cachot, University of Bordeaux / EPOC; S. Keiter, Orebro University / MTM Research Centre

The growing production of plastics increased the amount of plastic debris in aquatic ecosystems. Their degradation lead to the emission of microparticles (MPs) when their size is between 1-5000 µm. MPs can result from runoff and degradation (biodegradation or weathering) of macroplastics (MPs) of marine products 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 PFOs, 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 microparticles particles (vigin or spiked). No differences were found regarding sub-lethal endpoints (genotoxicity, photobehaviour response (PBR) and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or controls. 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 microparticles in the effects of chlorpyrifos on molecular biomarkers in marine mussels
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Plastic particles within the microns range (microparticles, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine ecosystems...
Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

Dissipation of the carcinogenic ptaquiloside in water resources
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Ptaquiloside (PTA) is a natural carcinogen found in a few 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 5 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: \( k_{obs} = k_{H} + k_{neutral} + k_{salts} \). The rate constants are: \( k_{H} = 25.7 \pm 1.0 \text{ M}^{-1} \text{ h}^{-1} \) and \( k_{neutral} = 9.5 \pm 0.6 \text{ M}^{-1} \text{ h}^{-1} \) and \( k_{salts} = 4.8 \pm 0.1 \text{ M}^{-1} \text{ h}^{-1} \). The activation energy for PTA hydrolysis at pH 4.6 is approx. 75 kJ mol\(^{-1}\). Hence, hydrolysis is a function both of pH and temperature. The purpose of this investigation was to study the degradation of PTA under near natural conditions using 10 different surface and groundwater bodies from Denmark 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.

On-line detection of algal toxins in sea water
S.F. Bodini, SYSTEA; F. Pasquazzi, Systea SpA; A. Porchetta, L. Micheli, G. Volpe, L. Fabiani, University of Tor Vergata; L. Sanfilippo, P. Moscetta, Systea SpA; G. Pallecchi, University of Tor Vergata

Natural toxins produced by plants, algae and microorganisms represent a serious concern for public health. Current detection methods need expensive equipment, trained personnel and complicated protocols. In particular, the determination of marine biotoxins, released as a consequence of toxic algal blooms, is performed offline on fish / shellfish homogenates rather than on-line, resulting not appropriate for monitoring programs that require real-time warnings 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, it was developed and tested a direct Enzyme-linked Immuno-Magnetic Complementary micro assay for the detection of Domoic Acid, Saxitoxin and Okadaic Acid 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 analytical approach allows to combine antibody selectivity, convenience of a separation step through the use of magnetic beads and simplicity of colorimetric detection. Next, the manual assay was 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 Peltier refrigerated compartment was designed and incorporated in the instruments. 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 other devices for real-time data recording. When first toxic outbreaks related to O. cf. ovata occurred in 2005 along the Ligurian coasts (Italy), little was known on several aspects of the phenomenon. Although some Ostreopsis spp. were known to produce congeners of palytoxin (PLTX), O. cf. ovata was not known as a toxic species and its metabolic profile had never been investigated. Second, although PLTX itself was reported as one of the most potent marine toxins known, it was not considered as the causative agent of fatal food poisonings in the tropics, it had never been suspected to exert toxicity through inhalation. Last but not least, the role of the environmental conditions on O. cf. ovata proliferation and toxin production had been poorly studied. Therefore, the need for increased knowledge on potential risks for humans and ecosystem stimulated research in the field. An Italian interdisciplinary network was created, including scientists from the Academia and operators of the regional environmental protection agencies and food safety laboratories. This joint effort led to clarify many of the aspects related to the Ostreopsis phenomenon that still represents one of the most severe problems in the Mediterranean area. This presentation is meant to summarize the results of our studies on O. cf. ovata, highlighting inter- and intra-specific variability, structure of targeted toxin and, in some cases, linking such differences to the risk that PLTX congeners pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favour O. cf. ovata proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.

A decade of chemical studies on Ostreopsis. What’s left?
C. Dell’Aversano, University of Napoli Federico II, Department of Pharmacy / Pharmacology; L. Tartaglione, University of Napoli Federico II / Department of Pharmacy; M. Forino, University of Napoli Federico II Department of Pharmacy / Department of Pharmacy - University of Naples; R. De Gennaro, University of Naples; B. W. Strobel, University of Copenhagen / Plant and Environmental Sciences; H. Hansen, University of Copenhagen / Department of Plant and Environmental Sciences

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 contact with the surface of these particles. In this study we have compared the role of many of the aspects related to the Ostreopsis phenomenon that still represents one of the most severe problems in the Mediterranean area. This presentation is meant to summarize the results of our studies on O. cf. ovata, highlighting inter- and intra-specific variability, structure of targeted toxin and, in some cases, linking such differences to the risk that PLTX congeners pose to humans following inhalatory, dermal and oral exposure. Phylogenetic relationships among many isolates of Mediterranean O. cf. ovata were investigated as well as innovative molecular qPCR based assay was developed for monitoring activities. A general overview of the environmental conditions that favour O. cf. ovata proliferation and toxin production will be also provided based on laboratory data and in field observations. The methodological approach, besides addressing many of the palytoxin-related issues, may serve as template for facing in due time any emerging toxin-related threat to humans.
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 subdrivers (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

A. Maggiore, European Food Safety Authority (EFSA) / Risk Assessment and Scientific Assistance Department; A. Afonso, EFSA European Food Safety Authority; A. Cotopoli, EFSA European Food Safety Authority; A. Ortas, European Food Safety Authority; G. De Sanctis, D. Verlooo, C. Gardi, S. Dhollahner, Y. Van der Stede, F. Boelaert, M. Binaigia, J. Tarazona, EFSA European Food Safety Authority

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 subdrivers (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.

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. Cluster analyses of commonly detected CECs in this data matrix suggests that the co-occurrence of approximately half of the CECs can be attributed to dichotomous urban or agricultural upstream land use. Mixtures found in watersheds with urban influences commonly contained steroidal estrogens, BPA, alkyphenols, pharmaceuticals and personal care products. Agriculturally influenced sampling sites contained herbicides and pesticides in addition to BPA and alkylphenols, but mostly lacked pharmaceuticals and personal care products. Almost 3,000 resident and caged sunfish (Lepomis spp.) were collected from 27 of the 54 sampling sites and analyzed for indicators of stress associated with CEC exposure. In the presence of high aqueous CEC concentrations, glucose concentrations spiked in sunfish
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 managed concentrations enhanced fecundity in the F2 and 3 generations, while higher mixture concentrations resulted in declining fecundity. Taken together, this integrated series of studies indicates 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.; E. Evensted, Norwegian School of Veterinary Science; L. Evensted, The Arctic University of Norway; F. Falciani, University of Liverpool; T. Iguchi, YOKohama City University / Molecular Environmental Endocrinology; C. LaLone, U.S. EPA / Mid Continent Ecology Division; Y. Li, NIVA Vietnamese Institute for Water Resources Management; S. Mellander, Linköping University / School of Pharmacy and Biomolecular Sciences; E. Perkins, US Army Corps of Engineers ERDC; T. Rundberget, Norwegian Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Sylte, The Arctic University of Norway / Department of Medical Biology; D. Villeneuve, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Biomarker Research and Development; S. Yamanaka, National Institute for Water Research / Ecotoxicology and Risk Management

A number of exogenous compounds 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 the 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 EDs 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 theecdysone receptor (EGR) and the Juvenile Hormone (methyl farnesoate) receptor (MR) have been identified to be ecologically relevant. 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 define toxicity endpoints suitable for Integrated Approaches for Testing and Assessment, IATA, (5) identify potential EDCs and 6) practical implementation of AOP in risk assessment.

661 Assessing impacts of place-based mixtures of emerging contaminants on endocrine activity and adverse outcome pathways: comparisons of different life stages
R. Klunge, 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 evaluate the immediate effects of these chemicals have repeatedly not adequately detect all EDC components 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. Brauneck, 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 230, 239 and 254. A reduction of VTG production (maximal depression is 50%) and a non-specific anti-estrogenic 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 intimate 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 / exposed fish. Thus, we investigated the effects of two well-known hepatotoxics, 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 (vgl1, vgl3 and esr1) and hepatotoxicity-related marker genes (fabp10a, apoa1, cyp2k19 and cytochrome P450, CYP1A1) in the liver; - hyaluronic acid (a biomarker for liver toxicity) levels in headtail 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, VTG levels in males were lower in 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 / Ecotoxicology; E. Ellebrecht, M. Teigeler, Fraunhofer IME / Ecotoxicology

The discussion about the regulation of endocrine disruptors (ED) 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 survival, growth and reproduction. Adult and as well adult growth, sex ratio, vitellogenin levels and F1-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 for group C. Correspondingly, F1 generation fish offspring of group C 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
664  A Tiered Approach for Screening Chemicals for Biomagnification Potential in Human
H. Selck, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC
Chemical regulatory legislation of organic contaminants is generally based on an assessment of the chemical potential to persist (P) in the environment, bioaccumulation (B) in biota, and posses potential toxicity. Applying standardized exposure setups (i.e., water-only exposure) as historically has been employed in environmental risk assessment may underestimate bioaccumulation of hydrophobic organic contaminants (HOCs) in sediment-dwelling organisms because: 1) HOCs often accumulate in sediments to concentrations greatly exceeding the concentration in the overlying water; and 2) a number of papers illustrate that sediment-associated HOCs are available for uptake in benthic organisms. Alternatively, benthic species may be able to metabolize organic contaminants (i.e., biotransform), thus reducing their body burden. However, available information on the biotransformation capacity of benthic organisms is very limited. We conducted a number of experiments examining uptake and biotransformation of sediment-associated cyclic volatile methylsiloxanes (i.e., D4 and D5) in two deposit-feeding worms, namely, the estuarine polychaete, Capitella teleta and the freshwater oligochaete, Tubifex tubifex. This presentation will provide examples of how biotransformation capacity varies among the two benthic deposit feeders, and how biotransformation may reduce body burden and facilitate the removal of sediment-associated siloxanes. Including these factors in a hazard or risk assessment are likely to impact PBT assignment and categorization, and exclusion of benthic organism behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.

667  Toxicokinetics and biotransformation products of diuron and 3,4-DCA in the developing zebrafish embryo (Danio rerio)
E. Jarosz, UFZ / Bioanalytical Ecotoxicology; M. Kraus, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology; E. Küster, Helmholtz Centre for Environmental Research, Dept.Bioanalytical Ecotoxicology / Department Bioanalytical Ecotoxicology; T. Lackenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology; H. Selck, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC
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 toxicokinetics and the biotransformation of diuron and 3,4-DCA. In this study we investigate whether diuron and 3,4-DCA are metabolized only on 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 shocked-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 mass spectrometry (LC/MSMS). 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 Tmax around 48 hpf, Tmax 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 h. 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 enzymes are active from the first hours of embryo development and pinpoints to the biotransformation capability of the zebrafish embryo at this early stage.

668  Application of a generic fish PBTK model for binary mixtures of chemicals
E. Jarosz, UFZ / Bioanalytical Ecotoxicology; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology; M. Kraus, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology; H. Selck, Roskilde University / Dept Science and Environment; R. Windfeld, Roskilde University / ENSPAC
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 fulfill this objective: (i) Data collection of biological, physiological, 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 assay to evaluate oil spill-related toxicity in receiving freshwater systems
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Diluted bitumen (dilbit) transported from the oil sands in northern Alberta, consists of a mixture of chemicals, such as aromatic hydrocarbons, metals and other compounds, which may pose risks to wildlife and human health, if spilled into the environment. There is a major knowledge gap regarding remediation of oil spills into freshwater environments. The relative efficacy of different remediation strategies for these spill emergencies are untested. We have established an in situ amphibian assay to serve as an indicator of health and recovery in freshwater ecosystems, which can be applied to assess risk and remediation efficacy. In spring 2017, Wood frog tadpoles were placed in 5, partially submerged cages (50 animals/cage), which were tethered to the peat-organic shoreline of Lake 260 of the International Institute for Sustainable Development-Experimental Lakes Area (ISD-ELA), Ontario, Canada. Tadpoles were fed and monitored every other day and were euthanized when >50% reached their metamorphic climax (the day of forelimb emergence), to perform gross anatomical examinations, sample collection and relevant biochemical analyses. Major outcomes: 1. Time to metamorphosis (an established, sensitive biomarker) 2. Mortality rate 3. Morphometrics (total body mass, length and hepatic mass) Analyses: 1. Hepatic detoxification effort (ethoxyresorufin-O-deethylation (EROD) enzyme activity); 2. Thyroid hormones levels (sensitive biomarker for hormone disruption); 3. Triglycercide levels (reflecting body condition & energy stores). 4. Tissue contaminant levels (metals, PAHs) Baseline data for Wood frog development in Lake #260 were acquired in 2017, and potential pitfalls and solutions for the metamorphosis assay were identified. This assay will be used in the 2018 field season with the experimental shoreline dilbit spill and remediation strategies planned in Lake #260 at the ISD-ELA. In Keywords: oil spill, endocrine disruptors, metamorphosis, Wood frogs

MO002
APPLICABILITY OF RISK BASED, TIERED ASSESSMENT OF PRODUCED WATER DISCHARGE IN NIGERIAN SHALLOW OFFSHORE ENVIRONMENT
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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 hazard assessment 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 discharges 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 25mg/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

Oil spills are a global concern due to their capacity to affect wide areas of the ocean and the delicate balance 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 chemicals. 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 FINOSOL OSR52 and of the water accommodated fraction of a naphthenic North Sea crude oil produced with dispersant (WAF_<sub>OSR52</sub>) or without dispersant (WAF<sub>0</sub>) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAF<sub>OSR52</sub> and WAF<sub>0</sub> and then used as passive dossiers. Exposure to the dispersant caused 100% of mortality at concentrations ≥500 mg/L. Increased prevalence of malformations of zebrafish was observed at concentration ≥500 mg/L. In general greater sublethal effects were observed in the case of embryo exposure to WAF<sub>OSR52</sub> than to WAF<sub>0</sub>. Zebrafish embryos appeared as a good model to study the toxicity of WAF depending on the temperature and on the addition of chemical dispersants. Funded by the EU H2020-BG-2005-2 project GRACE (grant agreement #679266), Spanish MINECO (NACE project CTM2016-81130-R) and MECD (FP7 grant to A.E.), the Basque Government (consolidated research group IT101-13) and the University of the Basque Country (UFI 11/37).

MO004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea
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Marine diesel oil is produced and transported in large volumes in the Gulf of Finland and also used extensively as fuel in marine traffic in the Baltic Sea area. The heavily intensifying marine traffic in the area increases the occurrence of smaller spills and leads to higher risk of major oil spills, which would certainly have drastic consequences to the local ecosystem. Chemical composition, mainly the polycyclic aromatic hydrocarbons (PAHs), can be more variable between the different diesel fuels, affecting the toxicity of the diesel to exposed marine organisms. The aim of this study was to determine the changes in the concentration of PAHs, total petroleum, aromatic compounds and of biomarkers in Baltic Sea mussels (Mytilus spp.) exposed to a common type of low-sulphur marine diesel oil produced by Neste Oil’s Pervoo refinery in Finland. The diesel oil was applied to mussel aquaria as a water accommodated fraction (WAF). The exposure set-up consisted two replicate aquaria in each treatment; control, WAF-high and WAF-low, each with 200 mussels in 20 liters of artificial seawater (10°C). Water and WAF treatments were renewed every two days. Changes in PAH concentrations in water were constantly quantified using a TriO5 Environflu HC-500 fluorometer sensor. Another sensor was used to collect auxiliary data on temperature, turbidity and chlorophyll concentrations (mussels fed with algae). Biomarkers of oxidative stress, biotransformation, neurotoxicity and bioenergetics were measured from mussels at the start of exposure and after a one week recovery period in clean water. Water and mussel tissue samples were also taken to chemical analysis of PAHs. Based on the sensor fluorescence data the initial PAH concentrations were ca. 30ug/L in WAF-high and 15ug/L in WAF-low treatments. In a semi-static system with mussels the concentrations decreased during 24h after which the level remained stable until the next water exchange. During the recovery period PAHs occurred in water after every water exchange, supporting significant release of PAHs from mussels (both from shell surfaces and internal pools). Differences between the treatments were observed in various biomarkers measured. Combined fluorescence, chemical and biomarker data give important insights to the fate and toxic effects of marine diesel oil in the northern Baltic Sea environment.

MO005
Biliary PAHs and enzymatic biomarkers in the teleost Eucerius brasiliensis along four tropical estuaries in the Brazilian Northeast
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Bioaccumulation of Sulfur and Nitrogen Containing Hydrocarbons in Petroleum Substances

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A recent study aimed to characterize the composition of petroleum substances from different categories indicated that a variety of sulfur and nitrogen heterocyclic compounds were detected in the range of 0.18 - 16% and 0.2 - 10% for S and N, respectively. Given the limited information available on the bioaccumulation potential of these substance classes, a dietary bioaccumulation study with rainbow trout (Oncorhynchus mykiss) was performed to determine their potential to bioaccumulate and enzymatic activity levels within these estuaries, the different anthropogenic activity patterns. Snepe Estuarine Complex includes a developing industrial port complex, while Rio Formoso Estuarine System is within a low population density area focused mostly on tourism. Fish sampled in the two other estuarine systems near Recife metropolitan area, BJES and BPEC showed chrysene equivalent bile concentrations between 13 x 10^3 and 19 x 10^3 for BJES and BPEC receive a greater input of PAHs, associated with higher pollution levels near the entrance of the complexes.

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MO010 Cytotoxicity of the WAF of naphthenic North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mytilus galloprovincialis (L.)

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Oil pollution coming from accidental oil spills and from activities related to oil production and gas exploitation is a major threat to marine ecosystems. As a result, these coastal habitats are exposed to higher levels of contaminants, such as hydrocarbons. 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 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). The effect of the dispersant on the viability of mussel hemocytes was not significant. 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 reduce 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 test for environmental risk assessment of oil spills and oil response strategies in the marine environment. * Funded by EU H2020 GRACE project (679266), Spanish MINECO NAGE project (CTM2016-81130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UFI 11/37).

MO011 Determination of inorganic cations and anions in wastewater, surface water, and neutralizing amine solutions by IC coupled with a single quadrupole MS

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Inorganic cation and amine determinations are important to assess salt build-up in marine neutralizing solutions, or to meet regulatory discharge compliance from petroleum and municipal treatment plants wastewater. Additionally, municipal water plants require cation determinations to monitor secondary water characteristics. In the petroleum industry, alkanolamines (monoethanolamine, diethanolamine, and methyl diethanolamine) are used routinely to prevent corrosion during transportation to the refinery or to remove sour gases during the refining process. Processing plants require accurate and rapid analysis of complex mixtures in the endo-lyosomal 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 CT index). The general response of the mussel was characterized by paracellular and transcellular barriers, paracellular and transcellular barriers, higher prevalence values than in the reference site were recorded in the two polluted sites from Trondheim. Differences between the two mussel sizes were recorded in parasite burden, large mussels exhibiting a higher level of parasitization than small mussels. Lipofocein accumulation was higher and neutral lipid accumulation lower in the polluted sites than in reference sites in both study areas. Lysosomal and lysosomal activities were different between the two mussel sizes. Overall, all 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 (IT810-13) and UPV/EHU (UFI 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, South China

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On 3 August 2017, two container vessels collided in the Pearl River Estuary, southwest of Hong Kong, leading to release over 1,000 tonnes of palm stearin into adjacent waters. About 200 tonnes of the stearin reached south coasts of Hong Kong after two days. However, toxicity of palm stearin to marine organisms is unknown. This study, therefore, aimed to examine its contamination levels in seawater, sediment and animal samples collected from seven locations along the south coasts of Hong Kong; determine its toxicities to selected marine organisms including microalgae (Isochrysis galbana and Chaetoceros gracilis), the copepod (Tigriopus japonicus), the MS (Mytilus edulis), the mussels (Mytilus galloprovincialis) and the fish (Lepidogalaxias saliens), and derive interim water quality guidelines (WQG) of the palm stearin and thereby assess its ecological risks to local marine ecosystems. Samples of the palm stearin, surface seawater, sediment and three intertidal gastropods were collected twice (within seven days and four months after the incident) in six locations along the south coast of Hong Kong: Fatty acids in these samples were detected using gas chromatography-mass spectrometry (GC-MS) standard technique and were identified using the selected species. The results showed that all seawater samples collected from the six sites were heavily contaminated by the palm stearin after one week of the accidental pollution. We also found that although the palm stearin had little effects on marine animals, it was toxic to microalgae species as reflected by growth inhibition. Its toxic mechanisms on the microalgae may be associated with its adsorption onto microalgal cells, and redition 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 microbial 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 assess the ecological risk of the palm stearin in coastal environments of Hong Kong. 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

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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
Effects of oil spill on coastal seaweed in the Arctic
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In case of an acute oil spill response operation, decision making regarding the operational response strategy and prioritizing biology at risk must be resolute. 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 methodology and biology at risk. To provide data for assessing the effects of oil spill impacts 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 diesel. The results could be used in future oil spill combat strategy designing oil spill mitigation procedures in the Baltic Sea. In the present study, impacts of a crude oil and 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 was relatively removed after 3 days; 4) that, depending on the oil type, the use of dispersants is an alternative counteractive method but in the Baltic Sea their use is restricted by HELCOM recommendations since the chemically dispersed oil may cause severe toxic effects on marine biota. In addition, the use of dispersants under cold water conditions is not well studied. In the present study, impacts of a crude oil and the dispersant Finsal 2 on marine biota were investigated under cold conditions (5°C) at two salinities corresponding to the German (15.0) and southern Finnish coastal areas (5.6). Baltic Sea blue mussels (Mytilus tuberculatus) were exposed to the water accommodated fraction (WAF) and dispersed WAF (WAF-D) of naphthenic North Sea crude oil in a semi-static aquarium experiment. Concentration of WAF or WAF-D in the aquaria was 5%. The mussels were sampled after 0, 1, 7 and 21 days of exposure, and analyzed for accumulation of polycyclic aromatic hydrocarbons (PAHs), and biological effects including actinolychinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial communities extracted from the gills and digestive gland of the mussels were investigated by sequencing of 16S rRNA genes and quantitative PCR targeted to bacterial PAH-degradation genes. Water samples from the exposure aquaria were taken for oil and PAH analysis. Dispersant augmented the amount oil in the exposure water with 0.13 mg/l oil in 5.6 WAF compared to 44 mg/l oil in 5.6 WAF-D (GC-FID, petroleum hydrocarbons CnH2n). A significantly higher oil concentration was observed at the lower salinity WAF-D water with 44 mg/l oil at 5.6 and 1.82 mg/l at 15. The higher salinity and WAF-D elicited more oxidative stress and neurotoxic effects already after one day of exposure. Mytilus-associated bacterial communities also varied depending on salinity and the use of dispersant. The results indicate that during the application of dispersants salinity plays a key role for the fate and oil concentration in seawater as well as biological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

MO018
Multiple biomarkers on the estuarine guppy Poecilia vivipara to monitor two Integrated tropical estuarine
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Integrated approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuaries with ecologically relevant tools. The guppy Poecilia vivipara, native species with a broad tropical distribution, was utilized in such an approach, using in situ field exposures in cages...
MO019 NEW METHODOLOGY TO DETERMINE BTEX IN SOIL SAMPLES BY HPLC-DAD
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Benzene, toluene, ethylbenzene and xylene, commonly referred as BTEX, are contaminants of concern posing serious negative impacts on the environment and human health. At fuel stations where 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), Eclipse XDB C18 column (5µm x 4.6 x 250mm), flow of 1.5 mL min⁻¹, λ 205nm 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 were acquired using the OpenLAB 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 ppm for ethylbenzene and 1 to 85 for xylene. The curves were submitted to intra- and inter-assay repeatability analyses. 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 analysis 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 the next step.

MO020 Petroleum pollution of alluvial sediments near Sava river, Serbia
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Heavy oil "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 15m. 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 (Fraction III). 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 polycyclic (Fraction III), while the saturated hydrocarbon 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 groundwater consequently. The most represented fractions are: Fraction III (Polycyclic aromatic hydrocarbons (PAHs)), and to lesser extent fraction II (Acenaphthylene and Acenaphthene). Behavioural activities related to swimming speed and resistance were also evaluated. Individuals grown in the laboratory were used for in situ exposure and also as controls (CON) for IS and RES. Significant contamination by PAHs was evidenced from both estuarine systems, with higher phenanthrene and chrysene concentrations in the bile of resident fish at BPES, which in turn partially justified the significant induction of EROD and GST in these individuals. Resident fish at Bjes showed high EROD and GST induction that cannot be explained by PAHs contamination, and suggests the presence of other contaminants with mechanisms of action similar to dioxins, possibly from a paper industry. Elevation of GST activity was detected in three of the four sites assessed on both estuaries, and loss of swimming resistance was verified on individuals exposed at the same sites, indicating a correlation between GST and this behavioral effect relevant to survival of the species. Indications of acetyloxickinase inhibitors were not detected, except at the BPES inner region. This study shows the potential and feasibility of using the guppy P. vivipara on the evaluation and monitoring of pollution in estuaries along the Brazilian coast.
MO023 Risk-based assessment of produced water discharges - need for alignment
M.G. Snit, Shell International
Produced formation water is the main waste stream from upstream oil and gas activities. For offshore installations, next to produced water reinjection (PWRI), discharge of treated produced water is a commonly used disposal route applied inline with ALARP principles (As Low As Practically Achievable). 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 modelling, 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 50m, another approach might accept 100m (US-EPA). 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 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 hydrocarbons were analysed from water samples collected from 23 stations 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 into trace metal toxicity is significant for Cu and 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-dependant 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 PII; I. Marigomez, Euskal Herriko 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 thus, the risk of oil spills is gaining concern. Sea bass, Dicentrarchus labrax L., 1758) larvae exposed to produced water discharges and their mixture (NSS+Finasol OSR52) in a wide range of temperatures (5, 10, 15, 20 and 25°C). In order to identify temperature-dependant toxicity, acute toxicity bioassays using larvae and embryos of the sea urchin Paracentrotus lividus (Lamark) were performed. After the exposure period, EC50, 96h were calculated and length of larvae was measured to assess the inhibition of larval growth. Additionally, larvae abnormalities were determined to calculate a general index of toxicity (IT). In the present study, at 25°C NSS WAF provoked a lower inhibition of larvae 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, oil:dispersant and chemical dispersant toxicity. In our study, larvae abnormalities and reduced larvage 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 FPUI/5/05317 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 E. L. Marianii, Cefas Lowestoft Laboratory / Environment and Ecosystems Nine trace elements including As, Cd, Cu, Fe, Hg, Ni, Pb, V and Zn, and total petroleum hydrocarbons were analysed from water samples collected on two offshore oil 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 24h and 96h and the dilutions 6.25-12.5-25-50-100-100 % WAF were used. The LC50 on post larvae ranged from 17.67 % to 37.42 % WAF. The LC50 on post larvae ranged from 6.68 % to 16.51 % WAF. The LC50 acute toxicity responses showed a temporal variability of WAF as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.02% WAF); 96h (10.84 ± 3.37 % WAF).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 WAF.

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. Idowa, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry Polycyclic 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 polychlorinated dibenzo-p-dioxins (PCDDs) and dibenzofurans (PCDFs), 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 PACs have been found to be similar to dibenzo-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 mass spectrometry 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-chloroperylene is present in this sample. In addition, we observed multiple peak pattern reports on a marine fish. It is postulated that contamination is due to the 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 S. Sanni, International Research Institute of Stavanger / Environment; E. Lyng, D.M. Pampanin, International Research Institute of Stavanger / Environment
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 in a workshop setting to gather a data set 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 surveys, contamination by drill cuttings were 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 dispersants are an effective method to mitigate coastal impacts of oil spills; however, oil treated with dispersants may have unknown toxic effects on biota. 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 acclimated at the experimental temperature of 5°C to two different salinity regimes, the local 5.6 and the artificially increased 15.0 representing the southern part of the sea is more easily impaired than in those inhabiting the more saline southern regions. The current study is among the first controlling the biology of mussels in the Baltic Sea. Mussels were exposed to water accommodated fractions (WAF) and chemically dispersed WAF (dispersant Finasol OSR 51) 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, V\textsubscript{bas}); the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/MET), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/ diverticular ratio, Vacuolization, haemocytic infiltration, growth retardation and histological changes in digestive gland, gonad and gills. V\textsubscript{bas} increased significantly after 1 d in mussels exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MET/MDR 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 than at 15.0. Pathological responses (atrophy, hyperplasia, vacuolization, haemocytic infiltration, granulocytomas) were assessed, being more evident in mussels exposed to WAF and WAF-D (21d). 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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The objectives of this work was to investigate the toxicity of two blends of diluted bitumen ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to vidifferent 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 (Oncorhynchus 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 (LC50-96h = 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 (IC50-7 d = 0.312 g/L) compared to the weathered dilbit (IC52-7 d = 0.096 g/L). Rainbow trout exposed to unweathered CLB demonstrated a significantly higher toxicity (LC50-96h = 5.66 g/L) compared to the weathered CLB (LC50-96h = 1.5 g/L). LC50-6.4 g/L 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 (IC52 < 1.0) than with the weathered CLB (IC52 = 1.99 g/L). Volatile organic compounds (VOC), polyacrylic 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 polar and apolar fractions
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Regulation of produced water (PW) discharges on the Norwegian continental shelf is still based on maximum oil toxicity may be toxicological, with cover methods 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 PW compounds that contribute to toxicity. We have collected "diluted produced water" 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 PW amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC–MS, GC/GC–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. LC\textsubscript{50} values for the total PW extracts ranged between 0.05–0.98 mg L\textsuperscript{-1} (based on total GC amenable fraction analysis). For the apolar fractions, the toxicity was mainly attributed to the fraction with LC\textsubscript{50} values ranging between 0.17–0.57 mg L\textsuperscript{-1}. Interestingly, toxicity was mainly attributed to the apolar fraction of the fourth PW, with an LC\textsubscript{50} of 0.05 mg L\textsuperscript{-1}. For the PWs where toxicity mostly related to the polar fraction, this fraction spanned from 16–55% of the total PW (GC amenable fraction analysis). For the PW where toxicity mostly related to the apolar fraction this was 35%. This study indicates that diluted produced water contains compounds that are not amenable to GC, or that contribute to the GC–base fractionation of oil in water. This suggests that PW toxicity is not directly correlated with the GC quantifiable compounds that are used for regulating discharges today. Further studies should be 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 species. The central nervous system (CNS) operates at the core of the chain, as well as its life history strategies and Arctic adaptation, makes it a relevant and valuable test species to provide empirical data on oil component kinetics. C. hyperboreus of developmental stage copepodic three (CIII) and five (CV) were exposed to the water soluble fraction (WSF) of crude oil (Troll B) in continuous renewal system (4 or 8 d) followed by a recovery period (20 or 35 d). Water temperature, salinity and body size as well as biomarker responses, were measured at intervals during the exposure and recovery period. One compartment toxicokinetic models were fitted to the experimental data to estimate bioconcentration factors (BCFs) and elimination rates (Ke). The BCFs were consistently higher for the lipid-rich CVs compared to the CIIIs, indicating a higher bioaccumulation potential in the lipid-rich stage. The higher lipid volume fractions may explain the higher BCFs, although other factors like body size and activity levels may have contributed as well. The BCFs are well predicted by the octanol-water partitioning coefficient (log K\textsubscript{ow}). The slope of the relationship, however, differed between the lipid-poor CIIIs and the lipid-rich CVs. For the
population assessments (P)

MO035 Seabird-derived contaminants and genotoxicity to Collembola from the Arctic S. Kristiansen, University of Oslo / Department of Biosciences; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences; H. Leinaas, University of Oslo / Department of Biosciences; G.W. Gabrielsen, Norwegian Polar Institute; D. Herze, NILU Norwegian Institute for Air Research; K. Borja, Department of Biosciences, University of Oslo / Department of Biosciences

Several heavy metal concentrations and positions due to biomagnification their bodies contain high concentrations of many anthropogenic contaminants. In the Arctic they have been shown to function as important bioindicators of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritional and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collembola) contribute to a high proportion of the bird's diet and play a vital role in converting organic materials such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collembola. Two Collembola 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 isotopes of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collembola 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 and within a site no association between δ15N and contaminant loading was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collembola were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated dibenzenes (PCBs) or polychlorinated diphenyl ethers (PBDEs), and chloroalkanes (CHLs). No association was observed between contaminant concentrations in Collembola and habitat. DNA fragmentation was higher in Collembola from sites with high seabird influence, compared to sites with medium and low. No differences in micronucleus frequency (MN) was found between sites or species. This is the first study on MN in Collembola and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both δ15N and contaminant loading. DNA fragmentation was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).

MO036 Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013 H.K. Midthaug, Department of Biosciences, University of Oslo / Department of Biosciences; J.O. Bustnes, Norwegian Institute for Nature Research / Fram Centre; A. Polder, Norwegian University of Life Sciences / Department of Food Safety and Infection Biology; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences

Antarctic 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 bioindicators of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritional and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springtails (Collembola) contribute to a high proportion of the bird's diet and play a vital role in converting organic materials such as decomposition and mineralization. The aim of this study was to determine the exposure, accumulation and effects of seabird-derived contaminants on Collembola. Two Collembola 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 isotopes of carbon and nitrogen (δ13C and δ15N, respectively). In addition, Collembola 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 and within a site no association between δ15N and contaminant loading was found. The total contaminant loads in habitat samples were dominated by Hg, while no trend was found for organic contaminants. Contaminant concentrations in Collembola were dominated by Hg, followed by hexachlorobenzene (HCB), polychlorinated dibenzenes (PCBs) or polychlorinated diphenyl ethers (PBDEs), and chloroalkanes (CHLs). No association was observed between contaminant concentrations in Collembola and habitat. DNA fragmentation was higher in Collembola from sites with high seabird influence, compared to sites with medium and low. No differences in micronucleus frequency (MN) was found between sites or species. This is the first study on MN in Collembola and should be further explored. DNA fragmentation, sensitivity to induced DNA fragmentation and micronucleus frequency were associated with both δ15N and contaminant loading. DNA fragmentation was negatively correlated with higher chlorinated PCBs (6-7 chlorine substituents).
of south polar skuas 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
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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 Mexico 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 Mexico) in this species and compare with Xenopus laevis, a species that is used as a preferred biotest, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose, 188 species in mid-blastula transition were exposed for 96 to 6 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%, IT=4.0), the main alterations being microcephaly, cardiac and facial edema, malformations in the eye, notochord, tail, fin and intestine. However, the lightest concentrations of 0.1 and 0.3% induced microcephaly and cardiac edema, and the concentration of 0.5% and above induced to X. laevis will be malfunctioning 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 contaminants with the FETAX assay.

MO038 Monitoring fish health in a densely populated catchment in Central Germany

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 overview of the situation fish face in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment samples from the field with the Danio rerio embryo test (Dar-T), including the endpoints mortality, hatching success, heart rate, developmental delays and malformations. (II) Investigation of fish health by histopathology of actively (caged rainbow trout) and passively monitored (caught feral) fish focussing on the metabolically most important organ, the liver. (III) Additional inclusion of biomarker data like EROD activity (CYP1A1, indicating pollution with dioxin-like compounds), GST activity (glutathione S-transferase), which is responsible for transforming the neurotransmitter acetylcholine into choline and acetate. A decreased level of cholinesterase (ChE) activity in the animal tissue is a strongly indicative sign that some type of exposure to an inhibitory agent of this enzyme has occurred. Our objectives were to document ChE levels in house sparrows in response to their exposure to an OP product used in agriculture and determine the extent of their negative effects on birds. In the University Campus (UED, Durango, Mexico), we collected 19 house sparrows and serum ChE activity was determined by spectrophotometry before and after the consumption of food treated with malathion. The results show a ChE inhibition (11.58 %) after treatment (p = 0.03), also we observed nonsignificant

MO039 Multigenerational toxicity of Fipronil to Folsomia candida
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Fipronil is a pesticide widely used on agricultural pest control, especially in sugarcane crops. This compound acts as an inhibitor of nerve signals in insects, and pose as a risk to non-target terrestrial organisms (i.e. the collembolan Folsomia candida), which plays important roles in the maintenance of soil quality. The main objective of this study was to evaluate the ecotoxicological effects on the reproduction of three generations of the Folsomia candida species when exposed to fipronil worldwide over time, under a natural tropical soil. Test procedures were adapted from the ISO 11267 guideline. The chosen concentrations of fipronil were based on the recommended doses (RD) for the control of the pest Migdolus frymanus in sugarcane crops (RD = 1.3 mg of the commercial product / kg² of dw soil), what means 1.04 mg of fipronil / kg² dw soil. Concentrations tested were: 0.06; 0.13; 0.26 and 0.52 mg fipronil kg⁻¹ of dry weight soil. The EC50 values were 0.21; 0.18 and 0.09 (a.i.) kg² soil, for the first, second and third generation, respectively. According to the results, fipronil showed significant toxicity at low concentrations up to the third generation, causing effects on the reproduction and survival of Folsomia candida, and could be considered a highly dangerous pesticide for terrestrial arthropod organisms.

MO040 Fipronil effects on freshwater benthic algal communities
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Fipronil is a widely used broad-spectrum phenylpyrazole insecticide, effective against insects resistant to other agents as pyrethroids, organophosphates or carbamates. Accordingly, it has gained popularity worldwide as a pesticide in both agricultural and urban environments. Its wide use, resulted in the presence of fipronil in soil, surface and ground waters involving a risk to the environment and human. In addition, humans and animals are also exposed to fipronil, by ingestion of products containing residues. Previous studies showed the toxicity of fipronil to aquatic freshwater organisms using model species, but there is scarce information about its impact on wild organisms. This study assesses, for the first time, the impact of fipronil on the photosynthesis of natural freshwater algal benthic community. This community – periphyton- is a key element of aquatic trophic chains, and are routinely used as indicators of water quality. Results show L. catesbeianus species t 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 overview of the situation fish face in this river system and the resulting effects, we investigated biological parameters on different levels: (I) Evaluation of water and sediment samples from the field with the Danio rerio embryo test (Dar-T), including the endpoints mortality, hatching success, heart rate, developmental delays and malformations. (II) Investigation of fish health by histopathology of actively (caged rainbow trout) and passively monitored (caught feral) fish focussing on the metabolically most important organ, the liver. (III) Additional inclusion of biomarker data like EROD activity (CYP1A1, indicating pollution with dioxin-like compounds), GST activity (glutathione S-transferase), which is responsible for transforming the neurotransmitter acetylcholine into choline and acetate. A decreased level of cholinesterase (ChE) activity in the animal tissue is a strongly indicative sign that some type of exposure to an inhibitory agent of this enzyme has occurred. Our objectives were to document ChE levels in house sparrows in response to their exposure to an OP product used in agriculture and determine the extent of their negative effects on birds. In the University Campus (UED, Durango, Mexico), we collected 19 house sparrows and serum ChE activity was determined by spectrophotometry before and after the consumption of food treated with malathion. The results show a ChE inhibition (11.58 %) after treatment (p = 0.03), also we observed nonsignificant

MO041 Use of organophosphorus insecticides in agriculture lands, in a simple test birds says please no!
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Due to the human population increase and the consequent high demand for food, each day a larger area of the planet is dedicated to the practice of agriculture. Crops favor the reproduction of various organisms (invertebrates and vertebrates) that are combated with large amounts of pesticides, it are chemical compounds used extensively, and so all organisms are exposed from different sources such as food, water and soil, therefore the toxicity of agrochemicals, as well as the patterns of use and exposure is made that is made usable as indicators of water quality. Results show LC50 values of 0.74 mg/l (0.63-0.89) (p<0.001), exposing periphyton to fipronil under standard medium. However, toxicity was almost inexist when assays were done using natural river water. In this last case, the bioavailability of the fipronil was hypotetized to be reduced by natural substances present in the river water (solid suspended solids, organic matter, etc.). These results would contribute to a more realistic assessment of the environmental impacts of the use of this kind of pesticides.

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relationships (Pearson, R²=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 sparrows 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 M. Wang, WSC Scientific Group / Dept Efate Modelling; T. Preuss, Bayer AG / Environmental Safety; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team

In many cases EU member states prefer the use of country specific scenarios for the exposure or risk assessment of pesticides. This is sometimes requested due to specific geographical features or agricultural practice. In the present example, we demonstrate how the specific agricultural situation of the Netherlands was taken into account for the selection of landscape scenarios for use in population modelling. It is first shown how a country specific landscape scenario is developed. Then, the dose response obtained in a rat reproduction study with an azole fungicide is employed in a population-level risk assessment on small herbivorous mammals (Common vole, Microtus arvalis). The margins of safety obtained in that assessment would be reduced under realistic worst-case field conditions.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals from mining areas L. Carrera, IREC-UCLM / IREC-UCLM; A. Rodriguez-Perez, UCLM-IREC; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; M. Ortiz Sánchez, Instituto for Game and Wildlife Research (IREC) UCLM-CSIC-JCCM

The mobilization of metals from mining areas is an important ecological stressor in the earth's crust due to anthropogenic activities, such as mining, is one of the main contamination routes for wildlife. With 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 (biomarker of lipid peroxidation) and superoxide dismutase activity. However, no correlations were observed 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 Almadenjuegos, with an average (±SD) of 8.83±8.44 μg/g dw. These individuals showed no evidences of oxidative stress, but presented increased activity of glutathione peroxidase and reduced glutathione levels relative to the rest of populations, which would indicate that antioxidant system is protecting from oxidative damage to occur. Blood levels of these two elements were above those reported as susceptible to cause sub-lethal effects in reptiles for the vast majority of terrapins from the most contaminated sites (100% of terrapins from Solana del Pino with blood Pb levels > 15 μg/dl; 70.3% from Almadenjuegos with blood Hg levels > 2.76 μg/g dw). Faeces and carapace scales obtained non-invasively correlated significantly with blood levels for the case of Pb (R > 0.765, P < 0.001), but not for Hg (R < 0.1362, P > 0.127). Thus, these samples could be used as non-invasive methods for the analysis of Pb bioavailability in M. leprosa, and by extension in reptiles, which will contribute to the development of ecotoxicology in reptiles, a group very little studied in this regard.

MO044 An analysis of important life stages, exposure routes and test endpoints in amphibians and coverage by existing risk assessment regulatory requirements for plant protection products, part 1 A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Sánchez, Instituto for Game and Wildlife Research (IREC) IREC-CSIC-JCCM; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Department of Biology

Concerns have been raised that the current risk assessment of plant protection products (PPP) may not sufficiently cover the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific 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 suitable information allowing extrapolation to assess the hazard risk 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 of 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.

MO045 European common frog (Rana temporaria) larvae show subcellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bt) exposure levels used in mosquito control S. Allgeier, B. Frombold, University Koblenz-Landau; V. Mingo, Trier University / Biogeography; C. Bruehl, University of Koblenz-Landau / Institute for Environmental Sciences

Bacillus thuringiensis var. israelensis (Bt) is presumed to be an environmental friendly agent for use in either health-related mosquito control or the reduction of nuisance associated with mosquitos coming from temporary flooded wetlands. Amphibians co-occurring with mosquito larvae in these wetlands may be exposed to Bt products several times during their breeding season. Up until 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 Bt 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, acetylcholinesterase), 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 Bt exposures, while body condition was similar throughout the treatments. Furthermore, Bt 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 Bt 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 Bt 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 C. Monteiro, R. Alves, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; J.Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to seawater intrusion. Coastal ecosystems are highly productive and are considered very vulnerable to salinity changes. Among coastal ecosystems that will be impacted with seawater intrusion are wetlands, which constitute hotspots of biodiversity and represent relevant ecosystems for amphibians. This class of vertebrates holds the highest number of endangered species, and in Portugal this group is considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the influence of temperature on the adverse effects that increase of salinity may cause to tadpoles of the amphibian species Xenopus laevis. To address this objective, X. laevis tadpoles (Gosner 25) were exposed to a range of 5 NaCl concentrations under three temperatures: 20, 23 and 26°C. The following endpoints were monitored at the end of the test: feeding rate, body weight and growth rates. The differences reported for size between control and NaCl concentrations were mainly due to the tail length. For all concentrations, the feeding rate decreased with increasing NaCl concentration. As well, body weight decreased.
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 Dendrurus columbianus (ANURA: HYLIIDAE) TO WATER CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

V. Riveros, Universidad de Caldas; B. Toro, Universidad de Caldas / Biological Sciences

The pollution generated by agriculture, livestock and mining have impacted the watersheds in the Colombian Andes. Amphibians have been used to evaluate this contamination due their biphasic lifecycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of D. columbianus exposed to contaminants of agricultural, livestock and mining (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 mining 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/CN mining treatment (Z= -25.57, p= 0.001), and between Hg/CN mining and Hg mining treatments (Z= 21.525, 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/CN 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 (91%), 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 registered times of metamorphosis, show a time of this process that approximately 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

F. Streissl, EFSA / Pesticides Unit; K. Machera, Benaki Phytopathological Institute / Department of Agricultural Sciences; F. Von Blankenheugel, Rifcon GmbH

Rodent field effect studies relevant for pesticide risk assessment typically take place during crop development from spring to autumn and thus within a single reproductive season. However, animal survival covering multiple reproductive seasons has only rarely been considered. This includes also microtine rodents such as the common vole (Microtus arvalis), as they are considered as rather short-lived vertebrates. However, overwintering individuals are important for the survival of local populations, and potential pesticide exposure during maturation might impact survival during seasonal bottlenecks in winter from one to the next reproductive season. Furthermore, from a regulatory perspective and due to the one-reproductive-season-duration of most field effect studies in wildlife, there is an increasing concern on potential long-term effects from exposure occurring delayed or that the reproduction in the following season might be affected by exposure during a previous application season. Against this background we monitored individually marked common vole populations from a long term effect study on spray applications of Dithane M-45 (Mancozeb 80% WP) during one reproductive season further on into the following reproductive season. The test item Dithane M-45 was applied four times in June according to Good Agricultural Practice at an application rate of 2 kg a.s./ha. Trapping and marking of voles in the same investigation plots was conducted until September, followed by further trapping until spring of the following year and the onset of the new reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects resulted in very similar patterns in treatment and control plots, and the data show no indication that common voles were negatively affected by multiple applications of the test item also in the following year. Furthermore and up to now not documented for wild living common voles, the data gives evidence that free-living common vole individuals can reproduce for more than one reproductive season.

MO050  Long-term survival of mancozeb exposed common vole populations from one to the following reproductive season

F. Von Blankenheugel, Rifcon GmbH

For the purpose of this presentation we characterize the phenomenon of the development of the reproduction in the following season after an application of a pesticide. Here we present data of vole populations exposed to the fungicide mancozeb, which is used to control fungal diseases in crops. We report survival data of individually marked voles exposed to mancozeb during a single application season (June). Mancozeb is a commonly used fungicide. The aim of this presentation is to show that vole populations exposed to mancozeb during the reproductive season survive and reproduce in the following season. We present survival data of mancozeb exposed vole populations in different studies and field sites in Germany and submit this phenomenon to the scientific community. We found that vole populations exposed to mancozeb during the reproductive season survived and produced offspring in the following season.

MO051  An analysis of important life stages, exposure routes and test endpoints in reptiles with regard to coverage by existing risk assessment regulatory requirements for pesticides

A. Aldrich, Agroscope / Ecotoxicology; C. Berg, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santamaria, Instituto de Investigaciones del Ambiente / REE; JCCM; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; S.M. Weir, Queens University of Charlotte / Biology

Concerns have been raised that the current risk assessment of pesticides may not sufficiently consider the risk to amphibians and reptiles. To address these concerns, the European Food Safety Authority (EFSA) has published a Scientific Opinion on pesticides (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are covered by existing regulatory requirements for pesticides. The following results were obtained: 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/endpoints; 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 analysis of the currently 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**

**Amphimove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes**


The current decline of amphibian populations on global and local scales is discussed extensively around the world. 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 (aquatic and terrestrial life-stages in different habitats and different patterns and 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 the project Amphimove is to fill the data gap on terrestrial life-stage 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 and 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

A. C. Schröder, J. A. Doering, M. Schroeder, University of Minnesota; C. Pina, IDAEA / CSIC; J. Haro, Institute of Game and Wildlife Research (IREC), Haro, Institute of Game and Wildlife Research (IREC)

Analysis of the currently available data on a single AHR isoform of the African clawed frog and common snapping turtle to these selected DLCs. It is anticipated that this research will result in a single A(q)OP linking in vitro activation of the AHR to embryo-mortality with taxonomic applicability across phylogenetically diverse oviparous vertebrates, including birds, reptiles, amphibians, and fishes. This A(q)OP could guide more objective ecological risk assessments of DLCs to diverse taxa which are not easily studied, such as native species of reptiles and amphibians.

**MO054**

Do historically metal-exposed amphibian populations acquire resistance to lethal levels?

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The current decline of amphibian populations on global and local scales is discussed extensively around the world. 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. Specifically in terms of physiology (e.g., permeable skin) and ecology (aquatic and terrestrial life-stages in different habitats and different patterns and 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 the project Amphimove is to fill the data gap on terrestrial life-stage 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 and 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.

**MO055**

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A. C. Schröder, J. A. Doering, M. Schroeder, University of Minnesota; C. Pina, IDAEA / CSIC; J. Haro, Institute of Game and Wildlife Research (IREC), Haro, Institute of Game and Wildlife Research (IREC)

A quantitative AOP for activation of the aryl hydrocarbon receptor leading to early life stage mortality in amphibians and reptiles

A. C. Schröder, J. A. Doering, M. Schroeder, University of Minnesota; C. Pina, IDAEA / CSIC; J. Haro, Institute of Game and Wildlife Research (IREC), Haro, Institute of Game and Wildlife Research (IREC)

**MO055**

Assessment of metal contamination levels and stress responses of endangered sea turtles of São Tomé and Príncipe

I. F. Morão, S. C. Novaes, Polytechnic Institute of Leiria / MARE IPLeiria; I. Vieira, A. G. Magalhães, School of Agriculture of Coimbra / Environment, Life Sciences and Forestry; F. Tavares, CSIC / Department of Environmental Chemistry; T. Machado, Sea Turtles of São Tomé and Principe / Institute of Game and Wildlife Research (IREC)

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 the impact of pollution on the health status of these species. The aim of this study was to assess the metal contamination, notably accumulated by two species of S. Tomé sea turtles (Eretmochelys imbricata and Chelonina 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/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 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...
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. Comparison 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 contents and eggshells 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 of concern for the Loggerhead Turtle. The Amphibian Research Centre at the University of Cape Town estimated a range of pollution is occurring pollutants, such as POPs and endocrine disrupting compounds, since sub-lethal effects, especially when the eggs are covered, is difficult to discern. Based on the work presented here and those of others, it is obvious that more studies are needed to obtain a better picture of the chemical and biological interactions involved with Africa’s three largest reptiles in.

MO057
Improving knowledge flow: from consumer to environmental risk assessment
L. Vilimar Bouza, s. barmaz, R. Sharp, EFSA - European Food Safety Authority / Pesticides Unit; M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Arena, EFSA - European Food Safety Authority / Pesticides

The assessment of pesticide residues levels in environmental matrices is part of the risk assessment for non-target organisms under Regulation (EC) no 1107/2009. In the case of risk assessments for birds and mammals, according to EFSA (2009), the Tier 1 assessment uses default values for residues levels (in terms of residue per unit dose, RUD) and residue decline (in terms of a time weighted average factor, TWA). When the Tier 1 risk assessment indicates a high risk a higher tier assessment is required. One option is to refine the estimate for the level of residues that wildlife consume through their diet by calculating specific RUDs or by deriving substance/crop specific DT50 values which are then used to recalculate the TWA factor used in the risk assessment. Often the residues studied subjects in the consumer risk assessment are in the environment at the time of exposure feeding inhibition. These are then further evaluated with specific kinetic tools (FOCUS kinetics). It should be noted that the refinement of the RUD values is done only in rare cases since the dataset at the basis of the default values is relatively large. These refinements allows for a more realistic assessment accounting for the differences in residues decline due to the crop type, growth stage, climatic conditions across EU zones and to specific characteristics of the substance under assessment. Other parts of the data used for the consumer risk assessment for pesticides can also provide information for the environmental risk assessment. In particular, metabolism studies in plants are used for the identification of the pertinent metabolites to be further considered in the risk assessment of birds and mammals. The metabolism data for hen and raligoat can also be used for addressing such metabolites. The main scope of this work is to further analyse the standard dataset available and the specific guidance in use for the consumer risk assessment in order to better define how the data and knowledge developed in the context of the consumer risk assessments (internationally agreed methodologies, existing guidance documents) could be integrated in the environmental risk assessment. Particular consideration is given to the possibility of extrapolation between crops, use patterns (e.g. growth stages, application number) and European zones.

MO058
Increasing salinisation effects on Pelophylax perezi populations - Could historical exposure drive current species distribution?
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Coastal wetlands are a priority for conservation because they are biodiversity hotspots and have high ecological importance in ecosystem services. However, they are increasingly 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. Pelophylax perezi is distributed along all coastal territory in Portugal, where there are some populations historically exposed to environmental and 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 in what concerns to the input of pollutants in severities 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 EC90=11.98 mmol/L for seawater and NaCl, respectively). As well, for the sub-lethally monitored endpoints (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 degradations.

MO059
Wildfires effects on aquatic invertebrates organisms with in situ bioassays
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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 pollutants in several dilutions of seawater and concentrations of NaCl (used as a surrogate of seawater to increase salinity). A high number of pollutants have been identified, including hydrocarbons (PAHs) and metals associated to ashes. However, their toxic effects on the aquatic life have been largely ignored. The main goal of this study was to assess the off-site effects of wildfire on freshwater organisms through the use of in situ bioassays. These bioassays were conducted in a recently burned eucalyptus area located in Préstimo (Arruda, central Portugal) and occurred after the first severe wildfire events in the region. In the monitoring areas, seawater was sampled at two days of field exposition, the lethality was assessed through feeding inhibition, revealed a decrease in the feeding rate of aquatic invertebrates organisms in water bodies located downstream the burn area.
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 disruptors, 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 wastewater contamination. OPFRs, like Tris (2-Chloro-1-Methylvinyl) 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 had their DNA extracted from the gonadal DNA. 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.

Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO061

Short-term effects of fluoroxetine exposure on biomarker and behavioural responses of an estuarine fish

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Pharmaceutical compounds are routinely discharged into the aquatic environment. Antidepressants, such as fluoxetine, are frequently detected in both freshwater and estuarine systems of southern Brazil impacted by agricultural and industrial runoff: OPFRs, like Tris (2-Chloro-1-Methylvinyl) 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 had their DNA extracted from the gonadal DNA. 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.

Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

MO062

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 analyzed POPs in blubber of 217 stranded sperm whales (Physeter macrocephalus) from Italy, 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 isotopic dilution technique by GC-HRMS on a Trace GC Ultra coupled with a high-resolution mass spectrometer. Samples’ lipid content was determined gravimetrically. The relative abundance of the study contaminants followed the order DL-PCBs>PBDEs>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 PBDEs and 57.8 pg g⁻¹ (45.8-83.5 pg g⁻¹) for PCDD/Fs. Our results were in the same order of magnitude that those reported for the same species in the same area by a recent study from other authors save for PCDD/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 PBDEs levels, our results were lower that those reported for sperm whales from North-Atlantic. The PCDF congener profile provided the highest contribution to the total TEQ (hexa>penta> tetra>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 lw. and surpassing the threshold of 2100 pg g⁻¹ lw. in a bid for the Mediterranean. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Such effects threaten the maintenance of vital functions of the organisms. The Mediterranean Sea. This endangered species is subject to a number of threats such as exposure to high levels of contaminants. Such effects threaten the maintenance of vital functions of the organisms. Therefore, further studies are needed to assess the potential implications of POPs on sperm whale populations and to contribute to the conservation of the species.

Keywords: POPs, Sperm Whales, Mediterranean Sea.
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 ΣPCBs, 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 blubber levels. Overall, results indicate that the skin of bottlenose dolphins is altered due to exposure to ΣPCBs and ΣPBDs, which co-varied with ΣPCBs 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 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. Papadimitraki, S. Giokas, University of Patras / Biology; S. Dafni, National Park of Patras / Touhou. Monitoring Eleonora’s falcon (Falco eleonorae Géné, 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 3.370±0.433 - 11.34±0.829 nmol m-1 min-1 in May and 1.444±0.079 - 9.31±0.618 nmol m-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, while Cd and Pb concentrations were lower than the MAC-EQS values. All heavy metals measured were below the naturally relevant Pb concentration to the remaining Pb. The results of the present study showed for the first time that the assessment of a battery of stress indices in tissues of F. eleonorae, together with chemical analysis of data derived from their natural habitats, could serve as a valuable tool for elucidating the quality of its foraging grounds and, hence, the impact of land use on the species’ conservation status.

MO066 Optimising design and analysis of acute effect field studies

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Vertebrate risks 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 estimation, 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 data. An initial design considers 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 out the routes to reproductive 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 Neotropic Cormorants as indicator species

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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 PBDs on nesting aquatic birds of the Trinity River, using Neotropic cormorants (Phalacrocorax brasiliensis) 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 and PCBs. Results of its biological impact and exposure was assessed with AHR, IL1, SETAC Europe 28th Annual Meeting Abstract Book

MO068 Tracking the effects of a neonicotinoid insecticide on songbird migration

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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 non-target risk for adverse effects due to OC pesticides, PCBs, PBDs, and Hg. These results should be useful to wildlife managers regarding concerns over contaminant impacts of the Trinity River on wildlife.

MO069 A synthesis of the interactions between anticoagulant rodenticides and wildlife

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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 authorized 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, reviewed the main issues related to ARs and wildlife, specifically: AR use, 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 local 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 non-target exposure is common and the degree 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 suitable to assess risk; and primary AR exposure associated with agricultural activity may cause non-target species population declines, but there is no clear evidence for secondary AR exposure causing population declines. Alternatives to ARs (e.g., bromethalin, cholecalciferol, zinc phosphate) also pose a significant risk to non-target wildlife, livestock, companion animals and people. There are a number of key information needs to better understand the environmental risk from ARs. These are: improved understanding of AR-induced effects and risks to wildlife populations; knowledge of exposure and effects in invertebrates 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.

**MO701**

**Environmental determinants of the exposure to anticoagulant rodenticides in non-target species**

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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 Castilla-La Mancha. The sampling included 101 reptile, 166 mammals 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 (35%) of the analysed animals corresponding to 25 (51%) species. Ten species (53 individuals) corresponding to four mammals and six birds, had residues >200 ng/g, which is the threshold associated with adverse effects: these included common raven (67%), red fox (50%), red kite (38%), eagle owl (25%), common buzzard (17%), Western marsh-harrier (17%) and Eurasian badger (14%). The spatial analysis at the municipality level has allowed to identify the percentage of ungulates and red kites. Results suggest that chemical protection measures are particularly effective in the area of agro-industrial and intensive orchards. The presence of SGARs in predators was therefore more associated with the use of these products as biocides in urban areas or cattle farms rather than as plant protection products in cropland. This information could be used to implement effective spatial and temporal regulation policies that would benefit the rewilding process in this area, which is part of the most important dehesas in Spain.
MO073
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds
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The antidepressant 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. Faecal 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. Moulting 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/MS for fluoxetine and its metabolite, norfluoxetine. The preliminary results indicate that fluoxetine is detectable in the feathers and 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
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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 effects of 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 trap-checking 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 fields. Study fields were run by a large agricultural company; a group of untreated fields was run by another major developer, both the same fields were treated with the same fungicide. The study fields were treated in July and August 2014 with 100 g-i. e. ha−1 of iprodione. Population size (spearman rank correlation), abundance 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 (EFSAs, 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
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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 in Gyps bengalensis of 98-225 µg/kg body mass). Avian scavengers (vultures and bustards) fall after the collapse of the vulture populations 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 “muladareas” 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 fluoximin 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. Fluoximin was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffons (Gyps fulvus) analysed had 330 and 23 ng/g of fluoximin in liver and another 12 Eurasian griffons (Gyps fulvus) with concentrations of 2.83 µg/g of fluoximin in liver, but it was diagnosed as an intoxication 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.

MO076
Different approaches comparison for evaluation of hypopharyngeal glands (HPG) development in Honeybees (Apis mellifera L.)

Honeybees (Apis mellifera L.) and beneficial arthropods that play important roles in natural and also in the food and pharmaceutical industries. One of the conditions for maintaining healthy colonies is the proper development of the honeybee workers hypopharyngeal 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 hypopharyngael 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 (EFSAs 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 (surgical excision); - 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 ten acini from left and right HPG after HPG analysis of the samples 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 hypopharyngeal glands development the linear measurement combined with imaging should be used.

MO077
Bird and mammal focal species for pesticide risk assessment in rice
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Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through exposure to 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 are often included also in the right HPG and the right HPG and the right HPG of rice. To address this issue, we conducted a comprehensive literature review on bird and mammal species regularly occurring in rice paddies at the relevant time periods of potential pesticide exposure to identify appropriate focal species candidates for risk assessment. Our results show that the relevant species occurring in the wet environments of rice paddies indeed clearly differ from the focal species suggested for risk assessment for wildlife in cereals and thus provide a baseline for more realistic and rice-specific risk assessments for birds and mammals.

MO078

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Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

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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 the reintroduction project and one of them is the lead poisoning that lead to the mortality caused by hunting. An exposure to lead, even at sub-lethal levels, can be a stressful situation that implies an increase in circulating corticosterone levels. In birds that are rare and difficult to capture, blood sampling for both lead and corticosterone analysis can be a difficult task and with some risk for birds. For this reason, we decided to develop an alternative rapid and sensitive method to evaluate exposure to pollutants and their respective biomarkers is being directed towards the analysis of easy-to-collect samples, such as feathers moulted by birds. The objectives of this study are to quantify the degree of exposure to lead that the bearded vultures have in the Alps by analysing moulted feathers found in the field, relating them to corticosterone levels in the same feather and defining the factors that affect the fluctuations of these two components along transversal segments of feathers. The analysis of the segments of 20 different feathers from different bearded vultures revealed that the abnormal exposure to lead (probably due to the ingestion of ammunition) had a prevalence of 15% (three feathers with levels above 2 μg/g of Pb in rachis), and that the annual incidence of such exposure was 30% (a feather with an abnormal exposure during its development of approximately two months). The conclusion of this study is that the post mortem exposure to lead in different feathers of key bioindicators for the assessment of lead exposure in the environment and the associated risk to the sustainability of the population if this exposure reach lethal levels. Further, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NILS Science and TBBPA -DBBF.

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. Gómezm-Ramírez, University of Murcia / Department of Toxicology; J.O. Busnès, Norwegian Institute for Nature Research / Fram Centre; G.S. Eggen, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; G. Lepoint, University Maastricht / Department of Oceanology; J.M. Pérez-García, University of Leida / Department of Animal Sciences; T.V. Johnsen, Norwegian Institute for Nature Research NINA; A. Garcia-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. As a result, the understanding of the cumulative transfer of Hg and its effects at the organism, population and interspecific contaminant exposure. Due to the low amount of feather samples, Hg analyses of thyroid hormones have been carried out and the results will be presented at the conference with biological parameters and OHCs.

MO079 Post mortem stability of phase I and II biotransformation enzymes in the liver of kelp gull Larus dominicanus

J.J. Mattos, Universidade Federal de Santa Catarina / NEPAQ, Departamento de Agricultura; D.D. Lima, Universidade Federal de Santa Catarina / Biogasimica; B. Righetti, Universidade Federal de Santa Catarina / NEPAQ-CCA; L.O. Villas Boas, V.H. Dias, Universidade Federal de Santa Catarina / CCB; S. Costa-Silva, C. Kolesnikov, M. Antonellii, Associacao R3 Animal; K. Luchmann, Santa Catarina State University / Engenharia de Pesca; A. Bainy, Universidade Federal de Santa Catarina / Biogasimica

The measurement of biomarker responses to chemical contaminants in wild organisms represents a powerful tool in environmental monitoring programs. However, getting biological samples suitable for biomarker analysis may be challenging, since some programs rely on samples collected from carcasses. Shorter periods from death to analysis of biochemical biomarkers provides more accurate results, but how these parameters change at longer periods from death to analysis of biochemical biomarkers provides more accurate results. Moreover, the lack of information on reference values in GH and WTE complicates the interpretation. Acknowledgements: NILS Science and TBBPA -DBBF.

MO080 Thyroid-related gene expression, hormones, and thyroid gland histology in American kestrels exposed in ovo to two persistent organic pollutants, SCCPs and TBBPA-BDBPF

A. MacLeod, University of Maryland, College Park / Environmental Science and Technology; P.F. Henry, U.S. Geological Survey / Patuxent Wildlife Research Center; K.J. Fernie, Environment & Climate Change Canada / Ecotoxicology and Wildlife Health; N.K. Karouna-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-BDBPE). TBBPA-BDBPE 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 plastic products, textiles, paints, and household electronics. Although it is produced only in the US, Israel, and China, TBBPA-BDBPE is detected in environmental samples and wildlife tissues from across 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-BDBPE 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 da Luta, University of Coimbra; F. Mo 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 bat contamination by environmental substances, including metals, have focused on bat carcasses collected from marine environments (Corsica, Balearics) and a few cases in freshwater habitats. A comparison of concentrations of metals determined in non-lethal samples (wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savi, Nycalus 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 (Ps<0.05), except for Zn (P=0.223). Significant differences were also found between between non-lethal and lethal samples: wing membrane and shell. Samples from the Balearic Islands showed higher heavy metal concentrations (1.4 ± 1.2 mg/kg on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher [Hg] concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first survey at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable osprey populations of the Mediterranean basin in

MO085 Interactive effects of vitamin E and BDE-47 yolk supplementation on morphological and oxidative status of yellow-legged gull embryos F. Monti, University of Siena / Department of Physical Sciences, Earth and Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University / Department of Life Sciences, Earth and Environment; A. Sforzi, Marammà Natural History Museum, Grosseto; N. Bianchi, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Leonzio, University of Siena / Department of Physical Sciences, Earth and Environment

The osprey (Pandion haliaetus) has been historically used world-wide as a sentinel species for the biomonitoring of selected contaminants for aquatic ecosystems. In spite of this, occasional and fragmentary information are available for the species at the Mediterranean scale, where relict and vulnerable populations exist. In this study, we analyzed heavy metals concentrations in osprey eggs from three different populations of the Mediterranean basin (Corsica, Italy and Balearic Islands). In total, 21 unhatched eggs were collected, over a period spanning from 2005 to 2016. Multivariate analysis (Cadmium (Cd), Cadmium (Cd), Pd) in osprey eggs were analysed with the aim to: 1) evaluate geographical patterns of for possible identification of inputs at the regional scale; 2) to evaluate differences in concentrations between samples from different habitats (marine environments and wetlands); and 3) to investigate any differences in concentrations among different parts of the egg (i.e. content, membrane and shell). Samples from the Balearic Islands showed higher [Hg] concentrations (1.4 ± 1.2 mg/kg on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher [Hg] concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first survey at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable osprey populations of the Mediterranean basin in

MO086 Toxicological effects of PBDEs on aquatic organisms J. Alves, R. Mina, A. Alves da Silva, CFE - Centre for Functional Ecology, / Department of Life Sciences, University of Coimbra; F. Mo 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 bat contamination by environmental substances, including metals, have focused on bat carcasses collected from marine environments (Corsica, Balearics) and a few cases in freshwater habitats. A comparison of concentrations of metals determined in non-lethal samples (wing membrane and fur) collected from bat carcasses of four different species (Hypsugo savi, Nycalus 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 (Ps<0.05), except for Zn (P=0.223). Significant differences were also found between between non-lethal and lethal samples: wing membrane and shell. Samples from the Balearic Islands showed higher heavy metal concentrations (1.4 ± 1.2 mg/kg on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) had five times greater [Hg] than those from wetlands. Egg content and membrane showed higher [Hg] concentration values than those of the shell. On the contrary, for Cd and Pb (though with minor differences) higher concentrations were found in the egg shell. Our study represents a first survey at regional scale and provides a first set of data for the long-term biomonitoring of heavy metals for the vulnerable osprey populations of the Mediterranean basin in

MO084 Metallic element composition of egg contents and eggshells of the Kelp Gull Larus dominicanus J.D. van Aswegen, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydom, Nelson Mandela University / Department of Life Sciences, Earth and Environment 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 tend to feed at different trophic levels at different distances from the land and they are long-lived. Pollutants that have accumulated in the seabirds can be excreted in various ways from the body, one being deposition into eggs. Sixteen eggs of the Kelp Gull (Larus dominicanus) were analysed using ICP-MS (EPA 3050b method) for 30 trace elements, for both the contents and eggshells. We selected five elements (Cr, Sr, Ti, U, Zn) to compare and assess the absolute and relative compositional patterns in egg contents and shells. Mean concentrations for Cr in eggshells and egg contents were 3.8 and 18 mg/kg dm, for Sr it was 880 and 120 mg/kg dm, for Ti it was 0.00017 and 0.00022 mg/kg dm, for U it was 0.00057 and 0.000084 mg/kg dm, and for Zn it was 2.1 and 62 mg/kg dm, respectively. Of the five elements, only Sr (p = 0.0141) and Ti (p = 0.0013) concentrations showed significant positive regressions between egg contents and eggshells. Chromium and Zn showed a positive regression, but the regressions were not significant. Uranium also showed no association. The mean mercury concentration in the contents was 0.38 mg/kg dm, and the maximum was 2.1 mg/kg dm. The Toxic Reference Value for mercury in egg bird contents is 2 mg/kg dm, indicating concern about this element in the Swartkops River Estuary. Additional toxic implications, as well as comparisons with concentrations in other media will be discussed.
Sensitivity of freshwater pearl mussel juveniles (Margaritifera margaritifera) to different environmental and contamination factors

T. BELAMY, University of Bordeaux; A. LEGEAY, University of Bordeaux / UMR EPoC CNRS 5805; B. ETCHEVERRIA, University of Bordeaux / UMR CNRS 5805 EPoC; M. Baudrimont, Université de Bordeaux / UMR EPoC CNRS 5805

Margaritifera 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, freshwater pearl mussel (M. margaritifera) is estimated at 100,000 individuals with the largest population found in the river Dronne (Bordogne - FRANCE) with up to 15,000 individuals. Freshwater pearl musselss 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 Margaritifera margaritifera and restoration of river continuity of the Upper Dronne 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 life stage 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 Margaritifera margaritifera in the Upper Dronne river.

Using population modelling to reduce uncertainty - an example of a herbicide

M. Wang, WSC Scientific GmbH / Dept E fate Modelling; M. Foudoulakis, 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.

SETAC Wildlife Toxicology Interest Group

J.E. Elliott, Environment Canada / Science Technology Branch

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

MO098

A tool to integrate consumer and environmental exposure in life cycle impact assessment

M. Keller, University of Iowa; H. Faris, University of Iowa / DEPARTMENT OF ENVIRONMENTAL SCIENCE; P. Nortje, 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 LCA toxicity characterization. The aim of the present study is to update and extend the existing framework to consistently incorporate consumer exposure pathways in way fully compatible with existing LCA 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 exposure modeling. The chemical mass per functional unit in the consumer product is multiplied by the product intake fraction (PIF) to yields the total exposure expressed. The PIF represents the fraction of the chemical in products that is taken in by the consumer. It is determined by coupling fate processes in consumer environments (near-field) with existing environmental compartments and processes (far-field), via a consistent and mass balance-based set of transfer fractions. The developed tool already enables to calculate characterization factors for 22 types of building products, 8 types of personal care products, 7 contact food materials and multiple cleaning product-chemical 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 bw/day for an adult and 0.5 mg/kg bw/day 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 (4%) and on aquatic ecology (95%), whereas DEHP is 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 LCA, as an input to the LCA guidance efforts of the Life Cycle Initiative.

Towards the integration of an Agent-based Model into LCA framework to assess dynamic indoor air quality

A. Micoller, University of Bordeaux / The Life Cycle Group CyVi; P. Loubet, University of Bordeaux / ISM CyVi; T. 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 airtightness of low energy buildings has created particularly confined and polluted indoor spaces. 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 materials used. Nevertheless, the current use of LCA does not address scientific obstacles such as: (i) the inclusion of the dynamical effects of indoor pollution on human health and (ii) 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, leading to a multi-scale approach to indoor air quality. This work will present how LCA and emission data are integrated in Li-BiM and Be-BiM and how the model can be used to assess the environmental impacts from indoor air.

Adding the resource dimension to the WULCA framework on assessing freshwater use in LCA

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Effective management of freshwater resources is recognized as being at vital. At present, existing LCA 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: (1) to identify how freshwater resources can be classified 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 elementary 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 effects. Therefore, the methodology to determine their potential 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 stages 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. Campanili, IRD, UMR LIAS, S. Follain, Montpellier SupAgro, UMR LIAS; J. Burte, CIRAD / UMR GEAN; N. Benaisssa, National Agronomic Institute of Tunisia / Science de la production végétale; C. Sinfort, ITAP, Irstea, Montpellier SupAgro, UMR LISAH; S. Follain, Montpellier SupAgro, UMR LISAH 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 measures to prevent soil 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 integrate 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, contour ridges were modelled and the degradation factors were compared to the different types of WSCW. The impact of contour ridges on soil quality is evaluated in terms of soil erosion resistance and mechanical filtration. The results showed how contour ridges can modify topsoil erosion process and thus the impact on soil ecological functions for several production systems. In conclusion, it is necessary to integrate the positive impacts of water and soil conservation materials. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research efforts to include a methodological framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Key words: LCA, LCIA, Contour ridges, Environmental Exposure Assessment. - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract 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.

MO099
Comparing ProScale Hazard Factors with USEtox Effect Factors for human toxicity
T. Rydberg, IVL Swedish Environmental Research Institute; H. Holmquist, Chalmers University of Technology

The purpose of this study is to compare side-by-side, the Hazard Factors (HF) of ProScaleTM, and the Effect Factors (EF) for human toxicity of USEtoxTM, and analyse the results, as both factors have been developed as a metric for adverse human health impacts due to toxic effects. Hazard factors in ProScale are derived based on substances classification in the GHS/CLP classification system, reflecting hazard severity and exposure route. The factors were then filtered into two different sets of substances. All substances having a carcinogenic effect factor were compared separately. Tendencies of correlation can be identified, but differences are large. Interesting discrepancies, also of principal matters, have been identified. The results shown are very first results from comparison of ProScale HF and USEtox EFs for human toxicity. Further work is needed, and under way.

MO098
Integrating the Use Phase Impacts of Building Materials into Near-Field LCA Characterization
L. Huang, University of Michigan / Dept of Environmental Health Sciences; N. Anantas, US Environmental Protection Agency / National Risk Management Research Laboratory; P. Eggeby, D. Vallero, US Environmental Protection Agency / National Risk Management Research Laboratory; J.C. Bare, US. Environmental Protection Agency / National Risk Management Research Laboratory; O. Jollivet, University of Michigan

Historically, LCA has focused on impacts with far-reaching temporal and spatial scales, and not exposures to near-field goods such as consumer products and building materials. However, with increased use of LCA to support decisions related to chemical alternative assessments, characterization of the near-field exposures to these products is becoming recognized as increasingly important. Therefore, the US EPA has developed a research project to improve such characterization. Several recent papers have suggested that the exposures to these consumer products and building materials may be significantly greater than exposures to far-field emissions, and therefore, not including these exposures may result in decisions which are unknowingly biased in a manner which could lead to increased risk. The difficulty up to this point in time has been to characterize these exposures since the product compositions are often unknown and the pathways to exposure have been poorly characterized. This poster will describe the research efforts to include a methodological framework which demonstrates the methods by which the EPA intends to include exposures to these goods, the definition of Product Intake Fraction (PiF), the many exposure pathways being characterized, the methods for development of PiFs, and the data and models being recommended for a variety of populations to support this characterization. Finally, data gaps and other research needs will be discussed along with the future direction of the project. Key words: LCA, LCIA, Contour ridges, Environmental Exposure Assessment. - This work was conducted under US EPA Contract No. EP-16-C-000070 with the University of Michigan. Disclaimer - The views expressed in this abstract 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.

MO099
Combined use of Mixed-Integer Optimisation and Thermodynamic, Molecular and Charge Density attributes for predicting Life Cycle Production
Impacts of Chemicals
R. Calvo-Serrano, G. Guíllem Gosalbez, 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 basis 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 ρ-centres as attributes, for a better characterisation 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 ρ-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP).33.55%) or Eco-Indicator99 (EIP9) (18.34%).

MO100 Development of USEtox characterisation factors for micropollutants in effluent
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 of 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 characterisation 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 ρ-profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP).33.55%) or Eco-Indicator99 (EIP9) (18.34%).

MO101 Assessment of freshwater ecotoxicity with USEtox
M. LOT, CEHTA; P. Thomas, CEHTA 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/OEF project, by JRC-IES in ILCD handbook, by Wellcome Trust, for characterising the sustainability 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 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) threaten 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 reviewed 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 studies 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, sediment, soil, and air), the forms of each nutrient modeled, 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, Persson 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. Baiting dead zones and consequences for marine ecosystems. Science 321: 926-929. Disclaimer - The views expressed in this abstract are those of the authors and do not necessarily represent the policies of the U.S. Environmental Protection Agency. Mention of trade names or commercial products does not constitute endorsement or recommendation for use.
Damage Potential, Ecosystem Services Damage Potential, Biotic Natural Resource Depletion and Climate Change. However, only a few of these impact pathways are fully implemented in currently available LCIA methods, also due to lack of significant consensus on this novel impact category. Specifically, LUC has to be carefully evaluated when assessing microalgae’s cultivation systems, as they may be strongly diverse one each other, hence impacting through diverse paths. Cultivation layouts may range, in fact, from large open ponds to more compact photoreactors; they may be installed in diverse environments, such as fresh water ponds or offshore cultivation systems, either in brownfield lands in an optic of redevelopment of industrial areas, hence even generating a positive effect to the environment, mostly in terms of GHG’s fluxes and biodiversity. In this respect, the study aims at providing a consistent framework of the current methodology on LUC impact category and its application to bio-economy and, specifically, to microalgae’s production in order to provide support to business and policy decision making.

MO104 Application of LCA water use methods to renewable energy systems in Spain
L. Sánchez-De Castro, D. Garruan, Y. Léchon, CIEMAT / Energy Dept; L. Eymann, ETHZ Swiss Federal Institute of Technology; M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Sciences; L. Vázquez-Rowe, Pontificia Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science

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 the way that these are calculated. After having reviewed and compared the different 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 Re Manning 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. Ridoutt, 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 awaked the need to develop spatially explicit methods to calculate the product water footprint (WF) from a life cycle perspective. In this sense two parallel development paths emerged: 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 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 recharge the groundwater) but do not consider soil water. After having compared the different methodologies, a set of current limitations are highlighted.

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. Eymann, ETHZ Swiss Federal Institute of Technology; R. Kelley, 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 maximum sustainable yield. Therefore, the method developed uses a distance to target approach based on the fish stock for maximum sustainable yield (FSMSY) 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 FSMSY 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 achieved approach can be extended to other life cycle assessment methods and thus is reflected in spatially explicit LCIA of GM and is able to reflect the realised impacts caused by the overexploitation of fish resources.

MO107 Constructing life cycle inventories for the hydroelectric sector in Peru: methodological considerations and environmental impacts
L. Vázquez-Rowe, Pontificia Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science

According to recent reports, hydropower currently accounts for 46% of Peru’s daytime electricity generation. Low carbon emissions are usually related to this source of energy, making it an attractive option for nations with hydropower potential to meet increasing electricity demand without relying on burning fossil fuels. However, the new wave of hydropower plant construction is occurring mainly in three tropical river basins: Amazon, Congo and Mekong; therefore, an additional environmental impact must be considered: biogenic greenhouse gas (GHG) emissions due to the generation of biogenic carbon in reservoirs. Peru is planning on installing up to 2.000 MW of installed capacity in hydropower until 2021, but the input and output flows, as well as the environmental impacts that these generate have not been explored. In this context, a set of three run-of-river hydropower plants built in the past decade located along the Peruvian Andes were analyzed from a life-cycle perspective. The main objective of the study was to construct detailed life cycle inventories for each of these three hydropower plants with the aim of having specific information for real conditions in Peru. This information was used to compute the environmental impacts linked to the generation of electricity at the plants. Although the main aim was to determine the GHG emissions linked to this process, considering the important policy implications of decarbonizing the Peruvian electricity grid, other environmental categories, such as eutrophication or the depletion of abiotic resources, were also considered. The results computed show that GHG emissions per kWh of electricity produced were in the lower range of emissions observed in the literature, in all three cases below 3 g CO2eq per kWh. Biogenic emissions represented less than 5% of the total GHG emissions despite their location in a tropical nation, due to the arid conditions of the landscape in the Highlands, as well as the mild temperatures that are present in the reservoirs. Results intend to be of utility for an array of applications, including relevance in decision-making in the energy sector, policy-making at a national level, considering the implications in terms of meeting the Nationally-Determined Contributions to mitigate climate change in the frame of the Treaty of Paris, and for the international LCA community in an effort to expand the amount of inventories available for different geographical and technological conditions.

MO108 Global scale characterization factors for freshwater eutrophication from nitrogen and phosphorus emissions to water and soil
F. Brands, Radboud University Nijmegen / Department of Environmental Science; A. Beusen, PBL; R. Van Zelm, Radboud University / Department of Environmental Science

Eutrophication is a key water quality issue triggered by increasing nitrogen (N) and phosphorus (P) levels and potentially posing risks to freshwater biota. In life cycle impact assessment, spatially explicit characterization factors (CFs) of phosphorus emissions to freshwater causing eutrophication have been derived. However, for nitrogen impacts, no efforts have been undertaken yet. Moreover, neither for agricultural emissions of P nor for N spatially explicit CFs have been derived. Therefore, the goal of this research was to determine spatially explicit CFs for...
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 emissions of P or N to freshwater (via WWTPs) or agricultural soil and consist of a rate and an effect factor. To determine the fate factors, the change in N and P concentrations resulting from agricultural as well as from anthropogenic sources was modeled for every river basin in the world. Effect factors were based on 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 nitrogen and phosphorus 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 (MROI) 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. Dietzenbacher, 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 EE-IO 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 Wallon region is modelled in IO-tables. Imports from outside Belgium are included via the link with the use table of EixoBase. 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 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 harmonised 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. Shiromnita, 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 focused on the economic changes 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 multi-regional 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 from that 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.S. Leclerc, DTU / Management Engineering; M.Z. Hauschild, Technical University of Denmark / 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) cover up to 23 substances in 51 countries, but they are not always complete. The Multi-Regional Input-Output database EEX includes emissions emitted to air in 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, and the calculation of Ecoinvent-based National Energy-related Emission Inventory (EENEI) by upscaling processes from Ecoinvent 3.3 with national production volumes of electricity and complementing it with emission data from external sources. The resulting inventory EENEI covers 229 substances, including 51 radioactive isotopes. By comparing inventories and databases at midpoint level, we should be able to verify whether Ecoinvent 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 energy consumption or production occur. The potential to link any remote sensing or earth observatory GIS data that is tagged to an economic sector to the working of supply chains or to air in 44 countries and 5 regions. 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.

MO114 LCA data machine applied A. Ciroth, GreenDelta; M. Srocka, 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

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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, in a specific local area, e.g. 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 remodeling 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 marginal electricity mixes, a consequential effect on LCA results
M. Bilec, W. Collinge, University of Pittsburgh / Civil and Environmental Engineering; H. Rickenbacker, University of Pittsburgh / Civil & Environmental Engineering; A. Landsis, Clemson University / Environmental Engineering and Earth Sciences; C. Thiel, New York University School of Medicine / School of Population and Public Health

tiang on high performance building (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 underlying power generation processes. 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 (LCA) 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 material phase 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 energy use. The LEED Gold building is solely reliant on the region’s electricity grid, making its 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 LCA 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 efficiency and environmental performance of these 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 considered encompasses transportation infrastructure, maintenance of the vehicle, energy/fuel production and tail-pipe emissions. This framework is capable to characterize the per passenger km travelled (PVT) and vehicle km travelled (VKT) environmental impacts of an existing and proposed project. Since per PVT 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. MERCHAN, University of Liege / Chemical Engineering, PEPs; S. Groslambert, University of Liege / 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 different intermodal routes depending on the freight transport mode chosen (rail or road transport) for the major part of the intermodal route. Finally, we have analysed how the increase of rail freight transport in the modal split as a result of the possible development of the intermodal rail freight transport affects the environmental impacts of inland freight transport in Belgium. For this, three divergent Belgian scenarios with a time frame set in the year 2030 have been built for further analysis. These scenarios are directly linked to the third strategic goal of the European Commission’s White Paper on transport (2011). As a result, a best, worst and medium case scenarios have been developed, depending on whether the 30% shift will have been successfully accomplished, the status quo will have been maintained or the goal will not have been completely reached by 2030, respectively. The results obtained from this research will give initial indications for future rail freight development in order to define the sustainability impact of future intermodal transport. They could help in making optimised 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
I. Witt, Bayer AG / Environmental Safety; S. Beulke, Enviresearch 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 Ch2err < 15% and visual assessment as decision criteria. However, the Ch2err measurement misleading as it does not account for systematic deviations, while 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, supporting the subjectivity of visual assessment. Based on group discussions, we derived group consensus scores. Consensus scores showed little correlation with Ch2err (R^2 = 0.23). Among several proposed criteria, the SWARC (scaled and related areas, and can be especially useful for creating inventories in a larger scale.

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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 terbuthylazine, it was confirmed that banned toxic 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 for 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

"Southside" - Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

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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 (ENASGIPS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. But it was 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, degradations and consequences

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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...
Multi-year evaluations in the FOCUS Surface Water assessment - results of beta testing

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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 practice. Pwel Nature Science 135: 1727-1744 (MKEU and ECHO combined 2015): Multiyear 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 oils, Water and Air, York, UK. September 2013 Poulson V (2016): Higher tier assessments of aquatic and terrestrial studies. AGCHEM Forum, Brussels, Belgium. 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


MO126 Determination of runoff and drainage triggers for PEC surface water using automated simulation with FOCUS models

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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 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 were calculated for different scenarios at different application times within spray drift as entry path 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

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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 using low-cost samplers, for pesticide model validation. At each sampling point, event mean concentrations. The biases and uncertainties in terms of load calculations are addressed. Based on monitoring in different hydrogeological contexts the approach is demonstrated for deriving land and crop specific loads in catchments and exceedence of EQS values resulting in a risk map of impacted surface waters in Luxembourg.

MO128 Spatially distributed environmental fate modelling of terbuthylazine in a meso-scale agricultural catchment using passive sampler data

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The impact of agricultural practices on water pollution 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 demonstrated for deriving land and crop specific loads in catchments and exceedence of EQS values resulting in a risk map of impacted surface waters in Luxembourg.
MO129
Recallibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data
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Vegetative filter strips (VFS) are widely used for mitigating pesticide inputs into surface waters via surface runoff and water. To simulate and assess VFS in reducing surface runoff volumes, eroded sediment and pesticide loads the model VFSMOD (Muñoz-Carpena and Parsons, 2014) is frequently used. While VFSMOD simulates infiltration and sedimentation mechanistically, the reduction of pesticide load in surface runoff by the VFS (deltaP) is calculated with the empirical multiple regression equation of Sabbagh et al. (2009). This equation uses the following inputs: predicted reduction of total inflow (deltaQ) and eroded sediment load (deltaE, absolute surface runoff volume and eroded sediment load entering the VFS, linear adsorption coefficient Kg of the pesticide, and the clay content of the field soil (as a proxy for the clay content of the eroded sediment). The Sabbagh et al. (2009) equation, the coefficients of which were obtained by calibration against 47 data points, has not been widely accepted by regulatory authorities, on the grounds that its reliability has not been sufficiently established yet. Hence, evaluation against additional experimental data is necessary. Chen et al. (2016) proposed an alternative regression equation with a different structure based on 181 experimental data points. This equation uses fewer independent variables, but has more parameters than the Sabbagh equation. The objective of the present study was to improve the predictive capability of the Sabbagh et al. equation by broadening the dataset. For this purpose, additional experimental VFS datasets were compiled from the available literature and thoroughly checked for their suitability. Moreover, existing errors in the calibration and validation data points of Sabbagh et al. (2009) were corrected. The consolidated experimental dataset (n = 244) was used to recalibrate the Sabbagh and Chen equations. Moreover, a k-fold cross validation analysis was performed to assess the predictive capability of both models. The Sabbagh equation fitted the whole dataset slightly better than the Chen equation ($r^2 = 0.82$ vs. $r^2 = 0.79$) and performed consistently better in the cross-validation exercise (with respect to the prediction performance indicators $Q^r$, predictive $r^2$, and RMSEP). Finally, a maximum-likelihood-based calibration and uncertainty analysis were performed for the Sabbagh equation using the DREAM algorithm.

MO130
Vanda - Visualize and Assess: a tool for the pesticide risk mitigation in surface water
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The Directive 2009/126/CE of the European Parliament and Council on Sustainable Use of Pesticides introduced a community action framework to protect the Environment of the EU and requested Member States to implement policies and actions in order to reduce the risk of pesticide use. In the Region of Lombardy, in Italy, this Directive was adopted with DGR n. X/323/3. The aim of the present work is to develop an interactive, easy to use tool to use the potential of Vanda for the water contamination, assess the potential pesticide risk and identify areas where to introduce mitigation measures to reduce the contamination, and consequently to reduce the risk in the surface water compartment. The datasets to start with are the monitored concentrations of pesticides in surface water, produced by the Regional EPA. These values are used in this context as Measured Environmental Concentration - MEC. The ratio MEC/PNEC is proposed in this work as a sort of risk assessment, even though the limitation and the complexity of usage of monitored data is well known. In addition, the ratio MEC/EQS - Environmental Qualitative Standard (annual average concentration), is considered, to address the water quality with respect to the regulatory limit for pesticides in surface water (EQS 2000/60/EC). A MS Excel tool has been developed to map the monitored residues of pesticides, assess the potential pesticide risk (MEC/PNEC) and identify “hot spots”, that is areas where mitigation measures should be included. The tool is thought to be an anyone-can-use one, even with no particular knowledge of GIS or database management. Its peculiarity to be built inside MS Excel gives itself the possibility to share and to ease the dissemination of results. For more advanced mapping, the tool can interact with ESRI ArcGIS. The openness of Vanda makes it a tool suited to work with other environmental compartments or other environmental theamtics.

MO131
Selecting application dates for UK higher tier drainflow modelling: comparing the FOCUS PAT and CRD PAT rules, and assessing the role of soil trafficability
J. Camali, G. Hughes, Cambridge Environmental Assessments; J.A. Hingston, J. Evans, Chemicals Regulation Division

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 using 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 pesticide application selection of CRD PAT and FOCUS PAT was compared, with a view to drawing conclusions for the standard and refined UK higher tier drainflow risk assessment process.

MO132
Considering diffuse urban and agricultural sources of pesticides at the landscape and catchment scale
G. Hughes, J. Camali, Cambridge Environmental Assessments; F. Ericher, CEA for plant protection products (PPPs), there is a strong move towards landscape and catchment scale risk assessments as this allows for integrated risk assessments that consider multiple sources of pollutants, different exposure pathways as well as different receptors within a single framework. This landscape/catchment approach moves away from unrealistic worst case scenarios, designed to be protective of a wide range of usage situations, to a more realistic representation of usage environments that may be assessed on a site-specific basis. This poster will discuss the factors influencing the choice of 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 compound. In the aquatic environment, passive integrative samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordecone: the classical POCIS (Polar Organic Chemical Integrative Sampler) (with Polysulfonelufene membranes), the POCSiNy 30µm (with nylon membranes), and the POCSiNy 0.1 µm. Calculated sampling rates (Rs) were corrected by a PRC ( Performance Reference Calibration) approach. Laboratory calibration was done in triplicates under a continuous flow system, and the field calibration was done in triplicates in river Caperstere (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.09±0.01 L.day⁻¹ for the POCSiNy 0.1 µm and 1.34±1.38 L.day⁻¹ for the POCSiNy 30µm. Two distinct Rs have been calculated for the POCSiNy 0.1 µm: one for the first five days of the experiment ($R_s = 0.9±0.1$ L.day⁻¹ for POCS; $R_s = 0.48±0.50$ L.day⁻¹ for NOCSiNy 0.1 µm), and one for the overall experiment ($R_s = 0.19±0.02$ L.day⁻¹ for POCS; $R_s = 0.43±0.01$ L.day⁻¹). POCSiNy 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than
in the laboratory calibration (Rs=4.82 ±1.93 L^-1). PCOCIS and PCOCISny samples can accumulate chloride efficiently despite its hydrophobic properties. PCOCIS 30μm seem to be a useful tool to monitor short flash floods, which happen regularly in this area.

MO134 Temporary 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, at these sites, took from April/2014 to July-August, and September-October to 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 dimoxonazole, procionazole, fenamidone, niramulin and boscalid, were detected with low frequencies and their average residue levels in positive samples were also fairly low. Of the insecticides monitored, some organophosphorus, cadusafos, diazinon, fenitrothion, fenphosphate and prothiofos, two carbamates, carbofuran and fenobucarb, and endosulfan were detected with low frequencies and low residue levels. Among the detected pesticides, mepiquat chloride, clothianidin, thiacloprid, deltamethrin, dithianconazole, fenpyroximate, triflumuron, metolachlor, oxadiazon, simetryn and thionocarb 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, chloramzone, diuron, hexazinone and tebuthiuron), 3 fungicides (azoxystrobin, carbendazim 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 22 ng/L and from 2.8 to 74 μg/L, respectively, and mean 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%), carbendazim (93%), tebuconazole (90%), hexazinone (91%), imidacloprid (96%) and ametryn (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, carbendazim, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbendazim (10%), tebuthiuron (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuthiuron, reaching 107 ng/L.

MO136 Exposure scenarios for aquatic risk assessment of pesticides in Brazil
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A tri-partite 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 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. Rathjen, M.F. Winchell, Stone Environmental, Inc / Environmental Systems Modeling; P. Sur, Bayer AG Crop Science Division; O. 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 processes of the herbicide detections observed in daily sampling over 3.5 years at two locations along the catchment’s primary stream. The SWAT model was calibrated to observed flow and chemical monitoring data, then used to characterize the relative contributions of herbicides via surface processes, subsurface processes, and spray drift. In addition, very vulnerable fields with significant contributions to surface water exposure were identified. A quantitative comparison between monitoring data and simulated exposure profiles was made to single out those high residue concentrations that could not be attributed to any of these traditionally considered exposure pathways, and could ultimately be explained by point source contributions. The model results demonstrate that SWAT is capable of simulating streamflow in a small agricultural catchment, and is capable of simulating diffuse source pesticide concentrations. This allowed a quantification of an approach to associated model uncertainties and a method to distinguishing between diffuse source dominated high concentrations from those most likely affected by point sources. The SWAT model also proved useful in identifying the spatial variability in the dominant transport processes contributing pesticide 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
The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuary 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

Monitoring programme to investigate the presence of myclobutanil and its soil metabolite in Italian groundwater following use in pome fruit, stone fruit and vineyards

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Myclobutanil is a fungicide used mainly in pome and stone fruit areas, and in vineyards. For national registration in Italy, FOCUS groundwater modelling showed that the PEGw for its soil metabolite (X11292885; up to 6% of applied) reached up to 2 µg/L. This was accepted at EU level since the metabolite is not toxicologically relevant. However, according to national rules, this triggers a groundwater monitoring study, it was necessary to identify monitoring areas with the following characteristics: (i) be representative of an intensive use of myclobutanil, and (ii) reflect reasonable worst case scenarios for Italy. To facilitate this, a GIS-based indicator (PLI, Potential Leaching Indicator) was developed to integrate information about sales data, the spatial distribution of the target crops and the distribution of the FOCUS groundwater model scenarios throughout Italy. Use of the PLI allowed five suitable areas to be identified (Bolzano and Trento for apple trees, Verona for stone fruit and grapes, Forlì-Cesena for pear trees and stone fruit, and Matera for stone fruit). These areas are also representative of the FOCUS groundwater scenarios relevant in Italy (Châteaudun, Hamburg, Piacenza and Thiva). In each area, five monitoring wells were identified to cover a range of parameters (depth to groundwater, hydrology, pedology, and presence of the target crops). Subsequently, a three year monitoring campaign was conducted (autumn 2014-spring 2017). From a total of 150 samples analyzed, the concentrations of myclobutanil and its soil metabolite (X11292885) were below the LOD (0.001-0.002 µg/L) in all samples, and in alluvial, the number of positive detections was 23 and of these, 20 samples showed concentrations well below 0.01 µg/L. Only in one sample did the measured concentration exceed the trigger value of 0.1 µg/L. However, a number of factors indicate that this is due to point source origin. Even better results were obtained for X11292885 where the number of positive detections was only 13, with concentrations less or very close to 0.01 µg/L. Based on these results it can be concluded that the current EU groundwater directive values are used in risk assessments in order to evaluate the impact of plant protection products on groundwater. In higher tier groundwater monitoring studies the properties of the saturated zone can play a key role in evaluating the suitability of the site for groundwater protection. In the studies presented here, the properties of the saturated zone have been evaluated in terms of hydraulic conductivity, gradient and effective porosity and provide a representative parameter range.

MO140

Identification of areas at risk of groundwater leaching in Italy for the fungimant 1,3-dichloropropene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l. / Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl / RD; C. Vai, Dow AgroSciences Italia s.r.l.; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; 1,3-Dichloropropene (1,3-D), also known as Telone™, is an active substance used worldwide in soil fumigant products for the control of cyst and free-living nematodes. It is used in a variety of crops including fruiting and vegetable crops. Soil sorption studies have shown that 1,3-D and its metabolites present characteristics of highly mobile molecules with a potential to leach to groundwater when applied in vulnerable areas such as sandy soil and in areas characterized by shallow groundwater. European member states have a wide range of groundwater monitoring activities for plant protection products and their metabolites, but analysis of 1,3-D and its metabolites is not currently part of the routine programme. In this study we illustrate a methodology allowing to identify areas most at risk where monitoring should be focused in priority, taking the example of Italy. The methodology considers three parameters: i) crops distribution, ii) soil properties and iii) 1,3-D use. The data, structured as layers of information were managed within a GIS, and are intersected to get the so-called Uniform Geographic Units (UGU) which are areas of uniform in their characteristics and are representative of a specific set of values parameters. The data about the spatial distribution in Italy of crops where the 1,3-D is applied were first gathered from the last agricultural census, which provide information at a provincial scale. Successively, these data were refined at municipality scale. The identification of sandy soil areas in Italy was performed using pedological information extracted from different official sources. Subsequently, the information was combined in order to identify the areas where the percentage of sandy soils falls among three different categories (< 60%, 60-80%, > 80%). Also these data were structured as GIS layers, which were processed and represented using the same GIS of the crop distribution. Overlapping the crop distribution and sandy soil areas and by merging the two databases, it was possible to identify sub-communal areas where crops and sandy soils coexist, characterizing the extension in relation to the rest of the municipality and the province. Finally, by considering 1,3-D sales data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where Telone™ is applied.™ of DowAgroSciences.

MO141

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 to a direct groundwater leaching scenario. This model 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 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.

MO142

Influence of aquifer parameters on groundwater residue concentrations

F. Hegler, DR. KNOELL CONSULT GmbH; D. Liss, SGS Institut Fresenius GmbH/Agro; W. He, DR. KNOELL CONSULT GmbH; O. Naeh, SGS Institut Fresenius GmbH; S. Reitz, DR. KNOELL CONSULT GmbH / Environmental Fate / Modelling / GIS

FOCUS leaching models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1 m depth (PECgw; “Predicted Environmental Concentrations in groundwater”) from the unsaturated to the saturated zone. These values are used in risk assessments in order 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 modelling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data quality impact our modelling results. In this poster, 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/SEAGPest). The main issues when dealing with the new European GW monitoring data is to (i) evaluate how GW monitoring data can be used in PEC models were used to create a classification system for the input parameters K_{GW} of degradation rate coefficient. PEC_{GW} obtained by the simulation results demonstrate how can these results be trustable?

**MO145 Minimal variation in input parameters highly influences PEARL and PELMO results: how can these results be trustable?**
S. Ulucuçu, ICPS; L. Menaballi, International Centre for Pesticides and Health Risk Prevention

The calculation of Predicted Environmental Concentration of pesticides in groundwater (PEC_{GW}) is a crucial point in the registration 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 DT_{90}, K_{OM} and Freundlich coefficient (1/n). Great variations in PEC_{GW} values are anticipated when high variability occurs in one or more of the parameters listed above. In this work, we demonstrate that PEC_{GW} 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 K_{OM} determination was calculated applying the Horwitz equation), it is questionable whether a corresponding high variation in model is scientifically acceptable. In a previous project (York, 2017), dummy substances with different combinations of DT_{90}, K_{OM} and 1/n values were used in FOCUS PEARL, in order to quantify the influence of each single parameter on the final PEC_{GW}. It was verified that the sensitivity of PEARL model can be considered quite excessive. In this follow-up project, further calculations were performed using FOCUS PELMO to confirm the sensitivity of these two models, commonly used in a regulatory contest. Leachate concentrations were plotted as a function of K_{OM} and as a function of degradation rate coefficient. PEC_{GW} obtained by the simulations of these two models were used to create a classification system for the input parameters K_{OM} and DT_{90} according to models sensitivity. Conserved values for each parameter class, to be used in PEC_{GW} calculations, are proposed for all substances. This approach can minimize the effects of the intrinsic input variability providing a better scientific approach to the assessment of groundwater modelling in the regulatory context.

**MO146 European regulatory network on pesticide groundwater monitoring**
A. Gimving, The Danish Environmental Protection Agency / Pesticides and Gentechology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cgbb; A. Schwen, 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 only available in the national language of the origin country only, which makes it hard for other countries to use the data, and (iii) the interpretation of groundwater 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. Sossou, 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 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 1.0 cm-1 (EFSA 2012). On the other side, ESA has stated that effects of wash-off should not be considered as additional soil loading, 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 (EFPA). 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 were done under heavy rainfall and heatwave conditions. 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. 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. EFSA 2010: PPR opinion 1442 - Outline on exposure of organisms in soil EFSA 2012: Scientific Opinion 2562 – Science behind the guidance on soil scenarios EFSA 2015: Guidance Document 4093 - Predicting environmental concentrations in soil EFSA 2017: Guidance Document 4982 - Predicting environmental concentrations in soil

**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. Köhler, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamsoefit, 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. An alternative hypothesis is that such substances move so quickly in the soil column that they are taken up by plant roots to a lesser extent than indicated by static laboratory plant uptake studies. To address this particular question an outdoor container study was conducted with 14C-labelled 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 classes, e.g. refrigerants like HFCs and HCFCs, anaesthetics, and pharmaceuticals, pesticides, pyrolysis of PTFE (used as coating in many products like Teflon® or GORE-TEX®). Root uptake of TFA under static conditions has been determined in parallel with experiments using plants growing in nutrient solution (hydroponic 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. Holtermann, Wageningen University & Research / Agrosystems Research; 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. Relations 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. Sprayer 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. Consequently, the part of downwind spray which is applied is recorded during the experiments. Horizontal and vertical movements of the sprayer boom were recorded as well. Variance of spray deposits at 2 m downwind from the field edge was about 50%. At 5 m downwind variance was about 30%. 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. Holtermann, Wageningen University & Research / Agrosystems Research; J. van de Zande, Wageningen University and Research / Agrosystems Research

Pesticide residues in fruit and vegetables involve spraying techniques that apply the pesticide in upward or sideways direction. Particularly for high avenue trees the directed part of the spray that is blown towards the top of the trees may reach sideways may pass underneath the tree canopies and reach downwind areas easily. Measurements of downwind spray deposits for tree nurseries identify 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 with experiments in 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. Holtermann, 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 approximately 90,000 people live within 50 m of flower bulb or treated potato field. At 2 m downwind from the treated area. Airborne spray drift is measured up to 10 m height, whether their health is at risk. Recently, a research project was launched to assess regarding spray drift deposits similar to those established experimentally. Effects of fluctuating wind 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. Consequently, the part of downwind spray which is applied is recorded during the experiments. Horizontal and vertical movements of the sprayer boom were recorded as well. Variance of spray deposits at 2 m downwind from the field edge was about 50%. At 5 m downwind variance was about 30%. 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.

MO152
P. Adrian, M. Liegeois, M. Darriet, B. Joumel, ECHTRA SAS

There is no recent guidance on how to conduct a risk assessment for consumers for co formulators present in plant protection products. One of the reasons is the lack of exposure data when the product containing its co formulators 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 System. Simulation of pesticide fruit using an Information System however 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 formulator. The objective of this work is to develop a methodology to be applied under this 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
E. Pizarro Bouza, L. Ferreira, EFSA - European Food Safety Authority / Pesticides Unit

Science-based approaches and integrated risk assessments 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 derived from 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 international 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 throughout 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
J. Lee, Seoul National University / Department of Agricultural Biotechnology; Y. Shin, Seoul National University; J. Lee, College of Agriculture Sciences Seoul National Univ / Agricultural biotechnology; J. Lee, Seoul National University / Department of Agricultural Biotechnology; B. Kim, Seoul National Univ.; E. Kim, H. Ryu, Seoul National University / Department of Agricultural Biotechnology; D. Jang, Seoul National Univ.; X. Yuan, Seoul National University / Department of Agricultural Biotechnology; E. Park, S. KIM, Seoul National Univ.; M. Rehan, Seoul National University; J. Kim, Seoul National University / Department of Agricultural Biotechnology

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 and risk assessment and for risk managers’ 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.
MO155  Multi-focus Surface Water Calculations: What do they mean for real regulatory cases?  
D. Schaefer, Bayer Crop Science / Environmental Safety; G. Reinken, Bayer AG, Research & Development, Crop Science / Environmental Safety; A. Boleshan, Bayer AG, Research & Development, Crop Science; S. Heine, Bayer AG / Effect modelling; G. Goerlitz, Bayer Crop Science AG / Environmental Safety  
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 FOCUS sw 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 extended FOCUS sw weather data. Therefore, Surface water exposure is strongly driven by individual weather events triggering run-off 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-year 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  
S. Otto, Italian National Research Council, S. Gottardi, M. Pasini, Agrea SRL; R. Bondio, DOW AgroSciences Italia srl / RD; O. de Cirugeda Helle, Dow AgroSciences  
The main objective of the work was to study the effect of grass buffer strips on reducing the runoff of Spinosad. The study was performed in summer 2017 to test vegetated buffer strip removal efficiency of such buffers. Recent research suggests that these default removal 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-loam soil and slope ranging from 10 to 13%. Natural vegetation cover was 60-90%. The area initially to be run-off was organized in 2 phases: 1) Irrigation with sprinkler at 14 mm/h for 50 min (total: 12 mm), to simulate rainfall before runoff; 2) Run-on/Runoff event: 200 mm of water were released into the buffer area in 2:20 hours using a runner generator (flow of 85 mm/h). Water coming from the precipitation generator (Run) and water transferred into buffer area, the “Run-on” becomes “Runoff”, and runoff water was sampled at 0.75, 1.5 and 2.20 hours after Run-on start. During Run-on, irrigation continued until the end of run-on (other 33 mm), and a total of 45 mm were applied to buffer area. Given the frequencies of selected rainfall (low, return period of 2 years), the runoff/rainfall rate (high, 45%), the source to buffer area proportion (high, 10 to 1), and the plot slope (from 10% to 13%), conditions of the experiment can be considered highly precautionary, and more prudent than those of Focus R4. First results show that the runoff displacement ranges from 3 to 11 m from Runoff releasing. Analysis of spinosyns concentration are in progress.

MO157  EPA’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. This is the starting criterion 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 epoxiconazole. In September 2016, EFSA organised a technical meeting with stakeholders on its new guidance to exchange views. EFSA PPR Panel (EFSA Panel on Plant Protection Products and their Residues), 2016. Guidance on the establishment of the residue definition for dietary risk assessment. EFSA Journal 2016;14(12):4594, 129 pp. doi:10.2903/j.efsa.2016.4594. OECD (Organisation for Economic Co-operation and Development), 2009. Series on testing and assessment No. 63 and Series on pesticides No. 31 Guidance document on the definition of residue; ENV/JM/MONO(2009) 30; 28-Jul-2009. “Info session on applications – pesticides - technical meeting with stakeholders on EFSA GD on residue definition for dietary risk assessment. http://www.efa.europa.eu/it/events/event/160926

Alternative Approaches to Animal Testing for Ecotoxicity Assessments (P)

MO158  Investigations on the bioconcentration of xenobiotics in the freshwater amphipod Hyalella azteca  
C. Schliepichem, Fraunhofer IME / Department Bioaccumulation and Animal Metabolism; J. Holldener, Eawag / Environmental Chemistry; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; V. Kostfeld, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; D. Esser, A. Schulte, Fraunhofer IME / Ebersbach; B. Friel, 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 TGJ 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-vivo BCF testing: I) An invertebrate flowthrough 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 aspect of metabolism capacity to the existing BCF prediction model. 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 were 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.

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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 (IC50) were determined from 90-141 to 0.08-38 μM among these species for the environmental concentrations of fadrozole. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodontidae), white sucker (Catostomidae), rainbow trout (Salmonidae), and fathead minnow (Cyprinidae) were investigated for sensitivity to in vitro inhibition of aromatase by four additional inhibitors. Potencies of fadrozole, imazalil, propiconazole, and propiconazole relative to fadrozole 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 aromatase. This model provides improved data 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
D.A. Vignati, CNRS / LIEC UMR7360; G. Masson, Université de Lorraine and CNRS / LIEC UMR7360
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, neglects 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 contribution, we report 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 distillation, 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 better than 90%. In the case 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 assessment
K. Finlayson, Griffith University - Smart Water Research Centre / Australian Rivers Institute; F.D. Leusch, J. van de Merwe, Griffith University / Australian Rivers Institute
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.

MO162
Comparison of rat liver S9 to an animal-free alternative ewoSR9 in the Ames fluctuation assay
J. Brendt, RWTH Aachen University; B. Thalmann, EWOMIS; K. Bluhm, University of Saskatchewan; K. Kauffmann, RWTH Aachen University / Department of Biochemical Engineering; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Dept. of Environmental Analyses; A. Schiwy, EWOMIS; J. Büsches, RWTH Aachen University / Department of Environmental Engineering; H. Hollett, RWTH Aachen University / Institute for Environmental Research
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 money consuming method. Differences between cell cultures, for example, 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
Q SAR: a predictive approach for electronic cigarette toxicological assessment
D. Zarini, University of Isfahan; E. Papa, A. Sangion, University of Isfahan /
Department of Theoretical and Applied Sciences (DiSTA); E. Caruso, University of Insubria / DiSTA; S. Zucchi, S. Sterpone, E. Ferri, TRUSTICERT SRL

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 are available to predict the proportion of the adult population using the electronic 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, comprehensive assessment of e-cigarette 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. The selected end points data of the chronic ecotoxicity of human pharmaceuticals. Hirose, National Institute of Health Sciences / Division of Risk Assessment; T. O. Martin, Environmental Protection Agency / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P. W. Wilson, Sanofi U.S., Inc.; Health, Safety and Quality, explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecotoxicology concept. This poster will present the architecture, web-interface, and associated tools and a live demonstration of the web interface and associated web tools will be available.

MO164 Evaluation of QSAR models for daphnia and fish chronic toxicities of human pharmaceuticals

T. Yamada, National Institute of Health Sciences; M. Kurimoto, National Institute of Health Sciences / Division of Risk Assessment; H. Shiraishi, National Institute of Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Research; N. Tatarazako, Ehime University / Center for Theoretical and Applied Sciences (DiSTA); E. Caruso, University of Insubria / Center for Theoretical and Applied Sciences (DiSTA); Hirose, National Institute of Health Sciences / Division of Risk Assessment

Recently, medical regulatory agencies require pharmaceutical companies to assess environmental impacts of new pharmaceutical products before marketing. Hence, it would be valuable to predict ecotoxicity of new pharmaceuticals at developmental stage. The Ecological Threshold for Toxicological Concern, or ecoTTC, has been proposed as a natural next step to the well-known human safety TTC concept. The ecoTTC is particularly suited for use as an early screening tool in the risk assessment process, in situations where chemical hazard data is poor, or when an appropriate QSAR is unavailable. ecoTTCs are developed using statistical distributions of Predicted No-Observer Effect Concentrations (PNECs) to reflect the breadth and depth of the underlying dataset and, therefore, the ecological Threshold for Toxicological Concern, or ecoTTC, has been developed to define the potential acute toxicological profile of 265 molecules contained into MO165 Optimization and Accessibility of the Eco-Database and the Ecotoxicological Threshold of Concern (ecoTTC) tool

R. R. Otter, Middle Tennessee State University / Biology; M. Embry, ILSSI; S. E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M. Barron, U.S. EPA / Gulf Ecology Division; A. Beasley, The Dow Chemical Company / TERC; J. Brill, The Procter & Gamble Co. / Environmental Stewardship and Sustainability; H. Chang, FDA / Center for Tobacco Products; D. Chang, United States Environmental Protection Agency; D. H. Zhu, DuPont / Toxicology / Center for Environmental and Human Health; B. Furr, ILSI Health and Environmental Sciences Institute (HESI) / Health and Environmental Sciences Institute HESI; A. Kienzler, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-UECL EURVCAM; T. J. Norberg-King, U.S. EPA / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science; P. W. Wilson, Sanofi U.S., Inc.; Health, Safety and Quality, explore the data, upload additional datasets, derive threshold values based on specific criteria, and explore the potential use and application of the ecotoxicology concept.

MO165 Using toxicokinetic and toxicodynamic modelling to predict effects of chronic toxicity on rodent growth based on in vitro assays

T. O. Martin, Environmental Protection Agency / NHEERL/Mid-Continent Ecology Division; H. Sanderson, Aarhus University / Environmental Science / Environment; P. Thorbek, Syngenta / Environmental Safety

According to 2011 figures, 80% of the animals used for testing procedures in the European Unionic rodents and almost 23% are used in longer term repeated dose tests. Alternative methods to predict the effects of chronic toxicity in rodents can therefore make a significant contribution to the reduction, replacement and refinement (3Rs) of animal testing. Body weight is one of the many endpoints monitored throughout chronic toxicity tests. We aim to develop in silico models to extrapolate the effect of toxicant exposure, measured as an appropriate internal dose metric and its effect on growth over the duration of repeated dose toxicity studies. These models will be developed using data from regulatory toxicity testing of pesticides. Experiments will then be designed to assess the effects of known intracellular pesticide concentrations on cell population growth in vitro. Cell number can be converted to cell mass, after which it should be possible to model the effects of mixing internal doses on growth over time, in vitro and in vivo. The weight normalised effect on growth (mass; dose group / mass; control at a given time point) can then be calculated at various points along the predicted in vitro growth curves. These predictions can then be compared to corresponding in vitro data. These toxicodynamic models will be used for 10 pesticides, which will provide a good indication of the reliability and repeatability of the methods. Should predictions prove to be consistently accurate, this will provide a fast and inexpensive in vitro screen for body weight effects in rodents. Initially this may be applied as an alternative to range finding studies which are not a regulatory requirement but are commonly carried out prior to regulatory testing. In the longer term this may form part of a suite of in vitro and in silico alternatives to in vivo chronic toxicity testing.

MO167 Screening of metabolic- and neurotoxicity of environmental chemicals using C. elegans and transgenic zebrafish models

Y. Akam, S. Lee, University of Seoul; H. L. University of Seoul / School of Environmental Engineering; N. Chatterjee, University of Seoul / Environmental Engineering; J. Choi, University of Seoul / School of Environmental Engineering

Metabolic and neurodevelopmental disease have been attracting attention as...
MO170 Chemical availability of Organic Electrochemicals - A Nonanimal Approach to Identify Candidates for Reactive Toxicity
A. Böhme, UFZ - Helmholtz Centre for Environmental Research / Ecological Chemistry; G. Schuurmann, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry

Organic electrochemicals are important components within the exposomes 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 chemical interaction with nucleophiles (MIE: toxicity). For understanding the toxic efficacies of hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemical availability, a set of 58 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on $T_r$. 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 $T_r$ with increasing $K_{ow}$ is caused by a rate-determining transfer-step of the electrophile from lipophilic compartments into the aqueous cytosol. Finally, chemical availability, as a trade-off between log $K_{ow}$ and log $K_{m}$, is shown as a 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 OSIRIS (GOCE-2007-030717) and the BMBF-funded project ProHapTox (FKZ 031A422A and 031A422B) for financial support. [1] Mulliner D, Schüürmann G 2013. Mol. Inf. 32: 98-107. [2] Böhme A, Lapa A, Schüürmann G 2016. Chem. Res. Toxicol. 29: 952-962. [3] Fenech 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. Wendt, Schüürmann, Helmholtz Centre for Environmental Research - UFZ / Department of Ecological Chemistry

Electrochemical compounds such as α,β-unsaturated carbonyls are valuable reactants in organic synthesis and commonly used as industrial intermediates and products. At the same time, their electrochemical reactivity may become critical in case of uptake into organisms because of the ubiquitous presence of nucleophilic sites in proteins and DNA, leading to reactive electrophilic species. Exposure to electrophiles is of high toxicological concern. Thus, identification of toxicologically relevant compounds is desired. A step forward would be to predict – rather than measure – the electrochemical reactivity of compounds directly from molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on the quantum chemical descriptor Local Electrophilicity and investigated for their potential in aquatic toxicity was investigated. For this purpose, their 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 electrochemical compounds contained 97 α,β-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. Bicherg, F. 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 their mechanisms of action. In order to understand the toxic effects of some 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 Bauer et al. (2018) is used in combination with a data-driven approach which is derived from empirical data specific to the MechoA. The acute toxicity of esters to aquatic flora and fauna may be assessed against a hydrophobicity descriptor (i.e. log $K_{ow}$ 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 about 100 times less effective at hydrolyzing the polyesters than in fish and daphnids because they can produce two times more metabolite than mono-esters. The more reactive esters are usually unsaturated, like allyl/vinyl-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.

MOI73 Nanosecond pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos
K. Arizono, Prefectural University of Kumamoto / Faculty of Env & Synthetic Science; A. Yamazaki, National Institute of Health; M. Chida, Aichiak National College of Technology / Department of Chemical and Biological Engineering; H. Ishibashi, Ehime University / Faculty of Agriculture; S. Konno, National Institute of Technology, Aichi College; N. Tominaiga, Aichi National College of Technology / Department of Chemical and Biological Engineering

We developed and applied the nanosecond pulsed electric field (nsPEF) 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 nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MOI74 Moving 3D in vitro intestinal models forward: transcriptomic characterization of the RTgutGC cell line.
L.M. Legane, 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 vitro models which allow for focused investigation. 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 the use of 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 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 annotation to confirm. Over 43 genes were shown to be differentially expressed in the cell line compared to the native tissue while 229 were shown to be down regulated. KEGG pathway analysis revealed the presence of significant metabolism pathways still active in the model. This study provides the first in-depth sequence data of any rainbow trout cell line and identifies many commonalities between the 3D model and native tissue. Characterization of the RTgutGC transcriptome and genes and enzymes expressed in this model will greatly help in building realistic in silico models of exposure when integrated with other available chemical data.

MOI75 Impact of test concentration on the in vitro intrinsic clearance using trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals
H. Laue, Givaunaud Schweiz AG / Fragrances & T; L. Hostettler, Givaunaud Schweiz AG; K. Jenner, Givaunaud / Global Regulatory Affairs & Product Safety; G. Sanders, Givaunaud International SA / Regulatory Affairs and Product Safety; A. Natsch, Givaunaud Schweiz AG / Fragrances & CT

Bioaccumulation in aquatic species is a critical endpoint in the regulatory assessment of chemicals. The bioconcentration factor (BCF) is usually determined in fish (OECD TG 305). In vitro systems measuring biotransformation rates of chemicals to refine BCF model estimates have been established as alternative methods to refine predictive methods which are based on hydrophobicity (i.e. log Kow). Fragrance chemicals frequently contain different isomers complicating its analysis especially at low concentrations. Thus, they have been commonly tested at 1 µM. Results reported recently indicate that first order depletion rate constants (kdep) measured at test concentrations of 1 µM could underestimate the in vitro intrinsic clearance resulting in an overestimation of the BCFs. However, these observations were mainly reported for substances from one chemical class (polyhydroaromatic carboxanions, PAAH). For pyrene, chrysene and benzo[a]pyrene, kdep determined at lower concentrations were 4- to 12-fold higher than kdep measured at 1 µM. However, the effect of test concentration of industrial chemicals is lacking. The goal of this study was to compare kdep values using different concentrations (e.g., 0.2, 1 and 5 µM) for four fragrance chemicals. These chemicals represent a diverse class of high log Kow (4.3-6.5) industrial chemicals. Rainbow trout liver S9 fractions from different sources were used and their enzymatic activity characterized using commonly used fluorescence assays (EROD, p-nitrophenol glucuronidation and CDNB-gluthatine conjugation) and substrate depletion assays with testosterone, 7-hydroxycoumarin, pyrene and Cyclohexyl salicylate as reference chemicals. Decrease of the parent compounds was analysed by GC-MS or LC-MS and kdep values determined. For the lowest concentration (0.2 µM), ca. 2-fold higher kdep values were observed for Polysantol, Arombrix, Cyclohexyl salicylate and Karanal compared to kdep values determined with 1 µM. Measured kdep values were 2-fold lower with 5 µM except for a 4-fold lower rate for Polysantol compared to 1 µM test concentration. The biotransformation rates of the fragrance chemicals tested at 0.2 µM and 5 µM were then compared to the nPAH (0.2-5 µM) compared to PAHs indicating that their Keq may be substantially higher. Thus, for fragrance chemicals which are moderately to rapidly biotransformed, the use of 1 µM as start concentration seems to be a suitable approach to estimate the bioaccumulation potential.

MOI76 Biological effects of 3 metals on "D" larvae of Japanese oyster Crassostrea gigas
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; C. Caceres-Martinez, Universidad Autònoma de Baja California Sur

Crassostrea gigas is a bivalve mollusk from Japan that lives along the coastal systems of the Mexican Pacific. Due to the fact that in the last 10 years the populations have had problems in their survival, in this work the evaluation of 3 biomarkers was performed in "D" larvae of this species, exposed to the metals Cd, Cr, Pb and its mixture, because these xenobiotics, are in high concentrations in the sites where the oysters are grown. Bioassays (72 hrs) were conducted where the "D" larvae were exposed to different concentrations of metal and their mixtures at a proportion 1:1. With the obtained data, the LC50 was calculated and the evaluation of 3 biomarkers was measured in the surviving organisms: the degree of lipoperoxidation (TBARS: Buege & Aust. 1978), the activity of the AChE enzyme (Ellman et al., 1961) and genetic damage (Comet Test: Singh et al., 1988). The toxicity of metals according to the calculated LC50 values was: (from most to least toxic) Pb > Cd > Cr. This trend was also observed in mixture toxicity for Cd+Cr+Pb (45 ± 11.89 nM Tbars mg-1). The Kruskal-Wallis test indicated that there are significant differences in the degree of lipoperoxidation, inhibition of AChE activity and genetic damage between the exposed organisms and the control group. The metal with the highest oxidative effect was Chromium (32 ± 8.97 nM Tbars mg-1). And the metal mixture: Cd + Pb (45 ± 11.89 nM Tbars mg-1). In the evaluation of genotoxicity it was observed that Chromium had the highest effect (91% cells with damage) and Lead the lowest (43%). Cadmium and the mixture of metals caused inhibition in the activity of AChE (56% 38% respectively). The results of this study show that the Cd, Cr and Pb metals in sublethal concentrations have deleterious effects on the "D" larvae of Crassostrea gigas.

MOI77 Toxicity effects caused by exposure to Dichlorvos in organisms of different trophic levels
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; A. Perez-Rojas, Universidad Autonoma Metropolitana Iztapalapa / Laboratory of Aquatic Toxicology & Ecotoxicology; L. Gutiérrez, Universidad Autonoma Metropolitana Iztapalapa / Laboratory of Aquatic Toxicology & Ecotoxicology

Dichlorvos (DDVP) is an organophosphate insecticide considered by the EPA as highly toxic. Because there are few studies of the effects of DDVP in aquatic organisms The objective of this study was to evaluate the toxicity of Dichlorvos in organisms of different trophic levels Cladocerans: Daphnia magna, Daphnia exilis, Daphnia pulex and Simocephalus minutus. The ostracod Cypris sp. and fishes: Japanese char (Chrysophrys jordani) and juvenile zebrafish (Danio rerio). In addition their sublethal effects were evaluated by means of assessment of four biomarkers (growth rate, O:N index, lipoperoxidation and inhibition of acetylcholinesterase enzyme). Acute bioassays were performed, the organisms were exposed to 6 pesticide concentrations to determine the LC50. Subsequently tests with duration of 15 days were made where the organisms were exposed to a sublethal concentration (LC50), for assessment of 4 biomarkers (growth rate, O:N index, lipid peroxidation and inhibition of acetylcholinesterase enzyme). The LC50 values obtained in the bioassays varied from 5,300 to 0.021 mg L-1. In the tests it was evident that the cladoceran Daphnia exilis was more sensitive to DDVP compared

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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 layers 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
J. Mogn, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; A. Lillicrap, NIVA / Ecotoxicology and Risk Assessment; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization.
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 increasingly used in ecological risk assessment as well as in environmental monitoring programs. Our ongoing 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.
L. Genc, Wageningen University & Research / Toxicology; M.H. 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 differential impacts on physiological functions, development and homeostasis. For the purpose of this study, two cell lines were used together with the established models 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 three fractions, highest induction was observed in 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. 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. Petersen. University of Saskatchewan/Canada.

The project was funded by the Norwegian Research Council, project no. 221373.

Characterising estrogenic activity of arctic char tissue extracts in two fish in viva and in viva.
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 of up to 8 times higher levels than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that resident Arctic char might be at risk for adverse effects at the individual and population level. In this study the aim was to compare the toxic potency 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 macrophages of the following fractions (F) were produced: F1 - nonpolar POPs such as PCBs, PBDEs and most of the nonpolar pesticides, F2 - polar pesticides and metabolites of POPs, and F3 - polar POPs (phenolics such as chlorinated phenols and hydroxylated metabolites of PCBs and PBDEs). A method for isolation, culture and exposure of primary hepatocytes from Arctic char was used together with the established models 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 three fractions, highest induction was observed in 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 preformed to identify potential contributors to the observed effects.

Acknowledgements: The project was funded by the Norwegian Research Council, project no. 221373.

Changes in protein expression of primary sea turtle cells exposed to contaminants from anthropogenic activities.
C. Petersen, Wageningen University & Research / Toxicology; H.H. 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 differential impacts on physiological functions, development and homeostasis. For the purpose of this study, two cell lines were used together with the established models 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 three fractions, highest induction was observed in 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 preformed to identify potential contributors to the observed effects.

Acknowledgements: The project was funded by the Norwegian Research Council, project no. 221373.

Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.
L. Genc, Wageningen University & Research / Toxicology; M.H. 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 differential impacts on physiological functions, development and homeostasis. For the purpose of this study, two cell lines were used together with the established models 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 three fractions, highest induction was observed in 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 preformed to identify potential contributors to the observed effects.

Acknowledgements: The project was funded by the Norwegian Research Council, project no. 221373.
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 utilised. 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 of non-destructive methods for the detection of biomarkers 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 chemical exposure and effect, we optimised exposure and extraction methods and aimed to identify the nature of the chemical mixture and disease processes in wildlife. A prominent example are organic prodrugs that are known to accumulate in sea turtles - a polychlorinated biphenyl (PCB153) and perfluoronanoic acid (PFNA). The exposure was performed over 24 or 48 hours to three environmentally relevant concentrations (1 μg/L, 0.1 μg/L, and 0.01 μg/L). Global protein expression was then measured using quantitative LC/MS resulting in over 10,000 unique protein identifications. 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 PCB 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 Nemateode C. elegans as Alternative Bioassay

M. Amposah-Ofei, University of Duisburg-Essen; S. Saleem, E. Büttner, A. Bier, A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

The nemateode Caenorhabditis elegans is the first multicellular organism with a completely sequenced genome. Since more than 20 years, it has been employed as a model for assessing the environmental toxicity associated with sediments. More recent work indicates that this worm may have a toxicity-sensitization potential. 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 utilised. 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 of non-destructive methods for the detection of biomarkers 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 chemical exposure and effect, we optimised exposure and extraction methods and aimed to identify the nature of the chemical mixture and disease processes in wildlife. A prominent example are organic prodrugs that are known to accumulate in sea turtles - a polychlorinated biphenyl (PCB153) and perfluoronanoic acid (PFNA). The exposure was performed over 24 or 48 hours to three environmentally relevant concentrations (1 μg/L, 0.1 μg/L, and 0.01 μg/L). Global protein expression was then measured using quantitative LC/MS resulting in over 10,000 unique protein identifications. 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 PCB 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 Nonanomal Tool for Mimicking Phase I Metabolism

J. Moldrick, 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 chemicals’ 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 electronic 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-electrophilic phenol and dihydroxybenzene derivatives to their free potent electrophiles. The latter are trapped by coinubation 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 demonstrate the EU-funded project OSIRIS (OC07-CT-2007-103717) and the BMBF-funded project ProPhaTox (FKZ 031A422A and 031A422B for financial support.

MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes

M. Amposah-Ofei, University of Duisburg-Essen; S. Saleem, E. Büttner, A. Bier, A. Paschke, UFZ. Helmholtz Centre for Environmental Research / Department of Ecological Chemistry; G. Schüürmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

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 TDI, we developed six continuous QSAR models for acute and chronic aquatic endpoints for the main trophic levels: EC50, 96h and NOEC 96h algae (Raphidocelis subcapitata), EC50, 48h and NOEC 21d Daphnia magna, LC50, 96h 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 (R² 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.veghub.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 interspecific variability, the most sensitive species and the applicability domain index of the predictions. The users can choose a consensus or a weighted approach. The experimental values and the predictions are used to derived 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 - 80710/20 - 3716.65.4140) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/ES/416) for the financial support.

MO186 An integrated testing strategy to fill data gaps for environmental risk assessment of isocoumarins

G.E. Bragin, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Sciences; B. Hedgforth, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; B. Kelley, D. Letinski, ExxonMobil Biomedical Sciences Inc; J. Butler, ExxonMobil Biomedical Sciences Inc; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Laboratory; M. Lampi, ExxonMobil Biomedical Sciences, Inc. / Toxicology and Environmental Quality Benchmarks. Quantitative Structure Activity Relations (QSAR) endpoint estimates are often appropriate for chemicals with a very strong correlation to aquatic toxicity test data. However, QSAR estimates require comprehensive justification to demonstrate applicability, and still may not fully meet regulatory requirements, leading to extensive long-term toxicity testing. Here, limited, strategic environmental testing was used to support QSAR predictions, thereby reducing animal testing while still meeting regulatory requirements.
Aquatic toxicity testing with algae, daphnids and fathead minnows (OECD 201, ISO 20665 and OECD 210) was performed with isoocetol and isoondecanol. 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 isonicotins. The 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
V. Lioussa, K. Eisner, S. Limbeck, D. Rünstler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Glyphosate-based herbicides are widely used in agriculture. When these products are intentionally introduced into the market, they are needed 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. Nonanoic acid (a.k.a. pelargonic acid) is a biological 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 zebrafish 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 originally 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
Chem assay 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. As organic compounds, salicylates may act as constituents of the exposomes of waterborne flora and fauna. As organic compounds, salicylates are described in these REACH dossiers, with conflicting argumentations on which is most relevant. It is well known that Kₚow is a problematic parameter for surfactants, but this means that to reduce animal testing for bioconcentration factors and (baseline) toxicity of surfactants, insight in the key parameters of pure surfactant components driving uptake in biota is highly needed, alongside better understanding of elimination rate processes for such compounds. The BIONIC model could apply such key parameters for ionogenic surfactants. The phospholipid-water partition coefficient is considered to be the dominant contributor to the overall tissue-water partition coefficient for ionogenic surfactants, because membranes lipids allow for both ionic interactions at the zwitterionic head groups and hydrophobic interactions at the membrane core. Sorption experiments vary orders of magnitude higher affinities of ionogenic surfactants couldn’t be stored or sampled in large quantities. 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 12 past 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 (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined 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 assessed and ranked to ecological concern, 2) when the WWTP 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 decarboxylation 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 assay 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 disrupters. 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 quantities. OECD is currently validating this in vitro 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 12 past 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 (WWTP). Assessing the quality of the WWTPs outlets for endocrine active molecules is a major challenge for reaching the good ecological status of the natural water bodies defined 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 assessed and ranked to ecological concern, 2) when the WWTP 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 decarboxylation process. The major removal of the thyroid active molecule occurs during the nitrification step of the wastewater treatment.

MO191
Advances in lactation detection of Daphnia magna, Artemia franciscana and Paramecia caudatum
E.M. Salzer, V. Lioussa, X. Monforte Vila, D. Rünstler, University of Applied Sciences Technikum Wien / Department of Biochemical Engineering
Animal behavior is complex and multidimensional. Over the past decades researchers tried to qualify and quantify 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 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, in order to facilitate swimming behavior characterization and select an appropriate 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, a custom-made, portable multi-well plate was constructed. 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-fabricate 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 25 - 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. Shiraiashi, National Institute for Environmental Studies; H. Yamamoto, National Institute for Environmental Studies / Center for Health and Environmental Risk Assessment; 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 medical 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 ECOSAR software, which is well known for ecotoxicity QSAR tool, more researches have been 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 25 - Project 15-06) is gratefully acknowledged. 

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 content of this abstract neither constitute nor reflect official 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 and organ-related activity. The organization of the workflow of the evaluation of the impact of the compounds in zebrafish embryos is designed to define a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of end endpoints, analysis procedure, etc. – that can be applied by all the zebrafish toxicity community (SOP like protocols) and, eventually, to become the base for applying towards 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 three different concentrations (Log3 dose/response curve: 10μM, 33 μM, 100μM, 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-hexafluorooisopropylidenephone, 3-lodo-2-propynyl n-butylcarbamate, diethylstilbestrol, hexachlorophene, methylnercury chloride, rotenone and tetraethylthiuram disulfide.

MO196 MPA - an alternative for the standard procedure of Ames Test J. Rossetto Martins Zwarg, 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/mutagenicity 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 with 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 20 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 environmental monitoring studies.

MO197 SETAC Animal Alternatives Interest Group A. Lillevik, 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 alkylphenol monitoring in produced water L. Silvan, Norwegian Geotechnical Institute; C. Riccardi, INAIL; E. Eek, Norwegian Geotechnical Institute; M.P. Papini, Università La Sapienza / Chemistry; N. Morin, Environmental and Food Laboratory of Vendee / Chemistry; g. cornelissen, Norwegian Geotechnical Institute; A.M. Oen, Norwegian Geotechnical Inst. / Environmental Technology; s.e. hale, Norwegian Geotechnical Institute

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 platform and then directly discharged into the sea. Despite the low content of toxic compounds that remain in PW after treatment, the large volume of PW lead to high total amounts of toxic compounds discharged every year into the sea; thus an effective tool for monitoring the hydrophilic organic compounds (HpOCs) is necessary. Passive sampler devices (PSDs) are the most common tools for monitoring a wide range of organic contaminants in water. By this regard, several PSDs have been used to monitor hydrophobic organic compounds (HOCs) in PW including semipermeable membrane devices (SMPDs). However, SMPDs are not suitable for monitoring HpOCs in PW owing to the nature of these chemicals. It is therefore necessary to develop and standardize a passive sampler for HpOCs, such as APs. Polar organic chemistry (POCs) is widely used for monitoring wide range of HpOCs. It allows the time weighted average (TWA) concentration to be measured and thus assess fluctuation in discharge concentrations. POCIS is composed of a sorbent (OASIS beads), two polyethersulfone (PES) membranes and two stainless steel rings. POCIS is calibrated by evaluating the sampling rate (Rs), which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the Rs, following the extraction of both the sorbent and the PES membranes. This study 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 hydrophilic 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. Bartomeu, Agroscore/Reckenholz-Tänikon Research Station ART / Environmental Analytics; I. Hilber, Agroscore / Environmental Analytics; R. Scholin, ETH Zurich / Department of Environmental System Science; P. Mayer, Technical University of Denmark / Department of Environmental Engineering; T. Bacheli, Agroscore ART / Environmental Analytics

Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments. In this work, we describe and evaluate in situ methods using passive 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. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six different PAH-contaminated field soils. The PS were located in potted bags 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 analyzed 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 soils 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 spliced p.p'-DDE by Eisenia andrei in γ-sterilized and non-sterilized soils J. Skulcova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX; L. Bielikova, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX

The fate of organic chemicals and their metabolites in soils is often investigated in model matrices having undergone various pretreatment steps that may qualitatively or quantitatively disturb results. Presently, effects associated to γ-irradiation, spiking and dwelling of earthworms were studied in field-context (sterilization after contamination) and freshly spiked (sterilization prior to contamination) soils for the case of 1,1-dichloro-2,2-bis-(p-chlorophenyl) etylene (p.p'-DDE). Changes in its sorption and bioavailability were linked to the changes in soil organic matter (SOM) chemistry measured by Diffuse Reflectance Infrared Fourier Transform (DRIFT) spectroscopy. Qualitative interpretation of obtained DRIFT spectra revealed changes in SOM functionality relating to soil and sediments contaminated by hydrophobic 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. Here, we present the results of in situ PS concentrations of polycyclic aromatic hydrocarbons (PAHs) in six different PAH-contaminated field soils. The PS were located in potted bags 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 analyzed 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 soils 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.
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-radiation on SOM chemistry alone or in combination with earthworms. Following our findings, γ-radiation 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-radiation should be taken into consideration.

**MO201**
Dissipation in soil and bioavailability to earthworm of two fungicides: comparison of laboratory and field experiments
S. Houghton, G. Duguid, G. Argyropoulos, A. AgroParisTech; C. PELOSI, INRA (Institut National de la Recherche Agronomique)

The pesticide 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 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 dimoxystrobin 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 issuing 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 dimoxystrobin and epoxiconazole concentrations in soil were determined by an exhaustive extraction method and, to evaluate their availability, with a mild method engaging hydroxypropyl-β-cyclodextrin. At the same time, the bioavailability of the two fungicides was evaluated by determining their concentrations in exposed earthworms Apoecrita icterica and A. 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, but highly heterogeneous rates in laboratory; however, 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
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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 PELMTO) 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 this via an initial result in the input of the model is predicted important. 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 / 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 procedure designed to experimentally determine the uptake of active substances as well as metabolites via plant roots. 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) “C” 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 processes. 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, as known Abraham models, are preferred for such predictions. The and the respective partition coefficients were estimated as 0.12, 0.06, and 0.01 for soil sorption, and 0.01 and 0.001 for water sorption. In this study, the partition coefficients of neutral organic compounds between water and immobilised artificial membranes (IAM), liposomes (membrane lipid), 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 available domain of the models. Acknowledgement: 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
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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 investigate the effect of particle distribution on the partition kinetics 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 mass percentages of these fractions were 21.2%, 17.04%, 14.7%, 2.86% 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. The potential that HOCs could release to the looser surface was higher than that in the 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)
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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 burden 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 zebras are 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 zebrasfish and particle ingestion is an important route in PAH bioaccumulation. Therefore, it is of importance to consider the bioavailability of HOCs on suspended particles to improve ecological risk assessment.

Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomonas sp. strain ADP
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Atrazine is an 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 modified in 28 days. The data was non-parametric, and it was analyzed using Mann Whitney. The physiological relevance of the chemioattraction 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.

MO206
Methods for Deriving Site-Specific Relative Bioavailability Factors from Agricultural Bioavailability studies
B.H. Maze, ARCADIS; N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; A.K. Meyer, United States Army Corps of Engineers / Huntsville Center
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 and targets were 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 skeet targets were commonly prepared using coal tar pitch as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the skeet fragments 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 ratio of 5% in the diet for fourteen 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 those animals treated with soil 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 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
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 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/frit 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 f-factor 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* (msiol/insolution); note: msiol/insolution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFSAs, 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
Clodronate elimination kinetics in ewes
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Clodronate (CLD) is an organochlorine pesticide used from 1972 to 1993 against weevils of banana and black banana weevil, species usually consumed in the French West Indies. Previous studies showed a CLD absorption of 100% in goats and its metabolization and excretion. Consequently animals can be directly contaminated by involuntary soil ingestion. In case of contaminated soil 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.

Clodronate elimination kinetics in ewes
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Clodronate (CLD) is an organochlorine pesticide used from 1972 to 1993 against weevils of banana and black banana weevil, species usually consumed in the French West Indies. The objective of this study was to characterize the CLD elimination in ewes (linearity of absorption and reduce the bioavailability of organic toxicants. Earthworms are 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. Cocoon 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 28 days. The data was non-parametric, and it was analyzed using Mann Whitney. The physiological relevance of the chemioattraction 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.
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 CLDOH were quantified. In feces, CLD and 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 dependent with the dose. In consequence, the different results obtained of CLD in serum 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
M. Saint-Hilaire, Université de Lorraine UL / URAFPA INRA; T. Bortin, C. Intahavong, G. Lavoisier-Rempampou, T. Guiram, ANSES / Unité PBM; A. FOURMAR, Université de Lorraine UL; C. Feidt, G. Rychen, Université de Lorraine UL / URAFPA INRA; J. Parinet, ANSES / Unité PBM

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 still 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 chlordecone (CLDOH) in hogs, pigs and gerbils livers. Then CLD and CLDOH can be conjugated by the glucuronyltransferase. 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 1980 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 as followed: 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, CLD and its metabolites were analyzed. To conclude, the elimination of CLD in serum of ewe is not comparable with BCF measured with available guideline methods. The principle route of CLD elimination is via the feces. In urines, CLD and conjugated CLDOH were quantified. These results highlighted a better sensitivity of the new method and allowing 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 contamination of SOC and their bioavailability. One of the challenges is the understanding of how the chemical concentrations of SOC differ vastly in magnitude and spatial distribution within these areas. Mentioned as important drivers of these variations are the change in precipitation and temperature with increasing altitude and the locally prevailing wind patterns. Despite this knowledge, the task to interpret the results gained within studies on the spatial distribution of organic contaminants within high mountain areas remains difficult. To aid future researchers in their assessment this poster tries to condense the key information on fate and behavior of organic contaminants in high mountain areas. Therefore, fate determining variables with be named and the movement and bioavailability of organic contaminants throughout the seasons be described.

MO213 Pesticide occurrence in different apicultural matrices (honey bees, wax and pollen)
P. Calatayud-Vernich, M. Andrés Costa, Universitat de València / Environmental and Food Safety Research Group; F. Calatalyud, E. Simó, Agrupación de Defensa Sanitaria Apícola (apíADS); Y. Picó, University of Valencia / Medicine Preventive Sprayed crops with pesticides are visited by honey bees during pollen and nectar collecting process. Pesticides are transported inside the hive, where both, agrochemicals from agriculture and compounds used in-hive against varroosis by beekeepers are accumulated in wax, pollen and honey bees. Samples of honey bees (45), wax (7) and pollen (45) were obtained from 45 different apiaries located in Spain. The samples were extracted by a slightly modified QuEChERS procedure depending on the matrix, and then screened for 58 pesticides and its degradation products by liquid chromatography mass spectrometry (LC-MS/MS). The target analytes were chosen based on their potential toxicity to honey bees and their widespread use in plant protection or in the bee hive against varroa mite. Wax and pollen were the most considered matrixes and exhibited a wide contamination by pyrethroids and organophosphates. Beeswax lipophilic nature and its lowest replacement rate in the hive are responsible of its highest pesticide content. Acaricides used in beekeeping such as coumaphos, chlorfenavinphos, amitraz and fluvalinate were the most frequently detected pesticides in wax. Some pesticides used in crops as organophosphate chloropyrifos were detected in lower frequencies and concentrations. Pollen contamination pattern was similar to wax matrices. Acaricides applied in beekeeping were the most frequent and with the highest concentrations. Neonicotinoid acetamiprid and organophosphates chlorpyrifos and dimethoate were detected in pollen samples. Both insecticides are sprayed in crops and deposited on the pollen grains, which are transported to the hive during the foraging activity of the honey bees. Honey bee samples were less contaminated, although some acaricides were also detected. This fraction was calculated in the product of the concentrations detected in the matrices analyzed, honey bee colonies health could be compromised. Assessing pesticides content 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 honey bee colonies around the world.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.
N. Pucheu, INERIS, S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances

One of the main factor 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 PCD/D/Fe to plants and invertebrates has been studied. BCF in several plants and in earthworms had been measured and different models have been developed to predict primary poisoning, especially when both, the contaminant concentration in soil and the BCF needed with the REACH regulation are known. One of the conclusions is that the exposure concentration of terrestrial predators can be calculated in taking into account the quantity of soil contained in the earthworms guts and the contaminant fraction measured in the soil, assuming that both, 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 methods 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 guidelines and PCB-PCDD/F PCB-earthworm 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 BCF-earthworm 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?
F. Sanitaria Apícola (apiADS); Y. Pico, University of Valencia / Medicine Preventive Sanitaria Apícola (apiADS); Y. Pico, University of Valencia / Medicine Preventive

The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by meeting Environmental Quality Standards (EQSs). Normally, these standards are expressed as critical concentrations in the flesh of aquatic biota (biota EQSs) that 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. Biota monitoring (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...
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 they often do not compare to the same extent as the known, the exposure of dose is 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. Abara, Federal University of Technology Owerri / Department of Biological Sciences; L.A. Adjeroh, C.O. Ezea, Federal University of Technology Owerri / 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 to plants and animals, cause eruption in skin and various diseases. The objective 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 instrumental 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 presence of residual amount of detergent in the exposed carrot raises a public health concern as this food item is daily consumed by unsuspecting public. REFERENCES Chuku, E. C., Ogunka, -Nnoka, C. U. and Chuku, O. S. (2015). Effect of washing carrot with Omo detergent on the nutrient composition, shelf life, associated fungi and health hazards. Pacesetter Journal of Scientific Research, 1(1): 1 - 5 Institute of Public Analyst of Nigeria IPAN (2005). Training Manual for 2005 pre-admission workshop training. pp 287-288 Environmental risk assessment in time and space - new approaches to deal with ecological complexity (P)

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 assessment 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-situ 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 than the lower tiers. There is debate over the right way to place them. The risk assessors of uncertainty concepts often assume 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 uncertainty is 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 rather than just one component 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.
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, EFSAs has so far not published any guidance document. Population modelling is at least mentioned in several EFSA (draft) guidelines 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 acceptability. We 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 soil conservative fate factors of leachate samples after variable pre-equilibration times from JRC databases. Those series characterised the environment in the springtail model and drove the temperature-dependent model processes.

MO223 Dynamic modelling of fluxes of weathered polychlorinated biphenyls (PCBs) in soil: column experiments vs. modelling approaches in realistic environmental conditions
C. Vitale, University of Insubria; E. Terzaghi, University of Insubria (Como) / Department of Science and High Technology, Como; M. Morselli, A. Di Guardo, University of Insubria / Department of Science and High Technology
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 a dynamic air-soil particle mediated transport 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 in a dynamic-air, air-litter-soil model (SoilPlus model) to investigate the predictive ability and the improvements needed to obtain better predictions. The results of 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 infiel. 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).

MO226 Compensating for ecological risks of pesticides
S. Matezki, K. Swarowsky, German Environment Agency UBA / Department IV plant protection products; H. Hötker, Nature And Biodiversity Conservation Union (NABU) Germany / Michael-Otto-Institute; R. Oppermann, Institute for Agro-ecology and Biodiversity (IBAF); C. Bruelhe, University of Koblenz-Landau / Institute for Environmental Sciences; S. Matezki, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / Department IV plant protection products
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 the application. The reported yield 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 trophic 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 infiel. 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).
MO228
Historical control data of the optimized Zebrafish Embryonic Development Toxicity Assay (ZEDTA)
D. van den Oeteaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beeckhuijzen, 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 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 saccule/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 Zebrafish Embryonic Developmental Toxicity Assay (ZEDTA)
D. van den Oeteaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobor-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beeckhuijzen, 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 embryo 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 saccule/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 produce more malformations or mortality than exposure to adjusted ISO medium.

MO230
Reliability of ecotoxicological studies in fish
H. Winnemenn, Bavarian Environment Agency; H. Ferling, Bavarian Environmental Agency; G. Dembek, W. Schmidt, W. Koerner, Bavarian Environment Agency; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

Fish screening for evaluation in ecotoxicology valid bioassays are essential for deriving Environmental Quality Standards (EQSs). The generally established biotests using the three 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 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 EQSs. 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 properly defined confounding factors and/or insufficient number of concentrations tested, 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 decreasing the significant 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 inhabits 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). Through the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than those in an 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 of heavy metals 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, 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 Danio rerio
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; 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 studies at the International level. In our country the tests with this organism are only used in medical research, for this reason...
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 1,2-propylenesulfonyl (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, 0.5, 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 (increase in 17β-estradiol/testosterone [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 steroidalogenic 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 is 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.

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. Krasnov, NOFIMA; J. Lilhavainen, University of Helsinki; A. Ronkka, S. Saraei, A. Laiho, L. Elo, University of Turku and Åbo Akademi University; E. Vehniäinen, 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, cardiotoxicity, immunosuppression, tumors and alternations in reproductive expression in vivo. PAH toxicity has been studied for over 100 years and it is currently known that different PAHs have different modes of action (MoA). PAHs like retene and pyrene are aryl-hydrocarbon receptor agonists that up-regulate CYP1a expression and thereby induce their own metabolism, while other PAHs like fluoranthene directly inhibit CYP1a activity. We exposed newly hatched rainbow trout fry (Oncorhynchus mykiss) semi-statically to retene and fluorescence to either a single compound or as a mixture treatment for 1, 3, 7 and 14 days. Body length and yolk (energy) consumption were measured and the hearts collected and pooled at the end of every exposure period. Using transcriptomics, proteomics and metabolomics, cardiotoxicity was investigated at molecular level. Our results shows that fry exposed to retene and the mixture treatments, in relation to control, became shorter and in retene’s case, had used more yolk by day 14. Fatty acid composition of the diet exposure may affect growth or energy consumption by day 14. Microarray analysis showed that the different treatments caused very different alterations in the transcriptome, both in terms of the number of changed genetic expressions and when in time. The only gene (up-regulated at all sampling times and treatments was cyp1a1. In addition, cept and c1q and tnf-like domains expression were found similarly changed across all treatments but not at all sampling occasions. Using over-representation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Proteomic analysis is underway but protein expressions are suspected to show a low transcript to protein correlation (based upon literature). Heart tissue metabolomic analysis revealed that across all treatments only two out of 33 metabolites were found significantly different by day 14. Using omics methods, our study discovered several pathways affected by PAH exposure, together with phenotypic alterations, highlighting the unique MoA of different PAHs and as a mixture.

Assessment of the developmental cardiotoxicity of individual PAHs using integrated OMICS
C. Rigaud, A. N. Eriksson, University of Jyväskylä / Department of Biological and Environmental Science; A. Krasnov, 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. Lilhavainen, University of Helsinki; E. Vehniäinen, 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), hemorhaging, 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 phenanthrene can also produce cardiovascular defects (e.g. arrhythmia) via unknown AhR-independent mechanisms. In this study, we aimed 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 the evidence of which pathways are altered by PAHs, and thus help choosing candidate genes for further mechanistic toxicity studies. 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 livable with the known pathways. Exposure of the embryos by pyrene significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisoning 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. Human and fish cell lines were exposed to different doses of PBDEs until 72 hours. After these experiments, sub-lethal doses were chosen for long term treatments. Expression of genes related to cell cycle, stress, biotransformation, apoptosis and oxidative stress, were analyzed by enzymatic assay, spectrophotofluorimetry, immunoblotting and real time PCR. The preliminary results revealed that fish cell lines are more sensitive to the PBDE than human cells. A condition of oxidative stress was induced by the presence of reactive oxygen species (ROS), and relative modulation of scavenger molecules/enzymes, seems to be the crucial event that influences the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible for cancer promotion. Acknowledgements: the project CISAS “Centro Internazionale di Studi Avanzati su Ambiente, ecosistema e Salute umana” (CUP Be2F15010700085) is funded by CIFE- MIUR.

MO240
In silico estimate of affinity constants for perfluorinated compounds in rainbow trout (Oncorhynchus mykiss) proteins.
Da. Dejii Espositi, Iristea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Iristea Land; S. Casadio, University of Bologna / Department of Fish; M.P. Babut, Iristea / Water Perfluoroalkyl substances (PFASs) 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. PFCS 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 PFASs to these specific proteins are rare, refer mainly to mammalian proteins and to ACBP of the liver. In the present study, a survey of the binding constants of PFCs to 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 chemicals and the proteins of interest, may improve our ability to evaluate chemical-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 perfluorononanoate, PFNA) and L-FABP of rainbow trout and in human homologue protein. 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.

MO241
Impact of metformin on zebrafish (Danio rerio) embryos.
S. Miesek, University of Heidelberg / Aquatic Ecology and Toxicology; T. Brauneck, University of Heidelberg / Centre for Organismal Studies The bigauna metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its antihyperglycemic effect, metformin is one of the most abundantly prescribed antidiabetic medical treatment for 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%) gets excreted through urine and faeces, the poor metabolism 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 (C6H12N3O4HCl) according to OECD test guideline 236 for up to 120 hours post-fertilisation and analysed histologically with respect to acute and sublethal effects. n

MO242
Pyrogallol 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 pyrogallol by the Ames test showed that pyrogallol-containing hair gels has demonstrated that there was no 2-fold increase in reverters relative to the controls. However, it still needs to be determined its safety to the living organisms, when it is introduced to the environment. In this study, we evaluated its inhibitory effect on cytochrome c oxidase (COX) activity,
which is vital for energy production and is located in mitochondrial membranes. COX activities from zebrafish (Danio rerio), Corydoras (Corydoras 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 compounds with a complete inhibition at the concentration of 20 μM. 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. Tschudin (TCS, 5-chloro-2-(2,4-dichlorophenoxyl) 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 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 two 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 transferase (GST), was characterized, despite its widespread transport in 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, UNIVERSITÉ PARIS Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria in water bodies throughout the world. Their mechanism of toxicity consists of a potent inhibition of protein phosphatases 1 and 2 A, which causes disruption of the cytoskeleton and consequent cell death. They can also alter the antioxidant system and induce oxidative stress in various organs of many species. Microcystin-LR (MC-LR) is the most studied variant due to its high toxicity and frequent occurrence in surface waters. In this study, we used a Microcystis aeruginosa bloom extract containing the main hepatotoxin: Microcystin-LR (>95%), to compare the acute toxicity of this extract on two models: the common carp Cyprinus carpio and an omnivorous fish living in permanence in fresh waters in the presence of cyanobacteria and their toxins and the Wistar rat used essentially as toxicological model. Two doses, 20 and 100 μg equivalent MC-LR/kg body weight (BW), were administered by gavage to male and female of both models weighing approximately the same mass of 200 g. A 48 hours observation period was set to evaluate the effects on kidneys, intestine, lungs and gills were been assessed by histological observations and analysis of oxidative stress biomarkers: lipid peroxidation (LPO), reduced glutathione (GSH) level, glutathione-s-transferase (GST) and glutathione peroxidase (GPx) activities. The results obtained showed that the two sublethal doses of MC-LR cause in both species remarkable histological abnormalities characterized by a hemorrhage and inflammatory infiltrate in all organs. The analysis of the oxidative stress biomarkers in all organs of both models have shown a very significant increase in the lipid peroxidation level and the activity of the GST with a significant decrease in the concentration of GSH and the GPx activity. In addition, the most affected organs in the rat are the lungs but for the carp are the kidneys.

**MO245** Subchronic toxicity of a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congener on the common carp Cyprinus carpio

B. Berti, Z. Hadjer, H. Nasri, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria; N. Bouaicha, UNIVERSITÉ PARIS 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. In this study, the toxicities of 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), groups II and III were daily exposed by gavage (5 days per week) to lyophylized Microcystis aeruginosa bloom dispersed in 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. 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.

**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 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 or conventional crude oil to form diluted bitumen (dilbit) or bitumen diluted with dilbit (dilbit) that has been formulated for pipeline transportation. 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. In this study, the toxicities of 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), groups II and III were daily exposed by gavage (5 days per week) to lyophylized Microcystis aeruginosa bloom dispersed in 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. 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.

**MO247** Effect of skate oil and its metabolites on piscine Phase I metabolism

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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 aquatic organisms has been linked to adverse effects 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 water skatole and its metabolites, 2-aminoacetoephone, indole-3-carbinol, 3-methyloxindole, and 3-hydroxy-3-methyloxindole, can interact with fish CYP isoforms. Enzyme activities for CYP1A and CYP2A 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 CYP1A or CYP2A, 2-Aminoacetoephone, 3-methyloxindole and 3-hydroxy-3-methyloxindole reduced CYP1A enzyme activity by approximately 25-35%, whereas CYP2A 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. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15802S) and Swedish University of Agricultural Sciences.

MO248 Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights
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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 abnormalities. Gene expression patterns 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. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15802S) and Swedish University of Agricultural Sciences.

MO249 New insights on cross-species differences in the modulation of human and zebrafish nuclear receptors by single chemicals and environmental mixtures
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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 environmental hydrocarbon 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 an urban waste water treatment plant (WWTP), were screened on a set of recently developed in vitro reporter cell lines based on both human (h) and zebrafish (zf) NRs. The aim 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 abnormalities. Gene expression patterns 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. CZ.1.05/2.1.00/01.0024), CENAKVA II (No. LO1205 under the NPU I program), by the Czech Science Foundation (No. 18-15802S) and Swedish University of Agricultural Sciences.

MO250 Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos
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Triclosan (TCS) constitutes a common household product ingredient, given its antimicrobial activity, and has been widely used over the past decades. It enters the sewer system and can be transported to wastewater treatment plants (WWTP), sewarwaters and rivers, resulting in the contamination of the aquatic ecosystem. Consequently, it is urgent to evaluate its potential toxic effects to aquatic organisms. The triclosan 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 TCS 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 highthroughput testing strategy, incorporating different screening 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, nucleosides etc.) was established providing a broad coverage of the metabolome. Postaglandin F2-like derivatives have emerged as a reliable biomarker for oxidative stress in mammals and fish namely the F2 isoprostanes (F2 isoPs). This approach is an alternative to the classic targeted methods, as it did not focus on a few metabolic pathways, for which we already know that are affected by the specific stimulant and enables to unravel the involvement of unexpected metabolic pathways.

MO251 Isoprostanes in fish mucus - a non-lethal biomarker for oxidative stress
P. Bulloch, University of Manitoba / Chemistry; S. Schur, D. Muthumuni, Z. Xia, University of Manitoba; W. Johnson, University of Manitoba / Chemistry; V. Palace, IUSD-Experimental Lakes Area; G. Tanzy, Department of Fisheries & Oceans; F. Frac, Royal Veterinary College; M. Kramer, Department of Chemistry

The zebrafish has emerged as a powerful model organism to study 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 fish mucus 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 (2.1 mm x 50 mm, 3.5 µm particle size) using methanol (0.1% formic acid) and water as the mobile phase. Negative ion electrospray 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 quantify native F2-isopS. Native, non-labeled class II and VI F2-isopS were measurable in Crappie (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 as a simplified maternal transfer of selenomethionine in the fathead minnow (Pimephales promelas)**

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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 particular risk for a shortage of the internal transfer of Se. The purpose of this study was to develop and validate an embryo injection approach to model maternal transfer of selenomethionine (SeM), 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 panel, all of which achieved a maturation of the ovary. Separate groups of embryos were injected with SeM and selenomethionine (Pimephales promelas). 20 breeding groups (3 females:2 males) were fed a SeM-spiked diet of either 0, 3, 9, or 27 mg Se/kg bloodworms dry weight (dw) and bred 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 mg/kg embryo dw) and high (29.58 mg/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 on-going. 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 tool for evaluating maternal transfer of SeM. The embryo injection model could also support mechanistic and omic-based research in long-lived species of concern, such as white sturgeon, or in recreationally fished species such as rainbow trout (Oncorhynchus mykiss), an invasive, non-native and potentially toxic species. All fish were characterized in a short-term fathead minnow (Pimephales promelas) in invasive, non-native and potentially toxic species. All fish were characterized in a short-term
Zebrafish responses to the fourth-generation progestin drospirenone exposures

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Synthetic progestins (PGs) represent an important class of active ingredients of hormonal contraceptives. Although their mechanism of action is well known, it has led to environmental contamination by these substances. Although the knowledge about their environmental concentrations and effects on fish is still scarce, PGs are rapidly uptaken through fish gills and can cause deleterious effects even at low concentrations, such as the inhibition of fish reproduction. Drospirenone (DRP) arises as one of the most used fourth-generation PGs in hormonal pharmaceuticals. In contrast to its endocrine activity, it is known that DRP can interfere with other processes in fish, such on regulation of circadian rhythm. Thus, the present work aims to evaluate Danio rerio early life stages responses to DRP exposures at physiological and biochemical level. 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 a principal 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 biochemical processes 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 caging experiment as a tool for detection of in situ effects of untreated wastewaters: General stress and endocrine disruption

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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 certain chemicals were identified as being possible pollutants. Biochemical and physiological effects of these chemicals were tested on the zebrafish (Danio rerio) as immune response related genes, while light chain 3 (lc3II) as autophagy related genes. Activities were higher in specimens caged at downstream locality, while catalase activities were higher in specimens caged at upstream locality. The experience of the authors has led to the method of in situ experiments. 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 (c. 2 km from the town of Novi Sad / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX) and downstream (c. 15 km from the town of Novi Sad / Department of Biology and Ecology Laboratory of Ecotoxicology LECOTOX) of the direct 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 (il1β) and tumor necrosis factor (tnfα) as immune response related genes, while light chain 3 (lc3II) and dynecine (dyn) were selected as autophagy related genes. Expression activities were higher in specimens caged at downstream locality, while catalse 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 il1β 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 hypothyroid-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 genes, such as thyrotropin releasing hormone (trhr), thyroid-stimulating hormone receptor (tshr), sodium-iodide symporter (nis), thyroid peroxidase (tgo), thyroglobulin (tgb), transthyretin (ttr), deiodinases 1, 2, 3a, and 3b (dio1, dio2, dio3a and 3b), and thyroid hormone receptors alpha and beta (tbra and tbb). A loess regression method was successful in identifying maxima and minima of transcriptional expression during early development of both species. Also, observed transcriptional similarities between different species, including maternal transfer of almost all transcripts (confirmed in unfertilized eggs), increasing expression of most transcripts during hatching and embryo-larval transition, and indications of a fully functional HPT-axis in larvae. By making these data available to the community, we aim to aid in the development of hypotheses on the role of certain genes and pathways during development. Furthermore, it can function as a background reference dataset for designing and interpreting targeted transcriptional expression studies both for fundamental research and for applications, such as ecotoxicology.

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. Nototomid fish are the dominant group of fish in the Ushuaia coastal waters. Soares et al. (2016) found similarities between the Argentinean nototoms playing a key role in these ecosystems. The black southern cod, Patagonotothen tesselata 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 risk assessments related to water and sediment contamination and to provide an environmental risk in places where contamination already exists. Male fish were injected with 17β-estradiol (i.p, single dose of 10 mg/g or vehicle). Vitellogenic females were used as positive controls. Samples of skin and liver were obtained to assess vtg and estrogen receptor expression by qPCR and 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
vg-tir 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 ERE 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 ERE expression in skin are sensitive and non-harmful biomarkers of endocrinology in this Sub-Antarctic fish.

MO261
Thyroid disruption and its effects on neuronal development of zebrafish
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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 disrupting 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.

In the present study, we investigated thyroid hormone disruption in zebrafish in a bioassay battery and used the objective to assess the neurotoxic potential of the test substances based on different behaviour assays, the mechanistic link between thyroid and neurotoxicity will be made using transcriptomics, proteomics and metabolomics. This work will be conducted within the scope of the “NeuroBox”-project and in collaboration with the “Misse” project. In NeuroBox novel bioassays are developed, with the objective to assess the neurotoxic potential of water contaminants and develop water quality criteria, ultimately aiming to reduce the exposition of humans and the environment to these substances. In this context, the project is expected to further contribute to the understanding of basic mechanisms of neurotoxicity, its connection to thyroid disruption and to identify novel endpoints. This knowledge may then be integrated in a bioassay battery and used for the improvement of water quality guidelines.

MO263
Identification of toxicity pathways predicting adverse outcomes of chlorpyrifos in fathead minnows
K. Bihlm, University of Saskatchewan / School of Environment and Sustainability; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; J. Salazar Hernández, Universidad Autonoma Metropolitana Iztapalapa / Biología

Chlorpyrifos is an organophosphate insecticide that acts as a neurotoxicant through inhibition of the enzyme cholinesterase. The mode of action of organophosphates in Chlorpyrifos is an organophosphate insecticide that acts as a neurotoxicant through inhibition of the enzyme cholinesterase. The mode of action of organophosphates in

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 Hidrobiología; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología

In this study an evaluation 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\(^{-1}\)) to determine the 50 lethal concentration (LC\(_{50}\)). Subsequently a bioassay with a duration of 15 days it was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC\(_{10}\) and LC\(_{5}\)). The absorption of these 2 pesticides showed that Imiprotrin is more toxic (LC\(_{50}\) = 5.3 mg L\(^{-1}\)) than Dichlorvos (LC\(_{50}\) = 5.3 mg L\(^{-1}\)). 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 imiprotrin tests varied from 64.7 to 147.5 mM TBA mg\(^{-1}\) and was higher than that observed in the bioassays with Dichlorvos (22.6 to 93.8 mM TBA mg\(^{-1}\)). In the fish exposed to Dichlorvos a decrease of 43% to 86% in the activity of the AChE enzyme was observed and from 14% to 64% 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 Imiprotrin tests 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 Omeprazol on zebrafish embryos (Danio rerio)
A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; J. Salazar Hernández, Universidad Autonoma Metropolitana Iztapalapa / Biología

Omeprazol 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 bone density, decreased absorption of nutrients, osteoporosis and neurological disorders. Its toxic effects in the environment are little persisterent 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. Omeprazol has a neurotoxic and possibly genotoxic effect.

In this study an evaluation of the toxic effect of Omeprazol 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 LC\(_{50}\) (24 hours). The embryos were subsequently exposed to the LC\(_{5}\) and LC\(_{10}\) 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 (Elliott et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the LC\(_{50}\) 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 LC\(_{10}\). In the evaluation of the AChE activity, significant differences were obtained between the control and the embryos exposed to omeprazol (p < 0.05), in the concentrations LC\(_{5}\) and LC\(_{10}\); 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 LC\(_{10}\) (24%). This study showed that omeprazol 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
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The identification, analysis and evaluation of neurotoxic chemicals are a worldwide challenge. On the societal costs for neurological disorders caused only by endocrine disrupters in Europe was 'estimated to amount to hundreds of billions euros per
year. Considering the ecosystem services/principle, effects on single species, communities and whole ecosystems would increase that up 'to hundred times, similarly to when considering other chemicals such as neuroactive pharmaceuticals. 'Antidepressants such as venlafaxine are of increasing environmental neurotoxic concern. Venlafaxine is one of the most prescribed antidepressants in Europe and the U.S. and a known aquatic pollutant. It is a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine concentrations in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations/unin fish. The aim of this study was to analyze the neurotoxic potential of Venlafaxine on zebrafish 'nlarvae by evaluating transcriptomic profiles and behavioral alterations. The locomotor activity in 'unite light-dark transition test and thigmotaxis were evaluated in 5 dpf larvae exposed to 24 h to 1, 100 nM and 100 µM and Venlafaxine using DanioVision® and EthoVision. A significant difference in swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome level were verified in zebrafish chronically exposed to Venlafaxine'n1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples (n = 25 fish) and submitted 'to 'Sybr Green quantitative real-time chain reaction (qPCR). In addition to target gene selection and consideration targets involved in circadian rhythm regulation, muscle processes and responses 'unto abiotic stimulus. Behavioral results indicate decreased swimming distance and increased thigmotaxis 'inun fish exposed, in agreement with previous own data for continuous venlafaxine exposure. Results 'unfor qPCR indicated modulation of some of the pre-selected target genes such as sklp5, and currently 'unconfirmed qPCR being evaluated. Further investigation into this research will provide more proteome 'unand metabolism analysis. This study is expected to be part of a bigger overview and understanding of 'unite different effects of chemicals and pharmaceuticals on neuronal development.

MO270: 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, University of 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. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; E.D. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Dieldrine (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 C8), associated with mitochondrial metabolism, at 120 hpf. This comprehensive research could suggest the relevance of the 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.

MO273: Mitochondrial Disorders of Zebrafish Embryos Exposed to Individual Organochlorine Pesticides and Their Mixtures
I. 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 developmental and ecological studies. We evaluated mitochondrial dysfunction in dechorinated zebrafish embryos exposed to individual 5 OCPs (i.e., p,p-DDT, Dieldrine (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 C8), associated with mitochondrial metabolism, at 120 hpf. This comprehensive research could suggest the relevance of the 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.
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. von 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 mutants, generation of new models and the ability to track and study the development and behavior of conserved 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 C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill / Department of Environmental Science and Engineering; K.H. Lib.CopyTo, K. Lamann, S. Kimura, A. Cuthbertson, S.D. Richardson, University of South Carolina; T. McDonald, Y.M. Sey, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory; S. Duirk, University of Akron; J. Simmons, U.S. Environmental Protection Agency / National Health and Environmental Effects Research Laboratory. 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 chlorination or chloramination. Our results indicate that ICMs enhance the formation of both I-DBPs and non-I-iodinated DBPs when present during chlorination and that IPAM, 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_B_00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF124865 to SDR.

MO273 The use of a polymer inclusion membrane for the determination of arsenate by gas–liquid chromatography coupled to low detection limits by using a selected ion monitoring method. J. de la Cuesta, A. Martínez, J. de las Hueras, A. Vázquez, IDAEA, CID-CSIC / Environmental Chemistry; C. Fontas, University of Girona / Chemistry; J. Cattrall, S.D. Kolev, The University of Melbourne / School of Chemistry; E. Antico, University of Girona / Department of Chemistry; R.W. Catrall, S.D. Kolev, The University of Melbourne / School of Chemistry. Arsenic is a naturally occurring toxic element, which is present in waters in different areas around the world, including South Asia, South America and to lesser extent Europe [1]. Therefore, the World Health Organization has set the guideline concentration for arsenic in drinking water at 10 µg L\(^{-1}\) [2]. The most frequently encountered arsenic species in environmental and drinking waters is arsenate (As(V)). Therefore, highly sensitive analytical techniques are required for its determination in water samples. In the present work a novel flow analysis (FA) system has been developed for the determination of As(V) in environmental and drinking waters at the low µg L\(^{-1}\) level. The system uses a polymer incorporation (PI) membrane (Hilfbrand Co-poly(vinylidenefluoride-co-hexafluoropropylene) as the polymer and Aliguat 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 cell. The flow preconcentration of As(V) 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% NaBH\(_4\) and 0.5% ascorbic acid. This is followed by arsenite generation using another reagent stream incorporating 0.5% NaBH\(_4\) and 0.5 M NaOH. The generated arsenite is transported across the hydrophobic membrane of a gas-diffusion cell into a solution containing 0.02 mM K\(\text{MnO}_2\) and 0.05 M NaOH where it is oxidised thus producing a decrease in the K\(\text{MnO}_2\) absorbance, monitored continuously at 528 nm. Under optimal conditions the FA system has a detection limit of 2.8 \(\text{ng} \text{L}^{-1}\), and a linear range between 3.0 \(\text{ng} \text{L}^{-1}\) and 2.8 \(\text{µg} \text{L}^{-1}\). 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] Villavecilla I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sci Biotechnol 7, 307–323. [2] 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. Cimino-Mellia, Catalan Institute for Water Research (ICRA); J. SEVERYNS, AQUAFIN; J. Comas, L. Coroninas, Catalan Institute for Water Research ICRA Investments for upgrading wastewater treatment plants (WWTPs) with tertiary treatment to reduce microcontaminants loads in surface waters at a catchment scale can be daunting. Our hypothesis was that these investments seriously change upon selection of the Environmental Quality Standards (EQS) for unregulated microcontaminants, and hence there is a trade-off between EQS selection and investment which needs to be considered in decision-making. We used a customized Microcontaminant Fate and Transport Model coupled to an optimization algorithm to validate this hypothesis. We used the Llobregat river basin as a case study and diclofenac as the unregulated microcontaminant. The algorithm optimized the selection of WWTPs in this catchment requiring an upgrade to minimize the EQS exceedance of diclofenac in the most critical load. The simulations were performed for different scenarios: a) implementing the standard WWTP to WWTP investments, b) including an optional tertiary treatment for the Llobregat river basin was 8 M€/year (upgrading 8 WWTPs out of the existing 56 for fulfilling an EQS of 30 ng/l in the entire catchment). Such an investment seriously changed upon selection of EQS. The costs varied from 6 M€/year (upgrading 3 WWTPs for fulfilling an EQS of 100 ng/l) to 13 M€/year (upgrading 18 WWTPs, for fulfilling an EQS of 10 ng/l). We observed that the selection of catchment hydrological conditions during the upgrading analysis also plays a key role. The cost of the upgrades when considering low surface water flows (minimum environmental flows that ensure compatibilization of environmental needs and human water consumption) was 50% higher than the cost obtained with average flows (average

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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.** B. Tapié, Univ. Bordeaux, CNRS, EPOC UMR 5805 / EPOC UMR 5805; D. Devalot, 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. Budzinski, 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 uses) in waste water, and in the end their release into the aquatic environment. So, one of the ways to evaluate the local use of illicit drugs is to track drug residues in waste water treatment plants (WWTP). This study presents 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 (POCIS) 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 drugs uses (cocaine, heroin, amphetamine, cannabis, their major metabolites and some substitutes products such as methamphetamine) in effluent and in POCIS (LOQ from 0.01 to 0.1 pg/g). Secondly triplicates of POCIS were exposed in WWTP for calibration during 10 days. POCIS were collected at different times T1 days, T2 days, T3 days, T4 days, T5 days. Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaine, benzoylecgonine, cocaethylene, cannabinoid methyl esters, cannabinoids markers (11-OH and 11-nor-Carboxy-THC) and morphine over short exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoylecgonine to 0.2 L* h⁻¹ for cocaine.

**MO276 Passive sampling in surface water as an immission-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg.** T. Galle, Luxembourg Institute of Science and Technology; D. Pittois, M. Bayerle, Luxembourg Institute of Science and Technology LIST

The pressure on surface waters that is exerted by emerging pollutants depends on the loads arriving at treatment plants and the dilution by natural flow. Both can be variable depending on the compound, the contributors 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. Here we used passive samplers to monitor the immission situation in 15 surface waters under low flow conditions and different sanitary pressures in Luxembourg. We define sanitary pressure as the number of population equivalents divided by the surface of the catchment for a monitoring point. For that purpose, a catchment delineation is performed for each measurement point and the PE of discharging treatment plants within the catchment area is calculated. Based on the hygiene situation of the population and on the sanitary pressure, rivers were classified as low, medium or high sanitary pressure. Single laboratory precision in high-ionic-strength matrix, was 5% at concentrations >150 ng/L and accuracy, was 95.6-102% for concentrations >150 ng/L perchlorate, and 111% for concentrations < 150 ng/L perchorlate. Single laboratory precision in high-ionic-strength matrix, was 5% at concentrations >150 ng/L perchorlate, and accuracy, was 100-103.5% for concentrations >150 ng/L perchorlate. This study was realized to samples published in U.S. EPA Method 332.0 for determination of perchlorate in environmental waters. The method uses a Thermo Scientific™ Dionex™ IonPac™ AS20 column set, on a recently introduced compact IC system coupled with a recently introduced single quadrupole mass spectrometer. The selectivity of the mass spectrometer allows the quantification of perchlorate in high-ionic-strength 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 deionized water are 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 125-5000 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 perchorlate, and accuracy, was 95-102% for concentrations >150 ng/L perchorlate, and 111% for concentrations < 150 ng/L perchorlate. Single laboratory precision in high-ionic-strength matrix,was < 5% at concentrations >150 ng/L perchorlate, and accuracy, was 100-103.5% for concentrations >150 ng/L perchorlate.

**MO279 New opportunities for the non targeted analysis of environmental contaminants using gas chromatography - Orbitrap mass spectrometry.** P. Silcock, Thermo Fisher Scientific / GC-MS; D. Cardona, Thermo Fisher Scientific / Environmental Analysis

Since the middle of the 20th century GC-MS has made a long journey towards its current status as one of the major analytical techniques used in a diverse range of applications. Despite this, GC-MS has had more than four decades to wait for a new type of mass analyzer with the potential to advance capability over previously applied technology. Almost two years on from the first commercial introduction of Orbitrap GC-MS in 2015, in this presentation, we explore how this technology has been applied specifically to the analysis of environmental contaminants and how it is being developed to provide a faster, more focused, and less expensive approach to routine environmental analysis. Primary applications to be highlighted are the discovery of new disinfection by-products (DBPs) resulting from water treatment processes, using a non targeted approach, as well as the potential for addressing the difficult analytical challenges for a complex class of emerging persistent organic pollutants: short chain chlorinated paraffins (SCCPs).

**MO280 HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters.** S. Veloutou, Technical University of Munich; S. Bieber, Technical University of Munich / Chair of Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich / Chair of Water Systems Engineering

Trace Organic compounds (ToCs) in water can be biogenic or anthropogenic. These compounds can range a lot in terms of polarity. Reverse Phase Liquid Chromatography (RPLC) is the most common and widely used tool for the separation of non-polar and mildly polar compounds. However, for the separation of very polar compounds, techniques like the Hydrophilic Interaction Liquid Chromatography (HILIC) are needed. HILIC has been established since years as an analytical tool, capable to separate effectively very polar molecules. Using a serial RPLC-HILIC system coupled with ToF-MS the analytical screening of samples comprised of solutes with variability in structure and polarity can be achieved. Full-spectrum acquisitions in non-target screening approaches are producing large datasets with the detected features of the samples. Different workflows have been published, proposing ways to cope with the collected amount of data in an automatic, time efficient and reproducible way, which can be applied to samples with various matrices. These workflows in a form of general steps can be summarized as: a) filtering and prioritizing the detected features (peak picking), b) molecular formula assignment, and c) a search in one or more compound databases. A relatively young compound database for water relevant compounds is STOFF-IDENT. In order to achieve a comprehensive identification of the water’s organic content, Non-target screening strategies have become increasingly popular. This study was realized by analyzing river water samples with the established RPLC-HILIC-ToF/MS system and by using the STOFF-IDENT compound database. Its main aim is to demonstrate and discuss an efficient strategy for the non-target screening of aqueous environments, as a mean to facilitate the process of identification of very polar compounds. Three 240 composite samples were collected using time proportional samplers; upstream and downstream of a WWTP and wastewater effluent. The samples were analysed by the established
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
T. Anamal, I. Toolevski, T. Sosienksi, Agilent
Perfluorinated compounds (PFASs) are organic molecules that have a C-F bond in the alkyl chain and have a range of industrial uses and can be found in various household items and consumer goods. PFASs however can have adverse health effects while longer (C-chain >7) PFASs are bioaccumulative. PFASs are extremely persistent and have been detected in various environmental matrices. Consequently, the USEPA has public health guidelines in drinking water for 2 PFASs, namely perfluorooctanesulfonic acid (PFOA) and perfluorooctanoic acid (PFOA) at 70 ng/L. However, other PFASs 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 PFASs 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 (FOSAAs) and others were separated on a liquid chromatography (LC) using a reversed phase C18 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. Subsequently, detection and confirmation of PFOA and PFOA in 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
S. Nzube, Cape Peninsula University of Technology / Department of Chemistry; C. Van der Horst, University of The Western Cape / SensorLab Department of Chemistry; V. S. Somerset, CPUT / Chemistry
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 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 isolation of benzodiazepines in wastewater matrices. Employing solid phase extraction (SPE), detection and analysis of clonazepam and lorezapam as benzodiazepines. Keywords: Benzodiazepines; Emerging pollutants; Solid Phase Extraction; Spectroscopy; Wastewater

MO283 Monitoring source and drinking waters for Microcystis using online LC/MS/MS method
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In 2015 the USEPA announced an age-dependent drinking water Health Advisory (dWA) for the natural freshwater toxins, microcystins (MCs). For pre-school age children and adults, the MC dWA values are 0.3 mg/L and 1.6 mg/L, respectively. Although the dWA values are non-regulatory values, this announcement compels compelling health information that cannot be ignored. In parallel, EPA Method 544, a solid phase extraction/liquid chromatography tandem mass spectrometry (LC/MS/MS) method was released. Our goal was to create an online concentration LC/MS/MS method with 12 MCs that meets the EPA’s quality assurance/quality control (QA/QC) criteria. MC concentrations were measured in samples from freshwater lakes and drinking water. Samples were prepared by three freeze/thaw cycles, centrifuging, and filtering through a 0.25 μm polycarbonate filter. Our LC/MS/MS platform included an online sample concentrator with UHPLC for separation and a triple quadrupole mass spec for MS/MS analysis. This method included 12 MCs with LC retention curves from 0.5 – 5000 s up to values greater than 0.996. The MCs eluted between 2.2 – 5.2 minutes allowing for the analyses time to be 3) MC-RR, [Asp] MC- LR, MC-Hir, and MC- WR at concentrations above the low health reference level of 21 ng/L. Our data suggests that 1) by not including 12 MCs in Method 544, the true risk potential to exposure of MCs in drinking and recreational waters will be underestimated greatly, and 2) an unmet need may exist to develop new non-target screening methods for MCs. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.

MO284 Development of a LC-MS/MS-based method for screening of non-targeted chemicals of potential concern in northern pike
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Fish and seafood contaminant monitoring traditionally relies on the surveillance of known chemicals, an approach referred to as targeted analysis. However, very few tools are available to monitor “unexpected” or “unknown” compounds. Non-targeted approaches are particularly useful to detect emerging contaminants in items related to the human diet such as fish and seafood. The non-targeted approach is however quite challenging for trace contaminant analysis as it involves isolating relatively small signals in complex matrices, and this, in absence of a priori knowledge about the analyte identity. In the past decade, the coupling of liquid chromatography, high-resolution tandem mass spectrometry (HRMS/MS) and advanced data processing algorithms has proved to be a robust approach for the analysis of unknown molecules in biological samples. In this study, a non-targeted workflow was developed with the objective to detect/identify unexpected organic contaminants in a predator fish from the St. Lawrence River (QC, Canada), the northern pike (Esox lucius), with a focus on chemicals originating from plastic materials. An optimized method was applied to pike tissue sampled upstream and downstream of the Montreal’s wastewater treatment plant. The two sampling sites (upstream vs downstream) were then compared using Mass Profiler Professional Software and the data based on the selection of compounds to monitor and to study at specific sites. Here, we propose an approach to prioritize 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 spread over different regulatory basins, and its performance in differentiating plastic compounds in 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 isotopeologue peaks, adduct peaks, and homologue series were detected using the R package “nontarget”. Rarity scores were calculated for all detected peaks 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 isotopeologue
MO286
Analysis of Phenanthrene Transformation Products Using High-Resolution Mass Spectrometry Coupled to High-Performance Liquid Chromatography

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Polycyclic aromatic hydrocarbons (PAHs) are environmental contaminants generated by the incomplete combustion of organic compounds. Several PAHs have been identified as toxic, mutagenic and/or carcinogenic, which has led the United States Environmental Protection Agency (US EPA) to list 16 PAHs as priority pollutants. PAHs can be metabolized by mammals and some microbes to form hydroxylated PAHs (OHPAHs) and a variety of other transformation products (TPs). These TPs have the potential to be more toxic than their parent PAHs, but they are not included on the EPA priority pollutant list. Hence, they are often not screened for in environmental samples. Non-targeted screening based on high-resolution mass spectrometry (HRMS) coupled to high-performance liquid chromatography (HPLC) can detect unknown TPs in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. C_{18}, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxypheanthrene (OH-Phe) isomers. Baseline resolution of 2-, 4-, and 9-OH-Phe was achieved with the C_{18} and phenyl-hexyl columns using a gradient of water/methanol (mobile phase A) and a mixture of acetonitrile and methanol (mobile phase B). Gradient elution beginning with a relatively high percentage of organic solvent (≥ 70%) yielded satisfactory separation and peak shape without the use of an additive or buffer. Detection was carried out with a high-resolution time-of-flight MS employing electrospray ionization (ESI) in negative ion mode. The high organic solvent composition of the eluent enabled optimal ESI performance. Consequently, spectrometric sensitivity was preserved throughout each analysis. Further investigation will determine whether the fluoro-phenyl column is suitable for separation of OH-Phe isomers. The method will be used for separation of phenanthrene metabolites and other PAH TPs in non-targeted screening of bioremediated mixtures.

MO287
Strategies to monitor transformation products in the water cycle


Transformation products (TPs) are formed in the water cycle through both biotic and abiotic processes. Data available showed that TPs can be more persistent and toxic than their mother compounds. Well-known examples are bromate and NDMA that generate toxic TPs after ozonation. Despite the TPs potentially increased toxicity compared to their parent compounds, transformation processes are not routinely monitored, and in particular those induced by drinking water treatment remain elusive. This lack of information is mainly due to the technical and methodological challenges in TPs, which has led to the occurrence of pollutants in low concentrations. Candidate analysis methods for bioassays to assess potential effects or advanced chemical analysis to elucidate TPs, such as non-target high-resolution tandem mass spectrometry (HR MS/MS) methods combined with novel data analysis approaches. Here, we addressed the challenges of TP analysis and the scarcity of TP research concerning studies in drinking water in particular, building on the insights gained from previous work. In a recent project, we assessed the relevance of transformation products as specific for the drinking water sector through interviews with the concerned parties. Based on the sector’s reported needs, we then performed a lab-scale pilot to monitor TP formation of the three organic micropollutants carbaamazine, clofibric acid, and microcystin during the rapid sand filtration and ozonation, two readily applied biotic and abiotic drinking water treatments, respectively. The experimental results show that degradation of the parent compounds and TP formation are treatment and compound specific. In silico TP prediction and literature mining significantly facilitate TP identification, yet a number of TPs remains structurally unidentified, and for the majority of identified TPs toxicological risk assessment is missing.

MO288
Application of high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater

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Chlorination could remove some aromatic emerging contaminants (ECs) in wastewater, but may also convert the ECs into unknown transformation products (TPs). This study developed a method to systematically identify the TPs of multiple aromatic ECs using high-resolution mass spectrometry (HR-MS) and traced the parent aromatic ECs of the TPs. We spiked ten aromatic ECs (5000 ng/L) into 100-mL Milli-Q water. The water was chlorinated at an initial chlorine of 0.7 mg/L for ten minutes. The full-scan mass chromatograms of both the chlorinated (n = 6) 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 the signals of some parent TPs. We also characterized the formation 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 from the untreated water samples were identified 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 hydrogens 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 systematic identification of TPs in real water samples containing multiple ECs.

MO289
Unravelling the potential of a partial nitritation/anammox biomass towards micropollutants biodegradation


In the past few years, anammox-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/anaerobic ammonium oxidation (PN/A) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metoprolol, venlafaxine and carbaamazine). Batch experiments were performed under different condition (by selecting specific activating or inhibiting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitrifying bacteria), iii) aerobic conditions with allylthiourea (an inhibitor of ammonia oxidizing bacteria), iv) anoxic (optimal for anammox bacteria), v) aerobic with acetate (optimal for heterotrophic bacteria) and vi) anoxic with acetate (optimal for heterotrophic denitrifying bacteria). Ibuprofen was the most biodegradable compound, being significantly degraded under all conditions tested except heterotrophic denitrification. Sulfamethoxazole and metoprolol 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, carbaamazepine and venlafaxine were hardly removed (≤ 10% in the majority of cases). Results demonstrate that the activation of different microbial groups in combination with altering 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 detected 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 depleting the reactors from degradable carbon (enhancing the need of the microorganisms to go after difficult to degrade carbon) or increasing the load of degradable carbon (enhancing the need of the microorganisms to degrade carbon) might be more favourable for 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, 5, 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 0.98 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 differentiation in organic matter structure which caused a change in the maximum hydrolysis rate ($k_{h1}$) and hydrolysis half saturation constant ($K_{h1}$)). The results of this study will help to clarify toxic effects of micropollutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment. This work is partially supported by TUBA-GEIBIP Award of Turkish Academy of Sciences and BAGEP Award of Science Academy Society of Turkey.

MO291 Investigating inhibitory effect of anti-inflammatory pharmaceuticals on activated sludge
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The consumption of pharmaceuticals increases annually due to a variety of reasons including affordability, population ageing and population growth. Due to the obstacles in monitoring all these micropolllutants regularly, focusing on the most hydrolysed micropolllutant (MOP) removed in the sludge, determination of the reasons for the reduced reduction of the inhibition of the sorption mechanism of pharmaceuticals as well as to advance the modelling approaches. A laboratory-scale fill&draw 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 acetic acid (50 mg/L). To assess the acute inhibition of the micropolllutant, respirometric assays were conducted with pharmaceutical mixture (PMx) as dissolved in MeOH (10, 50, 75g/L of each: Naproxen, Dichlofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and Aquasim2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture ammendment with 10g/L PMx did not result in considerable change compared to control culture, but upon addition of a higher concentration (i.e., 75g/L) there was an increase in the initial substrate consumption rate and decrease in the OUR curve. A removal efficiency in the range of 33-55% was observed for tested pharmaceuticals at the end of the respirometric assays. Measurements showed that pharmaceuticals were not accumulated in sludge phase (i.e. <2%). Modelling studies reflected that maximum hydrolysis rate of slowly hydrolysable COD ($k_{h1}$) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50g/L. When the concentration of PMx increased from 10 to 50g/L, an increase in the initial COD value of slowly hydrolysable COD was noticed. Furthermore, 75g/L PMx resulted in differentiation in organic matter structure which caused a change in the maximum hydrolysis rate of slowly hydrolysable COD ($k_{h1}$) and hydrolysis half saturation constant ($K_{h1}$) for readily hydrolysable COD ($S_0$). The results of this work will help to clarify toxic effects of micropolllutants on microbial systems as well as will provide valuable data for the discharge of these chemicals into the environment.

MO292 Elimination of tramadol and methadone in model ozonation experiments: removal kinetics and identification of transformation products
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Since the conventional wastewater treatment has proven to be ineffective for a considerable number of pharmaceutical compounds, there is a high concern about their ever-increasing release into the aquatic environment. To mitigate this problem, advanced wastewater treatment technologies, such as advanced oxidation and membrane processes, are necessary to reduce or completely remove compounds in secondary effluent. This study was developed to test the elimination of tramadol and methadone, using ozonation. The experiments were performed in three different matrices, including pure water, phosphate buffer and secondary effluent from the Central wastewater treatment plant of the city of Zagreb. The removal rate of endocrine disruptors was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed by ultra-performance liquid chromatography/triple quadrupole-time-of-flight mass spectrometry. The experiment showed that ozonation at an ozone dosage of 0.05 - 0.5 mg/L completely removed both opioid compounds in less than 5 min in pure water and phosphate buffer solution, providing that pH of the ozonation medium was higher than 7. The elimination of opioids was significantly slowed down at acidic conditions, which indicated the importance of the amino group deprotonation for an efficient reaction with ozone. Elimination of selected compounds in secondary effluent was much slower than in organic-free water matrices, reaching 91.1% and 99.1% in the time period of 10 minutes for tramadol and methadone, respectively. Reason for the lower elimination percentage is ozone depletion by reaction with other organic compounds present in the secondary effluent. The removal of parent compounds was associated with formation of two main transformation products characterized by retention times 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.

MO293 Fate and transformation of persistent priority contaminants during potable water reuse: the challenge of producing safe water
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Potable reuse of wastewater is becoming more common as populations increase and freshwater resources become more scarce. Producing safe drinking water from treated wastewater is challenging due to the presence of contaminants that are not easily removed by conventional water treatment technologies. As a result, there is still need comprehensive research to understand the toxicity mechanism of these contaminants can be harmful for human and ecological health. In 2013, two Science Advisory panels determined two lists of priority emerging contaminants (ECs) to be monitored in aquatic ecosystems and human potable water reuse. The ECs were determined based on their toxicity, persistence, and formation potential by advanced oxidation processes in environmental water concentrations. This project is investigating the removal and/or transformation of 21 of these priority ECs through UV-CH$_2$O$_x$, microfiltration and reverse osmosis in three samplings from Full-Scale Advanced Wastewater Treatment Plant (Orange County GWRS) in order to make indirect potable reuse of wastewater safer. Ultra performance liquid chromatography-tandem mass spectrometry (UPLC-MS/MS) was used to quantify bisphenol A, p-nonylphenol, bis(2-ethylhexyl)phthalate, butylbenzyl phthalate, perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOS), diclofenac, ibuprofen, erythromycin, triclosan, 17α-ethinylestradiol, 17β-estradiol, estrone and chlorpyrifos. Gas chromatography mass spectrometry (GC-MS/MS) was used to quantify perethrin, galaxolide (PDD), polychlorinated dibenzo dioxins (PCDD), polychlorinated dibenzofurans (PCDF), technical dehydro and methylene-containing products. Toxicity studies on these reacted samples were also done, and the results show that many of the TPs are more cytotoxic after being chlorinated/brominated. Mass spectra obtained from these identified TPs and DBPs are being added to a user library for use in determining TPs in our sampled waters.

MO294 Evaluation of a nano-adsorbent for the removal of metallic carcinogens from wastewater
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South Africa is experiencing the worst drought in recent history, with water becoming a scarce commodity. However, the supply of good quality water is becoming increasingly vulnerable. A view of large-scale pollution caused by agricultural, domestic and industrial activities. Many technologies including coagulation, membrane process, dialysis, foam flotation, osmosis, photocatalytic degradation and biological methods have been employed for the removal of toxic pollutants from water and wastewater. These technologies are effective but have some disadvantages such as expensive equipment, high operational and maintenance, high energy requirements, generation of toxic residual metal sludge and incomplete metal removal. On the other hand, adsorption offers high efficiency, cost-effectiveness, easy handling and recovery of metals and other adsorbed species. Heavy metals are often found in wastewaters and the removal of these inorganic pollutants using bimetallic iron-based nanoparticles is still unclear. In this study, bimetallic iron-silver nanoparticles were chemically synthesized and immobilized with chitosan to form chitosan bimetallic iron-silver nanoparticles (CSF/Fe-AgNPs) to remove heavy metals from wastewaters. In this study, chitosan iron-silver nanoparticles beads have been successfully prepared and its efficiency in the removal of Cd(II) under ambient temperatures has been evaluated. The removal...
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.


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 Green Europe)” (WP I). Principal aims of the project: to evaluate treatment processes with combined analytical, toxicological and microbiological approaches; to evaluate advanced treatment options in a multiple barrier approach to improve removal of CECs and inactivation of pathogens; to integrate the experimental results in treatment process models and groundwater models to describe the fate of CECs; 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 transform products (TPs) formed under 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 pathogens as well as fate models for sorption processes were developed. In small-scale and full-scale experiments the following processes were assessed: biodegradation, ion exchange, adsorption, and physicochemical process steps. The project FRAME is a European research initiative supported by the European Union’s Horizon 2020 research and innovation programme. It is coordinated by the German Federal Institute of Hydrology (BfG) and involves partners from 12 European countries (including Ireland) and one non-European country. A total of 44 partners from academia, industry, and public authorities in the field of water treatment and use work together to evaluate the feasibility and performance of advanced treatment processes that can be employed at large scale. The project is expected to provide answers to a wide range of questions and will be of great importance to the water sector.

MO298 Sewage Epidemiology: Investigating the Impact of Phthalates on Human Health C. Allen, L. Jones, Dublin City University / School of Biotechnology and DCU Water Institute; F. Regan, Dublin City University / Chemical Sciences; R.U. Halden, Arizona State University / Biodesign Center for Environmental Security; A. Staines, Dublin City University / School of Nursing and Human Sciences and DCU Water Institute; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates are synthetic organic chemicals commonly used as plasticisers in polyvinylchloride and as additives in personal care products. Over 2135 kg of phthalates are produced globally each year with end use products including food packaging, coatings, paints, tubing 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 DHP 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, 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: monobutylphthalate (MBP), dibutylphthalate (DBP), di-n-octylphthalate (DONP), 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 L. Jones, Dublin City University / Biotechnology and Chemical Sciences; C. Allen, Dublin City University / School of Biotechnology and DUC Water Institute; F. Regan, Dublin City University / Chemical Sciences; A. Staines, Dublin City University / School of Biotechnology and DUC Water Institute; R.U. Halden, Arizona State University / Center for Environmental Health Engineering; J. Lawler, Dublin City University / School of Biotechnology and DCU Water Institute

Phthalates, a class of plasticisers, are ubiquitous within the environment, and in many cases, detrimental to human and animal health. This project reexamined the sources, environmental fate, and human health impacts of 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 dibutylphthalate (DBP), diisononylphthalate (DINP), diisodecylphthalate (DIDP), Diisopentylphthalate (DIPP), Diethylhexylphthalate (DEHP), Dibutylhexylphthalate (DBHP), Dibutyltallowphthalate (DBT), Di-n-octylphthalate (DONP), Diisononylphthalate (DINP), and Dimethylphthalate (DMPh). A selection of phthalate monoenes 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, and 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 also contribute to adverse 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 perfluoroalkyl acids.
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This study proposes to identify the origin of 30 poly- and perfluoroalkyl substances (PFASs) in influent of a French city (Bordeaux Metropolis). For this purpose, 16 samples of domestic wastewaters, 10 samples of wastewaters impacted both by 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 as 4.6-50.1 ng L\(^{-1}\)) with the predominance of PFOS, PFHxS, C\(_6\)-C\(_8\) PFCAs and 6-2 PTSA. High levels of 6.2 and 10.2 PTSA (> 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 as 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 influence 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 C\(_{6}\)-C\(_{8}\) PFCAs, 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 C\(_{6}\)-C\(_{8}\) PFCAs in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFASs 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 micropollutants such as pharmaceuticals residues, ingredients of personal care products and endocrine disrupting compounds (EDCs) in wastewater treatment plants (WWTP) and in receiving waters. In addition to 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 C\(_{6}\)-C\(_{8}\) PFCAs in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFASs molar concentrations.

The continuous release of these xenobiotics into the aquatic environment may lead to chronic exposure of organisms at all levels of the food chain.

MO302 Mass flows of antimicrobial compounds in Swedish sewage treatment plants
M. Ostman, J. Fick, M. Tysklind, Umea University / Department of Chemistry

Antimicrobial biocides are used to protect humans, animals, and environmental assets 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, wastewater 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 fluoroazolone. QACs and chlorhexidine were those to be targeted 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) and the elution order was identified by electrospray ionization coupled with an 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 indicates that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

MO303 Herbicides and fungicides in surface waters of agricultural regions of Ontario
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

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 (90% 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 fluoroazolone, 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 C\(_{12}\)- and C\(_{14}\)-alkylhexadecylpyridinium chloride and also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO304 Heterocyclic and fungicides in watersheds of agricultural regions of Ontario
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

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 (90% 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 fluoroazolone, 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 C\(_{12}\)- and C\(_{14}\)-alkylhexadecylpyridinium chloride and also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO305 A Study on the Distribution and Behavior of Nonylphenol in the Suyeong River, Korea
D. Kim, Pukyong National University / Department of Ecological Engineering; S. Kim, National Institute of Fisheries Science; K. Roh, Pukyong National University / Department of Environmental Engineering; Y. Kim, Pukyong National University / Department of Food science and Technology

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
A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic products that are exposed to sunlight. Following use, BPs can enter ambient environments directly via treated water discharges. Numerous studies have been conducted to detect the occurrence of BPs in the aquatic environments. However, the occurrence and fate of BPs in tropical waters remains poorly understood. In this study, occurrence and fate of seven BP-type UV filters (i.e., 2,4-dihydroxybenzophenone (BP-1), 2,2',4,4'-tetrabromo-2,4-dihydroxybenzophenone (BP-2), 2-hydroxy-4-methoxybenzophenone (BP-3), 2,2'-dihydroxy-4,4'-dimethoxybenzophenone (BP-4), 2,2'-dihydroxy-4,4'-methoxybenzophenone (BP-5), 4-hydroxybenzophenone (4OH-BP) and 4,4'-dihydroxybenzophenone (4DBH)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L\(^{-1}\) in dissolved phase and < LOQ to 2774 ng L\(^{-1}\) in solid phases. Suspended solids in the water column contained significantly higher amounts of BPs than sediments, while the concentration difference between bulk water and pore water was insignificant. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at evaluating the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.

**MO308**

**Occurrence, fate and environmental risk assessment of benzophenone-type UV filters in a tropical urban watershed**

K. Gin, National University of Singapore / Civil & Environmental Engineering; F. Mao, National University of Singapore / Civil and Environmental Engineering; L. You, National University of Singapore; M. Reinhard, Stanford University; Y. He, Shanghai Jiao Tong University

A variety of benzophenone compounds (BPs) have been used as ultraviolet (UV) light absorbers in personal care products and synthetic products that are exposed to sunlight. Following use, BPs can enter ambient environments directly via treated water discharges. Numerous studies have been conducted to detect the occurrence of BPs in the aquatic environments. However, the occurrence and fate of BPs in tropical waters remains poorly understood. In this study, occurrence and fate of seven BP-type UV filters (i.e., 2,4-dihydroxybenzophenone (BP-1), 2,2',4,4'-tetrabromo-2,4-dihydroxybenzophenone (BP-2), 2-hydroxy-4-methoxybenzophenone (BP-3), 2,2'-dihydroxy-4,4'-dimethoxybenzophenone (BP-4), 2,2'-dihydroxy-4,4'-methoxybenzophenone (BP-5), 4-hydroxybenzophenone (4OH-BP) and 4,4'-dihydroxybenzophenone (4DBH)) were investigated in a tropical urban watershed consisting of five major tributaries that discharge into a well-managed water body. The BPs concentrations were measured in four compartments, i.e., bulk water, suspended solids, pore water and sediments. Results showed that benzophenone concentrations varied from widely < LOQ to 122.6 ng L\(^{-1}\) in dissolved phase and < LOQ to 2774 ng L\(^{-1}\) in solid phases. Suspended solids in the water column contained significantly higher amounts of BPs than sediments, while the concentration difference between bulk water and pore water was insignificantly. Further study will evaluate the vertical concentration profile in the aqueous phases and in the solid phases. The concentration ratio of BP-1 to BP-3 will also be addressed, aiming at evaluating the degradation of BP-3 in the field. This will be followed by a preliminary risk assessment.

**MO309**

**Formation of disinfection byproducts throughout various drinking water treatment processes**

C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; P. Emiliano, ATLL Concessionaria de la Generalitat de Catalunya, SA; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry; F. Valero, ATLL Concessionaria de la Generalitat de Catalunya, SA

This study investigates the formation of disinfection byproducts (DBPs) throughout the treatment processes operating in the various drinking water treatment and desalination plants and distribution system that supply drinking water to more than 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, 48, and 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 mixtures generated by means of gas chromatography coupled to mass spectrometry detection. The list included the regulated (N-Nitrosodimethylethylenediamine (NDMA) and N-nitrosodimethylformamide (DMF)) and non-regulated (4-hydroxy-4-methoxy-2,2'-bipyridine (PDBP), 4,4'-dihydroxy-2,2'-bipyridine (4DBP) and 4,4'-dihydroxy-2,2'-bipyridine (4H-DBP)) DBPs. 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 monoamine or diamoine and chloramines; b) formation of typical secondary amine precursors; c) chlorination of nitrite in the presence of secondary amines; d) UV or sunlight photolysis of nitrite, in the presence of 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 coagulation polymers and some anion exchange resins constitute the main source of NDMA precursors. Although 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 monoamine or diamoine and chloramines; b) formation of typical secondary amine precursors; c) chlorination of nitrite in the presence of secondary amines; d) catalytic formation on activated 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 coagulation polymers 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**

**Presence and environmental hazard of psychoactive pharmaceutical compounds in coastal waters and biota from North-Western Spain.**

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Nitrosamines can form in water in specific conditions. N-nitrosodimethyamine (NDMA) is a typical secondary amine precursor. It is formed in ground water and drinking water from the reaction of nitrite with primary amines, as 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 monoamine or diamoine and chloramines; b) formation of typical secondary amine precursors; c) chlorination of nitrite in the presence of secondary amines; d) catalytic formation on activated 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 coagulation polymers 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.

**MO306**

**Drugs of abuse distribution in Turia River based on geographic information and ecotoxicological assessment**

M. Andrés Costas, University of Valencia / Environmental and Food Safety Research Group; J. Pascual-Aguilar, V. Andreu, CID-CSIC UV GV; Y. Pico, University of Valencia / Medicine Preventive

The aim of this study establishes the influence and the effects of the human pressure in a typical Mediterranean River Basin to determine accurately the point sources of contamination through an environmental forensics methodology. A total of 42 drugs of abuse were detected in the rivers. These drugs were classified according to their spatial incidence of drugs of abuse along the Turia River Basin. The occurrence of these drugs is higher near of the cities with highest population densities according to the descriptive model of territorial presence. Compounds used as drugs are used in cosmetics, pesticides, chelating agents, amine-based polymers, etc) and their occurrence is influenced by the proximity to the consumer sites. This study will be followed by a preliminary risk assessment.
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 (PPAs) in coastal waters and marine biota is still limited. Our work represents the first attempt to monitor 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 PPAs (benzodiazepines and anxiolytics) was studied in samples of sea water and tissue from 5 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 PPAs (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 by glyphosate in the AMPF. The data were then used to assess the human health risk assessment based on the measured tissue concentrations is underway. Our results confirm the presence of PPAs in coastal waters of the Rias Baixas area in concentrations 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. Moreover, it 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 a freshwater fish, the European chub (Squalius cephalus) and the AMPF (Fe) fish were sampled 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 a 96-well plate and 13C-AMP (wt/wt) was added before extraction with nullIQ water (5mL) and ultrasonic method for 30 minutes. The extract was then derivatized (FMOC-Cl) 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 still detectable after glyphosate export, conversion and management. Results obtained further monitoring of venlafaxine and citalopram in coastal waters is recommended. Moreover, it was possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/00516) and the European Regional Development Fund (ERDF).

M0314 Psychoactive compounds in mussels: analytical method development and occurrence assessment E.L. García, IDAEA-CSIC / Department for Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environment and Water Research IDAEA-CSIC / Department of Environmental Chemistry It is well established that wastewater treatment plant effluents release pharmaceutical compounds to the aquatic environment impairing water quality. The environmental presence of these compounds may cause negative effects in the exposed aquatic organisms. In order to evaluate the ecological risk that they may pose, it is relevant not only to evaluate the relevant environmental matrices (i.e. water, soil and plants). This method will help determine the risk posed to humans, animals and the environment when reusing wastewater for irrigation. Furthermore it will aid in evaluating the natural attenuation of emerging pollutants in the agricultural environment and therefore inform on the level of treatment necessary to undertake this practice sustainably.

M0315 MPHunter: a dedicated software for µFTIR-Imaging Microplastic data analysis. First development steps and future perspectives A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; S. Primpke, G. Gerds, Alfred Wegener Institute / Shelf Sea System Ecology, M. Simon, N. van Alst, K.B. Olesen, F. Liu, J. Vollertsen, Aalborg University / Civil Engineering Department Imaging-Micro-Fourier Transform Infrared Spectroscopy (Imaging-µFTIR) applying a Focal Plane Array (FPA) is the most promising analytical tool for direct and rapid analysis of microplastics (MP) deposited on IR windows or collected on suitable membrane filters. The amount of data produced during an imaging analysis (many GB), combined with the lack of specific features addressed to MP identification and quantification in commercial FTIR softwares makes the analysis of the IR map extremely time consuming and partially operator dependent. Although a novel automatic analysis pipeline has already been developed by Primpke et al. (2017), the spectral identification is still performed using a commercial FTIR software, limiting the use of the pipeline to the FTIR software’s owners. Here we present a dedicated software (MPHunter) for MP analysis which can export, convert and manage datasets from the two FPA µFTIR Imaging suppliers. The software, which can manage several million single spectra and many
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 128x128 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 database. In this way, the spectral similarity can be further refined to define particles. The resulting 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. 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 Primpke 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
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 being applied in the JPI Ocean’s Joint Action ‘BIA-ASTRAM’. 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 can be fulfilled 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 pratical steps to identify the microplastic particles in environment samples. All operations and analyses are performed in dust-free rooms in flow boxes and all equipment is plastic-free. First procedure is a three-step vacuum filtration to divide the particles in four fractions, above 500 µm, from 500 to 50 µm, from 50 to 10 µm and below 10 µm. After filtration the particles of the different fractions are on silicon filters made from wafers which are IR transparent. Now particle identification programs determine all particles in shape and dimension and store there coordinates for the subsequent measurements with FTIR and Raman microscopy. Both methods identify the microplastic particles on the filter by their chemical structure using spectral databases. This spectral search runs automatically. The databases include polymers, copolymers, fillers, inorganic and organic substances, paints and lacquers. The IR libraries use transmission, ATR and reflection spectra and the Raman libraries use spectra measured with 532, 633 and 785 nm lasers. Every particle is assigned about the spectrum to a substance. This can be a polymer or in case of a mixed spectrum a polymer with paint/filler or also not a polymer. The fractions above 500 µm and from 500 to 50 µm are measured mainly by FTIR and the fraction from 50 to 10 µm and some selected samples below 10 µm mainly by Raman. However, several samples of the fractions above 10 µm are measured also with both methods since a combination of both delivers complete microplastic particles analysis. Further parameters, as the integration time, 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.

MO318
Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics
T. Storslet, L. Sørensen, 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 used for the quantification of plastic waste in waste materials or other matrices. Hochhuth et al. (2020) applied pyrolysis GC-MS in combination with multivariate analysis tools such as principal components analysis (PCA) and partial least squares analysis (PLS) as a tool for the automated MP identification and quantification. However, pyrolysis methods are more complicated by the presence of naturally occurring organic compounds and the presence of multiple polymer types. Furthermore, weathering processes such as oxidation and biodegradation may alter the chemical composition of the polymers, especially at the surface. In this study, an automated method for MP classification was developed. Pyrograms with associated mass spectrometric data (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 laboratory. An unsupervised 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 realist test materials for studying ecosystem impacts
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, size and composition. This is particularly true 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 (≤ 5 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 microfibres). Plastic material was separated from sand and sheeting comprising ~70% 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 differential scanning calorimetry analysis. Particle size distribution (PSD) of the primary material and generated particles showed that 68% (by mass) of the particles were in the range between 0.5 and 2.0 mm. Particle number increased with decreasing particle size fraction. Scanning electron microscopy revealed a wide range of particle sizes and shapes reflecting the properties of the different polymers. ICP-MS and ICP-OES analyses revealed the presence of a broad range of metals and other elements (e.g. Al, Cr, Fe, Mg, Pb, S and Zn) associated with the final sample. Many of these represent common inorganic plastic additives used as colourants, fillers and stabilisers. The additive organic chemical profile of the macroplastic mixture was also determined by GC-MS analysis following extraction by ethyl acetate and ultrasonication. A broad
MO320 Optimization of the preparation of standards of high density polyethylene microplastics and quantification techniques by stereo- and confocal microscopy.

J. Rojo, E. Dümichen, Bundesanstalt für Materialforschung und -prüfung / 5.3 Mechanics of Polymers

Mechanics of Polymers; P. Eisentraut, Bundesanstalt für Materialforschung und A. Mueller on their major origins & mass balance of MPs in the Arctic Ocean, and contribution of MP in terrestrial systems. This indicates the necessity of MP in terrestrial systems, 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 portions 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 municipal wastes. The potential of plastics in aquatic environments is on the rise. This trend is mainly driven by the large production of plastics in general and their large use in the packaging, construction or leisure industry. The objective 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.

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. 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 Arctic ocean to the Pacific Ocean and is regarded as a hot spot due to the warming of the Arctic ocean. 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 Arctic ocean to the Pacific Ocean and is regarded as a hot spot due to the warming of the Arctic ocean.

MO322 Microplastics in Expanded Global Table Salt Product Samples and its implication

J. Kim, Incheon National University / Department of Marine Science; S. Kim, Incheon National University / Department of Marine Science

Microplastic pollution is becoming a global issue in marine environment. Among the various environmental media, some recent studies have identified microplastic contamination that remains in salt (sea salt, lake salt, rock salt). As salt is an essential human/animal food-item, microplastic contamination in salt is of great concern. The total salt production and microplastic contamination in the sea-salt production and microplastic contamination in salt on this study. As salt is an essential human/animal food-item, microplastic contamination in salt is of great concern. The total salt production and microplastic contamination in the sea-salt production and microplastic contamination in salt is of great concern. The total salt production and microplastic contamination in the sea-salt production and microplastic contamination in salt is of great concern. The total salt production and microplastic contamination in the sea-salt production and microplastic contamination in salt is of great concern. We purchased and analyzed the salt samples sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and sea-weeds. The goal of this study is to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and sea-weeds. The goal of this study is to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and sea-weeds. The goal of this study is to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and sea-weeds. The goal of this study is to identify the contamination of microplastic in commercial table salt products sold worldwide, 2) to elucidate any relationship to the microplastic contamination between sea-salt and sea-weeds.

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) / DTU Environment

Car tire wear is estimated to represent a major fraction of microplastic pollution in the environment. Rubber particles are transported by wind 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 various...
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 supernatant. 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 enhanced leaching of aromatic SOCs, while the sludge was not effective 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 leaching of aromatic SOCs. No inhibitory effect of rubber on microbial activity was observed. PLGA as positive control in short-term tests is not encouraged due to its limited biodegradability. Future work should consider longer durations, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

MO325 Evaluating sorption properties of tire materials using poly-parameter linear free-energy relationships (pplFER)
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.1 On the other hand recycled and shredded tire crumb rubber (TCR) is applied as filler material for example on turf fields.2 It was recently shown that tire materials are a substantial share (66%) on waste that is introduced into the environment as microplastic particles.3 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 vulcanizing chemicals (e.g. zinc oxide and sulphur (1-2%)).4 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 reefs.5 Moreover, sorption of rubbers to remove organic pollutants from water.6 The precise characterization of molecular interactions between tire materials and (organic) compounds is therefore important to evaluate and predict the behaviour of tire materials in aqueous systems. Poly-parameter linear free-energy relationships (pplFERs) provide the opportunity to describe the contributions of individual molecular interactions to overall sorption processes taking into account both the physico-chemical properties of the sorbent as well as the sorbate.7 They have been successfully used to describe and predict sorption of organic compounds to various sorbents.8 This work hence intends to investigate sorption properties of tire rubber crumb using poly-parameter linear-free energy relationships.1 B. Liebmann, Mikroplastik in der Umwelt, 2015. [2] B. Bocca, G. Forte, F. Petrucci, S. Costantini, P. Izzo, Sci. Total Environ. 2009, 407, 2183. [3] C. Laureti, Microplastics: Occurrence, Effects and Sources of Releases. 2015. [4] Y. R. Lin and H. Teng, Microporuous Mesoporous Mater. 2002, 54, 167. [5] R. B. Stone, L. C. Coston, D. E. Hoss, F. Cross, Mar. Fish. Rev. 1975, 37, 18. [6] L. Alamo-Nole, O. Perales-Perez, F. R. Roman, Desalin. Water Treat. 2012, 49, 296. [7] M. Abrahám, I. A. Zissimos, J Chromatogr A 2004, 1037, 29. [8] S. S. Endo, P. Grathwohl, S. Haderlein, T. Schmidt, Environ Sci Technol. 2009, 43, 3094.

MO326 Particle toxicity in the daggerblade grass shrimp (Palaemonetes pugio): micronized tire wear particles and microparticles
J. L. Halley, Charleston / Department of Biology; R. Leads, College of Charleston / Biology; S. Kell, College of Charleston / Graduate Program in Marine Biology; A. Correa, College of Charleston / Environmental Geosciences
Recent surveys of Charleston Harbor, SC (USA) have demonstrated that >75% of total microplastics at some locations are tire wear particles (TWP). An average car tire lasts for 40000 km and during its lifetime 30% of the tire tread rubber is worn limited biodegradability. Future work should consider longer durations, which may be necessary to provide sufficient biofilm colonization of rubber particles, and assess other (abiotic) degradation mechanisms.

MO327 Acute and chronic toxicity of micronized tire rubber to Hyalella azteca
E. Khan, L. L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment
An average car tire lasts for 40000 km and during its lifetime 30% of the tire tread will be emitted into the aquatic environment. Inevitably it interacts with aquatic biota. In comparison to the wealth of research on the impacts of microplastics (MPs), there is little on micronized tire rubber (microrubber, MR). Recent reports suggest that tire rubber contributes a significant proportion of ocean’s plastic and when rubber is found in the environment it is often classed with MPs, but MR is fundamentally different from MPs in terms of structural and chemical properties, and perhaps should be considered as a distinct pollutant. MR contains a suite of toxic substances; trace metals (notably Zn, Cd), polycyclic aromatic hydrocarbons (PAHs) and polymeric softeners (such as a pyrene and) and assorted volatile organics used in vulcanization and as antioxidants (e.g. aniline) which have been shown to leach into the aquatic 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 toxic, 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 distinct 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.

MO328 Acute and chronic effects on Hyalella azteca and chemical analysis of rubber particles and leachate - comparison of pristine micronized car tire to previous data on worn car tire particles
L. L. Halley, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment; K. Kämmermann, A. Jensen, Danish Environmental Analysis; F. Khan, Roskilde University / Science and Environment
Microrubber (MR) from car tires constitutes a significant contribution to particulate contamination of the aquatic environment. MR is produced from driving, in the interface between tires and asphalt, and may eventually be lead out to the surface waters, possibly together with leached granulated rubber particles used in artificial turf. 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 micronized tire rubber on Hyalella azteca, an ecologically relevant freshwater amphipod, with respect to toxicological 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 is 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 vivo. 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 points 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.

MO329 Applying nuclear techniques to study the biokinetics and toxicodynamics of proteins and microplastics
S. A. Foster, J. L. Halley, Charleston / Graduate Program in Marine Biology; M. Wehrhahn, University of Vienna / Department of Environmental Geosciences; T. Hüffer, T. Hofmann, University of Vienna / Department of Environmental Geosciences
microplastics and co-contaminants in marine biota

C. Lancot, International Atomic Energy Agency / Radioecology Lab; M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; A.J. Catarino, Heriot-Watt University / Institute of Life and Earth Sciences; T. Cresswell, ANSTO Environmental Research / Institute for Environmental Research; B. Danis, Université Libre de Bruxelles; T. Mincer, Woods Hole Oceanographic Institution; F. Oberhaensli, P. Swarzenski, International Atomic Energy Agency / Radioecology Lab; T. Tolosa, International Atomic Energy Agency; H.K. Karapanagioti, University of Patras / Chemistry Department; M. Metian, IAEA-EL / Radioecology Lab

Despite recent efforts in understanding the risks associated with marine plastic pollution, there remains a great deal of uncertainty regarding the potential impacts of microplastics and nanoparticles on wildlife and humans. This largely relates to the methodological and analytical limitations associated with studying relatively low and environmental concentrations of these plastics. The IAEA Radioecology Laboratory, in collaboration with a team of external experts, is tackling these challenges by applying nuclear and isotopic techniques to address important outstanding questions on the risks of microplastics to marine organisms. Novel approaches using radiolabeled plastic particles and associated organic and inorganic contaminants are being developed to very precisely quantify their movement, fate and impacts on a range of aquatic biota, under controlled laboratory conditions. Nuclear techniques are uniquely suited for this research given their sensitivity and capacity to measure biokinetic and toxicodynamic parameters over time. As such, these tools will allow us to address important knowledge gaps, including: (1) the biokinetics, biodistribution and toxicity of their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminant transport in the marine environment under low exposure conditions. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

MO330

Aggregation kinetics of plastic nanoparticles in fresh and marine phytoplankton culture media

G. Venet, EPOC, University of Bordeaux / UMR EPOC 5805; J. Gigault, University of Rennes 1 / Laboratoire Geosciences Rennes; M. Baudrimont, Université Bordeaux 1 / UMR EPOC 5805

Release of plastics debris in the environment has been catching more and more concerns in recent years, especially in aquatic environment. It has been proved that plastic particles are present everywhere in the aquatic environment and can cause important environmental and ecological problems. However, there is a lack of suitable analytical tools, and the environmental fate and transport mechanisms of nanoparticles have not yet been investigated. Indeed, several ecotoxicology studies investigate the impact of nanoparticles on aquatic organisms without addressing their aggregation state in aqueous media, whereas (1) the biokinetics, biodistribution and toxicity of their biological impacts of realistic concentrations of small plastic particles (< 100 μm) in marine biota; (2) the sorption kinetics of trace pollutants to microplastics; and (3) the influence of microplastics on the bioaccumulation of co-contaminants. Importantly, this research will allow us to test if microplastics can truly be bioaccumulated (i.e., cross epithelial membranes/tissues), and if they can act as a vector for contaminant transport in the marine environment under low exposure conditions. This poster will provide an overview of the techniques used to address these questions, as well as preliminary outcomes and future directions.

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 individual 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 IHg (~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 (chlorophyll content and DNA content of 16S rRNA gene) were determined as well as the EPS thiol 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 cystene 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 IHg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the older 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. 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 Hg influence by microorganisms living in biofilms.

MO334

Gaseous elemental mercury concentration and diurnal evaporional fluxes from the water-air interface in coastal environments of the northern Adriatic Sea

S. Covelli, Dipartimento di Chimica / Dept. of Chemistry; S. Kovanovic, Dipartimento di Matematica e Geoscienze / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; F. Floreani, E. Petranich, E. Pavoni, University of Trieste; F. Covelli, Dipartimento di Chimica / Dept. of Chemistry

Among pollutants widespread in the environment, mercury (Hg) stands out 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 for its toxicity, mobility and bioaccumulation potential. In coastal areas the Mediterranean biota (M. galloprovincialis) is to live together interlocked in exopolymeric substances (EPS), rather than as individual 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 IHg (~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 (chlorophyll content and DNA content of 16S rRNA gene) were determined as well as the EPS thiol 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 cystene 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 IHg accumulation was very rapid, within minutes of exposure. The uptake rate constant of the older 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. 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 Hg influence by microorganisms living in biofilms.
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 CLOF (Closed Loop Oxidation Flow reactor) (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 measurements, the background Hg level and the biogeochemical parameters influencing Hg behaviour. This new insights will be of help for future estimations of Hg mass balance in one of the most contaminated areas in the Adriatic Sea. Keywords: atmospheric mercury; mercury fluxes; fish-farm; Grado Lagoon.

M0335

Atmospheric mercury assessment: a contribution to global monitoring and effectiveness evaluation within the Minamata Convention

A. Fino, Italian National Research Council - Institute of Atmospheric Pollution Research (CNR-I1A); F. Sprovieri, A. Macagnano, E. Zampetti, P. Papa, G. Esposito, CNR Institute of Atmospheric Pollution Research Italy; P. Nicola, Instituto di Ambiente.

In 2013, the Minamata Convention on Mercury was adopted by governments recognizing mercury as a pollutant of global concern for both human health and the environment. After reaching the 50th ratification the convention entered into force on 16 August 2017. According to the Article 22, the Conference of the Parties should establish of arrangements for providing itself with comparable monitoring data concerning the level of mercury emissions, discharges, releases, and emissions to 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-I1A) and WHO implemented a UN Environment - Global Environmental Facility (GEP) 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 for mercury analyses in human and in the environment. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOSYM)”. The project contributes positively correlated with these results. This research provides the first quantitative relationship between simulations and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

M0336

Assessment of Hg impacts on mountain river ecosystems

S. Le Faucheur, Institute F.-A. Forel, University of Geneva / Département F.-A. Forel des sciences de l’environnement et de l’eau; F. Pierron, Université de Bordeaux / UMR EPIQ CNRS 5805; C. Moniecourt, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Bouletta, RioTinto.

Mountain rivers are high flow systems which can experience, even daily, high water height variations due to the presence of dams along their courses. These conditions limit the use of water and sediment analyses for their composition limit the use of water and sediment analyses for their composition. The experience made within the project suggests that there is a urgent need to coordinate the global efforts in atmospheric mercury monitoring by integrating existing monitoring programs worldwide in cooperation with other on-going programs such as GEO (Group on Earth Observation, www.earthobservations.org) and specifically with the GEO Flagship “Global Observation System for Mercury (GOSYM)”. The project contributes positively correlated with these results. This research provides the first quantitative relationship between simulations and analysis of Hg in ambient air in order to strengthen capacity to provide globally comparable data. The poster gives an overview of preliminary results coming from the pilot survey campaigns carried out with mercury novel passive sampling.

M0338

Influence of Avian Biovecors on Mercury Speciation in a Wetland

J. Kickbush, Acadia University / Biology; M.L. Mallory, Acadia University / Biology; T. Christensen, Acadia University / Earth and Environmental Sciences; T. Christensen, 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. 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 reduction rates) for different biovecors. These results showed that the net photo-oxidation rates for freshwater were low, with mercury reduction and oxidation reactions very close to being in balance. We also found that the amount of total reducible Hg(II) changed significantly in three of the lakes over several sampling months. Dissolved organic carbon concentration was a key factor positively correlated with these results. 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.
Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure E. Junqués, Instituto de Environmental Assessment and Water Research (IDAEA-CSIC); M. Gari, IDAEA-CSIC / Environmental Chemistry; R. Lulli, General Direction of Public Health and Consumption; J. Giménez, Instituto de Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry

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 through 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 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 HCB, 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 THg acceptable daily intake (ADI) of 1 µg/kg bw. This equivalence showed that the equivalent intake for MeHg, involving provisional tolerable weekly intake of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intake in adults and children (7-12 years of age), respectively.


Fish consumption is linked to the prevention of some human diseases, especially reduces the risk of cardiovascular diseases and diabetes as well as the development of high-quality protein, vitamins and n-3 fatty acids. At the same time, fish consumption is considered a major pathway of mercury (Hg) exposure in humans. More than 90% of this Hg present in fish tissue is found essentially in its organic form (methylmercury (MeHg)), which is the most toxic form of Hg. Due to the potential adverse human health effects, international agencies have established Reference doses (Rd) as recommendations to Hg intake. Some studies have been associated the fish consumption with the Hg bioaccumulation, in areas along the Mid-Atlantic Ridge (MAR) exposed to active hydrothermal fields. The Azorean archipelago is located in the North Atlantic Ocean close to the MAR. The last fishery statistics for fish consumption per capita in the Azores archipelago shows that, each Azorean consumes about 80 kg of fish per year being the region with the highest consumption of fishery products in Portugal. This study is the result of a review of all published articles indexed in Web of Science that presented Hg concentration in the muscle for fish species captured in the Azorean Exclusive Economic Zone, and additional new data from fish obtained by recreational fish. The selection of species was based on the fish landing reports (1994-2015) of Azores Fisheries Statistics (SIEPES) and fisheries sources. Around 140000 tonnes per year of these commercial fish species are discharged. Despite low Hg levels in fish, every year the population of this area is exposed to more than 1500g of Hg via fish consumption. However, the species with the highest concentration of Hg are not always those that contribute to a higher human exposure. The fish species Mola mola exhibit higher values than the permitted for fish consumption and carnivores fish species generally exhibit higher concentration of Hg than omnivores fish species. On the other hand, demersal fish species demonstrated higher Hg concentration than pelagic fish species. Finally, the target hazard quotient (THQ) is < 1 for all fish species, meaning that the level of exposure is lower than the reference dose, and indicating that the daily exposure is not likely to cause any negative health effects during a lifetime in the human population.

Mercury concentrations in black bread from the Gippsland Lakes, Victoria, Australia. L. M.казьин, 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 bushfires and planned burns. This study, conducted in 2015, aimed to determine if the concentrations of mercury in black bread 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 kitchen fish from the Lakes from 1980 to 1998, but even then fish samples were identified by species and location. 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 sampled 25 years later. Consumption of fish and seafood is a significant health risk for babies was 0.83 but significantly reduced later in life if the lowest Hg concentration, children may eat only one 188 g portion/month. If the amount of portio ns 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, 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 species presenting a bioaccessibility below 50%. Moreover, after grilling, the bioaccessible fraction. Hg bioaccessibility in raw samples ranged between 60% green tea in Hg and MeHg bioaccessibility contaminants. In this context, the aim of the present study was to assess the effect of tea consumption and their potential effects on reduction of bioaccessibility of MeHg detected in seafood does not always reflect the amount that will be available through seafood consumption. Nevertheless, the 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. Pavoni, A. Muggia, J. Sotir, R. Pralinech, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; Noosphere Studies NAS RA / Environmental geochemistry department

**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, M. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; King Abdullah University of Science and Technology (KAUST); A. Pavoni, University of Trieste

**MO344 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada**

M. A. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; Noosphere Studies NAS RA / Environmental geochemistry department

**MO343 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish**

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**MO342 Spatial and temporal variation of mercury accumulation in Thalassia**

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, M. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; King Abdullah University of Science and Technology (KAUST); A. Pavoni, University of Trieste

**MO341 Main sources of mercury releases in Armenia**

A. Aleksyan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Noose Studies NAS RA; G. Tepanosyan, Center for Ecological-Noose Studies NAS RA / Environmental geochemistry department

**MO340 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment** (northern Adriatic Sea)

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**MO338 Spatial and temporal variation of mercury accumulation in Thalassia**

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**MO337 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, M. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; King Abdullah University of Science and Technology (KAUST); A. Pavoni, University of Trieste

**MO336 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada**

M. A. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; Noosphere Studies NAS RA / Environmental geochemistry department

**MO335 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, M. Zardac, E. Yumvihoze, A.J. Poulain, J.M. Blais, University of Ottawa / Biology, Canada; King Abdullah University of Science and Technology (KAUST); A. Pavoni, University of Trieste

**MO334 Main sources of mercury releases in Armenia**

A. Aleksyan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Noose Studies NAS RA; G. Tepanosyan, Center for Ecological-Noose 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 smelting - Copper smelting - Concentrator products and other industrial use (luminous/fluorescent lamps, thermometers, 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.
Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Minamata Convention on Mercury entered into force on 16 August 2017. As the cinnabar mines of this region have been mined without interruption since the fourth century BC until 2002. A probabilistic human health risk assessment has been carried out in order to establish whether mercury contamination of Almaden embarrassed human health at any point in the cinnabar mines area. This methodology could be used to establish if mercury contamination after mercury mines closure around the world endanger human health. E-mail contact: david.bolonio@upm.es, https://orcid.org/0000-0002-9166-1861

MO352 Concentrations of mercury in two offshore skates: sandy ray and shagreen ray J.E. Nicolau, Cefas Lowestoft Laboratory / Environment and Ecosystems Mercury concentrations in muscle and liver tissues from two offshore species of skate were examined. Concentrations of mercury in muscle of Leucoraja circularis (n=12) were found to be 0.08 µg/g (10.5 cm total length, 157–490 m water depth) and L. solitaria (n = 24; 28.5–100 cm total length, 130–426 m water depth) were 0.02–1.8 and 0.04–0.61 mg kg\(^{-1}\), respectively. Concentrations of Hg increased with total length. Only the largest specimen had a concentration of Hg in muscle >1.0 mg kg\(^{-1}\). Data were limited for specimens >90 cm long, and further studies on contaminants in larger-bodied skates could usefully be undertaken.

MO353 EMPIR project "MercOx - Metrology for oxidised mercury" I. Fettig, Federal Environment Agency (Umweltbundesamt); M. Horvat, Jozef Stefan Institute; I. de Krom, VSL; D. Douglas, LGC; T. Rajamaki, VTT Mercury (Hg) is one of the most toxic metals, and is regulated by the Industrial Emissions Directive (IED) 2010/75/EU, the Air Quality Directive 2004/107/EC, 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 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 Gunnevik fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations. Water samples were exposed using DGTs with an aragonite diffusion gel and a spheroid-thiol resin gel. Pore water data show a net production of MeHg in the GF control, from an initial 8.7 to 393 ng/l within the first month, but it then drops off to 147 and 18.4 ng/l after 3 and 6 months respectively. Compared to the control, an initial reduction of 86% MeHg in pore water is seen for the AC treatment, that increases to >95% for the 1, 3 and 6 month time series. The BC treatment causes 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 Me-Hg-concentrations measured by DGT were similar to concentrations in extracted pore water, indicating that pore water MeHg is available for uptake.
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 metrological support and development. The overall goal of the EMPIRE – MercOx project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and controlling 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 gas standards are required, as well as tissue/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 C. Liu, National Taiwan University / Department of Bioenvironmental Systems Engineering; W. Chen, Kaohsiung Medical University / Department of Biomedical Science and Environmental Biology; Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering 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 body weight. The chemical 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/organ, 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) was most accumulated in muscle. The gill burden was found to be below the scale used in assessment for risk in 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 tilapia 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 H. Penjavel, University of Aveiro; A.M. Soares, F. Morgado, University of Aveiro / Department of Biology & CESAM; S. Abreu, University of Aveiro / Dep. Biology & CESAM 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 European 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 is relatively high (…). and compares these Hg concentrations with the maximum levels of Hg for certain contaminants in foodstuffs 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 (for most of the fish species) or the concentration of 1.0 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 (P)

MO356
Ring-test of different implementations of the General Unified Threshold Model of Survival (GUTS) R. Ashauer, University of York / Environment; T. Jager, DEBt Box Research / Dept of Theoretical Biology 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 significant improvements in scenario predictions. The main conclusion is 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 errors of source as well 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 S. Augustine, Akvaplan-niva; A. Gers, Bayer AG / Crop Science Division / Department of Environmental, Social and Spatial Change; K. Lademann, Research Institute gaia; E. Zimmer, IBACON GmbH; T. Preuss, Bayer AG / Environmental Safety; V. Ducrot, Bayer AG / Environmental Safety Ecotoxicology 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 to non-target species or untested 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 TK/TD 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, zebrafish 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 for these two 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 test for effects of exposure at lower food conditions. We suggest two 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.

MO358

TK-TD modelling as 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 derive provability by using most long-term exposure scenario, 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 temperature and light conditions as well as nutrient availability. 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 freshwater 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 efficiencies were close to or above 0.9 for all four tests and, thus, the model was considered suitable for simulating effects of different exposure patterns on the growth of Lemma. 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 characterised by short-term pulses, margin 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 confirmed the variation trend predicted by the TK-TD model. The exposure profiles considered here will, with a high probability, not lead to unacceptable effects on macrophytes. This project demonstrates the usefulness of modelling as additional tool in risk assessment of plant protection products, particularly for extrapolation between scenarios which cannot all be tested experimentally.

MO359

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 variable-exposure variable and organism response over time. Here, changes in SSD (and the corresponding HC50, concentration causing 50% survival) of experimental scenarios were used for 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 inputs for the SSD calculation. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HC50s were determined. The analysis was performed separately for two compounds. Results with both toxicants revealed that the sensitivity ranking for the fish species and consequently the HC50 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 exposure profile. Additionally, longer exposure durations did not always result in lower HC50s. 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 untreated exposure patterns.

MO360

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 used 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, we extended the use of EasyGUTS for the aquatic risk assessment for the evaluation of time variable exposure. This poster presents the verification process 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.

MO361

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 waters states TK/TD 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 parameters. Particularly for TKTD models it is important to inform TKTD models with results obtained from chronic studies with test organisms 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 specifically designed peak-exposure experiments to answer both questions. We will employ short-term experiments, lasting 48h with two short peaks of 4h duration, at 3 different treatment 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 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 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.

MO362

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. Apparently, toxicity endpoints, such as the LC50s, have been reported to depend on ambient temperature (participates in aquatic invertebrates and 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.

**MO365**

The use of population models in copper risk assessment: a case study with *Acienser transmontanus*

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Current metal risk management consists of 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 (*Acienser 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 NetLogo. 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 (EC, values) for population equilibrium density were situated in the same range as population level endpoints (LC, 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 EC, values were derived with the IBM by extrapolating observed (conventional) LC, values from literature. Hereby, 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 study, 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). The TKTD model for *Daphnia magna* was adapted 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**

Deriving predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model

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Health and environmental risks posed by perfluoroalkyl acids (PFAAs) have been a major concern of public health and as a result many European and international health authorities have started to consider sadness for PFAAs as emerging contaminants, both for ecosystems and for human health, is still somewhat unexplored. Linking external exposure to the effective dose of the chemical is one of the main tasks of Environmental Risk Assessment procedures, through the establishment of safe ecological thresholds such 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...
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 test a new method 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 J.D. Stark, Washington State University / Dept of Entomology; C. Mitchell, Washington State University / School of the Environment; V. Chui, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health

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 (Oncorhynchus tshawytscha) and coho (Oncorhynchus 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-RRM links concentrations of OPs to % Acetylcholinesterase (AChE) inhibition which is then linked to sublethal impacts that are incorporated into matrix 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 T. Claudepierrre, URAFPA-INRA / URAFPA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFPA INRA; M. DELANNIOY, URAFPA-INRA / URAFPA INRA; A. El Haji, T. Oster, C. Malaplate, Université de Lorraine UL / URAFPA-INRA; N. Tran, Université de Lorraine UL / École de chirurgie, Faculté de Médecine, Nancy; F. Yen-Potin, C. Feidi, Université de Lorraine UL / URAFPA INRA

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 lack of predictive models for predicting neurotoxic effects and neurodegenerative diseases has often been suspected, 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 CLD. Following a direct treatment with the molecule. 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 F. Bauer, KREATIS; P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment

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 (eco)toxicity. Mechanisms of Action are similar to Molecular initiating Events which govern molecular interactions between xenobiotics and biological material. Using the accumulated knowledge of MechaoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechaoAs. Consequently, a new method to predict MechaoAs with high accuracy and with simple rules was developed. Using a relative Risk Model that incorporates 6 general MechaoAs including 23 detailed MechaoAs. The MechaoAs are given mainly for mammals and fish but information on other species was also included. We used a training set of 301 molecules, and validation set of 491 molecules. Our method was built as a linear decision tree composed of 62 decision rules. This method achieved 92.0% correct classifications for the training set and 92.3% for the validation set. 6% of the predicted classifications were slightly different from the literature MechaoA for the training set (3.4% for the validation set) and 1% of the training set was misclassified (4.3% in the validation set). Finally, only 1% was out of the applicability domain for the training set while no molecules from the validation set were unclassified. This model is both simpler and performs better than the previous methods we developed (Bauer et al 2018). We compared this method with Verhaar (as updated in 2008) (Verhaar et al., 1992, 2000, Enoch et al., 2008) and Russon (MOA classification by OASIS implemented in OECD QSAR Toolbox) (Russon 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 used essentially 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. Brøndt, 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, algicides 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 (T_{1/2} < 10 d) to compounds with higher persistence (T_{1/2} > 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 of octylisothiazolinone was not closed. In addition, transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Alivibrio fischeri than the
respective parent compounds. Nevertheless, for most biocides the degradation half-life is longer than time intervals between rain events in Northern Europe. Hence, though many of the used biocides are degrading relatively rapidly in soil most of the compounds residues may accumulate in soil surrounding biocide treated buildings, due to repeated input with every driving-rain event. Consequently, most biocides can be considered as "pseudo-persistent"-contaminants in this context. This was verified within the present study by (sub)urban soil screening, where concentrations of up to 0.1 μg g⁻¹ were detected for parent compounds as well as terbutryn degradation products in soils below biocide treated facades.

MO372
Biocides in facade coatings: Influence of pigments on the phototransformation of biocides
M.M. Urbanczyk, Aarhus University (AU) / Department of Environmental Science (ENVS); U. Bollmann, Aarhus University / Environmental Science; N. Borth, Dr. Robert-Murjahn-Institut; U. Schoknecht, BAM Federal Institute for Materials Research and Testing; K. Bester, Aarhus University / Environmental Science
Biocides are common additives in facade coatings to protect the materials against biological deterioration. In-can as well as film preservatives are used for this purpose. Nevertheless, these biocides leach to the environment when the façade is getting in contact with driving-rain. Long-term exposure tests in natural weather showed large gaps in the mass balances, indicating towards other loss mechanisms. The present study focused on phototransformation as a major pathway for active ingredient loss. In laboratory experiments in UV-weather chambers the formation and fate of pigments and their influence on the phototransformation of biocides was investigated. The latter is based, inter alia, on Emission Scenario Documents (ESD) providing methods for release estimation of active substances from biocidal products to the environment. In case of rodenticides (product type 14 of BPR), the current available ESD for Rodenticides (2003) has been reviewed to take account of realistic biocidal product applications as well as worst-case environmental exposure assessment. The German Environment Agency (UBA) has commissioned Dr. Knoell Consult GmbH for drafting a revised ESD for PT 14 (rodenticides) on the basis of European Competent Authorities experiences gained during active substance approval and product authorisation, experiences from a workshop on risk mitigation measures for anticoagulant rodenticides, knowledge and common practice of trained pest operators, rodenticides associations, experiences from awarding public and private authorities and furthermore. New scenarios or sub-scenarios have been developed in case of application of rodenticides in sewer systems (with reference to the different types of pipe systems) and of application in and around buildings (distinction between direct applications on paved and unpaved soil; integration of an indoor baiting scenario). A new scenario for bank slopes of water courses has been established, whereas the waste dumping and landfill scenario from the original ESD for PT14 has undergone minor adaptations. When exposure of the terrestrial compartment is considered the transport of biocidal active substances to aquifers and groundwater has to be allowed for. In case of rodenticide application an appropriate approach for estimation of local concentrations in groundwater is newly included in the revised ESD for PT14. The risk assessment for primary and secondary poisoning of non-target organisms was revised in order to provide a more generic approach, i.e. identifying focal non-target organisms. Furthermore, guidance already provided for plant protection products has been considered. The presentation aims at providing an overview of current developments in environmental emission and exposure estimation of rodenticides as biocidal products.

MO374
New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage
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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 emissions scenarios 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 behavior of biocides entering the environment through sewage systems. 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.

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. Ahting, I. Noeh, German Environment Agency (UBA) / Biocides; A. Thoma, F. Sacher, DVGW Water Technology Center; M. Kaiser, S. Fuchs, Karlsruhe Institute of Technology / 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 an 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 included. 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 behavior of biocides entering the environment through sewage systems. 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.

MO376
The 'risk envelope approach' applied to environmental risk assessments for disinfectants - a strategy to reduce workload for biocidal product families
A. Vanden Bosch, ARCHE; L. Jansen, Arche consulting; S. Navis, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation; E. Van Ael, A. Ghikere, Arche consulting; F. Verdonck, ARCHE; T. De Wilde, Arche consulting / Laboratory of Aquatic Ecology, Evolution and Conservation
Under the Biocidal Products Regulation, applicants can apply for authorisation of biocidal product families (BPPs), which consist of products with similar uses, the same active substances, similar compositions within specified variations and similar levels of risk and efficacy. Especially when consortia are formed and products from multiple companies are grouped into a single dossier, building a dossier to demonstrate safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the BPPs, in the interest of the applicants as well as the competent authorities. BPPs are typically subdivided into subfamilies called ‘meta SPCs’. The subgrouping in meta SPCs considers a.o. the composition, formulation type, product type (PT), risk mitigation measures (RMMs), classification and labelling (CL) and shelf-life of the respective products. The challenge in producing environmental risk assessments, however, most often do not coincide with the factors that determine the meta SPC structure. Instead, other grouping strategies are more fit for purpose. The risk envelope approach is a strategy routinely applied in...
plant protection product dossiers. It entails that - for each area of risk assessment - the key parameters driving that risk assessment are identified. Subsequently, the uses are grouped and ranked according to these key parameters. As such, one or more worst case or ‘critical’ uses can be identified. It if can be demonstrated that there is no undue risk to men or environment for the critical use, all other uses are considered to be covered as well. A case study will be presented whereby the concept of the risk envelope is applied to the environmental risk assessment for a BPF of disinfectants (PT 1-5). Risk assessments can be grouped (a) for different products/uses within a meta SPC, and (b) for different products/uses across meta SPCs. Overall, applying the risk envelope approach may lead to a great reduction in workload, whilst allowing for easy addition of products/uses to the BPF at a later stage. The benefits and potential difficulties of this approach will be discussed in detail.

MO377 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, K. Rauschenberger; J. Pohle, German Environment Agency (UBA) / Section Biocides; C. Meier, German Environment Agency (UBA) / Biocides; M. Ahling, J. 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 altering impacts on the behavior of bio-hazard substances and contaminating 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 single 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 measuring programme for the 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-prioritized biocidal substances and relevant transformation products that are of particular concern for the environment. Instead of monitoring individual entries into the environment, our approach aims 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 environmental behavior of bio-hazard substances and contaminating 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.

MO378 A case study on exposure assessment of biocides in PPCP using exposure assessment models
M. Kim, H. Kwon, KIST Europe / Environmental Safety Group; Y. Seol, University of Science and Technology; J. Kim, KIST Europe; E. Choe, Korea Institute of Industrial Technology; S. Kim, KIST Europe / Environmental Safety Group
Several accidents caused by the use of chemical products created a need for risk assessment of chemicals used in Pharmaceuticals and Personal Care Product (PPCP) in Korea. CMIT/MIT which is a mixture of 5-chloro-2-methyl-2H-isothiazol-3-one and one of the isothiazol-3-one is used in PPCPs as preservatives and antimicrobial agents. With its inhalation toxicity, this compound has been used as humidifier disinfectant from the 1990s without considering its exposure route and caused a lot of victims to suffer from its adverse effect. In contrast, CMIT/MIT was detected in toothpaste and the products containing the mixture were recalled in 2016 even though its toxicity via oral route is not known. The aim of study is assessing the exposure of CMIT/MIT in PPCP and comparing discussed with two different levels of consumer exposure tools. ECETOCTRA.3 was used as tier 1 model which is basic and simple but conservative calculations and ConsExpo was used as tier 2 as it can be more precisely redefined and covers more specific estimations. The gap of estimated exposure values which have been derived from these two different model was identified. It is concluded that difference between exposure calculation equations and input values affects the results. And each level of model has its strengths and weaknesses. Several improvements are needed to apply European models assessing in reflection of Korean exposure scenarios.

MO379 Hazard evaluation of biocides and its metabolites for the aquatic compartment
D. Hernandez-Moreno, INIA / Environment; M. Blázquez, 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 ECO-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, half life, persistence, biodegradation factors, aquatic chronic toxicity for fish, invertebrates, algae and WTPM 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 as: 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, marine organisms being the least studied. There was not reported data for around 8% 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 2% of 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 (< 7%) 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.

Acknowledgement: LIFE-COMBASE project (LIFE15 ENV/E000416)

MO380 Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015
Imposex is TBT-induced malformation 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 antibiotic regulations on industrial chemicals when these 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 (TPT/TN). The concentration of VDSI in 1991 (2.3 µg/kg w.w.) were low in N. lapillus at eight stations in 2015. At most stations, VDSI was 0 or close to 0 and below the OSPARs Background Assessment Criteria (BAC=0.3). The highest level (VDSI = 0.828) was found at the shipping channel Karmsundet, 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. Darriet, 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 biocide 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 for the realistic worst case scenarios concerning the leading behavior of the case. The biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives 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 algacide applied in swimming pools. The poster will present an overview on following key points: 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 environment 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
Tied to the market authorisation 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 ensure assessing the leading behaviour. In the case of the biocidal products applied in swimming pools to disinfect or to control algae growth in water, several actives 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 algacide applied in swimming pools. The poster will present an overview on following key points: 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 environment 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 Giardia, 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 - Bicoca / 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 describes a two-tiered approach to calculate PECsoil and PECgw 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 kgN Ha⁻¹ 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% of the substances actually distributed 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 national and international databases, so 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 the veterinary use only. We noted that veterinary 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 Comparing methods for estimating environmental emissions**
The environmental risk assessments consist of information on exposure and hazards of chemicals to environmental compartments. Environmental emissions for 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.

**MO385 Quick scan to monitoring data of veterinary pharmaceuticals in the Netherlands**
S. Koole, T. ter Laak, KWR Watercycle Research Institute
On the Dutch market, approx. 260 active substances are used in different veterinary medicines. As a quick scan, we investigated the potential contamination of animals to environmental occurrences of veterinary medicines in Dutch waters to feed possible policy measures. For this, we gathered information from detected compounds in both groundwater and surface water, as these sources are related to drinking water production. From the bulk of the compounds on the market no measurement data are known (84%). Of the 260 compounds used in veterinary medicines, only 24 are measured, and in total 23% of the substances actually detected. These detected involved 15 antibiotics, four anti-parasitic resources, three anthelmintics and one painkiller. Our quick-scan confirms that a good insight into the presence of veterinary medicines in the water cycle is still lacking. Not only measurement data is limited, it became clear that data on local and regional surface waters is missing or fragmented. We propose inclusion of monitoring data in national and international databases, so 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 specific veterinary use only. We noted that veterinary 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.
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 market products, including ethylene, propylene, benzene, toluene, xylene, etc. They are all 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, enabling 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, considered 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 products will have slightly different LCI results depending on different amounts of products derived from the steam cracker. Such a collaborative 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 ecoinvent database

F. Bellizaro, L.A. Oliveira, Institute for Technological Research IPT; M.R. Saade, V. Gomes, University of Campinas UNICAMP; M.G. Silva, Federal University of Espírito Santo; G. Moraga, Universidade Federal do Rio Grande / NORIE; A.B. Passuello, Federal University of Rio Grande do Sul; V.M. Jahn, University of São Paulo USP; O.S. Yoshida, Institute for Technological Research IPT

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 ecoinvent 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 ecoinvent. 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 ecoinvent 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, the treatment of the lognormal distribution for uncertainty values is significant lower than measured variations across manufacturing sites, which is inconsistent with a conservative estimation approach. Thus, uncertainty information provided by ecoinvent might contain inconsistencies and leads to error in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount parameters, performed in an 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

X. Zhang, Paul Scherrer Institute / Laboratory of energy systems analysis; C. Bauer, Paul Scherrer Institute / Laboratory for Energy Systems Analysis; T. Terlouw, University of Applied Sciences / Cernips Institute of Sustainable Development; M. Beuse, ETH Zurich / Energy Politics Group, Department of Humanities, Social and Political Sciences

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’s 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 not necessarily different. Peters et al. have recently applied in real scale, the application of nanomaterials as adsorbents 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 application regions 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. Bahramifar, Tarbiat Modares University / Department of Engineering 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 rarely 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 (FeO₂@SiO₂-NH-SH) composites, which function with a similar thyroid 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 adsorbents, it is also associated 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, ethanol, methanol, DCC (N,N’-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of test comparing the impacts between MGO-NH-SH and FeO₂@SiO₂-NH-SH estimated respectively 37, 34, 40, 31, and 26% more climate change, water 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, ethanol and DCC can reduce the impacts significantly.

MO391 Quantifying the influence of consumer behaviour on water, energy and greenhouse gas footprints of shoe

S. Shahmohammadi, Radboud University / Environmental Science; Z. Steinmann,
Environment

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

MO394

Ecotoxicity and fate of Ag and CeO2 nanomaterials in outdoor lysimeter experiments


Nanomaterials (NM) will enter the environment via diverse pathways. Sewage sludge is a reusable fertilizer applied on farmland, as well as different industrial processes. Thus, an understanding of the fate and toxicity of these NM is crucial for the assessment of environmental impacts. As the NM are very familiar with the labor and time intensity, which accompanies data collection and processing. While the amount of life cycle assessment (LCA) models and findings of the lysimeter study. For Ag NM the results indicate that a 300K emission factor of the soil microflora (ammonium oxidizing bacteria and constant inhibition of the soil microflora (ammonium oxidizing bacteria and natural processes. However, there are other scenarios like the exposure of the terrestrial environment via runoff. Therefore, our aim was to investigate the ecotoxicity and fate of CeO2-NM and Ag-NM under environmentally relevant conditions in outdoor lysimeters over around 2 years (CeO2-NM) and 3 years (Ag-NMs). Nanomaterials of the OECD Sponsorship Programme, namely NM-212 (CeO2) and NM-300K (Ag), were used for the experiments. Two concentrations for each CeO2-NM and Ag-NM were applied via sewage sludge into the top 20 cm of lysimeter soil. In addition, CeO2-NM were applied via simulated rainfall over four weeks on the surface of the lysimeter soil and afterwards mixed into the top 20 cm to simulate ploughing. Subsamples of the soils were incubated under laboratory conditions for 180 days to study the comparability of outdoor and laboratory results regarding ecotoxicity. The results from our long-term lysimeter experiments showed no detectable horizontal displacement in combination with very low remobilization for both tested NM over 2 to 3 years. Thus, indicate that the sludge applied NM and the NM applied via simulated rainfall remained nearly immobile in the pathway between soils and leachate. However, Ag uptake in the roots of wheat, corn, and barley indicates that the chemical conditions in the rhizosphere induce Ag-NM remobilization from the incorporated sewage sludge even after three harvesting cycles. The CeO2-NM did not induce any adverse effect on the investigated soil microorganisms and the plant growth. At the higher Ag-NM concentration, a constant inhibition of the soil microflora (ammonium oxidizing bacteria and substrate-induced respiration) was observed over about 3 years in the lysimeter study, while there was no effect at the lower Ag-NM concentration. The 2018 ecotoxicological results of the laboratory experiment over 180 days reflect the findings of the lysimeter study. For Ag-NM and CeO2-NM the results indicate that a hazard assessment based on data from laboratory tests is acceptable.

MO395

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 (Ag(S) and Ag(S) is considered as toxic to soil organisms. In the STP the AgNMs adsorb to sewage sludge (Schlicht et al., 2017) and the arising bisulfides 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 60, 90, 180 and 360 days, the soil samples were collected, dried, and analyzed for metal content in the digestive gland and rest of the body. 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. Preliminary data show that there are mostly ions present in the digestive glands, but NPs were also detected when the NPs were exposed only to solution. This point 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 isopods as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).

MO396 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 Sciences; 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 earthworms, the organism respiration rate was measured in ecotoxicological tests. From Eisenia fetida, biomass and the metabolic rate (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/ZN8/01576).

MO399 Evaluating the Cellular & Humoral Immune Responses of the Terrestrial Isopod, Porcellio scaber, to Gold Nanoparticles C.A. Mayall, University of Ljubljana, Biotechnical Fac. / Biotechnical Faculty; D. Drobné, 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 metal 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 recognition of gold nanoparticles (AuNPs) and the potential effects of AuNPs on the immune system of Porcellio scaber. The relationship between NPs and the immune system will be discussed. The results show that the immune system of the isopod Porcellio scaber is able to recognize the gold nanoparticles and that it may modify its response to these particles.

MO397 Terrestrial isopods as models to assess the biotransformation of nanoparticles inside the organisms: an example with silver and gold nanoparticles A. Jernej Kokalj, University of Ljubljana, Biotechnical Fac. / Department of Biology; P. Kralj, University of Ljubljana, Biotechnical Fac. / Department of Biology; J. Lynch, University of Birmingham / Geography, Earth and Environmental Sciences; S. Novak, University of Ljubljana / Biotechnical; D. Drobné, University of Ljubljana / Department of Biology

Phyico-chemical properties of nanoparticles, such as their size, shape and dispersion, depend on their environment. Most commonly anticipated alteration of metal based nanoparticles is their dissolution and alteration in size, which are interrelated. Our previous in vivo studies with crustacean isopod Porcellio scaber have shown that the dissolution of some metal nanoparticles (NPs), such as copper oxide and silver NPs, drastically increase inside the animals. These in vivo studies were typically the 14 days feeding experiments and afterwards the total metal content (both NPs and metal ions) was analysed in digestive glands of the animals. With the advancement of analytical techniques, such as single particle (sp-) ICP MS, it is now possible to analyse only the NPs content in the digestive gland and distinguish the signals from metal ions. This also enables to proof whether NPs are formed secondary in the organisms after ingestion of metal salt solution. We present a study where terrestrial isopods were fed silver and gold NPs and their respective metal salt controls via feeding on leaves, and afterwards the NPs and 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. Preliminary data show that there are mostly ions present in the digestive glands, but NPs were also detected when the NPs were exposed only to 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 isopods as models to assess the transformation of NPs will be discussed. This work was funded under NanoFase project (grant agreement No 646002).
hemocyt, 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 ecosystem and biosphere processes. These processes—such as 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 andrei, pot worm Enchytraeus albidus and soil nematode Caenorhabditis elegans were used following OECD and ISO protocols to determine ecotoxicity of nanoparticles. AgNO3 was tested as an ionic control for AgNP. Then, AgNP-PVP and AgNP are mixed at different ratio (1.5, 2.5, 3.5, 4.5) in order to understand the toxic effects of AgNP-PVP in the case of their different transformation rates at WWTP. Lufa 2.2 soil is mixed with biosolid (500g/L) to be used as exposure medium. Biosolid is sampled from WWTP where anaerobic digestion and sludge management. AgNP-PVP, AgNP and their different mixtures are spiked to the exposure medium. Survival and reproductive toxicity are determined with the standard toxicity test explained by Castro-Ferreira et al. [6]. Animals and exposure media are analyzed for total Ag concentrations. Therefore, lethal and/or reproductive toxicity are evaluated by considering the Ag concentrations in the exposure media (soil and porewater) and in the animals. Metabolism of AgNP-PVP and AgNP by soil organisms are determined. References [1] Ex-post evaluation of certain waste stream Directives final report European Commission – DG Environment 18 April 2014 retrieved from http://ec.europa.eu/environment/waste/pdf/target_review/Final%20Report%20Ex-Post.pdf [2] Johnson, A.C., et al. (2014). Chemosphere, 112, 49-55. [3] Topuz, E. et al. (2014). Bioresour. Technol., 128, 129–137. [4] West University / School of Biological Science; S. Bosch, D. van Gestel, CAM. (2017). Water Research, 47, 3866–3874. [5] Konstantinopoulou, F. et al. (2013). Waste Manag., 33, 1870–1881. [6] Kent et al. (2014), Environ Sci Technol, 48, 8564–8572. [6] Castro-Ferreira, et al. (2012). Chemosphere, 87,1222–1227. Acknowledgement This study is funded by Horizon 2020 Marie Sklodowska-Curie Actions Individual FellowshipsProject “TESInSAB” (Project Number: 704803) and Istanbul Technical University, Scientific Research Projects Fund (Project # J39961).

MO403

Short-term induced molecular stress responses in coelomocytes of Eisenia fetida earthworms in vivo exposed to silver nanoparticles

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Much of the work conducted to-date in nanoecotoxicology 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 and exposure assessment can impact the toxicity. 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 lividium 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, uncoupled and PVP), 5 types of polystyrene (50 nm unfunctionalised, amino (+ charge), carbonyl coated (- charge) and 100nm, 300nm unfunctionalised), 4 types of TiO2 nanoparticles (uncoupled, PVP, F127, Pleurotic 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 uncoupled 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 sulphidised 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, pharmaceutics, cosmetics, biomedical products and industries. Cerium oxide nanoparticles (CeO₂ NPs) are used in various fields such as medicine, aerospace, cosmetics, and as chemical-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 (0)), diethylaminoethyl dextran to confer a positive charge (DEA-CeO₂ (+)), and polyethylene glycol an negative charge (CM-CeO₂ (-)). The range of exposure concentrations were 0.02-1562.5 mg Ce/L. The coelomocytes were exposed exc 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 q-RT-PCR. In addition, cytotoxicity and genotoxicity were determined by using trina blue assay and comet assay respectively. The responses varied significantly among exposure concentration and charge of polymer coatings. The results showed that positively charged DEA-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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The increasing 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 (WWTs) 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), while seawater markers of nanomaterials, sp-ICP-MS, and TEM are 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 increasing 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 (WWTs) 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 on biotic markers of aquatic organisms to assess their effect on Daphnia magna and anaerobic metabolism in Daphnia magna. Organisms (14-d old) were exposed to 25-125 µg/L of NM-300K for 96 h in a WWTP effluent or in ASTM medium. Daphnids were analysed for changes in acetylcholinesterase (AChE), glutathione S-transferase (GST), catalase (CAT), lactate dehydrogenase (LDH) activities, and lipid peroxidation (LPO). Results showed a significant increase of CAT activity in negative control comparatively to ASTM control, thus suggesting induction of oxidative stress by effluent. The dispersed 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 dispersed-control relatively to negative-control, suggesting deleterious effects of dispersed to daphnids. Biomarker responses to NM-300K were more marked when added to effluent comparatively to ASTM, especially for higher concentrations. There was a significant decrease of AChE activity in effluent (25 and 75 µg/L) and ASTM (125 µg/L) media, which implies impairment of control and modulation of neural transmission signal 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 at 125 µg/L in effluent suggests an increase in anaerobic metabolism and higher stress for daphnids. Unexpectedly, 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 dispersing agent highlights the need for further study on its effects in organisms prior to its application, in order to understand the AgNPs behaviour under standard 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
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 accidentally. 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 employed in novel cutting-edge applications as nanomedicines. In this study we investigated five biomedical NPs, namely aminated polystyrene (PSNH$_2$), europium-doped-cerium oxide (CeO$_2$@Eu), carbon dot-doped silica (SiC@B), and polyethylene glycol-functionalized silica (SiO$_2$-B and SiO$_2$-PEG, respectively), and we assessed their behaviour and biological impacts in natural river (NRW) and seagrass (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 PEYlated SiO$_2$ NPs. In fact, SiO$_2$ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PSNH$_2$, 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 sedimented fractions of suspended NPs in the two 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 spectrofluorimetric assays. SiO$_2$-based NPs bioaccumulation studies were examined in bivalves, which (MMNMs) were isolated using 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 repeatedly in 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


The aquatic ecotoxicity of a marketed nanosilver product was examined in original samples as well as in spiked samples. The results obtained for the isolation of MNMs from the environmental matrices. Two procedures were compared with ionic silver. The aquatic ecotoxicity of a marketed nanosilver product

MO410 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyporheic copepods as a direct comparison with ionic silver

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As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify read-across from ionic silver to silver nanofoms. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoforn with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comparing the effects of this silver nanoforn with silver nitrate using the following internationally recognized standard ecotoxicity tests: Toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoforn was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional dissolved silver (0.45 µm membrane filtered) and colloidal dissolved silver (3 kDa centrifuge filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Filter size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separate prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F-FFF) coupled to ICP-MS (for the silver nanoforn only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rates of tested particles of silver and silver nanoparticles were measured in the ecotoxicity tests over a period of 28 days (following OECD Test Guideline No. 29), with measurements of the same three silver fractions. This showed a different dissolution behaviour in both test media, which agreed with observations in the ecotoxicity tests.

MO411 Investigations on the uptake pathway and accumulation of silver from manufactured silver nanoparticles in the freshwater amphipod Hyalella azteca


As part of the REACH Substance Evaluation for silver, new data was required to be generated to further justify read-across from ionic silver to silver nanofoms. Therefore, the aquatic ecotoxicity and fate and behaviour of ionic silver and the smallest silver nanoforn with the highest specific surface area registered under REACH were tested. An ecotoxicity testing programme was undertaken comparing the effects of this silver nanoforn with silver nitrate using the following internationally recognized standard ecotoxicity tests: Toxicity to Daphnia magna (OECD Test Guideline No. 211). The silver nanoforn was fully characterised and was an aqueous suspension containing approximately 37% nanoparticles with spheroidal-like shape (mean primary particle size 9.4 nm). Total silver, conventional dissolved silver (0.45 µm membrane filtered) and colloidal dissolved silver (3 kDa centrifuge filtered) were measured (ICP-MS) in samples taken from test vessels. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion to be filtered. Filter size & Zeta Potential were determined (DLS) in vessels without test organisms. Elemental particle size distribution was analysed in separate prepared samples of the test item in test medium by means of asymmetric Flow-Field-Flow-Fractionation (4F-FFF) coupled to ICP-MS (for the silver nanoforn only). Based on measured silver concentrations, silver nitrate was more toxic than nanosilver to both algae growth and Daphnia reproduction, for all silver fractions. Size and Zeta Potential measurements are inconclusive for all tests and it appears that the test concentrations were too low / particles too few to resolve from control / background level (using the Zetasizer Nano equipment). In addition, the dissolution rates of tested particles of silver and silver nanoparticles were measured in the ecotoxicity tests over a period of 28 days (following OECD Test Guideline No. 29), with measurements of the same three silver fractions. This showed a different dissolution behaviour in both test media, which agreed with observations in the ecotoxicity tests.

MO412 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyporheic 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 mg/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 ones 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 how NPs are distributed in the environment, their bioavailability and 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 hyporheic copepod species and less related with DOM concentrations. The hyporheic zone is a region underneath streambed 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 hyporheic 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 rate of *Parhyale hawaiensis* a widespread hyporheic 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**

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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 0.081mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effect of ZnO NPs on the growth rate of *S. rubescens* was assessed by determination of growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition 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**

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Sunscreens represent one of the main source of engineeredTiO2nanoparticles (TNPs) source in coastal ecosystems, especially during summer period. Their adverse effects were generally investigated using bare model TNPs and only few studies were based on the NPs extracted from commercial products. Therefore, this study aims to evaluate the effect of TNPs extracted from three different commercial sunscreens upon freshwater and marine organisms: microalgae (*Pseudokirchneriella subcapitata; Dunaliella tertiolecta*) and crustaceans (*Parhyale hawaiensis*). Microalgae were used as a bioindicator for growth rate, nutrient removal and lipid production. The toxic effect of ZnO NPs was estimated by the half maximum inhibition 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.

**MO415 Silver nanoparticles affect the early development of Tisbe battagliai: pristine vs aged particles**

A. Georgantzopoulou, Norwegian Institute for Water Research; N.W. J. Forkas, SINTEF Ocean / Environmental Technology; K. Vassilaros, SINTEF Ocean / Environmental Technology; 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 transformation 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 (50µg coated in 5nm, nanoComposite) 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 over time. The 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.

**MO416 Silver concentration in the haemolymph of a tropical marine amphipod fed with silver nanoparticles and silver chloride**

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The relatively recent development of engineered Ag nanoparticles has expanded significantly in the last years. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like *Parhyale hawaiensis*, 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 *Parhyale hawaiensis* exposed to food containing AgNP and AgCl. We hypothesized 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 formulated fish feed pellets. After 1 hour of feeding, each organism was placed and exposed to a new piece of fish feed for 14 days. After exposure, the haemolymph was collected using a thin glass capillary, weighted and analysed. Three pooled samples of 4 organisms (2 females and 2 males) were tested per exposure concentration. The silver determination in haemolymph was carried out by a graphite furnace Atomic Absorption Spectrometry (GFAAS). A higher amount of silver in the haemolymph was absorbed from AgNP feed, reaching 8.4±0.7 ng mg⁻¹ for AgCl, at the longest exposure time. The increase of silver concentration was related to the exposure duration. Therefore, it appeared that ingested silver is more bioavailable to *P. hawaiensis* as AgNP than when it is in its salt form. Data strongly suggest that nanoparticles were uptake by the gut and distributed in the
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-walled carbon nanotubes on bivalve mollusks 
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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 pharmacokinetics. 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 in 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 CNMs. The bivalve mollusk 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 Ni-MWCNTs. CNTs and other CNMs are expected to cause oxidative stress biomarkers responses (LPO) and antioxidant enzymes activities (SOD and GPx) compared to Ni-MWCNTs. In the present study, it was clearly demonstrated that nanomaterial toxicity can be attributed to core structure and surface functionalization, which have been shown to alter the level of toxicity.

MO418
Assessment of genotoxic and proinflammatory effects of different Silica and Titania Nanoparticles on human bronchial cells 
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The widespread production and use of titanium dioxide (TiO$_2$) and silica (SiO$_2$) nanoparticles (NPs) in consumer products and in different industrial and medical applications raises concerns about their possible toxicity. We studied potential genotoxic-oxidative and inflammatory effects of two amorphous silica NPs (precipitated NM200 and pyrogenic NM320) and two anatase TiO$_2$NPs (NM100 size 50-100 nm and NM101 size 5-8 nm) furnished by JRC. NM characterization was performed by TEM and DLS. Human bronchial (BEAS-2B) cells were exposed for 24h to 0.1-100 µg/ml of selected NMs to evaluate: cytotoxicity (trypan blue assay), direct/oxidative DNA damage (Fpg-comet assay) and inflammatory effects (IL-6, IL-8 and TNFα release by ELISA). In culture medium NM200 was better dispersed than NM203, NM100 resulted better dispersed than NM101 at 100 µg/ml and both titania showed similar agglomerates sizes at 10 µg/ml. We found lack of cytotoxicity for all NPs. Slight direct DNA damage at 10 and 100µg/ml and slight oxidative DNA damage at the lowest concentration were induced by NM200. NM203 induced dose-dependent direct DNA damage statistically significant at 100 µg/ml and oxidative DNA damage at low concentrations. NM100 induced dose-dependent direct DNA damage and oxidative DNA damage at 1 and 10 µg/ml. Direct DNA damage, statistically significant at 100 and 10 µg/ml, and induction of oxidative DNA damage at 100 µg/ml were found for NM101. Both silica NPs induced slight IL-8 release at 100 µg/ml, NM203 induced also IL-6 release at 10 and particularly at 100 µg/ml (262.2 fold of control). Both TiO$_2$NPs induced slight IL-8 release at 100 µg/ml but only NM101 induced significant IL-6 induction at 100 µg/ml. The findings show higher genotoxic/oxidative and inflammatory effects for NM203 in respect to NM200, probably due to its higher surface reactivity determining a strong interaction with the proteins in the medium and higher protein-mediated cell interaction. The findings also show DNA damage for both TiO$_2$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. Soretti, Oregon State University / School of Chemical, Biological, and Environmental Engineering; J.A. Nason, Oregon State University / Chemical Biological and Environmental Engineering; R. Kaege, Eawag - Swiss Federal Institute of Aquatic Science and Technology

Previous research has highlighted the importance of particle-particle interactions in controlling the environmental fate of engineered nanomaterials (ENMs). Yet, their 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 ENMs. However, the properties of the ENMs are dynamic and can be altered via myriad 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. In the objective of this research is to develop 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, 12 different ENMs were selected and exposed to different wastewater 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 investigate the effect of the media on the properties of the ENMs, including size, surface charge, stability/aggregate structure, and hydrophobicity. In the future research 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., surface water). In simulating these processes of multi-resistance of the ENMs to different environmental systems (e.g., freshwater, wastewater) the aggregation behavior of the ENMs will be evaluated. 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 nanotoxicology matures there is a call for the research focus to shift 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 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 (CeO$_2$NP) and silver nanoparticles (AgNPs) routes of entry we explore the role that these materials 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 exposure concentrations and coating mechanisms (electrostatically stabilised citrate and sterically stabilised PEG coatings) have upon the uptake of CeO$_2$ and AgNPs and transformations they undergo during sediment exposures. Accumulation of CeO$_2$ through 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
Examining 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 be performed to determine the surface chalcophile elements present. In the future, we will compare the sorption properties of the TiO2 NPs to 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 photolysis (photodynamic activity), and fluorescein dye conversion (ROS generation).

MO422
Influence of organic compounds on the sulfidation kinetics of copper oxide nanoparticles
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Organics released to the environment from 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 ENM. In this study, we examined the influence of DOM on the surface transformations and the role of DOM in determining the transformation rates. Our results suggest that DOM can influence the transformation rates of ENM, and that the transformation rates can be modulated by the presence of DOM.

MO423
Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes
M.D. Montañó, University of Vienna / Environmental Geosciences; B. Gerstmann, A. Laycock, N. Tepe, T. Hofmann, F. von der Kammer, University of Vienna / Department of Environmental Geosciences

The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanometrology, 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 MS (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, we used a multidisciplinary approach, including our new instrument, spICP-TOF-MS. The precision and accuracy of single 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 chosen to help answer the question of how multi-elemental monitoring by time-of-flight will impact the detection of ENPs.

MO424
Assessing potential risks of Nanodrugs and their delivery systems in fish using Light Sheet Microscopy
D.L. Windell, University of Exeter / College of Life and Environmental Sciences; J. Moger, The University of Exeter / College of Engineering, Mathematics and Physical Sciences; M.J. Winter, The University of Exeter / College of Life and Environmental Sciences; S. Owen, AstraZeneca / Safety Environment Health; C. Tyler, University of Exeter / Biosciences College of Life and Environmental Sciences

Nanotechnology applications have increased dramatically in recent years including in the pharmaceutical sector. The unique properties of nanoparticles can 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 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 polymeric polymer and fluorophore coating, we have traced their uptake and tissue partitioning using a casper mutant zebrafish 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 organs. Depuration studies indicated a steady loss of the gold nanoparticles from the pronephric kidney over time. We also investigated for biological responses using specific zebrafish 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)
MO426  Effect of ageing on poly cyclic 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 biochars that were thermally aged by either H₂O₂ 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 in vitro-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  H. Fischer, Institut für Umweltforschung / Institute for Environmental Research BioV; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; K. Smith, RWTH Aachen University / Institute for Environmental Research  Silicone passive sampling is a common method for sampling bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often silicone sample containers 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-scale trials. 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 the first 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  L. Silvan, g. cornelissen, s.e. hale, Norwegian Geotechnical Institute  Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: α-HCH, β-HCH, γ-HCH and δ-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 γ-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 worldwide concern and constitute a threat to both human and ecological security. Various remediation 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 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 (BC₃), from greenhouse tomato waste (BC₄) and from durian shell (BC₅), 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 α-, β-, γ- and δ-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, 26.6 ± 3.5 g m⁻³ with 0.003 ± 0.001 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  M. Renningen, RWTH Aachen / Bioi; G. Päkeron, ExxonMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Engineering  Frequently, the total PAH sediment concentration reported for a sample is 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 is an inappropriate model for such concentrations. Concentrations of PAHs in sediments expressed as organic carbon-normalized concentrations (Cₐₚ₉) for evaluating risks to benthic organisms based on the calculated magnitude of PAH toxic units (TUₚ₉) (Hawthorne et al., 2006). However, due to the heterogeneous nature of organic carbon in field sediments, potential risks of adverse biological effects from sediment-associated contaminants are most conveniently assessed by calculating concentrations of chemicals (Cₖ₈₉) in sediment pore water, not to C₉. Recent advances in equilibrium passive sampling methods (EPSMs) offer a promising alternative to the measurement of C₉ and support improved risk-based decision making since bioavailability of sediment contaminants can be directly quantified via Cₖ₈₉ (Mayer et al., 2015; Burkhard et al., 2017). When using EPSMs, polymer to water partition coefficients are crucial for reliable calculation of Cₖ₈₉. To date partitioning coefficients are available for parent PAHs across different polymers (e.g. PDMS, POM) (Lidy et al., 2015). In this study, an equilibrium passive sampling method was developed for investigating alkylated PAHs in marine and limnic sediments and used for risk evaluations of both pyrogenic and petrogenic PAHs. The method is based on solid phase microextraction (SPME) with different silicone materials (PDMS coated glass fibers and hollow fibers). Partitioning coefficients for the PDMS coated fibers (K₉₈₉) were calculated for selected target alkylated PAHs which have previously not been available. K₉₈₉ for additional alkylated PAHs of interest were then predicted based on the experimentally reported K₉₈₉ values. Finally, the new method was demonstrated by in-situ deployment at seven field stations of different pollution levels. Further insights between in-situ and ex-situ EPSM deployment were obtained by comparing the results of in-situ Cₖ₈₉ measurements with corresponding laboratory derived measurements using sediments collected from the same stations.

MO430  Spatial Distribution of HOCs on the Palos Verdes Shelf Superfund Site  A.R. Taylor, University of California Riverside / Environmental Sciences; J. Wang, University of California Riverside; D. Schlenk, J. Gan, University of California, Riverside / Department of Environmental Sciences  Hydrophobic organic contaminants (HOCs), such as DDTs, PCBs, and currently used pesticides contaminates 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 and humans. Fish and invertebrates that eat these contaminants, like fish and current use pesticides, such as fipronil and pyrethroids, have also been detected in sediment from the shelf during preliminary experiments, indicating that these contaminants may have been deposited onto the shelf via urban waterways. In this study, we assessed the spatial distribution of current-use insecticides pyrethroids and fipronil in the top 2 cm of sediment on the Palos Verdes Shelf Superfund Site. Concentrations of total pyrethroids (Cyﬂuthrin, Permethrin, Lambda-cyhalothrin, Cyfluthrin, Cypermethrin, and Ecy-permethrin) ranged from n.d. to 170.15 ng/g and total fipronil (/? Fipronil-α of fipronil desulfuryl, fipronil sulfide, fipronil, fipronil sulfone) ranged from n.d. to 5.59 ng/g. On-going research also aims to understand the spatial distribution of legacy HOCs (PBDEs, DDTs, PCBs) in the shelf area and assess their bioavailability in order to determine their risk to both organisms living on the shelf and possible routes of human exposure. These findings will be made available to the federal and state agencies for use in environmental risk assessment and designing management strategies.

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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. João Rocha, ICBAS – U.Porto, CIMAR; M. Lam, RWTH University Aachen; P. van Hees, Orebro University / MTM; M. Comber, Mike Comber Consulting; S. Villalobos, BP; E. Vaiopoulou, European Petroleum Industry Association

MO432 Analysis of exposure pathways for occupational health risk assessment of PAHs in soils. Only a small fraction of AhR agonists in soils. The leachable fraction was generally greater for more hydrophilic PACs, such as more polar PACs composed of two or three rings. Concentrations of PACs in all soils, indicating low availability of the compounds in environmental risk assessment of PACs. The occurrence of 77 PACs including PAHs, alkylaromatics and heterocyclic NSO compounds (NSO-PACs) were considerably lesser than total initial concentrations has previously been developed for this purpose, however it 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 bioavailability of 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. In risk assessment of hydrophobic chemicals that are strongly associated to the sediment/sediment organic matter, freely dissolved concentrations (C_diss) are more representative than total concentrations (C_Tot) 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. MO434 Verification of read-across for aquatic hazard properties of Petroleum Substances in REACH registrations Y. Verhaegen, CONCAWE; C. Hughes, Shell Health / Risk Science Team; L. Camenzuli, ExxonMobil Research & Engineering; T. Suranya, Shell Global Biomedical Sciences / Toxicology and Environment Science Division; M. Comber, Mike Comber Consulting; S. Villalobos, BP; E. Vaiopoulou, European Petroleum Industry Association

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. Tran, Technical University of Denmark / Environmental Engineering; S.N. Schmidt, 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 acute toxicity. In this study, the extractions were done 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 at 12.5 mg/L, the percent recovery of 1/200th of the measured concentration. Further analyses of exposure parameters are in progress to better understand and quantify the resulting toxicity. Further, experimental work was performed to estimate the bioavailable concentrations of hydrocarbons using biomimetic solid phase microextraction (BE) on water accommodated fractions (WAF) prepared with each substance at a nominal loading of 50 mg/L. This method simultaneously extracts and concentrates dissolved hydrocarbons onto a polydimethylsiloxane coated fiber which is then thermally desorbed into a gas chromatography for quantification by flame ionization detection. The measured BE data provide an analytical surrogate that correlates to target lipid and hence WAF toxicity. New BE data showed similar agreement with earlier data collected on WAFs prepared with substances from the same categories. The BE method is a convenient predictive tool used to screen petroleum substances for testing. In summary, predicted toxicity and BE measurements for additional petroleum substances presented in this work strengthen the basis for aquatic hazard classification of petroleum substance categories.

MO439 Bioaccumulation factors of synthetic musks and other hydrophobic contaminants in mangrove mudmussels.  
S. Baven, McGill University / Singapore-Delft Water Alliance; E. Segovia, H. Zhang, W. Lee, G. Juhel, National University of Singapore; F. Smedes, RECETOX / Environmental chemistry and modelling; B.C. Kelly, National University of Singapore / Civil & Environmental Engineering

The occurrence of a range of historical and emerging hydrophobic organic contaminants in mangrove ecosystems in Singapore. In particular, the levels of synthetic musk fragrance compounds, polychlorinated biphenyls, organochlorine pesticides and polycyclic aromatic hydrocarbons were measured in mangrove sediments, clams and caged mussels. In addition, the freely dissolved concentration of these organic chemicals in water was assessed with silicone rubber passive samplers. Results showed that polycyclic musks are present in mangrove ecosystems, and can accumulate in the tissues of mussels. In the present study, bioaccumulation factors (BAFw, wet weights) were calculated for all the samples/sites and log BAFw, averaged 4.0±0.3, 4.4±0.3, 4.7±0.3, 3.9±0.7 and 4.3±0.4 for galalactone, traseolide, phantolide, celestolide and tonalide respectively. Overall, the empirical models fit reasonably well the bioaccumulation of polycyclic musks in both caged and native mussels in tropical mangroves. The study of the bioavailability of hydrophobic compounds in highly dynamic environments such as mangroves can be sometimes intricate, and the usefulness of passive samplers and sentinels species such as bivalves was confirmed in the present study.

MO440 Effect-based characterization of mixtures of environmental pollutants in sediments collected between the Arctic and Australia  
A. Jahne, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology; M. Landmann, Helmholtz Centre for Environmental Research - UFZ GmbH / Department of Cell Toxicology; M. Bergmann, Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research / HGF-MPG Group for Deep-Sea Ecology and Technology; J. Bräunig, The University of Queensland / Queensland Alliance of Environmental Health Sciences (QAEHS); S. Schaefer, Federal Institute of Hydrology / Biochemistry and Ecotoxicology; A. Sobek, Stockholm University / Department of Environmental Science and Analytical Chemistry ACES; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology

There is a multitude of pollutants that combine persistent and hydrophobic properties. In aquatic environments, they are largely deposited in sediments. The amount and characteristics of the organic carbon determine how strongly they are bound or if they are readily available for partitioning to biota and bioaccumulation. Curr

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. muz, UFZ - Helmholtz Centre for Environmental Research / Cell Toxicology; A. Jahne, Helmholtz Centre for Environmental Research - UFZ GmbH / Cell Toxicology

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 bioconjugation (uptake via food). This shortcoming obstructs correct interpretation of HOC 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 (PSD) is an appropriate and convenient analytical 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 equilibration approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180) have been selected as target compounds, covering a log Kow range from 5.66 to 7.15. Reference: [1] Rusina TP, Carlsson P, Viana B, Smides 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, malaeapae in the northern Gulf of Mexico
S. Chiaiasson, 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 no evidence of contamination of blue crab megalopae 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 megalopae in 2010 and 2011 exceeded the lower limit of the No Observed Effect Concentration range for aquatic invertebrates set by the U.S. Environmental Protection Agency. BHT is a common preservative in food, pharmaceuticals, and cosmetics and is considered safe in marine environments but exhibits 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
x. guo, 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 are largely unexplored. In this study, we are investigating the uptake of water soluble perylene clusters (PNCs) from blue crab (Callinectes sapidus) and subsequent transport across the cell membrane by endocytosis. Using a microfluidic flow chamber and temperature control has enabled us to record the dynamic process of perylene bioaccumulation in single bacterial cells and examine the cell-to-cell heterogeneity. Although with identical genotypes, individual E. coli cells exhibited a high degree of heterogeneity in perylene accumulation dynamics, as shown by the high coefficient of variation (CV = 40%). This remarkable heterogeneity was exhibited only in live E. coli cells. However, the bioaccumulation of perylene in live and dead S. aureus cells showed similar patterns with a low degree of heterogeneity (CV = 0.36). We found that the efflux systems associated with Tol C played an essential role in perylene bioaccumulation in E. coli, which caused a significantly lower accumulation and a high cell-to-cell heterogeneity. In comparison with E. coli, the Gram-positive bacteria S. aureus lacked an efficient efflux system against perylene. Therefore, perylene bioaccumulation in S. aureus was simply a passive diffusion process across the cell membrane. With the use of SMFM, the motion and distribution of perylene nano-clusters (PNCs) formed in water at very low concentration were visualized with high temporal and spatial resolution. Moreover, the transport of PNCs across the cell membrane was also real-time captured, demonstrating that they entered macrophage cells by endocytosis. Supplementing the well-recognized routine of passive diffusion through membrane lipid bilayer, the uptake of HOCs in the form of nano-clusters by endocytosis was proposed to be an additional but important mechanism for their uptake into living cells. HOCs distributing in the environmental systems in the form of nano-clusters, as exemplified by PNCs in this study, may have significant implications for understanding their environmental fate and potential toxicological effects.

MO444 Impregnation factors of freshwater fish by organic micropolutants in the Marne Hydrographic network
N.F. Molbert, UPMC UMR METIS 7619 / Biogeochemistry; M. Cheveuil, EPHE / UMR METIS 7619; F. Alliot, EPHE / UMR Metis; R. Santos, HEPIA; J. Mouchel, UPMC UMR METIS CNRS/UPMC; A. Goutte, 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 micropolutant families (Polychlorinated Biphenyls (PCB), Organochlorine Pesticides (OCP)) and more volatile 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 was 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 (water surface 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. Phthalates were the most abundant chemicals, with concentrations in fish muscles in the range 4±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 micropolutant levels and health status of chubs, suggesting low ecotoxicological effects of these contaminants exposure in the Marne hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pomphorhynchus laevis were not contaminated. In the study of 60 chubs, no PCB and OCP phthalates. Further validations are needed to confirm the transfer of these pollutants from host to parasites and to investigate the potential benefits of this detoxification pathway for parasitized chubs.

MO445 Environmental occurrence and distribution of organic UV stabilizers in the sediment of the North and Baltic Seas
C. Apel, Helmholtz-Zentrum Geesthacht; R. Ebinghaus, Helmholtz-Zentrum Geesthacht / Department for Environmental Chemistry
Organic UV stabilizers are of emerging environmental concern due to their large production volumes and expected 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 sunscreens to protect human skin against harmful effects of UV radiation. The pathways into the marine environment are either indirect by wastewater treatment plant discharge 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 regulation REACH. Numerous others are currently listed under the European community rolling action plan (CoRAP) to be re-evaluated in the next years. Due to their chemical properties, most UV stabilizers accumulate in sediment (logKow > 3) and have potential for persistence or pseudo-persistence. Environmental data from coastal and marine waters are scarce and scattered. In this study of 60 sediment samples 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-350 vessels were filled with the liquid extracted silica activated and approximately 5 g sediment that was spiked with appropriate isotope labelled standards. The extracts were extracted with dichloromethane for three 10 min-cycles at 100 °C. The extracts were solvent-changed to methanol and reduced in volume to 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 multichpase (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 d.w range.

MO446 Is Lake Como a "uniform lake"? Information from its inhabitants (zooplankton and fish)
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 237 SETAC Europe 28th Annual Meeting Abstract Book
Argano), 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, phytoplankton and c) in levels of pollution between the pelagic areas of the two branches, evaluated along a monthly and seasonal sequence. Preliminary data tell that the taxa 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
F. Ko, National Museum of Marine Biology and Aquarium / National Dong Hwa University / Institute of Marine Biology; C. Chu, National Dong-Hwa University / Institute of Marine Biology
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 copepods (Acanthella crassa) 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 than in high 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 (log Kow) in plankton, however the linear regression slopes of log BCF and log Kow are different between phytoplankton, rotifer and copepod, suggested 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. Benner, I. Politowski, M.P. Hennig, H. Holler, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Centre of Aquatic and Crop Research; R. Blust, L. Bervoets, University of Antwerp / Institute for Tissue Research
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 a change in their environmental behavior. In our study, the weathering of 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 the fate of these substances. Due to the lack of information on the influence of MWCNT on organic chemicals in aquatic ecosystems, proactive research is needed to estimate potential risks, especially for sediment-dwelling organisms as a part of the 'Trojan Horse' effect. In the present study MWCNT were irradiated by simulated sunlight (300-400 nm) for 90 days. The weathered MWCNT (wMWCNT) were used to investigate their influence on fate and distribution of the biocide triclocarban (TCC) in a sediment-water system. This substance was chosen because of its hydrophobic properties and strong affinity to sorb on MWCNT. The concentration of wMWCNT has a significant impact on the distribution of TCC in natural water. 10 ng and 10000 ng wMWCNT/L in MiliQ water led to an adsorption (log Kow, in OECD medium: 7.6 L/kg) of 10% and 65% of TCC, respectively. We will report experiments on the distribution of TCC in water with different types of personal care products (PCPs) by using short weathered MWCNT, shaken for 2 h with 1 mg wMWCNT/L and subsequently incubated in a sediment-water system in the dark for 180 hours. A scenario of C11-TCC only will serve as control. TCC is sorbed onto the wMWCNT and accumulate in the natural sediment by fast sedimentation of wMWCNT-TCC complexes. Production and release of carbon based nanomaterials are predicted to further increase in the near future, thus the interactions of nanomaterials with organic pollutants will be of growing importance to assess environmental consequences. Acknowledgements: The work is supported by the European Project NANO-Transfer that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule
B. Joumel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA
Exposure 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 often difficult to analyse and 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 judgment. 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 inputs 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 and exposure 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 hydrophilic 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
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 determined 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 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: assessment of the human exposure with methodological and environmental occurrence
T. Combi, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceánografico; 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 pharmaceuticals) is rising throughout the sediment and biota. 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 for surface sediment samples from São Paulo coastal areas through microwave-assisted extraction (MAE) and triple-quadrupole mass spectrometer analyses (GC-MS/MS) revealed the presence of UV-filters (especially octocrylene and EHCMS) and fragrances (tonalide and galaxolid). 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) has 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 the materials for risk assessment refinement. The 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. Badjah, King Fahad 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.
High 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 polyycyclic 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, tidal bag, 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 tidal 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. Lutich, 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 Dechlorane (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 up-take pathway in our model and found that facilitated transport via albumin and bile micelles through the aqueous boundary layers must accounted for, for hydrophobic chemicals such as HCB in order to get correct results. Subsequent simulations with the super-hydrophobic chemical Dechlorane 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.

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. Cromie, 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. Odin, 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. Shaab, BASF SE; J. Roembke, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kabouw, BASF SE; S. Braeker, 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. The current risk assessment scheme will not allow detection of a potential risk to earthworm communities and the incorporation of these new studies into the risk assessment scheme should be prioritized. The role of pesticides and other chemicals (P)

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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 a novel approach: putting representativeness/comparability of examined earthworm communities, site- and soil properties of the different locations as criteria in the analysis. Based on these criteria a statistical assessments of representative and comparable earthworm communities in relation to the field exposure were conducted. The assessment revealed that – using data from representative and comparable study sites - there was no concentration related effect of a five-year use of the product regarding diversity and abundance of different earthworm communities.

TU002 Contextualising statistically significant differences observed in mesocosm studies within historical control data
F. Joyce, Cambridge Environmental Assessments; H.S. Schuster, Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology
Mesocosms (which aim to replicate communities residing in edge-of-field waterbodies) are used as part of the higher tier aquatic risk assessment for plant protection products (PPPs) in the EU registration process. When setting up mesocosm studies, care should be taken to standardise communities present in each replicate to reduce variability and maximise statistical power; indicated by minimum detectable differences (MDDs). However, being dynamic and complex systems, variability can often still occur between replicates, which can affect the reliability and interpretation of the results. Statistically significant differences can occur due to natural variability rather than biologically relevant effects, but determining this for regulatory authorities the results of a single mesocosm study can be challenging. One option is to contextualise the experimental results from a single study using available historical control data; this is an approach often used for laboratory studies performed under standard conditions. It is, therefore, proposed that this approach can be extrapolated to mesocosm studies, given that they are also performed under standardised conditions as much as possible. Cambridge Environmental Assessments (CEA) have a wealth of control data from historical mesocosm studies, with samples collected in spring, summer and autumn, thus capturing the variability in population and community dynamics over multiple years and seasons. Here we present our review of this historical control data, and how this provides a baseline to aid interpretation of results from individual studies, allowing an assessment of biological relevance and thus the appropriateness of influencing the regulatory acceptable concentration (RAC). When integrated into the aquatic risk assessment, this will represent a realistic worst-case scenario.

TU003 Enhancing the utility of the ECOTOX knowledgebase via ontology-based semantic 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 sensitivity. To accomplish these goals, the initial steps entailed: 1) validating the results of the automated code mapping approach were evaluated against a set of manually annotated phenotypes as induced by exposures to ten well studied chemicals (atrazine, bisphenol A, cadmium, copper sulfate, cypermethrin, dioxin, EE2, malathion, or Tris(1,3-dichloroisopropyl)phosphate) in six vertebrate species (carp, zebrafish, fathead minnow, mouse, rat, trout). The context of this presentation neither constitute nor necessarily reflect US EPA policy.

TU004 ECOTOX Knowledgebase: New tools for data visualization and database interoperability
C. Elonen, U.S. EPA/ORD/NEHHRL; 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 ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated database that contains ecotoxicity data from single chemical exposure studies to terrestrial and aquatic organisms. The ECOTOX Knowledgebase provides risk assessors and researchers consistent information on toxic effects of chemical 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 searchable fields. Study details such as species, taxonomic 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 coding 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. These new 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 data warehouse
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A steadily increasing number of databases in ecotoxicology and ecology combine and manage 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. Automation 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 data warehouse (https://portal.edaphobase.org/). Edaphobase combines spatially explicit information on quantities of soil organisms, environmental parameters, and vegetation. The data in the warehouse are coming from different sources, covering a wide range of study locations and time periods. The study program went beyond regulatory requirements and comprised 6 independent long term studies that ran up to five years and were statistically derived endpoints provided by the USEtox multimedia fate model [3]. This model requires for each single chemical dozens of physico-chemical parameters as well as data of ecotoxicity to freshwater aquatic life and toxicity to human for cancer and non-cancer effects. For PEF/LCA, 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 chemical agencies (ECHA) for more than eight thousand chemicals all the physico-chemical properties (166'926 test results), ecotoxicity (242'729 test results) and human toxicity data (41'381 test results) available in the IUCLID 5.5 database (as of March 2017). The database has been used to calculate unique value for chemical properties
Deriving physico-chemical input data for the USEtox model from the REACH database for thousands of chemicals using R-Studio program

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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, human health, and cancer risk and non-cancer risk for human and aquatic wildlife. For PEF calculation, the 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 IUCLID 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 Klimasch 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 (QSRat or 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 (QSRat/QSPR). In particular, OECD QSAR toolbox and the EPIsuite estimation models played a fundamental role for this data gap filling purpose.

Toward a possible Toxicity Test Battery Integrated Index for Nanomaterials

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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 toxicological and ecotoxicological approaches performing an end point 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 proposed, 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 results of the analysis 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

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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 potential environmental impacts of PPP and the limits of some actions (e.g. the use of PPP). This study illustrates that a 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-es, to evaluate farm economics. Up to the 1990-es, 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 electronic 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-es 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 potential handwritten PPP use beyond the digital datasets. 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 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 is a key element of 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 species population growth, and 3) to ascertain whether potential (direct) or indirect effects of NNs (e.g. via pollinators) are correlated with NN usage risk. This study illustrates that a 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-es, to evaluate farm economics. Up to the 1990-es, 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 electronic 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-es 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 potential handwritten PPP use beyond the digital datasets. 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 ecotoxicological risks of PPP usage in apple orchards.

TU011 Regression-based models reveal sources of pollutants in Norwegian marine sediments

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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. Sørjerd 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 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 platform discharging produced water A. Tonosyby, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; L. Manfra, R. Di Mento, G. Moltedo, B. Catalano, ISPRA Institute for Environmental Protection and Research; G. Martuccio, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; C. Sebbio, G. Chiarietti, O. Faraponova, M. Amici, C. Maggi, G. Romanielli, G. Sesta, G. Granato, F. Ventì, P. Lanera, S. Marini, F. Onorati, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area; M. Amici, C. Maggi, G. Romanielli, G. Sesta, G. Granato, F. Ventì, P. Lanera, S. Marini, F. Onorati, ISPRA Institute for Environmental Protection and Research / National Center for Laboratory Networking Ecotoxicology Area. The advent of high throughput sequencing 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 microorganisms 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 both ‘phylogenetic’ displays and highest DDT 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 gradient 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 Xanthomonadaceae (Alphaproteobacteria) 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 exploit the full potential of microorganisms to urbanization and the potential of bacteria to be used in bioindication or monitoring along with more traditional indexes.

TU013 Utilising biomarkers in a multispecies approach to relate organochlorine exposure and biological effects V. Weepen, North-West University - School of Biological Sciences / School of Biosciences; Vanrhooyst, University of Pretoria / Zoology; R. Gerber, North-West University / Unit for Environmental Sciences Management; N. Smit, North-West University / Environmental Sciences and Management Due to their persistence and global distribution the use of organochlorine pesticides (OCPs) have been banned in most countries around the world. However, in a number of countries where the use of DDT is ongoing, DDT and its metabolite DDE is still allowed. This practice is not without controversy and reports on ecological and human health effects are increasing. The Phongolo River floodplain in the north-eastern South Africa is a high risk malaria area where DDT is used as vector control agent through indoor residual spraying (IRS). This region is also regarded as a biodiversity hotspot in southern Africa and concern has been raised regarding the risk posed as a result of the long term use of DDT. Over the past seven year’s studies have been undertaken to determine the degree of DDT exposure in the aquatic ecosystem through analyzing DDT and other OCP bioaccumulation in a number of different aquatic species. Concomitant biomarker analyses were 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. Bioaccumulation of DDT (and its metabolites) and HCHs were measured before and after IRS application periods in two decapoda, six fish and two amphibian species. Biomarkers of exposure (cytochrome P450 and acetylcholine esterase) and effect (palatine, superoxide dismutase, malate dehydrogenase, protein carbonyl, and cellular energy allocation) were analysed in the same organisms. Using principal component analysis and discriminant functional analysis the exposure and effect data were integrated to elucidate the responses of aquatic biota to OCP exposure. Although higher trophic level organisms (i.e tigerfish - Hydrocynus vittatus and Musky - Esox lucius) displayed a trend of increased DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-Hexachlorocyclohexane, were included in the analysis, significant relationships with cytochrome P450 and lipid energy reserves were obtained. The result therefore indicated that biological responses were not related to DDT but rather to HCH exposure.

Microbial community ecotoxicology in environmental risk assessment and ecosystem monitoring (P)
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 isotherm equation (Praus et al. 2007) was fitted to the bioaccumulation data. During the determination of the isotherm, a plateau was reached over 5 µg 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 isotherm allowed to estimate a maximum adsorption capacity of 102073 µg g⁻¹ and an equivalent constant of 0.378. Photosynthesis inhibition was correlated (R²=0.75) to diuron concentration in the water. The data did not clearly highlighted a relationship between bioaccumulation and photosynthesis inhibition. This study establishes that diuron bioaccumulation in biofilm is nonlinear, and allows to calculate the equilibrium constant and maximal capacity of the biofilm regarding diuron uptake. These two constants can be used to further prediction of diuron bioaccumulated in biofilm from concentration in the water. The innovative coupling of toxicokinetic and toxicodynamic approaches would provide original information about pesticide behaviour and impact in periphytic microorganisms.

TU016 New insights into the biotransformation of sulfurlamid: role of ammonia oxidizing bacteria and community shifts
T. Yin, National University of Singapore / Civil and Environmental Engineering; Y. Yang, S. Te, National University of Singapore; K. Gin, National University of Singapore / Civil & Environmental Engineering
Emerging organic contaminants (EOCs), such as perfluoralkyl and polyfluoroalkyl substances (PFASs), are ubiquitously detected in the environment and have raised increasing concerns due to their adverse effects on ecosystems and humans. N-ethyl perfluorooctane sulfonamide (N-EtFOSA), belonging to PFASs, is used as the active ingredient in the pesticide. Sulfurlamid, which is particularly important in the control of leaf-cutting ants in some developing countries. Previous studies have investigated its degradation in activated sludge, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-EtFOSA. This study used Alliotuia (ATU), an inhibitor of ammonia monooxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other members to N-EtFOSA biotransformation and find potential N-EtFOSA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-EtFOSA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-EtFOSA. This implied that AMO was probably not involved in the biotransformation of N-EtFOSA, and thus the inhibition of AMO by ATU had no adverse effect on its biotransformation. ATU-treated sample was more diverse than a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlorambus increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU017 How can three herbicides impact the fatty acids of the freshwater diatom Gomphonema gracile ?
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Fatty acids are essential elements for the structure of biological membranes and for the storage of metabolic energy. They are used as a source of energy by metabolism at each trophic level, making fatty acids biochemically and physiologically important compounds (Neves et al. 2015). In the trophic chain, many fatty acids are only synthesized by microalgae and bacteria before being transferred via herbivorous invertebrates to fish and ultimately to humans (Arts et al. 2001). For example, highly unsaturated fatty acids (HFA) such as eicosapentaenoic acid (EPA; 20:5(n-3)), can not be synthesized de novo or in insufficient proportions by an herbivore on its biotransformation. ATU-treated sample was more diverse than a Shannon index of 4.04 while that of the ATU-untreated sample was 2.43. The abundance of Candidatus Protochlorambus increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-EtFOSA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU018 Use of BioLogEcopeleTM to evaluate the effects of ZnO nanoparticles on soil microbial communities
V. Romano, Parthenope University of Napoli / Science and technology; v. pasquali, University Parthenope; s. schieno, 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, durability, and to the reduction of the amount of applied fertilizer. Zinc oxide NPs have been largely used nanofertilizers seeds their spreadingco crops seems to increase their growth and yield. This increasing use could lead to their introduction in the environment occurring also via unintentionally pathways. Actually, some studies reported ZnO NPs negatively affect soil microbial activities and consequently the biogeochemical cycles. These effects could be evidenced by assessing metabolic profiles of cultural, aerobic, heterotrophic microorganisms (Biolog). BioLogEcopele was successfully used to detect short and long-term changes of functional diversity of soil microbial communities. This method was based on the determination of the oxides profiles related to several different carbon sources. This study aims to investigate the changes in the metabolic profile of soil microorganisms when exposed to ZnO nanoparticles by using the BiologEcopele. The inoculum was prepared by mixing the NaCl solution of the selected microorganisms along with different oxidative condition to the exposure for each one to two different type of fertilizers (F1 and F2). The fertilizers were added with ZnO Bulk, ZnO NPs and ionic zinc (ZnSO₄) at 230 mg Zn/kg. Then, the fertilizers with Zn compounds were added to the farm soil. After 15 days of soil exposure to fertilizers with ZnO Bulk, NPs and ZnSO₄, the eluates were obtained. Different elution strategies were tested upon, (1) Pseudokirchneriella subcapitata (6.25%, 12.5%, and 25%) and (2) Lepidium sativum (50%). At time 0, 15, 30 days fresh soil samples were assessed by using the BioLogEcopele approach. The occurrence of the microbial oxidation of each BiologEcopele™ C source was calculated as probability ‘p’ on a binomialal scale of data in order to identify the treatments able to preserve the highest possible oxidizing ability of C substrates and those negatively affecting it. ZnO-nanofertilizers were more toxic than fertilizers with ZnO in bulk form, for algal growth, instead for plants, the effects of ‘ZnO-nanofertilizers’ depended on the fertilizer type: only F1 + ZnO NPs resulted more stimulating than F1 + ZnO Bulk. Preliminary Biolog results seem to highlight that the microbial community
was mainly affected by ZnO NPs. The integration of the classical ecotoxicology with BiologEcoplate approach could represent a good strategy to establish the environmental risk related to the use of nanofertilizers. Keywords: microbial community, ecotoxicology, nanofertilizers

TU020
Environmental factors-regulated disease dynamics of tilapia lake virus (TILV) transmission in farmed tilapia ponds
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BACKGROUND: Outbreaks of tilapia lake virus (TILV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TILV disease dynamics should be clearly elucidated to prevent the potential economic impacts on aquaculture.

OBJECTIVE: The main objective of this study was to make the TILV disease dynamics by constructing an epidemiological model to implicate aquaculture management among farmed tilapia ponds.

METHODS: The mortality of Nile tilapia infected by intraperitoneal (I.P.) injection with different TILV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explore TILV highly artificial environmental conditions, sacrificing some of the susceptible-infectious-mortality (SIM) model was applied to describe cumulative mortality data to estimate mortality rate (α), transmission rate (β), and basic reproductive number (R0) for Nile tilapia posed by TILV under treatment of colibactin.

RESULTS: In toxicity assay, LD50 estimate of Nile tilapia infected by I.P. injection with different TILV dosage was 57127.5 TCD50 mL−1. In chronic toxicity test, CuO NPs explained CuO toxicity, TiO2 NPs when incubated in ANW, whereas both the diatom Chlamydomonas reinhardtii and the cyanobacterium Synechocystis sp. were significantly inhibited biomass production of both green algae in the standard medium, using four freshwater species from three major algal groups: green algae (Chlamydomonas reinhardtii and Nannochloris ocline), diatom (Raphidocelis subcapitata), and cyanobacterium, that has the smallest cell of the four tested species, was reduced in ANW in all algal species except the R. subcapitata.

CONCLUSIONS: TILV transmission could be affected by environmental factors such as temperature and aquaculture density. Results of toxicity assay and disease epidemiologies could provide insights into aquaculture management of TILV disease by controlling potential factors in tilapia ponds. Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

TU021
Natural organic matter alleviates TiO2 and CuO nanoparticle toxicity in four algal species
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Although the knowledge concerning synthetic metal nanoparticle (NP) effects on aquatic organisms has improved during the last decade, most research has been conducted under TILV highly artificial environmental conditions. Sacrificing some of the experimental reproducibility to obtain more environmentally relevant data, we studied the 72-hour effects of uncoated CuO (CuSO4 as ionic control) and TiO2 NPs on two endpoints, biomass production and photosynthetic maximum quantum yield (Fv/Fm), in nutrient-adjusted natural water (ANW) and the OECD201 standard medium, using four freshwater species from three major algal groups: green algae (Chlorella vulgaris and Dunaliella tertiolecta), diatom (Raphidocelis subcapitata), and cyanobacterium (Synechocystis sp.). Metal toxicity on both parameters at 72 h was reduced in ANW in all algal species except the cyanobacterium, presumably because of natural organic matter (NOM) binding to the NPs and solubilized ions. The biofilm-forming diatom was most resistant to NPs when incubated in ANW, whereas both the diatom and the cyanobacterium were not inhibited by TiO2 at concentrations up to 100 µg/mL throughout. TiO2 significantly inhibited biomass production of both green algae in the standard medium (EC50 = 143 ± 1 mg/L), but only R. subcapitata was inhibited in ANW (EC50 = 31 mg/L). TiO2 NPs did not significantly inhibit Fv/Fm of any species either medium up to 100 mg/L, indicating a lack of toxic effect on the photosynthetic apparatus. The sensitivity to CuO remained at a similar level in the standard OECD medium (biomass based EC50 = 0.2-0.9 mg/L) for all species, but differed over orders of magnitude in ANW (EC50 = 3.16-16 mg/L). The cyanobacterium, that has the smallest cell of the four tested species, was consistently most susceptible to Cu toxicity. While shedding of Cu ions from particles explained Cu toxicity, TiO2 effects were at least in part due to observed cell multiplication heteroaugmentation. Overall, Fv/Fm was a less sensitive toxicity endpoint than biomass, but the two parameters were strongly correlated (Spearman’s ρ = 0.6-0.9) when toxicity was evident, again proving Fv/Fm as a rapid method for toxicity detection. The observed discrepancies in toxicity indicate that using different model organisms, experimental endpoints and conditions could provide valuable information about the behavior of emerging contaminants in the environment, thus improving the quality of risk assessment. Research was funded by IU223-5.

TU022
Chlorinated solvent contaminated groundwater: a glimpse inside the environmental microbial communities and their potential for bioremediation
P. Pretto, R. Ricci, Biosearch Ambiente; T. Lettieri, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

Chloroethenes are among the most frequent pollutants affecting groundwater in Northern Italy due primarily to industrial and extensive use of the solvent. 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 andgeochemical 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.

TU023
Impact of the antihistamine fexofenadine on structure and functioning of less chlorinated microbial communities from agricultural soils
P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; J. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; J. Fahlin, T. Brodin, J. Klümmler, Umea University / Department of Ecology and Environmental Science; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment

Efforts to design pharmaceuticals to control microorganisms (e.g., antibiotics and fungicides) on aquatic microbial decomposers and the functions they provide are rather well-documented, while knowledge about effects of other micropollutants is scarce. In a recent study the antihistamine fexofenadine was shown to impact the microbial decomposition of plant detritis, however, the mechanistic basis for this remains unexplored. We therefore conducted a microcosm experiment, with the microbiologically 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=15-10) 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, sporulation of aquatic fungi, bacterial abundance, fungal and bacterial denitrification, etc. 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 led to major treatments to an increased proportion of microbialy-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.

TU024
Innovative tools and metagenomics for the monitoring of rivers and lakes: the European project INT-CATCH
M.D. Scrimshaw, Brunel University / Institute for the Environment; J. Marchegiani, Italian Institute of Health ISS / Environment Health; M. Carese, Italian Institute of Health ISS; O. Tcheremesskia, Italian Institute of Health ISS / Environment Health
Microbial communities provide a large range of ecosystem services such as primary organisation, and more intricate risks on ecosystem structure and function. Assessing the impacts of chemicals still largely relies on approaches that are based on assays in simplified laboratory settings at the single level. Therefore, the goal of this field survey was to examine the tolerance of microbial communities to copper indicates lake 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.

**Tolerance of sediment-microbial communities to copper indicates lake contamination**

A. Tili, Eawag / Department of Environmental Toxicology; C. Bonineau, Irstea Lyon; A. Dabrin, Irstea Lyon-Villeurbanne / UR MALY; E. Lyateau, Universite Savoie Mont Blanc; B. Ferrari, Centre Ecotoxic EAWAGEPPL. 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 bentthic 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 copper and bacterial communities in sediments, as well as the copper concentration gradient by 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 tested in a defined medium with controlled conditions (DCT) 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 with the copper concentrations in the sediments. Overall, our findings support the fact that 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.

**Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf-decomposition? – A case study using species-specific qPCR assays**

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Aqueous hyphomycetes, a polyphyletic group of freshwater fungi, are considered key players in leaf litter breakdown, an important ecosystem function in aquatic systems. Structural implications of anthropogenic stressors in aquatic hyphomycete communities have mainly been analysed using spore morphology, which does not allow assessing direct inferences on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the impact of a model fungicide to the fungal community composition and addressed the question how leaf 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 (A. acuminata, H. stellata, N. lugdunensis and Tetracladium marshallianum), was exposed to the model fungicide and the resulting communities were then evaluated in terms of fungal abundance, community structure and function.

**Hydrodynamic conditions alter the tolerance of biofilm communities towards chemical stress**

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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 by changing hydrodynamics. Even though biofilms have been studied to decreases 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 PBE approach. Focusing on the protozoan aquatic hyphomycete 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 algae cultures.

**Tolerance of metal contamination in aquatic and soil microorganisms**

resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species within the biofilm development using stable Cu isotope techniques was studied.

Bioaccumulation levels of Cu in the young biofilm (20 days) were similar between the colloidal, capsular and cellular fractions. Finally, the isotopic approach showed that after 40 days of exposure, the isotopic ratios in the three fractions of the biofilm were similar to the ratio in water of the second phase of exposure (~0.25). These results suggest (i) an intense and rapid renewal of the biofilm and of the bioaccumulated Cu and (ii) that Cu concentrations in a mature biofilm at a given time reflect the last period of exposure. In addition, analysis of Unifrac distances showed a very 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.

TU029 Cyanobacterial Bloom in the Lake Varese: Characterisation of Microbial Communities by Metagenomics analysis
D. Conduto 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. Napieroka, 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 region of 3 m (MESO), 9 m (MEO) and 13 m (MEO) and 2.5 times the Secchi disk depth measured in situ on sampling day (2.5x SECCHI). The samples were characterised for their chlorophyll a content, nutrients, cyanotoxins and genomic DNA was extracted for metagenomics. Purified DNA samples were subjected to 16S sequencing (variable region V3-V4) and for Shotgun analysis. All 16S samples were MiSeq sequenced as 2x250bp paired reads, the corresponding shotgun samples as 100bp paired reads. shotgun analysis was performed for sample collected from 3/8/2016 until 5/10/2016 and only for EPI and 2.5x SECCHI. The results showed that a peak of cyanobacteria was observed around 14/9/21.9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the MESO condition. Community composition of the overlying water column composition was also observed for protozoa and actinobacteria. Our result suggests that the major differences in bacterial community composition during the bloom are concentrated in the SECCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom. This hypothesis is also supported by the cyanotoxin data although complementary 18S metagenomics sequencing would be required for a more reliable prediction of potential toxiphic eukaryotes.

TU030 Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope techniques was studied.
D. Conduto 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. Napieroka, T. Lettini, European Commission Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit
The growing world demand for metals increases metal element mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of tetravalent metals are very scarce. Zirconium (Zr) is a tetravalent non-radioactive element for which the global demand is increasing in the last decades. Benthic microorganisms community (periphyton) have shown good potential as a biomonitoring tool to assess metal exposure of aquatic organisms. In this work, the effect of Zr on periphyton biodiversity and biochemistry was investigated to apply this tool to zirconium and other tetravalent metals contamination assessment and to better understand their potential impacts on aquatic ecosystems. Glass slides were immerged in a pond in Cestas (near Bordeaux, France) for one month to be colonised by periphyton. They were distributed in 3 aquaria containing a synthetic culture medium (Dauta, 1982) and effective concentrations of 0.2 ± 0.1 µM C0 (C1), 0.5 ± 0.3 µM (C2) or 2.9 ± 0.3 µM (C2) of Zr (μM). One slide per section was sampled after 1, 2 and 4 weeks of exposure. Species richness (S16S and 18S OTUs), cell fluorescence, photosynthetic activity, microsymbiosis identification, polysaccharide and protein contents. Biomass, proteins, polysaccharides and diatoms abundance increased significantly showing the growth of the biofilm during the experiment. No significant Zr exposure effects were observed on biomass, polysaccharides but their productions appeared to be slightly lower in C1 and C2 at t2 and t4. Diatoms growth rate in the C2 condition was significantly lower than in C0 and C1. Results obtained by pigments fluorescence measurements showed significant cyanobacteria decrease in the C2 condition over the exposure time as well as the brown alga between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microeukaryota composition but not over the reference (C0) and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganism play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganisms composition which could disturb periphyton key functions. A better understanding of effects of metals on microeukaryota would improve risk assessment of metalic exposure in aquatic ecosystems.

TU032 DNA metabarcoding demonstrates effects from copper at environmental concentrations on microbial diversity in marine periphyton biofilms
C.N. Doose, INRS - Centre Eau Terre Environnement; S. Morin, Irstea Bordeaux / UR EABX, C. Fortin, Institut national de la recherche scientifique Centre - Eau Terre Environnement
The growing world demand for metals increases metal element mobilization in aquatic systems. Although the effect of metals on freshwater ecosystems is well documented, studies on the impacts of tetravalent metals are very scarce. Zirconium (Zr) is a tetravalent non-radioactive element for which the global demand is increasing in the last decades. Benthic microorganisms community (periphyton) have shown good potential as a biomonitoring tool to assess metal exposure of aquatic organisms. In this work, the effect of Zr on periphyton biodiversity and biochemistry was investigated to apply this tool to zirconium and other tetravalent metals contamination assessment and to better understand their potential impacts on aquatic ecosystems. Glass slides were immerged in a pond in Cestas (near Bordeaux, France) for one month to be colonised by periphyton. They were distributed in 3 aquaria containing a synthetic culture medium (Dauta, 1982) and effective concentrations of 0.2 ± 0.1 µM C0 (C1), 0.5 ± 0.3 µM (C2) or 2.9 ± 0.3 µM (C2) of Zr (μM). One slide per section was sampled after 1, 2 and 4 weeks of exposure. Species richness (S16S and 18S OTUs), cell fluorescence, photosynthetic activity, microsymbiosis identification, polysaccharide and protein contents. Biomass, proteins, polysaccharides and diatoms abundance increased significantly showing the growth of the biofilm during the experiment. No significant Zr exposure effects were observed on biomass, polysaccharides but their productions appeared to be slightly lower in C1 and C2 at t2 and t4. Diatoms growth rate in the C2 condition was significantly lower than in C0 and C1. Results obtained by pigments fluorescence measurements showed significant cyanobacteria decrease in the C2 condition over the exposure time as well as the brown alga between t2 and t4. Principal response curve (PRC) analysis showed significant changes over time of microeukaryota composition but not over the reference (C0) and the C2 condition. Giliates were less impacted by Zr exposure than flagellates which tended to disappear in the C2 condition. Biofilm microorganism play a wide role in major ecosystem processes. Regarding these results, Zr exposure can impact the periphyton microorganisms composition which could disturb periphyton key functions. A better understanding of effects of metals on microeukaryota would improve risk assessment of metalic exposure in aquatic ecosystems.

Copper biofilm was observed around 14/9/21.9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the MESO condition. Community composition of the overlying water column composition was also observed for protozoa and actinobacteria. Our result suggests that the major differences in bacterial community composition during the bloom are concentrated in the SECCHI depth region while composition of the EPI zone is more or less constant. Cyanobacteria were found highly abundant in Lake Varese and are therefore likely responsible for the bloom.

This hypothesis is also supported by the cyanotoxin data although complementary 18S metagenomics sequencing would be required for a more reliable prediction of potential toxiphic eukaryotes.
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU/033
A Time-series Study of Soil Microbial Community Compositional 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 petrol, however, the indicator which 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 accepted or rejected; however, the potential impacts need to be further studied in the natural environment evaluating the metabolic effects in soils persist beyond 6 months post contamination.

TU/034
Evaluation of riparian groundwater qualities using microalgal response to petrotaluent contamination
O. CHAMSI, ECOLAB UMR5245 CNRS UPS INPT; E. Navarro, CSIC - Spanish National Research Council / Dept. Reursos marinos renovables; J. Sanchez-Perez, S. Sauvage, ECOLAB 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, ECOLAB UMR CNRS UPS INPT; E. Pinelli, ECOLAB UMR 5245 CNRS UPS INPT

Contamination of ecosystems by pesticides, pharmaceuticals and trace metals makes our approach a new useful bioindicator of ecotoxicity. Over the last three decades there has been a significant decline in marine pollution monitoring-related studies in South Africa. Very little research has been conducted to assess the prevalence of imposex in whelks and also very few studies have been conducted on comparisons between contaminants in different marine invertebrates at the same sites. The current study was conducted in July 2017 to compare metal bioconcentration between mussels (Mytilus galloprovincialis) and whelks (B. lagenaria) as well as measure imposex prevalence in B. lagenaria at Bloubergstrand, Granger Bay and Green Point, Cape Town, South Africa. This was done in order to identify suitable bioindicators of ecotoxicity by determining whether the mussels and whelks bioaccumulate metals in the same way and to assess imposex prevalence in whelks (as an indicator of tributyltin contamination). The concentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Cd, Ni, Mo, Pb) were measured in intertidal sediment, M. galloprovincialis and B. lagenaria and imposex prevalence recorded in B. lagenaria. Results showed that the highest prevalence of imposex in whelks and metal concentrations were recorded Granger Bay, an area of high boating activity. The most important result was that the whelks had higher bioconcentrations of metals than the mussels at all sites. Identifying biomonitor should be linked to purpose of investigation before selection of species, and mussels have been considered 'ideal' biomonitor of contamination in South Africa. Given the ubiquitous distribution of B. lagenaria along the South African coast, which is not the case for M. galloprovincialis that only occurs on the west and south east of the country, the proposal is made that B. lagenaria could be considered as alternative bioindicators of ecotoxicity in contaminants of the region.

Recent developments in environmental risk assessment for pollinators (P)

TU/038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (Bombus terrestris)
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinsson, University of Oslo / Department of Physics; K. Borda, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Biosciences

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 sub-lethal effects of neonicotinoids on honeybee health (e.g. reduced pollen collection, reduced foraging activity and reduced weight gain). In the present study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by heart rate fluctuation asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was outside these limits could be investigated for the mean proportion of females and first-year-birds could be considered collectively. For many indices females and males needed to be studied separately due to sexual dimorphism. Females had significantly mean body weights than males (287g vs 258g) but there was extensive overlap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat depots were 23-65% and 28-75% for females and males, respectively. The level of kurtois within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.

TU/036
Identifying suitable marine biomonitor in South Africa: Mussels vs Whelks
C. Sparks, Cape Peninsula University of Technology / Conservation and marine sciences; W. Samuels, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences

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

TU/035
Can post mortem data be used to monitor population health in response in the barn owl?
L. Walker, Centre for Ecology & Hydrology; E.D. Potter, NERC Centre for Ecology & Hydrology / Lancaster; M.G. Pereira, Centre for Ecology & Hydrology / Lancaster; R. Shaw, Centre for Ecology & Hydrology (NERC)

The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.ac.uk/) is national long-term project that monitors contaminant residues in a range of avian predator species. Each bird that is submitted to the scheme is given a post-mortem examination during which approximately 60 macroscopic observations and measurements are made. The information gathered during this examination could potentially be used to monitor health status of the birds at the time of their death or at a particular stage of their development. Previously we have focused on examining health indicators for the sparrowhawk, Accipiter nisus. We were able to establish baseline “norms” for indicators that could be broadly categorised as indicators of change in: (i) population demography because of altered recruitment, survival and mortality (measures were sex ratio, proportion of first-year birds, and proportion of deaths from starvation or disease); (ii) change in nutritional status (measures were body weight, fat score, condition index) that may be a pre-cursor for subsequent population impacts, (iii) physiological stress (as measured by heart rate fluctuation asymmetry) that may be an indicator of fitness. In the current study we investigated whether these population health indices could be applied to barn owls, Tyto alba. We were able to establish baseline “norms” in the form of Shewhart charts. For example the mean proportion of birds that were female was 48% with a prediction interval of 38-59%, and so years in which the prediction interval was outside these limits could be investigated for the mean proportion of females and first-year-birds could be considered collectively. For many indices females and males needed to be studied separately due to sexual dimorphism. Females had significantly mean body weights than males (287g vs 258g) but there was extensive overlap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat depots were 23-65% and 28-75% for females and males, respectively. The level of kurtois within 10th primary feather weight precluded this metric from being used to investigate fluctuating asymmetry. This study shows that the proposed population health indices generally can be reported for barn owls. Establishing these population health indices can then be used to provide an early warning of whether chemical or other stressors are affecting the demography of barn owl populations.
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, Rificon 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 2010). The aim of this poster is to summarize the available 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 includes the calculation of risk quotients (RQs) for honey bee larva. This considers exposure routes for the treated and for off-field (PPPs) and as seed treatment (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 ECPA impact analysis (Miles and Alix 2013) and compared the first 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*
R. Becker, BASF SE Agrarzentrum Limburgerhof; J. Lueckmann, Rificon GmbH; S. Schmitzer, IBACON GmbH; B. Szczesniak, Eurofins Agroscience Ecotox GmbH
* on behalf of the ICPPR non API working group. As bumble bees are commercially available and their biology is well-known, they can be used for ecotoxicological semi-field and field trials. However, experiences from current field studies on bee brood development, and consequently impacts of pesticides on bumble bee and honey bee populations, such as how the experimental set up can influence queen reproduction success, as bumble bees (Bombus terrestris L., Hymenoptera, Apidae) are commercially available and their biology is well-known, they can be used for ecotoxicological semi-field and field trials. However, experiences from current field studies on bee brood development, and consequently impacts of pesticides on bumble bees have already been tested for years. Currently, an ICPPR Non-Api working group is developing a standardized method for semi-field studies with bumble bees. Based on the protocols of the ICPPR working group, several semi-field studies have been conducted. The central endpoint in this higher tier studies is the colony reproduction success (production of sexuals), 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. For this, several parameters influencing this most important endpoint were analyzed. We tried to answer some open questions concerning the colony reproduction success, such as how 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
High-tier risk refinement of solitary bee species in the field - is the well-known 'focal species' concept a suitable approach*
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According to EFSA (2013) bumble bees and solitary bees have to be considered in addition to 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 cornuta or O. bicornis as test organisms for the risk assessment, and higher-tier semi-field testing with Osmia as proposed by the ICPPR non-API working group has been published. 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 in 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 (Bombus terrestris) versus honeybee (Apis mellifera) acute oral and contact toxicity - Preliminary results of ECPA company data evaluation

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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 apart from the honeybee also bumblebees and solitary bees. In the need to address long term effects on bumblebees, the ICP-PR Non-Apis Working group designed a range 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 Dinmothio EC400 (Perfekthion) was evaluated within a 2 Years of Solitary bee field ring testing and Final Conclusions (ICPPR Non-Apis Working Group)

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The publication of the proposed EFSAs 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, OECD/EPPO Guideline No. 170 and recent discussions on non-Apis and solitary bee toxicology. The objectives of the ICP-PR Non-Apis workgroup 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 (Osmia bicornis and Osmia cornuta) and 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 2016 and 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 feeding system, the nest building materials and the size of the hives are quite variable. However, there are no specific methods for toxicity tests to stingless bees. So, in our laboratory we are developing and standardizing methods to test the toxicity of pesticides to species of stingless bees. We test the Acute Contact Toxicity Test protocol of OECD guidelines (214) established to European honeybee for the stingless bees Scaptotrigona postica and Melipona scutellaris. For this, we used the ICP-PR standardized test method. The test item was kept in 250 mL cages (ten bees were placed per cage, such that each treatment contained thirty bees from three colonies), fed in groups through microtubes (1.5 mL) punctured in extremities, and kept in a chamber of biochemical oxygen demand (BOD) at 29 ± 2 °C, relative humidity of 70 ± 10% and in constant darkness. The diet used was composed of 50% (w/v) aqueous sugar solution. Our observations showed that to perform the Acute Contact Toxicity Test for stingless bees some adaptations in OECD (214) are necessary, like to adjust the temperature of the incubator (29 ± 2 °C instead of 25 ± 2 °C), anesthesia should be done by cooling and the time should be adequate for each species. The development of these tests will allow the development of safer strategies for the protection of biodiversity and, at the same time, support the expansion of agriculture, which is an important socio-economic activity in the region.
considered. With this normative Ibama expects that pesticides be used efficiently and potential pitfalls are illustrated. The methods used need to adequately reflect the properties of the tested substance and the circumstances of the application as well as potential influences of behavioural aspects such as foraging behaviour. Also, residue kinetics of a given substance have to be considered and must be reflected in the time points used for sampling. Here, we present recently employed approaches for studies which may be lost and require more thorough and long-term follow-up. The methods discussed are based on 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 formulation. The different methods are compared and advantages and potential pitfalls are illustrated.

TU054 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. Tachida, Chiba Institute of Technology / Nanobiology

Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothianidin, Dinotefuran, Thiamethoxam and Nitpyram are popular. Their usage began from the beginning of 1990 and is increasing till 2008 in Japan. Recent annual total usage of seven insecticides is not increasing, approximately 400 tons per year in Japan. Nevertheless, their potential off-target effects on managed (e.g. Apis mellifera) as well as wild (mostly non-Apis) species has been reported. Our phylogenetic controlled analysis shows that bee bodyweight is a robust and scientifically sound predictor of bee sensitivity to neonicotinoids exposure. Our phylogenetic controlled analysis shows that bee bodyweight is a robust predictor of bee sensitivity to neonicotinoids exposure and potential pitfalls are illustrated.

TU053 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 (Ibama) and completed by the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama) is responsible for establishing policies for protecting pollinator insects against pesticides effects. In this context, it was very interesting that colony feeding studies were originally developed to directly assess the insecticidal properties of insecticides and designed to determine modes of action rather than effect levels. Most 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 research needs for ensuring that procedures to protect bees can be improved, especially regarding native bees. Hence, a matrix of selection for Brazilian bee species was proposed for selecting native species for use in pesticide risk assessment. This matrix provided the basis for selecting meliponines (stingless bees) as a priority group. In the near future Ibama intends to assess the need of changes in the risk assessment procedure, eventually including a stingless bee as a representative species.

TU052 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 / DlQUA CGASQ; R. Rebolo, iBAMA / CCONP

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 uncertainties understood about their occurrence, their behaviors and their procedures to protect pollinator insects against pesticides effects. 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 explains in an accessible way how the normative should be applied. NI 02/2017 is widely based on US/Canada’s approach, which means that it focuses on Apis mellifera data; the models used for screening are Bee-Rex and AgDrift; tests required for tier 1 are the same and there is one scheme for foliar applications and other for soil/seed/truck treatments. But there are few modifications: 4 tiers, the last one being post-registration monitoring; use of a safety factor of 10 for non-Apis bees; residue trials must be performed in Brazil and for tier 2 a crop grouping is considered. With this normative Ibama expects that pesticides be used efficiently without incurring unacceptable risks to bees. Although Ibama has a full framework for risk assessment established for honeybees there are still gaps in knowledge and methods and recent experiences.

TU051 New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experiences

M. Perssleidl, Tier3 Solutions GmbH; U. Zumkier, Tier3 Solutions GmbH / Regulatory Science; A. Rossbach, Tier3 Solutions GmbH / Field team; C. Wolf, Tier3 Solutions GmbH

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 (mostly non-Apis) species have emerged as an intensively discussed topic. In current risk assessment, A. mellifera is used as a pure exposure surrogate in pollen and nectar. The different methods are compared and advantages and potential pitfalls are illustrated. The different methods are compared and advantages and potential pitfalls are illustrated.

TU049 Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach

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With this normative Ibama expects that pesticides be used efficiently and potential pitfalls are illustrated. The different methods are compared and advantages and potential pitfalls are illustrated. The different methods are compared and advantages and potential pitfalls are illustrated. The different methods are compared and advantages and potential pitfalls are illustrated. The different methods are compared and advantages and potential pitfalls are illustrated.
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 thiamethoxam 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 treatment differences for pollen stores, overall colony strength and overwintering survival were comparable 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 thiamethoxam and metabolite C16A217204 (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 thiamethoxam residues found in pollen and nectar were 1.0 µg/Kg and 3.0 µg/Kg, respectively. The residues of C16A217204 were below the 1.0 µg/Kg LOQ. In an on-going study, residues in pollen and nectar in untreated succeeding crops of sugar beets were also found to be low. The maximum thiamethoxam residues in pollen and nectar were 2.6 and 0.55 µg/Kg, respectively. A maximum C16A217204 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 thiamethoxam residues detected in pollen and nectar. It also provides additional support for the lack of effects reported in field studies following exposure of crops to levels of thiamethoxam 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 used as a tool to test pesticides toxicity
P. De Koninck, T. Roat, University of Birmingham; M. Régnier, Maloprint, Switzerland; L. Jeker, Swiss Bee Research Center / Agroscope; Y. Christen, University of Applied Sciences and Arts Northwestern Switzerland
We conducted a feeding study with thiamethoxam and carbendazim to test for alternative 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 in Apis 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: 201522368-5).

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 (Brodtschneider, R. et al.)[1] 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 thiamethoxam (TMX) at 0.1, 0.3 or 1 ng/bee, based on the homing 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 rates and gene expression for treatment TMX 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" /> [1]Brodtschneider, R., Libor, A., Kulpiewiser, V., Crailsheim, K., 2017. Food consumption and food exchange of caged honey bees using a radioactive labelled sugar solution - PLOS ONE | https://doi.org/10.1371/journal.pone.0174684

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 have been used for pesticide risk assessment. While the in-hive development of honeybees is relatively well understood and can be validated 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 95% exposure 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
A. Görlich, WSC Scientific GmbH; M. Wang, WSC Scientific GmbH / Dept Efate
Modelling: J. Kleinmann, A. Görlich, WSC Scientific GmbH
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 pattern of the parasitic bees. For the semi-field study colonies with sister queens of equal strength were used. From these a subset of colonies was selected based on history of movements, 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 bees in hives (all frames and walls). Additionally, to include also the number of foragers in the assessment, hives were weighted with and without bees. To avoid an influence of the time of the day on the number of foragers counted with photography all colonies were photographed at a parallel time at the same time of the 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 elicitor 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, higher tier 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 Peninsula University / Chemistry.

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 Chemists 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 obtained for cooked 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 (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 2-28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 days possibly due to the reduction in pest populations to a level where they no longer had a complete impairment in reproduction at 56 days. These results are revealing of early sub-lethal biological alterations in connection to contaminant toxicity and bioavailability. Bioaccessible bismuth (Bi) concentrations (using KNO3) were correlated to SOD activity and suggest an important contribution to the overall toxicity. Bi is used increasingly to replace lead in several industrial applications including the production of alloys and munitions formulations. 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 concentrations decreased in exposed white 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 commersoni): are all the metals accumulated in the heat-stable fraction (HSP) detoxified by binding to metallothioneins?

N. Uren, INRS-ETE / Centre Eau Terre Environnement; S. Jacob, P-G. Campbell, P. Couture, Université du Québec à Rimouski / Centre Eau Terre Environnement

Metallic contamination. After isolation of the HSP fraction, we determined the associated metals. For each metal, higher concentrations were measured in the HSP fraction of the exposed fish than in the reference fish, but overall, metal-handling strategies did not vary between the reference and exposure fish, with the exception of As. For Cd and Cu, a major peak was observed after a retention time of 16 minutes, corresponding to the retention time of MT, suggesting that these two metals were reasonably well detoxified and bound to metallothioneins (MT) and metallothionein-like peptides (MTLP). MT and MTLP are mainly found in the subcellular cytosolic HSP fraction, generally obtained after homogenization, differential centrifugation and heat-denaturation steps. It is normally hypothesized that metals present in the HSP fraction are detoxified. To confirm this hypothesis, the nature of the metal-binding ligands found in the HSP fraction needs to be determined. Thus, the aim of this work was to investigate the ligands binding metals (As, Cd, Cu and Se) in the HSP fraction from hepatic cells of white 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.

TU065 Assessment of Toxicological Impact of Anthropogenic activities on Onitsha Stretch of River Niger in Southeastern Nigeria

A.C. Udebuani, Federal University of Technology / Department of Biotechnology; J.J. Nwajuba, Federal University of Technology Owerri / Department of Biotechnology; p. Abara, federal university of Technology Owerri / Biology

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 Onitsha 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
chromatography. The result obtained showed that six heavy metals with varying concentrations were obtained in the order of Zn>Pb>Hg>Cd>Cr>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs to include PAH, phthalates, PCDDs, PCDFs, 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. Thus, there need therefore to regulate the activities of people, especially the influx and disposal of pollutants into this surface water.

TU066 Comparing metallic elements in corals from South Africa and the Mascarene Basin
V. van der Schruff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwe Yive, University of Mauritius / Chemistry; H. Bouwman, North-West University / Unit for Environmental Science and Management
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 skeleton 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 Alwih Sholal constitute 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-one 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. We been ear to analyze well as two are different organisms in hard corals. 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.

TU067 Cytochrome P450, fat and ageing: new insights into metal toxicology
N. Rai, Orebro University / The Life Science Centre, School of Science and Technology; P. Olsson, Orebro University / The Life Science Centre-Biology; L. Jaeger, Orebro University / The Life Science Centre-Biology
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 analyse whether metals in different organisms and other biotransformations 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 understood. Cyp11a2 is a cytochrome P450 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 interconnection 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-35B2 genes on exposure to both the metal mixture and environmental sample. However, the upregulation was above 15 fold in the metal mix than in the one. 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, pool-2, aca-2 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 Baque 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 PIEU/EHU; U. Izaguirre, 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; 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 Platinum (Pt) is a tool for understanding the role of elements in natural conditions, but since the 1970's the strongly increased industrial use of Pt, especially for car 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 health monitoring 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; Low = 50 ng/L; Medium = 100 ng/L and High = 10 µg/L) for 3 (T3), 7 (T7) and 28 (T28) days. The condition index of each individual was calculated as well as the gametogenic 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 properties 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 were observed and confirmed at different locations, especially in the digestive gland. Moreover, significant increase in lipofuscin content occurred at all exposure times. On the other hand, neutral lipid levels showed a significant decrease at T28 for the exposure conditions Medium and High. Only minor and non-significant alterations 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 of biological organism in such as cellular (lipofuscin accumulation, neutral lipids deployment) are impaired in oysters. Acknowledgements: Work funded by, Basque Government (ITB10-13), UPV/EHU (UFI 11/37), EU FP7 Ocean 2013-2 Project SChEhMA (Project-Grant Agreement 614002), IdEx University of Bordeaux.

TU071 Ecological Risk Assessment of Trace Metal Contaminated Tropical Estuarine Sediment, Southwest Nigeria A. Usese, University of Lagos, Nigeria / Department of Marine Sciences; O.L. Chukwu, University of Lagos Nigeria / Marine Sciences; R. Naidu, The University of Texas at Austin / Marine, Earth, and Environmental Sciences. A study was conducted to assess the level and extent of contamination by heavy metals in the coastal sediment of Lagos lagoon, the largest of the eight lagoons that make up the lagoon systems of Nigeria. This study evaluated the level of contamination and potential ecological risk of trace metal (Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) concentrations in sediment from 15 sites in Lagos lagoon during the dry and wet season by an Agilent 7500c (Agilent Technologies, Tokyo, Japan) Inductively Coupled Plasma Mass Spectrometry (ICP-MS). With only few exceptions, the concentrations of trace metals in the order Fe > Mn > Zn > Cr > Pb > Cd > Ni > Li hardly reached 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 runs-off, industrial activity, domestic and solid waste dumping. Estimated pollution load index (PLI), geochemical accumulation (Igeo ?) 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 toxicology assessment G. Pascual, Tohoku University / Civil and Environmental Engineering; I. Garcia, N. Takahara, 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 microalgae 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 a study metal species play an important role on human health due to activity. However, for the other study metal, Pb, any positive, biological function has not been reported. All tests were run in transparent microplate (96 wells), and pH of test solutions was adjusted at 6.5. The algae growth was determined measuring the fluorescence (453/685 nm). In the first experiment, the microalgae 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 microalgae 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, the EC50 after 72hours were 140, >1200 and 293 µg/L for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 µg/L, respectively and in BBM, they were >300 µg/L in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg/L 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.

TU073 Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico. M. Monoz-Najera, G. Barrera Escoreci, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiología; P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiología Human population has seen the deterioration of resources derived from overexploitation and contamination by anthropogenic activities, an example of this is water. Due to the growing demand for this resource, associated to population growth, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites where over time were declared protected natural areas. Population/settled on its banks to make use of the water, as well as of the organisms linked to these aquatic bodies, which represents economic sustenance for the inhabitants. On the other hand, it is common to use the water for various purposes, many of which contradict each other. Such is the case of the Tenango Dam, in Puebla, Mexico, which is used for fishing, irrigation, recreation and electric power generation, among other purposes. The objective of this study was to evaluate the condition of water and tilapia quality. Five field/trips were made in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, nitrites, nitrates/nitrogen and phosphorus; also metals: cadmium, chromium, copper and lead were determined in both water and tilapia. Results indicated that the physicochemical parameters are within Mexican admissible ranges. Nitrite and inorganic phosphorus exceeded the acceptable limit for urban use and protection of aquatic life. Lead and chromium in water exceeded the limits in four collections; and tilapia, only in two of them. Cadmium and copper registered in water behavior similarly exceeding in two seasons the levels allowed by Mexican law, while in tilapia, cadmium only exceeded the acceptable limits in consumption in two seasons. Based on the concentrations of nutrients and metals, it is concluded that water and the Tenango dam is not suitable for urban use, nor for the protection of aquatic life and tilapia should not be consumed. These levels of contaminants could represent a risk to the life/animal associated with this artificial water body. The diverse uses and the absence of a management strategy have deteriorated the dam's water quality and also the tilapia as a resource associated with it; finally, this situation compromises the integrity of an aquatic body included in a site declared as a protected natural area.

TU074 Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks in Nigeria. O. Oke, Federal University of Technology / Department of Environmental Engineering; M. Munoz, University of the Basque Country UPV/EHU / Department of Zoology and Animal Cell Biology,  Research Centre for Experimental Marine Biology and Biotechnology. Heavy metals have been implicated as a causal factor in literally any health problem including infertility and cancer. Their presence in most cosmetic products may pose more harm than envisaged. Lipsticks are common beautifying cosmetics used by young women as matured ladies. This study investigated the presence of heavy metals in most lipsticks to help predict the possible risk associated with the use of these products. The main objective of this paper is to evaluate the hazard quotients of heavy metals due to daily ingestion or use of lipsticks among users and also to evaluate target cancer risks due to its use. This study was carried out in Wukari, Nigeria, samples of different lipsticks and lip glosses of many colours and texture were collected and analyzed for heavy metals contents (lead, Arsenic, Chromium, Cadmium and Mercury) using Atomic Absorption Spectrophotometer (AAS). The result of the mean concentration of the heavy metals are as follows; Lead, ranges between(2.65-7.40 ± 0.17) mg/kg;
Increased industrialization has resulted in an unprecedented dissemination of toxic metals in the environment. The use of copper sulphate in various industrial and agricultural applications has increased significantly. Copper sulphate is used in various industries, including the treatment of water to remove metal ions, as a fungicide, and as a wood preservative. However, its use has also led to the accumulation of copper in the environment, posing potential risks to human and ecological health.

The study investigated the concentration of selected heavy metals in food and environmental samples from the South African province of Western Cape. The samples included vegetables, water, and soil. The study used various analytical methods, including atomic absorption spectroscopy (AAS) and inductively coupled plasma-mass spectrometry (ICP-MS), to determine the metal concentrations in the samples. The results showed that the concentrations of copper, lead, and cadmium in the samples exceeded the threshold values set by the South African National Environmental Management Act (NEMA) and the World Health Organization (WHO).

The study concluded that the increased use of copper sulphate in agriculture and industry has led to the accumulation of heavy metals in the environment, posing potential risks to human and ecological health. The results highlight the need for more stringent regulations and monitoring programs to control the use of copper sulphate and other heavy metals in the environment.
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 calibrated and compared 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 Waters
G. Burton, University of Michigan / School for Environment and Sustainability; M. Hudson, University of Michigan / School of Natural Resources and Environment; S. Nedrich, A. Rentschler, University of Michigan; K. Thiamkeelakul, University of Michigan School for Environment and Sustainability; S.S. Brown, The Dow Chemical Company / Environmental Remediation and Restoration
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 selected 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 + biochar. Experimental field tests implemented novel methodologies, using Limnocorals (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-acclimatizing 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. Toxicity 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, sediment 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
REEChangE - Rare Earth Elements Ecotoxicology in a Changing Environment
H. Tien, Hamburg University of Applied Sciences/University of the West of Scotland; S. Heise, Humburg University of Applied Sciences / Life Sciences
REEChangE focuses on the anthropogenic release of the 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 poisoning 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 REEChangE addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxicological responses obtained for Aliivibrio fisheri and Raphidocelis 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 changes in environmental parameters (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests were applied to monitor the toxicity responses in overlying water and sediment. This includes tests with Aliivibrio 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 current 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.
C. Wolmarans, H. Pienaar, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology
Sediment characteristics generally entail metals, minerals, organic content, elements, particle size, conductivity and pH. The origin of metals in sediments 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 Marico River, South Africa. Sediment samples were collected from the hypolimnion, the substrate at various sites, dried and sieved using an Endecott dry-sieving system to collect fractions <200µm and ≤50µm. The total sediment samples ≥200µm 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 230 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 in the information on the relationship between 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
A.d. Mesquita, Department of Biology / CESAM - University of Aveiro / Department of Biology; S.M. Marques, University of Aveiro / School of Environment and Sustainability; S.M. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biologia Department / CESAM; A.M. Gonçalves, University of Aveiro / Department of Biology and CESAM, Aveiro University
Anthropogenic activities, such as agriculture or industrial activities are the main source of pollution contributing for the degradation of the coastal environment and thus affecting the living organisms of the aquatic systems. Copper is often released into the aquatic systems, and may affect these ecosystems and its 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 behaviour activity of the organisms during the exposure time to copper sulphate and subsequently it was determined the antioxidant enzymatic activities of GST, GRd 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 the ecological 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 *Astellus 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 end-points (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, Pb and a mixture of these three metals under semi-natural conditions. In each bucket, we placed *Astellus aquaticus*, *Daphnia magna*, *Cryptoceras* in riparian soils with different physical properties, *Enchytraeus* with Elodea canadensis (macrophytes) and *Raphidocelis subcapitata* (algae). The theoretical metal concentrations were 1.5 μg/L Cd, 70 μg/L Cu, and 72 μg/L Pb. Half of the medium was renewed weekly. The effects of the metal mixtures and natural stressors were examined after 4 and 8 weeks, on the individual level (total metal accumulation, survival, shoot and root length), the population level (species densities, biomass, and community structure (diversity, evenness). Preliminary results show a high variability between replicates. We observed no significant differences in species densities between the metal treatments after 4 or 8 weeks. After 4 weeks, we found that Cu and the mixture negatively affected shoot and root length of *E. nuttallii* compared to the control treatment. However, after 8 weeks, we did not find these significant differences. As we could not find any significant effects of the metal at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

TU085 The influence of soil properties on lead bioavailability and toxicity to *Enchytraeus crypticus* L. Zhang, VU University Amsterdam / Animal Ecology; C. van Gestel, Vrije Universiteit Amsterdam / Ecological Science

Soil properties are important factors modifying metal bioavailability to soil organisms and subsequently affecting the metal toxicity. The present study aimed at investigating the bioavailability and toxicity of lead to the potworm *Enchytraeus crypticus* in soils with different properties. Soils with Elodea canadensis (macrophytes) and *Raphidocelis subcapitata* (algae). The theoretical metal concentrations were 1.5 μg/L Cd, 70 μg/L Cu, and 72 μg/L Pb. Half of the medium was renewed weekly. The effects of the metal mixtures and natural stressors were examined after 4 and 8 weeks, on the individual level (total metal accumulation, survival, shoot and root length), the population level (species densities, biomass, and community structure (diversity, evenness). Preliminary results show a high variability between replicates. We observed no significant differences in species densities between the metal treatments after 4 or 8 weeks. After 4 weeks, we found that Cu and the mixture negatively affected shoot and root length of *E. nuttallii* compared to the control treatment. However, after 8 weeks, we did not find these significant differences. As we could not find any significant effects of the metal at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

Safe by Design: responsible and innovative research for safe and sustainable chemistry (P)

TU087 In silico approaches to screen and design safer chemicals E. Papa, A. Sangion, P. Gramatica, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

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 for 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 in 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 approaches (model, such as Flame Retardants (FR), Personal Care Products (PCPs) 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 from ecotoxicological datasets E. Galimberti, ICPS International Centre for Pesticides and Health Risk Prevention; F. Galli, waivers safety authority (FEA); A. Moretto, Università degli Studi di Milano; E. Papa, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA)

Recently the International Center for Pesticides and Health Risk Prevention (ICPS) of Milan-WU, joint with the Wageningen University and Research Centre of Wageningen- NL, worked on a data collection project commissioned by the European Food Safety Authority (EFSA). The aim of the project was to investigate the comparability of the EC50, approach (Effect Concentration affecting a percentage x of test organisms) to the current NOEC approach (No Observed Effect
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 EC$_{10}$ or EC$_{20}$ 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 as they take into account concentration-response 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 EC$_{10}$, EC$_{20}$, and EC$_{50}$ 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 TiO$_2$ and CeO$_2$ nanoparticles in rainbow trout

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In the framework of the project GUIDEEano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on the the toxicity and bioaccumulation of these NPs trying to establish some relationships between cytotoxicity and the related effects. Bioaccumulation studies with rainbow trout have been performed for CeO$_2$ NPs and TiO$_2$ NPs of 4-8 nm uncoted 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 spectrometer 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 TiO$_2$ NPs. A difference was observed for the uncoted 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 CeO$_2$ NPs coated with citrate whereas Ce was only detected in the stomach of fish treated with CeO$_2$ NPs uncoated or coated with PEG. After 7 days of depuration, Ce residues reached basal levels indicating a lack of accumulation of these CeO$_2$ NPs. These results indicate a different behavior for the CeO$_2$ NPs and TiO$_2$ NPs. No relationship could be observed between the coating and the observed effects.

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TU090 Colloidal 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 technologies 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, limits their effectiveness in breathing space and transport 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 complicate 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 framework of the project 2010 NANO-SETAC, we aimed to develop innovative nano-enable formulations for the conservation and restoration of modern and contemporary artworks that 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, at the end of these 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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Safe-by-design in chemistry may possibly contribute to a circular economy by avoiding the introduction of hazardous substances. Specifically in nanotechnology the terms “Safe innovation” and “Safe-(r)-by-design” are popular, referring to the goal of considering safety aspects already at an early stage in the innovation process 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 assess the potential for exposure. After this 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

M. Schnaitz, C. Soni, EMPA Technology & Society Lab

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, since nanomedicine is complex, and combinations of many properties in 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 “Safe-by-Design” framework aiming at supporting the needs of SMEs in an early stage of innovation. The framework comprises sustainable material design considering the whole life cycle of polymeric nanobiomaterials, environmental and human health risk assessment. Difficulties 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 waste-specific guidance and mediation. These guidelines aim to facilitate the communication among the different stakeholders in the value chain and with regulators for safe and sustainable innovation.

TU095
1-Octanol and 2-Butanone as biofuel candidates - Using "Green Toxicology" for biofuel development
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The development and production of biofuels, and thus also the risk of a release in the environment, is rising. This implies an increased risk for a release into the environment. Aquatic systems are particularly considered to be vulnerable to fuel contaminations. (Eco)toxological bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These bioanalytical tools can assess adverse effects of many substances on various organisms and endpoints and thus provide a rapid and reliable screening of potential biofuels for identification of potentially harmful biofuel candidates at a very early stage of product development. This testing strategy is part of a framework proposed by the new discipline of "Green Toxicology" which strives to move safety considerations of newly developed chemicals to the earliest possible moment of its lifecycle. Aquatic toxicity is considered as one important ecological endpoint relevant for biofuels. Therefore, the investigation of aquatic toxicity of promising biofuel candidates focused on acute immobilisation of Daphnia magna and acute embryotoxicity and teratogenicity of Danio rerio. Moreover, genotoxicity of the biofuel candidates was also investigated in the Micronucleus assay with V-79 cells to assess the potential effects on human health. This study focuses on the investigation of two biofuel derived fuel candidates: 2-Butanone and 1-Octanol. Both substances are considered very promising alternative fuels. The toxicity testing revealed a very low acute and developmental toxicity for 2-Butanone compared to 1-Octanol. 2-Butanone induced acute toxicity and genotoxicity in concentrations > 2 g/L and even teratogenic effects were found at 822 mg/L. 1-Octanol did induce effects in concentrations between 7 - 15 mg/L. The overall results indicate that 2-Butanone is not harmful for aquatic organisms and should be focused in the further biofuel development. For a further integration of this screening approach in the biofuel development, more biofuel candidates can be investigated and, thus, more detailed information on their potential toxicity can support the development and production of green biofuels. This work was performed as part of the Research Cluster "Biofuels from biomass" funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TU094
Investigation of the toxic effects of new mixtures of: diethyl ether, solvents (DES) in the environment and human health
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The development of environmentally benign and green synthetic protocols, due to their concern over the environment, has boosted the tendency 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 utectic solvents (DESes).[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. DESes have proved to be environmentally sustainable and alternative to the conventional organic solvents in synthetic chemistry, able to increase efficiency of organic transformations. These solvents have attracted widespread academic and industrial interests, and have found almost unanimous worldwide approval. Cosmetics have "come in" 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 synthesise DESes, along with their low cost, it is thought to a possible use of them in the formulation of cosmetic and beauty products. Some of these DESes 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 presented as gels, meaning of the fact that they have water retention properties. Toxicological studies on ChCl+Glycerol and ChCl+Levulinic acid (never studied before) on algal species of the genus Symbiodinium and on skin in vitro cells have been carried out in order to extend the limited knowledge about toxicity at environmental and human level, as well as the biodegradation pathway of this family of solvents. Preliminary results show extremely low toxicity on 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

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 CO₂ versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TI/098 A Study on the development of Food LCI DB and PCR for estimating environmental footprint in South Korea
S. Choe, 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 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 registration. The result shows 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 CO₂ versus natural gas. It is shown that neural network models can serve as an initial screening tool for identifying environmentally beneficial new production pathways.

TI/099 Transition from ILCD To Environmental Footprint: changes in the database structure, format, nomenclature, methods and other adaptations.
S. Fazio, EC-JRC; E. 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)30196) established the Environmental Footprint (EF) scheme. The common methodology, nomenclature, software 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 categories, and technical details with respect to each impact category, documenting specific choices made when implementing the characterization factors as well as guidelines for future implementation. Furthermore, a list of changes made from the ILCD to the EF package, beyond the LCIA methods recommended (i.e. Elementary 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 EF-XML website. Among the above mentioned 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 characterisation factors 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; E. 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 2007, 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 fulfills 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 - LCF German project: online registration facility that can be used to register data from other nodes running on soda4LCA, and meant to make available only fully compliant data (while the nodes can host also intermediate data) The changes that have been applied can be summarized as follows: - ILCD validation tool: additional validation profiles added for EF scheme. Checks against different parameters for Elementary Flows, location IDs, new LCIA methods, Flow Properties, Unit Groups and schemes, according to the changes made in the DB structure - soda4LCA: new access profiles are available for data stocks. The developer can now select entire data stocks and restrict the access only to authorized users. The entire data stock can be now downloaded directly, while before it was possible only at the single dataset level. The registration form includes a statement for the use of data within the EF framework. Declaration of compliance in the registration phase and possibility of multiple registration in more than one registry at once (a dataset can be both ILCD and EF compliant and therefore registered in two registries with different compliances declared). - LCDN registry: 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 LCI's in the perspective of the applicability of the impact assessment method of the Ecoinvent database
M. Bairz, 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 inconstancies in its eco-profile products, where use and consumption are sometimes confused. The analyst faced with this 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, 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 minus input within the same drainage basin) and the application of AWARE. The presentation elaborates on the various operation parameters water in a chemical plant and the link to the life cycle inventory phase and ILCD flow names. The PlasticsEurope methodology for calculating eco-profiles is expandable or adaptable to all kind 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 go LCA. The presentation aims to attack LCA data for 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 long time evolution during the long lifetime span of buildings has not negligible impact on our current environmental performances. 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://dyplca.pigine.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 SimPro 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. Time dependent environmental 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 force. The new method allows considering fossil and biogenic carbon for climate change proposes without clinging on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic LCI integrates the real temporal variations of environmental performances. A new framework of LCA is needed for a better 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 IRB; J. Gudar, Stockholm Environmental Institute  
That location matters when it comes to quantifying environmental impacts of agricultural commodities. The increasing importance of the increasing transparency 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-Ag method, these impacts are underrepresented. This 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 Trase platform allows for real-world path 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 CO₂-equ. emissions associated, on the one hand, to annual production of soybean 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 the impact associated with food production and transport. Further work that addressed allocation and compensation in the entire supply chain, mainly LUC, for which considering sub-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 transparency 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  
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. About 1000 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 annual 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 SimPro 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. Time dependent environmental 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 force. The new method allows considering fossil and biogenic carbon for climate change proposes without clinging on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic LCI integrates the real temporal variations of environmental performances. A new framework of LCA is needed for a better 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.

TU105  
Network LCA as a tool to enhance data collection and usage in a value chain analysis  
M. Lundqvist, VTT Technical Research Centre of Finland; M. Myllysilta, S. Majaniemi, VTT Technical Research Centre of Finland Ltd  
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 related impacts of toxicity and climate change. 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 transparency tool is meant to provide science-based evidence to the ongoing debate on global responsibility, while assisting supply chain management and governance decisions.
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 flows of 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, publically 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 build up of flow metadata. 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. 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, publically 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 build up of flow metadata.

TU109 Endocrine disruption in Mytilus galloprovincialis: Is ethinylestradiol a vitellogenin inducer?

L. Fernández-González, P. Sanchez Marin, University of Vigo / Ecology and Animal Biology; G. Grueiro Noche, S. Muniategui Lorenzo, University of A Coruña / Analytical Chemistry Department; A. P Díaz, University of Vigo / Biochemistry Genetics and Immunology; r. beiras, University of Vigo / Toralla marine sciences station (eicma); M. Galloprovincialis (Vtg), the egg-yolk precursor in female oviparous animals, is a common biomarker of estrogenicity widely used as an indicator of endocrine disruption in aquatic environments. Nevertheless, in the case of mollusks, 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 synthetic estrogen 17α-ethinylestradiol (EE2) induces the production of Vtg in Mytilus galloprovincialis at two exposure times and different nutritional regimes. For that, we used a shotgun label-free proteomics approach by high resolution LC-MS/MS to identify and quantify Vtg in mussels gonads. In this way, we can verify if the energetic balance is a key confusing 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 % dry weight per day) or with a high regime (equivalent to 5.55 % dry weight per day), representing negative and positive energy balance respectively. For the feeding regime, shotgun 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 to compare to the sorlent control, although this increase was not statistically significant. In mussels exposed for 24 days to 100 ng L⁻¹ EE2, Vtg levels were significantly higher that 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 Gammaridae and pelagic diatoms exposed to different concentrations of natural particulate matter from different sources in riverine regions (SP, ATB, STB and ELSS). 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 negatively to the presence of oil sands material through toxicological effects and toxic 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 high 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 developed for a couple decade among ecotoxicological assessment approaches in the aquatic field. It offers some prospect for understanding and predicting 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 hereditary effects on the DNA function, may add up to mediate 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 species. 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 genetically 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 16°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 by a reference unpolluted station in site impacted by various human activities.

TU12 INVERTOX: Characterising individual metabolic variability of the freshwater invertebrate, Gammarus pulex
T.H. Miller, Kings College London / Analytical and Environmental Sciences; J. MacRae, The Francis Crick Institute / Metabolomics; N. Bury, University of Suffolk / Division of Diabetes and Nutritional Sciences; S. Owen, AstraZeneca / Safety Health Environment; L. Barron, Kings College London / Analytical and Environmental Science

The (pseudo)peristence of emerging contaminants and other organic micropollutants in the environment represents a risk for the organisms that are exposed to them. Omics technologies are providing a powerful tool within environmental toxicology to better understand the variability 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 contaminant induced and moulting (changes due to age) induced variations that may influence data interpretation. Thus, we have characterised the effect of these factors on the metabolic variability in the freshwater invertebrate, G. pulex. Herein, an analytical method is presented 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, mating stage and acclimatisation period affected the metabolic 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 select- or enrich metabolically active individuals for invertebrates. Preliminary Data

TU13 Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river
V. Svava, Helmholtz Centre for Environmental Research GfK / Effect-Directed Analysis; M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; T. Luckenbach, Helmholtz Centre for Environmental Research UFZ / Department Bioanalytical Ecotoxicology

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 the case of amphipods 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 Holtemme (Saxony-Anhalt, Germany). Sites 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 cytochrome oxidase I (COI) gene and comparisons of 9 microsatellite 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 Antenna 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 and has been used in acute ecotoxicological tests. An ecological toxicological tests. P. 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, whitin a week, but no information on antenna’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 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 organism 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 undertook full regeneration. At the end of each experiment, another picture was taken to determine the difference between the regenerating length (n=80) before and after full regeneration. Ammonia generation occurred from 7 to 20 days (n=80) after amputation and males and females behaved differently. 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 test their ability to regenerate in the redeveloped experimental conditions. Acknowledgement: Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq-PVE Process: 400362/2014-7) for funding and PIBIC for undergraduate fellowship. Amanda dos Santos e Gabriel Rampaço Magalhães for technical contribution.

TU115 Added value of community approaches in environmental risk assessment
M. Hammers-Wirtz, T. Strauss, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaiae 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 are recognized. Marine and Freshwater invertebrates are an ideal test organisms. Furthermore in 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 mesocosms studies have been used as higher tier tool in risk assessment of plant protection products in the EU since the 1990ies. In the last decade they have been developed to be able to evaluate non-standard species that cannot be covered by the current lower tier studies. However, community tests were often criticised for their high variability and low statistical power. In the last decade, 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 sequences 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 procedures to lower tier testing 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
J. Lucas, Cape Peninsula University of Technology / Department of Conservation and Marine Sciences; B.G. Struyman, Cape Peninsula University of Technology / Biodiversity and Conservation; J. Odendaal, Cape Peninsula University of Technology / Department of Environmental and Occupational Studies 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 ecosystems. The Olifants River, one of South Africa’s most important rivers, has significant water quality and quantity. Numerous pollutants result from these activities, with metals being particularly prevalent in most urban rivers. These pollutants are known to affect freshwater macro-invertebrate 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 showing the relationship between water quality and invertebrate communities. 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, km 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
M. Martínez-Haro, IREC- Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; P. Acvedo, IREC- Instituto de Investigación en Recursos Cinegéticos; A.J. Paix-Costa, MARE-BEB; I.R. Vieira, ICBAS & CIMAR, University of Porto / Department of Life Sciences; N. Álvarez-Ospina, Universidad Potsdam; L. Guillermino, ICBAS & CIMAR University of Porto / Department of Biology; R. Ribeiro, Universidade de Coimbra / Life Sciences; J.C. Marques, Fraunhofer IME, Würzburg. 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 provides for chemical and ecological evaluation and sets requirements regarding the establishment of cause-effect relationships in the assessment of environmental quality. Under this approach, the European Marine 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 show 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 combined could it be possible to determine whether the integration of ‘quality elements’ (bioassays and biomarkers) did (or did not) provide an increased understanding of EU water bodies. Overall, this project allowed us to efficiently contribute to national and international efforts focused on evaluating the water quality in European water bodies.

TU118 Chronic testing of mayfly and stonefly species - Development of a new approach
M. Brüggemann, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; K. Hund-Rinke, Fraunhofer IME / Department of Ecotoxicology; K. Schlich, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; C. Schönberg, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology Aquatic organisms, especially lotic invertebrate species originating from running waters, are exposed to releases of plant protection products which are mainly used in agriculture. Since lotic invertebrate species are regarded to be very sensitive but are hardly considered in chronic ecotoxicology testing, we developed a test system in order to investigate chronic effects on mayfly and stonefly species. After the establishment of a test system for stonefly larvae Protonemura sp., the next step was the establishment of a method for testing of mayfly species Epeorus sp. In the developed test system, contrary to usual indoor stream systems, not the water body itself, but test vessels inside test containers are circulated, thereby creating a target flow. The test containers are filled with medium and contains ten replicates each. Each replicate is a small cage, which serves as individual compartment for individual testing of one test organism. The set-up is designed as follows: compartments are adapted to the natural habitat of the test organisms. As endpoints growth, emergence and mortality are observed during a 21 day exposure period. For the studies we use field collected larvae which are adapted to laboratory conditions.
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 stonefly 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. After one day of acclimation, 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 mayfly larvae testing with different aquatic insects, 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 drainages 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 μg L⁻¹, and the equivalent to 126.8 μg 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 responses every toxicant level. The CAR formulation (dissolved in dechlorinated tap water) with 85% of the active compound was added to the test system. The results of the performed tests as well as a comparison between testing of mayfly and stonefly species will be presented.

TU121 Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation of L. morgana
P. Zizza, C. Gambardella, E. Costa, F. Garaventa, M. Faimali, CNR ISMAR

Ecotoxicology is aimed to assess, monitor and predict the effect of contaminants in the environment. Looking for new and alternative approaches in this discipline has become of increasing importance. Furthermore, within the 3Rs approach (reduction, refinement and replacement) the basic idea is to reduce the use of vertebrate organisms and to refine the procedures to minimize pain, suffering, and distress. To achieve this goal, ecotoxicology needs analytical tools, able to detect environmental concentrations of toxicants. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including crustaceans, crustaceans, rotifers and echinoderms. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment eluates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed alteration of marine invertebrates as ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken into account in ecotoxicological risk assessment.

TU122 Benefits of Using Ecologically and Economically Valued Invertebrate Species for Ecotoxicological Analyses: Potential Phototoxic Effects Comparing a Freshwater Vertebrate and Invertebrate
E.N. Vebrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources.

In Louisiana, crayfish are not just a standard invertebrate species found in bayous and rice fields but also a staple in the cuisine and culture. Over 82 million pounds of crayfish are harvested annually, resulting in a $45 million industry; therefore, they are both ecologically and economically valued in the region. In 10 years of research, SBR system has proved to be sensitive to a wide range of contaminants, such as metals, organic compounds, micro and nanomaterials, both polymeric and not, and even environmental matrices such as sediment eluates. The amount of robust and significant data produced supports the suitability of this methodology to be applied to aquatic invertebrates. Here we reported a brief summary of SBR’s applications, which show the relevance, sensitivity and versatility of the swimming speed alteration of marine invertebrates as ecotoxicological endpoint. These data also contribute to support the hypothesis by which behavioral endpoints, such as swimming alteration, represents attractive approach that should be taken into account in ecotoxicological risk assessment.

TU123 Impacts of anti-cancer drugs on freshwater rotifers at environmentally realistic concentrations
N.B. Martins, University of Minho, Department of Biology & CBMA / Department of Biology; A. Pradhan, University of Minho / Department of Biology; F. Cassio.
C. Pascoal, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology

As human population increases, the presence of emergent chemical contaminants (ECCs) in freshwater increases. ECCs have shown to be persistent and bioactive, reaching the freshwater aquatic systems mostly untreated, where their fate and behavior is little understood. Anti-cancer drugs are among the ECCs of concern due to their high cytotoxicity and increasing usage. The administration of drugs in corals, instead of single drug treatment, make the assessment of the environmental risk of these compounds a difficult task with much information lacking on sub-lethal effects on aquatic species. We used two cytotoxic drugs aiming at linking their effects on the reproduction inhibition of the rotifer *Brachionus calyciflorus* with processes of oxidative stress. The rotifer was exposed to the effects of overgrown of a antimonialbacter (5-Fluorouracil, SFU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Fluorouracil had a stronger effect (EC₅₀=0.074 mg L⁻¹) on the population growth rate than Doxorubicin (EC₅₀=13 mg L⁻¹) and toxicity effects were detected at environmentally relevant concentrations. Two concentrations of each drug were chosen for binary mixtures and two concentrations per drug were used to assess reactive oxygen species (ROS) accumulation and plasma membrane damage with epifluorescence microscopy. In the presence of low concentrations of SFU, there was a reduction of the toxicity induced by DOX indicating possible antagonistic effects between both drugs. At concentrations, as low as EC₅₀ we found accumulation of ROS in a dose dependent manner showing a clear correlation between ROS accumulation and the toxicity of these compounds. Furthermore, this indicated that both drugs could interfere with reproductive processes and apoptosis like effects, cellular effects were found with possible consequences for the community at the long term.

TU124 Development in vitro and in vivo methods of measuring acetylcholinesterase and general esterases in aquatic invertebrates

Y. Cao, University of Copenhagen / Department of Plant and Environmental Sciences; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

Quantification of acetylcholinesterase (AChE) and other esterase activities 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*. We compared 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 the species with the highest activity.

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 for ACh activity in vitro; 3) to compare in vitro with in vivo measurements, the GE in vitro and the GE in vivo; and 4) to measure the production of 5-thio-2-nitrobenzoic acid; 2) AChE-assay using acetylthiocholine iodide for ACh activity in vitro; 3) to compare in vitro with in vivo measurements, the GE in vitro and the GE in vivo; and 4) to compare in vitro with in vivo measurements, the GE in vitro and the GE in vivo. The maximal GE activities in *D. magna* and *C. riparius* were 345±44 and 151±51 nmol min⁻¹ mg⁻¹ protein for *D. magna* and 75±9 and 40±5 nmol min⁻¹ mg⁻¹ protein for *C. riparius*, respectively, making *C. riparius* the species with the highest activity.

The maximal GE activity was measured in *D. magna* and C. riparius. The results of GE-assays using 1-NA and 4-MUB showed comparable activities across substrates. Focusing only on AChE-activity in vitro the maximal activities were 13.2±4.3 and 3.2±1.1 nmol min⁻¹ mg⁻¹ protein in *D. magna* and *C. riparius*, respectively, making *C. riparius* the species with the highest activity. The GE-activity in *D. magna* was higher in *D. magna* and lower compared to *C. riparius*.

TU125 Factors influencing bioaccumulation of metals and pollutants in corals

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Bioaccumulation is the total accumulation of contaminants in and by an organism from all sources and routes of uptake. Bioaccumulation is normally defined as the sum of the mechanisms of bioconcentration (contaminants obtained from water only), and biomagnification (contaminants obtained from food). Corals pose a conundrum to classifying uptake mechanisms, due to their particular growth forms. Biomagnification in corals can occur through both filter and suspension feeding. It is also known that metals in corals will consistently reflect metallic element composition of the water of a particular area – hence, bioconcentration. Other methods of metal uptake are difficult to assign to one of these categories. Metal particles in suspension in the water are trapped by the defensive mucus layer and ingested by the coral colony as ‘food’. This might be seen as biomagnification. However, biomagnification is traditionally associated with trophic transfer through prey items, and thus the term does not fit the normal description. In this case, we propose that this route of uptake be called ‘particulate vectored accumulation’.

Corals can also include other elements into their skeletal lattice by substitution of Ca²⁺ with other divalent metallic elements. “Latticine inclusion” might be an apt novel term for this occurrence. The crystalline structure of the CaCO₃ coral skeleton differs between hard and soft corals, being either aragonite or calcite. Different metals may interfere with different crystallographic structures and small metal particles in suspension can also simply become lodged in the pores and cavities of the particular hard corals, where it may be made part of the eventual skeleton by overgrowth. This pathway might conceivably be considered ‘particulate bioconcentration’. Zoanthellate algae are known to accumulate metals differently from their hosts. We surmise that the intricacy of the symbiosis between algal cells and coral tissue will make it difficult to asportion relative metal contributions (and therefore toxicity) to each of the two symbionts. These potentially different routes of uptake of elements and pollutants may complicate ecotoxicological studies of corals, but may also indicate new avenues of investigation and explanation.

TU126 Survival, metabolic rates and locomotory activities of a groundwater-obligate coped species under long-term exposures to tetrachloroethylene

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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⁻¹ in groundwater bodies. Studies on surface water species have shown that TCE causes oxidative stress in aquatic organisms, however, to our knowledge the effect of TCE on a groundwater-obligate species has not been investigated to date. More importantly the effect that 1.1 µg L⁻¹ TCE may have on groundwater species under chronic exposures is unknown. In this study, we investigated the effect of 1.1 µg L⁻¹ TCE on survival, oxygen consumption, and locomotory activities of a groundwater-obligate coped species (*Moravia 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 (Loilo Systems, Denmark) and a custom-made oxygen sensor (Dish Reader, PreSens, Germany). The system allows simultaneous measurement of 2 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.
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⁻¹ and 100 mg·L⁻¹) and fluorene (100 mg·L⁻¹ and 200 mg·L⁻¹), 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 transcripts 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⁻¹ = 2 h and 12 min) in water was lower than fluorene (100 mg·L⁻¹ = 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. After fluorene exposure, transcripts levels of phase I gene were higher in 200 g·L⁻¹ (96 h). Transcript levels of all genes were higher in oysters exposed to 100 mg·L⁻¹ of pyrene (24 h). Besides, CYP2A1U1 (24 h and 96 h); GOTO-like (24 and 96 h) and SULT-like (24 h) were higher in oysters exposed to pyrene 50 mg·L⁻¹. EROD and GSTm activities were higher in oysters exposed to 100 mg·L⁻¹ of pyrene (96 h). These results suggest an important role of phase I and II biotransformation genes and enzymes in pyrene metabolism. This study contributes to the identification of new biomarkers of PAHs contamination in C. brasiliana. Moreover, it 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 PARMAROMATUS TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOR (ITALY) AND OF AN ADJACENT MPA
I. Caliani, F. Bellucci, M. Vitale, University of Siena / Department of Physical, Earth and Environmental Sciences; M. Fossi, University of Siena / Department of Physical Sciences, Earth and Environment; S. Fratini, University of Florence / Department of Biology; C. Petti, CIBM Centro Interuniversitario di Biologia Marina; S. Casini, University of Siena / Scienze Fisiche della Terra e dell’Ambiente. 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 parmaromatus. This investigation is part of the IMPACT project (Port on Impact on Marine Protected Area: cross-border co-operative actions), which has the purpose to deploy cross-border 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 (MPA) of the marine reserve, just a few miles from the Livorno harbor, where we intended to explore the eventual 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 (erythrocytic nuclear abnormalities, ENA assay) in the crabs. The levels of trace elements and PAHs were also evaluated in the sample 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. parmaromatus, 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, Ti nanoparticles (TiNPs) are widely used in aquatic environments. Interaction of ephyrae of jellyfish Aurelia aurita or A. salina with titanium in coastal environments has raised concerns about the toxicity of Ti to inhabiting organisms. Once in the aquatic environment, TiNPs interact 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 and 100g/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 lowered metabolism, represented by lower euryelectrin transport system (ETS) activity, which decreased along exposure time decreased their metabolic response (lower % glyco gen (GLY) and protein (PROT) contents). Moreover, contaminated individuals activated their antioxidant defences increasing the activity of superoxide dismutase (SOD), cata lase (CAT), glutathione peroxidase (GPx) and glutathione S-trans ferases (GSTs), which still were not enough to prevent cellular damages (revealed by the increased of lipid peroxidation in mussels exposed to Ti).

TU130 Comparing interspecific Artemia response 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. Experiments were carried out in laboratory conditions, widely distributed and ecologically relevant. Although C. brasiliana was exposed to pyrene (50 mg·L⁻¹) was the double of that recorded in water from the Odil 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 and 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 Art emia species when compared to the control, but being different between species. However, native A. salina presented a lower performance (higher number of broods and offspring production; lower % non-viable nauplii) than A. franciscana. The results of this work highlight the competitive advantage 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 Odil estuary would not be a region 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: ephyrae of jellyfish Aurelia aurita (L.) as bioindicators in contamination studies of the jellyfish Aurelia sp. and Sanderia malayensis
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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 food webs, generally they are not yet used 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 malayensis as model organisms in ecotoxicological bioassays. A series of experiments were carried out in laboratory controlled conditions, in order to characterize some experimental parameters that can influence the frequency of endpoints and the general end-point frequency of effects, and 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 pulsation 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 EC₅₀
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
S. morena, C. Gambardella, M. Faimali, F. Garaventa, CNR ISMAR
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 ecotoxicology and 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 crustacean Artemia sp. and the echinoderm, sea urchin embryos owing to the determination of only one toxic fraction and the orthogonal comparison to C. urchin. As a result, it was tested separately to establish the concentration of the fraction with the highest toxicity. 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 emerge toxicity, 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 K_Cr(III) (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, excepting 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 vary as shown for Pb (acclimated). Also, opposite outcomes regarding monophyletic species indicates that it is not accurate to use species from different climates to estimate toxicity.

TU134
Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity
S. Lee, Seoul National University / System Toxicology Research Center; M. Cho, Korea Institute of Toxicology; S. Yoon, W. Kim, Korea Institute of Toxicology / System Toxicology Center
Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxide 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 toxicants 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 transcriptional 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 the water flea genome database. After the BLAST and alignment, the genetic information of 10 key eicosanoid genes, such as pla2, cos, 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 the expression of pla2 gene which was commonly down-regulated by all the eicosanoid targeted drugs. Interestingly, some genes, such as pgd2 and gvx1, 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 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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Phytoplankton and marine invertebrates are subjected to 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 emerge toxicity, 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 K_Cr(III) (to check for sensitivity), to the metal Pb and to mancozeb were made. Since size is crucial on organisms’ tolerance, neonates’ body length was also measured. No difference on daphnids sensitivity was spotted among generations, excepting 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 vary as shown for Pb (acclimated). Also, opposite outcomes regarding monophyletic species indicates that it is not accurate to use species from different climates to estimate toxicity.

TU136
Chronic effects of BPA, BPS, and BPSIP in Daphnia magna
Y. Hong, B. Jeon, I. Ryoo, J. Lee, K. Ji, Yongin University
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-hydroxyxenyl 4-isopropoxyphenylsulfone (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 (<p < 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 Y. Kim, KIST Environmental Safety Group; Y. Seol, KIST-Europe / Environment Safety group 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 organism. In EU R & D guidance 2004/35/EC on plant protection of MEHP acts as a low acute 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 malondialdehyde, reproduction rate and growth of daphnids during chronic (21d) 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? B. Ponti, ChemService Srl; R. Bettinetti, University of Insubria / DSTA; D. Garagna, ChemService s.r.l.; F. Casarotto, University of Insubria; M. Neri, ChemService srl - Controlli e Ricerche 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. 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 malondialdehyde, reproduction rate and growth of daphnids during chronic (21d) 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.

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius M.D. Bordaual, University of Aveiro; A. Rodrigues, University of Aveiro / Biology Department and CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; J. Pestana, CESAM & University of Aveiro / Biology 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 population adaptation to environmental changes and their 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 using clonal lineages. An alternative methodology has been applied for sexually reproducing organisms, using environmentally relevant genetic variation regarding tolerance to contaminants 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 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 requirement in EU R & D guidance 2004/35/EC on plant protection. First instar larvae of C. riparius were tested against probenecid (1 mg/L of BPA, 5 and 10 mg/L of BPS, and 1 mg/L of BPSIP (<p < 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).

TU141 Effects of Amitraz on Chironomus riparius: life history and biochemical responses H.R. Monteiro, University of Aveiro / Department of Biology and CESAM; J. Pestana, CESAM & University of Aveiro / Biolo, Polytechnic Institute of Leiria / MARE IPILeiria; A.M. Soares, University of Aveiro / department of Biology & CESAM; B. Devreese, Ghent University / Laboratory for Protein Biochemistry and Biomolecular Engineering; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPILeiria Amitraz is a very effective formamidine insecticide used in agriculture to control a large array of pests (fruit trees and cotton pests). Due to its widespread use and high persistence, there is an elevated risk of contamination of adjacent aquatic ecosystems. However, the information of amitraz toxicity to aquatic non-target invertebrates is scare. 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. 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 Analysis of mixtures of bisphenol A and UV filters Octocrylene and OD-PABA on Chironomus riparius using a specific RT-PCR array A.M. González, UNED / Mathematical Physics and Fluids; J. Martínez-Guitarte, UNED / Física Matemática y de Fluidos Ana-Belén Muñiz-González, José-Luis Martínez-Guitarte, ´UnGrupo 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-dimethyaminobenzoate (OD-PABA), and BPA to mimic the oxidative stress resulting from PCPs and interacting with plastic of PCP containers. These mixtures were used to reach the biota of freshwater ecosystems. 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 ecosystems, 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 mixture. Endpoint profile choice was done by retrotranscription and Real-Time PCR using a specific array covering a number of relevant metabolic pathways like endocrine system, immune response, stress response, detoxification mechanisms and apoptosis among others. Using an array could improve the toxicological evaluation of the cellular effects of the compounds favoring the identification of new molecular biomarkers useful for ecological risk assessment and toxicity tests. The methodology used to design the array can be used with other 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), C2015-64913-R/a.A.B.M.G is the receiver of a pre-doctoral contract from the National University of Distance Education (UNED).

TU141 Oxidative effects of mono- (2-ethylhexyl)-phthalate on Daphnia magna in both molecular and population level Y. Kim, KIST Environmental Safety Group; Y. Seol, KIST-Europe / Environment Safety group 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 organism. In EU R & D guidance 2004/35/EC on plant protection of MEHP acts as a low acute 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 malondialdehyde, reproduction rate and growth of daphnids during chronic (21d) 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.
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 amitraz for 10 days, while there was a significant decrease in DNA damage levels at 10 and 40 µg L⁻¹ treatment. 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-MMA/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-16773).

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, University of Aveiro / Department of Biology & CESAM; T.T. Neves, University of Aveiro / department of Biology & CESAM; P. Silva, Universidade de Aveiro; J. Ulcar, 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 enhanced productivity. Although soil contamination may result in long-term changes due to applications, which may result in environmental problems. More recently, nano-pesticides were introduced in the market with the intent to improve the efficacy and decrease environmental negative effects. However, the chronic and subchronic ecotoxicological effects of nanoparticle 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 collombola 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 LUFA 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 collombolan responses (survivability, reproduction) measured for three generations; and 2) Cu spiking performed at the start of each new cohort phase (three generations) was repeated in every soil generation, resulting in Cu-induced soil composition 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 repeated Cu spiking, the collombolan 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 different between them in the long-term exposure. This study further emphasises the importance of using multigenerational approaches to obtain more ecological relevant evaluations of environmental risk associated with chronic exposure to soil agrochemicals.

TU143 Effects of multiple environmental stressors on Eisenia fetida coelomocytes: cell viability and different behaviour of amoebocytes and eleocytes N. García-Velázquez, University of the Basque Country / Zoology and Animal Cell Biology; Research Centre for Experimental Marine Biology and Biotechnology PIEUVEHU; E. Uriarbañarteanzea, 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 PIEUVEHU. 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 longer exposure times and higher complexity levels (organism, population). Since soils are subjected to multiple environmental stresses (e.g., temperature, salinity, organic matter depletion), it is of great interest to assess how these stress scenarios pose changes in earthworms at cellular level. Coelomocytes compose a heterogeneous cellular group where two major cell subpopulations are distinguished, amoebocytes and eleocytes. However, the behaviour of those subpopulations against different stressors is still unclear. Hence, 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 (19°C vs. 26°C) and copper treatments (Cd: 5.25 mg kg⁻¹ dw., Ag NPs: 0-100 mg kg⁻¹) 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 cytometry analysis was used to determine mortality of coelomocytes and changes in the relative proportion amoebocytes/eleocytes. Coelomocytes extruded from earthworms maintained under low OM content exhibited high 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 dependant on metal form and was enhanced by environmental factors (increased temperature and low OM). These results reinforce the potential role of coelomocytes at cellular level for an accurate soil health assessment in a global warming scenario. Acknowledgements: Basque Gov (IT10-13), 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 Ecology 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. Rodolfo, 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. The objective of this study 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 standardized 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 Trimmer Spearman Karber (TSK) and EC₅₀ and EC₉₀ 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 essentially the active ingredient formulations containing the 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 underpin 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 grown. Arthropods are considered to be the most species-rich taxon with over 31 (000) species described. Terrestrial arthropods are relatively easy to sample, and collection normally has less ethical restrictions then for higher animals. We reviewed 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 they are more sensitive to the effects of environmental pollution. Therefore, we conducted a review of the 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
Effect of spray drift reduction techniques on pests and predatory mites in orchards and vineyards


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 a 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 key pests on apple (Cydia pomonella and Lobesia botryana 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 80005 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 microorganisms

S. Kim, Y. Chae, D. Kim, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

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 this framework, 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, MP10F1). The behaviour patterns were recorded and quantified. Diving beetle fed the adult zebrafish, which exposed under MP10F1 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 MP10F1 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 beetle on control group was calculated as 0.63±0.10 zebrafish wet mg/sec. The exposure group, which fed MP10F10 exposed zebrafish, showed the significant decreasing (p < 0.05) of ingestion rate (0.55±0.08 zebrafish wet mg/sec) during 591±85 seconds. On diving beetle, the MP were finally found at crop organ until 720 min after ingestion, and did not transfer to other 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 Basic Science Research Program through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT, and future planning (2016R1A2B3010445).

TU150

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-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 the (PA) content in polyester/cotton blend (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 that fiber fragments were generated during the simulation of industrial washing (Gyro wash). Fiber fragments were identified with REM and the EDX analysis of showed fluorine (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 fluorinated 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 DWR treatment of fibers such as flame retardants was 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.

TU153  A cost-effective methodology for separation of microplastics from freshwater systems

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Plastics, one of the most demanding material worldwide, are considered one of the most emerging aquatic pollutants due to their ubiquity, high persistence and insufficient management. Especially, microplastics (< 5 mm) are of scientific and social apprehension as they can reach high densities, derive from a variety of sources and can interact with biotic and abiotic environment. Currently, the concerning about the occurrence of microplastics (MPs) in freshwater systems has been increasing, notwithstanding there is no unified method for MPs separation in these systems. This result in inaccuracy data that differs in quality and resolution, not allowing data comparison between different studies (large-scale spatial and temporal comparisons). Hence, this work aims to address the effectiveness of distinct 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 distinct methods. These methods included density separation methods using sugar, olive oil and zinc chloride, as well as organic matter degradation methods using hydrogen peroxide (per hydrogen peroxide 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 recovered microplastics, the cost 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 motile macrofauna, we tested the hypothesis of a valid correlation between microplastic and specific water parameters. In situ water parameters, microplastic (5mm – 250 µm), and in situ derived spectral reflectance measurements (ASD FieldSpec) were taken during field campaigns at three different river mouths (Trave 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 combustion, 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.
TU155 Coastal accumulation mapping of microplastic particles emitted from the Po River, Italy: Integrating remote sensing, in situ sample collections and ocean current modelling
E.C. Arwood, RSS Remote Sensing Solutions GmbH; F.M. Falcieri, CNR - ISMAR; R. Beck, University of Bayreuth, Animal Ecology; I. M. Bochow, Helmholtz Centre Potsdam - GFZ German Research Centre for Geosciences; M. Matthies, University of Osnabrueck / Institute of Environmental Research; J. Franke, RSS Remote Sensing Solutions GmbH; S. Carmiel, M. Scelvo, CNR - ISMAR; C. Laforsch, University of Bayreuth; F. Siegert, RSS Remote Sensing Solutions GmbH.

Phytoplankton 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 increased 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 (analyzed 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 across 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.

TU156 Cause and effect of the plastic industry in South Africa as a developing country
C. Verster, North-West University - School of Biological Sciences / Environmental Sciences and Development.

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 aquatic 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 were found in 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.

TU157 Understanding the distribution and fate of microplastics in a tertiary sewage treatment plant in the UK
R.M. Blair, S. Waldron, University of Glasgow; C. Gauchotte-Lindsay, University of Glasgow / Infrastructure and Environment; V. Phoenix, University of Strathclyde / Civil and Environmental Engineering.

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 freshwater bodies. The MPs were extracted from five (5)-sized fractions at each 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 influent to outflow. Further, high variability of MP 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 the misidentification of cellulose and other FPI 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.

TU158 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. In this study, weathered MPs were used to mimic the potentially more complex processes that occur in the environment. Weathering of MPs can lead to the modification of particle properties, for example by changes in physical or chemical characteristics, or the elution of substances from the particles. This study focused on the effects of weathering on the survival rates of copepods and daphnia, and on the formation of biofilm. The MPs were extracted from 5 treatment stage in removing these contaminants before discharge into recipient freshwater bodies. The MPs were extracted from five (5)-sized fractions at each 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 influent to outflow. Further, high variability of MP 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 the misidentification of cellulose and other FPI 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.

TU159 Occurrence and characteristics of fine microplastics in sewage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscope method
Y. Kameda, Chiba Institute of Technology / Creative Engineering; N. Yamada, T. Yasuda, Chiba Institute of Technology.

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 aquatic environments and so on. This research shows occurrence and characteristics of MPs in sewage water, sewage treatment water, river water by coagulation and FT-IR microscopy method 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 statistical analysis of distribution of MPs by FT-IR microscopy. MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectrum data. Based on these data, contribution of MPs from personal care products to total MPs concentration will be discussed as well as estimation of sources of MPs in various water samples.

TU160 Detection of micro-paint particles and microplastic in harbour soil samples using FPA-μFTIR-Imaging-FTIR
A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, N. van Alst, F. Liu, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering (26%), ally coated (Aalborg University / Civil Engineering Department 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 bacteria 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 (5000-500 µm and 500-10 µm) were submitted to flotation using ZnCl₂, followed by sample cleanup using enzymes and H₂O₂ and HCl 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 (20%) and polyurethane (17%). The particle size distribution showed the most abundant size ranges were between 20 - 40 µm and 40 - 80 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-paint particles were successfully extracted and detected in a recreational harbour 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
R. Herling, NIVA - Norwegian Institute for Water Research; T.C. Schell, IMDEA Water Institute / Ecotoxicology; R. Hurley, Norwegian Institute for water research; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; M. Vighi, IMDEA Water Institute / Earth and Environmental Sciences 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 fate of MPs entering WWTPs during treatment processes. MPs not retained by WWTPs are directly discharged into the aquatic environment through WWTP effluents, whereas the majority of MPs are assumed to be retained and accumulated in the sewage sludge. Runoff, after application of sewage sludge to agricultural fields, may consequently serve as an additional source of surface water contamination by MPs. Therefore, 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 influent, outflow, and sludge (humid and dried) were sampled during two different seasons (spring and summer). In addition, river water and sediment samples were taken 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 20 mm). 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 composition using FTIR spectroscopy. Finally, the most suitable analytical methods 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
A. Gomiero, International Research Institute of Stavanger / Environment; G. Skogerbo, IVAR; K. Øysæd, A. Voltan Kruijvel, International Research Institute of Stavanger Microplastics as a potential health and environmental problem has gained increasing attention recently. Microplastic is defined as plastic pieces smaller than 5 mm in diameter, and the sources of microplastic are many. State of the art literature reports that microplastics are ubiquitous worldwide. While several authors report frequent occurrence of different plastic particles in natural compartments of marine, freshwater and terrestrial ecosystems; others point out the accumulation of micro- and nanometric sized plastic particles through the marine and terrestrial food webs posing the risk of marine and terrestrial life and ultimately the human health. Despite of these studies point out the occurrence of micro plastics in freshwater systems including surface and groundwater basins, very little in known about their occurrence in the drinking water. In this study, we focus our research work and their implications on human health. According to the WHO men should consume 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 system collection point as well as in different sites of the urban area. A fast and sensitive method based on a GCMS-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
V. Verney, CNRS ICCF / Photochimie-CVP; G. Bissagou Koumba, UC Clermont, F. Delor Jestin, Signy ICCF; Z. Dombian, H. Askanian, CNRS ICCF; J. Peiry, E. Roussel, O. Voldoire, CNRS Geolab; A. Schaal, L. Duranton, Observatoire du Microplastique; M. Liboiron, Memorial University of Newfoundland
It is now known that the vast majority of microplastics found in the seas and oceans originate from lands. In such a process freshwater environment (rivers and riverbanks) play a major role. It is therefore necessary to imagine the scenario that a used plastic, becoming a waste after use, will be found in the environment if it has escaped to a waste treatment stream. Its stay in the environment can persist for very long time and this waste will then be exposed to a set of environmental constraints (UV, rain, wind, mechanical erosion, ...) which will continue and amplify its degradation, leading to its fragmentation The work we have undertaken consists of: 1. Mapping its presence, the mobility and chemical composition over time of macroplastics present on the banks of an experimental site of the Allier River, and linking it to the density of the vegetal areas. 2. Set up on site a controlled pollution to follow its fate along the time 3. Analyse the composition of macroplastics extracted from the sediments, especially at the entrance of the abandoned channel, where it may exist some vortices of flow. These first three points are the topic of the Plastigceans project supported by the CNRS[1, 2, 4]. Collect and analyze the composition of microplastics in the surface waters of different french rivers (Allier, Charente, Loire, Touvre, etc.). To do this, we rely on citizen science operations, in particular thanks to the contribution of the babybel sampling net [3,4], which makes it possible to multiply samples and analyses. 1. Occurrence of plastic litter in the Allier river in France, Vincent Verney; Gaëlle Bissagou Koumba, Alexandre Garreau, Florence Delor Jestin, Erwin Roussel, Olivier Voldoire, Jean-Luc Peiry; To be published 2.https://www.researchgate.net/project/PLASTICCAGES 3. Compromise agency, the case of babybel, Max Liboiron, Engaging Science, Technology and Society (3, 2017), 499-527 4. http://lapugialegaueva.org/laboratoirerecyclen.html

TU165
Spatial and temporal trends of microplastics in an urbanized Canadian river
M.S. Ross, T. Bujaczek, S. Kolter, MacEwan University / Department of Physical Sciences; D. Locky, MacEwan University / Department of Biological Sciences
Microplastics are ubiquitous contaminants in the marine environment, but quantities that are often present in the freshwater environment are not well studied. This study investigates the occurrence, composition, and potential sources of microplastic contamination in the North Saskatchewan River, an urbanized river flowing through the city centre of Edmonton, Alberta, the fifth largest city in Canada. Surface water samples were collected monthly during the summer of 2017 using plankton nets with 53μm mesh. Samples were collected from seven sites throughout 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 coloured fragments, films, beads, and fibers were identified, with the majority of microplastic contamination 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
S. Turner, University College London / Geography; A.A. Horton, Centre for Ecology and Hydrology; N. Rose, University College London / Department of Geography
A historical record of microplastics extracted from a radionuclide (239Pu and 137Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particle 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. Polystyrene 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, linked to atmospheric deposition of plastic to the lake, suggests 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 flux of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

TU167
Microplastics from sewage treatment works and storm water outfalls discharging into the Victoria Harbour, Hong Kong SAR
C. Mak, Y. Tsang, The Chinese University of Hong Kong / School of Life Science Environment Science; K. Chan, The Chinese University of Hong Kong / Life Sciences
We conducted surveys of microplastic pollution in the surface waters and sediments from Deep Bay, Tolo Harbour, Tsing Yi, and Victoria Harbour in HK SAR. In the microplastics survey (June 2015 to March 2017), the averaged concentrations of microplastics in local coastal waters and sediments respectively ranged from 51 to 270 (0.92-1.01) and 49.2-100 (2.05-2.71) particles per kilogram. The highest concentration of micro-plastics (coastal water) was recorded at 35.642 particles per 100m3 in March 2016 in Victoria Harbour (West Kowloon). Therefore, we also study the effluents directly discharged from chemical enhanced primary sewage treatment works (Stonecutters Island STW) and secondary sewage treatment works (Sha Tin STW, and two stormwater outfalls (SWOs) (Kwun Tong Ferry Pier, New York) and T. Ma Tei Typhoon Shelters) which are potential microplastic pollution sources entering into the Victoria Harbour. Effluent samples from each of the three sewage systems were collected in three weekdays per month and different seasons (December, March, June and September) to determine spatial, temporal (seasonal) variations of microbeads in treated sewage and stormwater discharges. The average concentrations of microbeads present in effluents from STWs and SWOs respectively ranged from 137,239 to 1,081,597 particles per 100m3 (December 2016 to March 2017) that consider as moderate emission level. Biological samples (fishes and mussels) are also collected in two SWO for the assessment of microbeads abundance and composition in its digestive system. Microplastics of different shapes from sewage and biota (mainly fragments, lines, fibres, and pellets) were identified by means of Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy. Zebrafish exposed to microbeads individually would ingest different sizes of polyethylene microbeads (10-22μm, 45 to 54μm, 90-106μm, 212-250μm 500-600μm) and their digestive tracts and gill filaments were fully occupied by microbeads. Mixtures of microbeads in environmental related concentrations are used for expression profile of cytochrome P450 1A1(CYP1A1) and vitellogenin 1(VTG1). The highest concentrations in zebrafish adult (Danio rerio) are (i) the upper and lower size boundaries for microbeads ingestion (ingestion range:10 to 600μm), 2) amount of microbeads accumulated inside the digestive tracts, and 3) expression profile of oxidative stress-related gene (CYP1A1) and endocrine-related gene (VTG1).

TU168
Models for Data Synthesis, Sampling Design and Scenario Analysis: Some experiments using the INCA-MP model of microplastic fate and transport in soils and surface waters
M. Futter, Swedish University of Agricultural Science / Aquatic Sciences and Assessment; J. Crossman, University of Windsor; J. Ledesma, V. Russo, E. Lannerlård, SLU Swedish University of Agricultural Sciences / Aquatic Sciences and Assessment; L. Nizzetto, NIVA
Quantification and classification of microplastics in soils, sludge and surface waters is both time consuming and expensive. Ideally, measurement campaigns can be focussed on areas that are likely to provide the greatest returns on effort yet this is often difficult to accommodate. Here, we show how the INCA-MP model for Microplastic pollution Source Tracking (MPST) and high frequency water quality monitoring can constrain estimates of microplastic mobility in terrestrial and freshwater environments. Through the application of uncertainty analysis in INCA-MP, it is possible to identify the most sensitive pools and processes when making predictions of microplastic fate and transport. Furthermore, knowledge gaps related to these pools and processes can then be targeted for more intensive field sampling campaigns. As an INCA-MP includes sophisticated routines for tracking the environmental fate of current and emerging micropollutants, the model can be used for risk assessment of co-transported contaminants. Such information is needed both for more targeted sampling
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. Campanale, C. Massarelli, G. Bagnuolo, Italian National Research Council; V. Uricchio, 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, 352 to 13.4 kg/µm² showing significantly higher abundances during February than April campaign (Mann–Whitney U Test = 18.00; p-value = 0.028). A total of five polymer have been characterized: PE, PP, PS, PVC and TDI-PUR. All samples contained at least three polymer types: PE, PP and PS. PE accounted for 77% of the total particles identified, followed by PS (12%), PP (10%), PVC (0.9%) and PU (0.4%).

TU170 Removal of 10–500 µm microplastics from wastewater effluent by disc filter M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department; K.B. Olesen, Aalborg University / Department of Civil Engineering; F. Liu, J. Voltersen, Aalborg University / Civil Engineering Department

In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10–500 µm and the identification technology was micro-FTR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grindsted, Denmark operated by Billund Spildevande A/S. The treated wastewater was sampled before and after the disc filter by collecting the effluent into 10 µm stainless steel membrane filters. A large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical and potentially significant component of the global microplastic life cycle. Herein we report results from a monitoring study with the main objective of evaluate the occurrence and concentration of microplastics in an urban Italian river and assess the hypotheses that microplastics amount could vary in response to temporal and seasonal trends. The efficiency of a disc filter to remove microplastic concentrations, two seasonal sampling campaigns have been planned (February and April 2017).

Superficial waters samples were collected with three surface plankton nets fixed in the middle of the river simultaneously for two different time slot (11:00-13:00 and 13:00-15:00) for a total of six replicates for each campaign. Sample extraction and purification, validation of visually based microplastics identification was achieved using proton–nas–chromatography–mass–spectrometry (Pyrolysis GC–MS). The composition of microplastic was studied in term of size, shape, color and polymer type. Results from the six replicates are expressed as mean values (±DEV. ST.) of number of particles per cubic meter (p/m³). Microplastics were found in each net sample for a total amount of 22152 items collected, photographed, enumerated and categorized. Sample concentrations ranged from 3.52 to 13.4 p/m³ showing significantly higher abundances during February than April campaign (Mann–Whitney U Test = 18.00; p-value = 0.028). A total of five polymer have been characterized: PE, PP, PS, PVC and TDI-PUR. All samples contained at least three polymer types: PE, PP and PS. PE accounted for 77% of the total particles identified, followed by PS (12%), PP (10%), PVC (0.9%) and PU (0.4%).

TU171 PlasticBudget - Project on the environmental assessment of microplastic emissions N. Thomsenmann, Fraunhofer Institute for Environmental, Safety, and Energy Technology UMSICHT

 Shortly after the introduction of many types of plastics (e.g. polyurethane, polyethylene terephthalate, polypropylene) in the 30s, 40s and 50s, first traces of plastics in the environment have been detected. Packaging, pellets and parts of a kitchen sponge were found in the stomachs of seabirds; Whales and seals were caught in polypropylene cords. By weathering and fragmenting larger plastic objects (macroplastics) into smaller pieces (microplastics), plastic waste in the environment seems to be gradually disappearing. However, as recent research shows, microplastic is found in freshwater, on beaches and in open water, in the deep sea and in the Antarctic ice. It is taken up by organisms and potentially significant component of the global microplastic life cycle. Herein we report results from a monitoring study with the main objective of evaluate the occurrence and concentration of microplastics in an urban Italian river and assess the hypotheses that microplastics amount could vary in response to temporal and seasonal trends. The efficiency of a disc filter to remove microplastic concentrations, two seasonal sampling campaigns have been planned (February and April 2017).

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TU172 How do we know that microplastics are different from natural particles in their effects on biota? Z. Gerdes, M. Ogomowski, E. Gorokhova, Stockholm University / Department of 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 polymers, sizes 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 caused by particles to be separated from those caused by other factors. This separation is crucial for testing MP-specific effects, as many test organism 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 most strongly suggest that particle controls are essential for identification of MP-specific effects, so that MP impacts can be assessed based on ecological soundness.

TU173 Influence of environmental conditions on the sorption of organic pollutants to microplastics M. Simon, Aalborg University; N. van Alst, Aalborg University / Civil Engineering Department

In this study the efficiency of a disc filter to remove microplastic concentrations from wastewater effluent was evaluated. The size range of particles addressed was 10–500 µm and the identification technology was micro-FTR imaging spectroscopy applying a focal plane array (FPA). Effluent wastewater was collected at the wastewater treatment facility at Grindsted, Denmark operated by Billund Spildevande A/S. The treated wastewater was sampled before and after the disc filter by collecting the effluent into 10 µm stainless steel membrane filters. A large-scale water sampling device. The filtered volume of effluent wastewater before the filter was 200 L and 1.6 m³ after the filter. The residue collected on the filters containing a mixture of organic matter, inorganic particles and microplastics was subjected to a purification procedure including enzymatic digestion, chemical and potentially significant component of the global microplastic life cycle. Herein we report results from a monitoring study with the main objective of evaluate the occurrence and concentration of microplastics in an urban Italian river and assess the hypotheses that microplastics amount could vary in response to temporal and seasonal trends. The efficiency of a disc filter to remove microplastic concentrations, two seasonal sampling campaigns have been planned (February and April 2017).

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TU174 Influence of environmental conditions on the sorption of organic pollutants to microplastics 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 wastewater contaminants and are hence a factor that needs to be considered if the environmental fate of pollutants is examined. Some contaminants, among those also micropolllutants 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. Thus, the aim of this study was to clarify the sorption behaviour of dissociating compounds to microplastic particles. We measured the equilibrium partitioning between 19 typical wastewater contaminants (pharmaceuticals, personal care products, pesticides) and microplastics at three different pH values (4, 7, and 10). The investigated compounds showed a wide variety in their physico-chemical properties, e.g. a log $K_{oc}$ range between 0.1 and 5.8 and $pK_a$-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 $K_{oc}$ 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 polyethylene and polyamide.

TU174 Influence of microplastics on transport of organic contaminants in soil T. Huffer, S. Swalek, T. Hofmann, University of Vienna / Department of Environmental Geosciences


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. Schmieg, 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

Polystyrene is a lightweight, heat-resistant plastic that can be found as microplastics in freshwater systems, and is often used as food packaging. The purpose of this study was to investigate the effects of polystyrene microplastics on the behavior and biochemistry of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10,000 polystyrene particles per liter (cryogenically milled, < 100 µm) in combination with different concentrations of pesticides. The results show that polystyrene microplastics can affect the behavior of the snails, including a decrease in feeding and successful reproduction. These findings are highly relevant for the management of microplastics in the environment and highlight the need for further studies to understand the long-term impacts of microplastics on freshwater ecosystems.

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. Freshwater microplastics, focusing on the transfer of chemicals to the environment, is of particular importance. In this study, we explored the effects of conditioning on the transfer of chemicals from plastic to freshwater. The presence of microplastics in the environment can affect the behavior and ecological interactions of organisms, and is of particular concern in freshwater systems. Freshwater microplastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. The study aimed to assess the impact of conditioning on the transfer of chemicals, including 17α-ethynylestradiol and 17α-ethynylestradiol and deters. The results show that conditioning can affect the behavior and ecological interactions of organisms, and is of particular concern in freshwater systems. The study aims to assess the impact of conditioning on the transfer of chemicals, including 17α-ethynylestradiol and 17α-ethynylestradiol and deters. The results show that conditioning can affect the behavior and ecological interactions of organisms, and is of particular concern in freshwater systems.
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 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 forms of plastic. Therefore, it is important to understand potential environmental impacts of both polymer types. We compared effects of exposure to polylactic acid (PLA; biopolymer) and polystyrene (PS; oil-based polymer) on primary life history traits in the crustacean Daphnia magna, a standard model 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 fractionality of > 50 µm, up to 100,000 particles/L), distinct in combination with organic pollutants (pharmaceutical, pesticide), in different life stages of brown trout (Salmo trutta f. fario). For that purpose, we conducted a fish early life stage test (FELST) according to OECD 212. The endpoints of interest were heart rate, hatching success and mortality. After consumption of the yolk sac by the fish larvae, we additionally investigated the level of oxidative stress by means of the fluorescent dye DCFDA, associated to the markers of oxidative stress. To confirm, we examined effects of polystyrene particles (< 50 µm, 10,000 particles/L) alone and in combination with the pesticide methoate in juvenile (11 months old) brown trout. In this experiment, the mortality rate, biometric parameters, the level of oxidative stress, the induction of the 70 kD stress protein (Hsp70) and the inhibition of acetylcholinesterase were under investigation. Furthermore, we examined histopathological effects in gills and in guts of the trout. First results showed no effect of microplastics on mortality and biometric values of either larvae or juvenile brown trout. Further analyses are still in progress. The present study is part of the joint research project “MiWa” (microplastics in freshwater systems) funded by the German Federal Ministry of Education and Research (support code: 02WRS1378).

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 community because their ability to be accumulating in the tissues of biota. MPs can reach the aquatic environment through the Wastewater Treatment Plants (WWTPs) or affect the degradation of macroplastics. 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 controls, 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 whole 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, except 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 suggests that the toxicity of MPs could be related to the association of MPs towards 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 biivalves, 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 is missing. Therefore, we analysed 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 µ M L⁻¹ over 6 weeks at 16 °C. After the exposure, the gill and soft tissues were analyzed for malondialdehyde concentrations as well as for the remaining abundance of hydrophilic, non-enzymatic antioxidant substances (ORAC assay, oxygen radical absorbance capacity) – an estimate of the remaining antioxidant capacity. The analysis of lipid peroxidation

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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 long-term sub-chronic effect 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**

**Analysis of the Trojan horse effect of a mixture of microplastics and chlorpyrifos in an aquatic microcosm study**

J. Deerman, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; X. Chen, University College London; T. Strauss, Research Institute gaia / gaia - Research Institute for Ecosystem Analysis and Assessment; H. Hollert, RWTH Aachen University / Institute for Environmental Research

Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Besides 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 concentration was used in a complex ecosystem water phase test 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 polystyrene microbeads. Beside the control microcosms (C), an MP-control (MPC) group was treated with 4 mg MPL. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 5 μg/L (H) in the water phase. After 14 days of treatment, all 24 aquaria contained 16 L water and a 3 cm sediment layer, both taken from outdoor ponds. The natural plankton community got enriched by the amphibid *Crangonyx pseudogracilis*. After a pre-treatment period of five weeks, the experiment run for eight weeks. A chemical analysis of CPF in the water phase of the stock solutions and the treatment groups L and H (day 14) 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. 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 similarly 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 been underestimated in previous studies and the treatments L and H (day 14) was performed. The reason why the presence of MP (without CPF) might have led to enhanced abundance still needs to be clarified.

**TU186**

**Microplastics exposures of fish: internalization and effects on behavior and growth**

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Microplastics (MP) can potently enter the terrestrial environment via sewage sludge deposition on agricultural land. In some countries plastic bags are used as soil cover in home gardens and agricultural land to act as mulch film. Due to fragmentation of these plastic bags, secondary MP may enter the soil and can be further transported along the soil column by bioturbation. Despite the potential presence of MP in terrestrial environments, data regarding the effect of MP on terrestrial organisms are very scarce. In this study, we investigated if terrestrial isopods *Porcellio scaber* and earthworms *Eisenia andrei* avoid soil contaminated with microplastic. We tested microplastic extracted from facial scrub and fragmented from plastic bag. The mean size of MP from facial cleanser was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of samples). All experiments were performed in a sub-chronic exposure (48 h) and the number of animals at each side was recorded. Earthworms were exposed in one test container that was washed when the applying control soil and MP contaminated soil. Before the animals (10) were placed into the test container the divider was removed. The number of animals on each side of the soil was counted after 48 h of exposure. Our results indicate that isopods show no preference or avoidance behavior towards facial scrub microbeads or plastic bag microplastic contaminated soil. This was shown for both types of exposures, individual and group. On the other hand, earthworms clearly avoided the facial scrub contaminated soil test, whereas they were not affected by plastic bag MP. It remains to be investigated how longer exposure to MP would affect the behavior of terrestrial organisms. Also it is of interest how environmentally aged MP (e.g. coated with biofilm) would affect the organisms. Knowledge in this field is important to assess the potential hazard of microplastic deposited on soil.
feeding with microplastics 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. McGorran, Royal Holloway; P.R. Cowie, Field Studies Council Scotland; P.F. Clark, The Natural History Museum; J.P. McEvoy, D. Morritt, 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 33-47% of fish ingested plastic, mostly 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 B. Del Felice, Università degli Studi di Milano; R. Bacchetta, University of Milan; P. Tremolada, University of Milan / Department of Biomolecular Sciences and Biotechnology; M. Parolini, University of Milan / Department of Environmental Science and Policy 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 to microplastics (MPs), small plastic particles (dimensional range Daphnia magna ingesting 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, release test after 24 hours of exposure of MPs showed that 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. SUPLAN, University of Birmingham; I. Lynch, University of Birmingham / Geography Earth Environmental Science; J. Saddler, The University of Birmingham / 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 crustacean Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2-3 mm) to D. galeata (1.3-2.0 mm) which span 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 polybead carbonylate 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, 72 hours exposure to a range of mass concentrations (also compared on the basis of the 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 SMZ800) 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 fluorescently-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 polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU190 Determination of microplastics in mackerel stomachs by enzymatic digestion and µFTIR G. Gueirwe-Noche, Universidade de Coru / Grupo Química Analítica Aplicada (QANAP); V. Fernández-González, J.M. Andrade-Garcia, Universidade de Coruña / Grupo Química Analítica Aplicada (QANAP); P. Lorcé-Rehés, Universidade de Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Aplicada (QANAP); S. Muniategui, 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 is able to microplastics (diameters ≤5 mm). The presence and accumulation in the ocean is cause for concern for several reasons, one of the most important is that they can be ingested by marine biota [1]. Different studies have shown the effects on the biota, such as intestinal blockage, decreased mobility or death [2]. Microplastics can absorb persistent bioaccumulative and toxic compounds from seawater. Once ingested, the absorbed pollutants may be transferred to the respective organisms. A variety of methods has been developed to measure microplastics in biota. One important aspect of these analytical methods is the extraction of microplastics from interfering biomass. Many studies have employed one or more chemicals (KOH, H2O2) to dissolve the biomass, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for µ-spectroscopy-based analyses. An enzymatic digestion has been developed and optimized for digesting biological material without destroying microplastics. Different times and enzymes were tested to optimize the enzymatic protocol. In addition, the enzymatic protocol was compared with chemical digestion (KOH) for the treatment of mackerel stomachs. The optimized enzymatic protocol has been applied to quantify the microplastics debris present in the mackerel stomach. Identification and characterization of microplastics was done by µFTIR. Acknowledgement: Financial support is acknowledged to the Program of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) potentially co-financed by ERDF (ED431C-2017/28) and by the Ministry of Economy and Competitiveness (subproject CDTI-2016-77945-C5-3-R (ARPA-ACUA)). References: [1] V. Hidalgo-Ruz, L. Gutov, R.C. Thompson and M. Thiel, Environmental Science & Technology 46, 3060 (2012). [2] M. Cole, H. Webb, P. K. Lindeque, E.S. Fileman, C. Halsband and T. S. Galloway, Scientific Reports 4, 4528 (2014) [3] J. Wagner, Z.-M. Wang, S. Ghosal, C. Rochman, M. Gassel and S. Wall, Anal. Methods, 9, 1479 (2017)

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, J. Schrank, C. Leforsch, University of Bayreuth / 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 crustacean Daphnia inhabit all kinds of aquatic systems and forms part of the plankton community acting as algae grazers (filtrators) and predators (raptors) making them an important indicator species in the foodchain. The Daphnia family includes species ranging in size from D. magna (2-3 mm) to D. galeata (1.3-2.0 mm) which span 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 polybead carbonylate 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 the 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 SMZ800) 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 fluorescently-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 polybead microplastics on D. magna, D. pulex, and D. galeata are presented here for the first time.

TU192 Photocatalytic degradation of microplastics under UV irradiations V. Verney, CNRS - ICCF / Photochimie-CVP; G. BISSAGOU KOUMBA, UCA-ICCF; F. Delor Jestin, Sigma-ICCF

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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 photocatalysis of the material. This scenario is accompanied by a physical fragmentation into increasingly 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 Polylactic 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 (thefiltration, ion, and liquid chromatography). 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  
I. 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 have the potential to contribute to the litter load of this environment. If 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)  
J. Park, Korea Institute of Toxicology; J. Choi, Korea Institute of Korea KIT; Y. Jung, Korea Institute of Toxicology; S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group

Increasing worldwide contamination of the marine environment with plastics is raising public concern of potential hazards of microparticles to environmental and human health. Microparticles formed by the breakdown of larger plastics and thus are identified by the International Nomenclature of Cosmetic Ingredients (INCI). The 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. 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  
N. Phuong, Université de Nantes; L. Poirier, Université de Nantes / MMS; f. lagarde, Institute of molecules and materials of Le Mans / Institute of Materials and Molecules of Le Mans IMM UMR CNRS; M. Déniel, Institut des molécules et matériaux du Mans; A. Kamarri, A. Zalouk-Vergnon, Université de Nantes / MMS

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 contaminated environmental compartment. 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 23 g of sediment samples in triplicates with 4 different MP types: polyethylene (PE), polypropylene (PP), polycrylnyl chloride (PVC) and polyethylene terephthalate (PET). MP extraction from sediments was performed using milliQ-water combined with centrifugation technic. 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 statistically acceptable 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 kg per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by μFTIR-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 physico-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 are based on the hypothesis 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 (CPF) is widely used as an active ingredient in insecticides. Since 2005 CPF 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 environmental quality standards (EQS) of CPF 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. baillia taken from the EESA authorisation dossier and 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 HC, from a species sensitivity distribution (SSD) for crustaceans and insects using...
The lowest achievable EF of 5. The SSD reveals branchiopoda and amphipoda 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 amphipoda. 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 set was revised to include chronic bioavailable data for sediments in waters with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data show that the amphipod H. azteci 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 EQSs (wt) of 0.32 µg/g dw was derived by applying an AF of 10 on the chronic NOEC for C. riparius. For comparison, also the equilibrium partitioning method was used to derive an EQS from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQStier2 of 0.016 µg/kg dw. Without this AF, the EQSsol,AQ would be in the same order of magnitude as the calculated EQSs (wt). 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

I. Wilson, A. Peters, G. Merrington, wca; J. Chowdhury, International Lead Association / Senior Scientist -Environment

Lead (Pb) is a chemical for which one EQS has been set and is applied across all countries. Current guidance for the EQS (Environmental Quality Standard) is used in Europe is through a compliance assessment, effectively a comparison of the measured concentration of the chemical of interest in a water sample and the EQS. An indicative tiered compliance assessment of the Europe-wide bioavailable lead EQS of 1.2 µg/L (EQSbioavailable) was undertaken following a regulatory freshwater monitoring data from six European member states and FOREGS database. A tiered approach was carried out to ensure the EQS is derived and used to account for, by correcting the measured dissolved metal concentrations in the water sample to a bioavailability-based concentration to be compared to an EQSbioavailable. In Tier 1 measured concentrations were compared against the EQSbioavailable. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Liganig 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 Liganig 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 EQSbioavailable. The waters showing the greatest sensitivity to potential lead exposures are characterised by relatively low DOC (< 0.5 mg/L), regardless of the pH and calcium concentrations. Whilst some risks due to lead are possible this is due to the combination of sensitive waters with elevated lead concentrations, as there is very little overlap of the distributions of site specific PNEC values and dissolved exposure concentrations.

TU199 Assessing compliance of European Freshwaters for copper: accounting for bioavailability

A. Peters, I. Wilson, G. Merrington, wca; D. Heijerick, ARCHE; S. Baker, European Copper Institute

The importance of accounting for bioavailability in understanding the effects of metals has long been recognised in terms of setting environmentally relevant regulatory limit values. Attempts to deliver practical, routine methods to do so have failed. For regulatory purposes in Europe an agreed Environmental Quality Standard (EQS) for a substance must be a fixed value: the same EQS is applied for all regions, and the same EQS must be set for the bioavailable forms, and it is termed EQSbioavailable. This study determines the levels of compliance of European freshwaters with a copper EQS, and evaluates the usefulness of a tiered approach to compliance assessment for copper. The first tier compares the dissolved metal concentration to a threshold, estimated using either regional or continental water chemistry data. At Tier 2, the bioavailable metal concentration is calculated using the physico-chemistry of the water body, and compared to the EQSbioavailable. It follows that the thresholds at Tier 1 must be set at a level which will ensure protection of sensitive environments. The value of the threshold has important implications in terms of the financial costs of the compliance assessment. For copper, setting the thresholds at the same level for the whole of Europe (i.e. continental) would leave some countries with costly and unwanted monitoring requirements. Deriving the threshold on a country specific basis enables effective use of resources without compromising on the level of protection. A very high level of compliance for copper is observed where bioavailability based thresholds are used for the implementation derived from regionally relevant water chemistry data (99.3%). Sites where elevated ambient background levels of copper are combined with very high bioavailability, principally when the waters have low DOC concentrations, are those most likely to be at risk due to copper exposures.

TU200 Are lead exposures a risk in European freshwaters? A map of EQS compliance assessment accounting for bioavailability

I. Chowdhury, International Lead Association / Senior Scientist -Environment; A. Peters, I. Wilson, G. Merrington, wca

Lead (Pb) is a priority substance for which the bioavailable Environmental Quality Standard (EQSbioavailable) of 1.2 µg L−1 has been set under the European Commission directive 2010/60/EU for application across all countries in Europe. In the present study, a tiered approach was applied to undertake a compliance assessment of the EQSbioavailable using the FOREGS database that includes paired data for water quality parameters and measured Pb concentrations from freshwater streams and rivers across Europe. In Tier 1 measured dissolved Pb concentrations were directly compared against the EQSbioavailable. In Tier 2, Bio-net, a user-friendly tool based upon Biotic Liganig 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 chronic Pb Biotic Liganig Model (Pb BLM), the final tier in the tiered approach. The maximum Pb concentration in FOREGS is approximately 11 µg L−1. At Tier 1 screening, only 16 (2.0%) water samples of the whole dataset (n=797) have Pb concentrations that are greater than the EQS of 1.2 µg L−1. The exceedances further decreased to 3 (0.4%) and 1 (0.1%) upon accounting for bioavailability at Tier 2 and 3 respectively. The map of site-specific PNECs (predicted no effect concentrations) as calculated by the Pb BLM identifies that the most sensitive waters in the database are all those with extremely low concentrations of DOC (< 0.5 mg L−1). The greatest frequencies of such sites are found in the alps and Norway. The lowest PNEC values for Pb are around 0.5 µg L−1, and the WFD EQS value of 1.2 µg L−1 is equivalent to approximately the 4th percentile of the dataset. The results indicate that the European freshwater bodies with low anthropogenic pressure are unlikely to fail the compliance with the EQS, with the exception of very local situations such as historic mining sites.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)

TU201 Modelling survival under chemical stress. A comprehensive guide to the GUTS framework

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Testing, analysing and predicting the lethal action of chemicals on organisms plays a central role in the fields of ecotoxicology and toxicology, both for scientific and 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 now be viewed as special cases of a new 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 increasing 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 treatise 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

W. Wang, WSC Scientific GmbH / Dept Environ Modelling; K. Billau, WSC Scientific GmbH

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
can help to evaluate sublethal
response curves, which often are sigmoid shaped. It is
investigated when the specific shape of a dose-response
curve provides us with contrasted pictures. We
additional tracer of potential preys
ingestion of contaminated food. Further, we considered this congener as an
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
effects of contaminants on animal growth and reproduction to cope with the thermal stress. Moreover, a
higher male production (p < 0.05). Reduced body length at elevated temperature
results indicated that Cu accumulation in tilapia, then combined with bioavailability and
subcellular partitioning to estimate the Cu binding situation and mechanism of
toxicity on gill. We developed a mathematical framework that quantified the Cu
examine the Cu accumulation in tilapia, then combined with bioavailability and
Metal could bind to transport protein, then accumulate in the cellular and tissue. It
points out that the metal ion accumulating in target subcellular compartment could
reflect the metal toxicity. Copper (Cu) plays an essential role in cellular metabolism of
aquatic organisms, but it would cause toxicity with excessive accumulation. The
purpose of this study was to conduct the short-term exposure experiment to
examine the Cu accumulation in tilapia, then combined with bioavailability and
subcellular partitioning to estimate the Cu binding situation and mechanism of
toxicity on gill. We developed a mathematical framework that quantified the Cu
affinity and the amount of transport protein in different subcellular compartment.
Results indicated that Cu accumulation in metabolically active pool (MAP)
preference to organelles than heat denatured protein, and Cu accumulation in
metabolically detoxified pool (MDP) was metal rich granule. The estimated parameters
of maximum Cu influx rate, total number of transport protein and affinity constant didn’t have significant differences between MAP and MDP. However, the conditional stability constant of MDP 0.45±0.005 ml g^{-1} was
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 that of MAP 0.096±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 metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive components and cause deleterious effects. Nevertheless, metals can also be detoxified by mechanisms 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 layers 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 layers 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 biosynthetic capacities. Total hepatic metal concentrations were significantly higher in exposed fish than in reference fish, with Cd (x5), Cu (x8) 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 metallothioneins. 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 relative changes in a trade-off between growth and toxic 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 (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, dose-intensity-based prediction, as well as the development of an appropriate test that informs 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 Club cells, and culminating in the adverse outcome of mixed-cell type adenocarcinoma in the in vitro. The AOP is independent of route of exposure and grounded in overlapping mechanistic events for naphthalene, styrene, ethylbenzene, isoniazid and fluensulamide 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 and 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 matured eels. However, to date researchers have not been able to link contamination with eel recruitment in their 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 (i) 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 (ii) 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 and the estrogen receptor (ER) by DLCs (i.e., 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in 7 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 primary target organ for exposure, 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 for assessing the effects of EDCs on the pituitary gland of salmonids.
system using pituitary cells isolated from coho salmon and previtellogenic female rainbow trout. Preliminary studies were performed to optimize culture conditions and to establish the time course of fshb and LH [lhb] subunit gene expression with and without addition of endogenous sex steroids (estrogen [E2] or 11-ketotestosterone). These initial studies suggested culturing with and without E2 was valuable as it could mimic the (+) feedback effects on LH that is observed from in vivo studies. After optimizing assay conditions, a suite of 12 contaminants and other hormones was evaluated for their effects on fshb and lhb gene expression. Each chemical was tested at 4-5 different concentrations up to solubility limitations in cell culture media. Results indicated more chemicals altered LH synthesis than FSH. The more potent chemicals were estrogens (E2EE) and aromatizable androgens (testosterone), which induced lhb. The estrogen antagonist 4-OH-tamoxifen decreased the E2-stimulated expression of lhb. Among several SRBsI-tested, the sertraline metabolite norsertraline was notable for both increasing fshb synthesis and decreasing the E2 stimulation of lhb. These results indicate that diverse types of chemicals can alter gonadotropin production in fish. Further, we have shown that pituitary cell culture is useful for screening chemicals with potential endocrine disrupting activity and can support quantitative adverse outcome pathway testing. Supported by EPA-STAR grant R835167.

TU213 SETAC Mechanistic Effect Models for Ecological Risk Assessment of Chemicals Interest Group
E. Zimmer, IBACON GmbH

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

TU214 Metal and mineral resources in LCIA - What’s the problem?
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The current lack of consensus on how to assess impacts from abiotic resource use in life cycle impact assessment (LCIA). Unlike other environmental impact categories, abiotic resource use does not just have one single, explicitly agreed-upon, international management goal. The SUPRIM project focuses on impacts which occur directly from the use of abiotic resources such as minerals, metals, and natural materials. It concerns impacts associated with their availability or accessibility, but excludes impacts covered by other impact categories, such as toxic emissions or adverse working conditions. The current state-of-the-art LCIA for abiotic resources has been criticized by representatives of the metals & mining industry. The LCA community is developing new methods, which all focus on different issues associated with resource use. This lack of a broadly accepted method, likely attributable to the lack of a common perspective on resource use and a common understanding of the potential problem(s) related to the use of resources, was the starting point of SUPRIM. The aim of the project is to obtain an understanding of different stakeholders’ views and concerns regarding potential issues associated with the use of resources. The gained insights are provided in the form of a structured overview of those views, and used as a basis for further method development. They are achieved by “taking a step back” towards a structured discussion about potential problems with resource use, and different motivations behind resource management concepts. To guide the discussion towards a clear outcome, a framework was developed. It introduces distinctive criteria for the evaluation and/or formulation of perspectives and problems on resource use, which will enable a comparison of differences and overlaps between stakeholder views.

The framework will be applied in a workshop with project external stakeholders from industry, policy and academia. The workshop outcome will be used to guide the further development of impact assessment from abiotic resource use in LCIA, such as a reduced future availability of the resources themselves, changes to their ability to provide functions, losses of certain desired properties in the environment or the technosphere, or an increased difficulty to access them. We aim to present both the framework developed for the formulation and evaluation of perspectives, and the outcome of its first application during the stakeholder workshop.

TU215 The relevance of the end-of-life stage for the environmental impact of batteries
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Numerous LCA studies exist in the field of energy storage, especially batteries. However, the majority of these studies focus on the production and use phase, while the battery disposal or recycling is usually evaluated in separate studies that focus explicitly on this part of the life cycle. While of lower importance when comparing very similar batteries (e.g., different lithium-ion batteries (LIB)) with similar 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 LiFePO4 battery (reduction of the avoided production of the battery), a hybrid aqueous ion battery (AHIB) and a vanadium redox flow battery (VRFB), all with their own end-of-life scenario. 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 AHIB 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 (AHIB 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 impact 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 it change 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. Gamberini, 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 LIFE12 ENV/IT001058 WEEEnmodels, 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 Impact) modelling were performed for each EEE category. 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 A produces a damage decrease for all EEE 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 environmental credits. This is due to the avoided burdens associated to the manufacturing of the new EEE, since the system boundaries have been enlarged under the consideration of the avoided production of the fact. Attributional and consequential LCI modelling performed different LCIA results. Following the methodology guide 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

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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 energy consumption (Schiraldi, 2011; Melnikov, 2013). It is beneficial to apply the economic maximum utility theory have been developed in economics and key factor and most of the previous studies understand the well-known relevance of the use phase of energy-related products, where the quality 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 some of the household appliances: air conditioning, lighting, cooking appliances), EAC (due to improved energy efficiency of nuclear power 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, PETP, 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 would 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. Nishijima, 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 efficiency (Müller 2006; Kagawa et al., 2011; Nishijima, 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 logit parameters by 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 also discuss how we could improve the system for obtaining more economic and environmental benefits.

TU221

Economic lifetime, hazard functions, and car inspection system

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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 assessing and estimating the economic lifetime of vehicles and 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 vehicle purchase and trade-in. ‘In this paper, we develop 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 this paper, we found that the inspection policy has been on average effective at reducing CO2 emissions, but with a potential for further improvement in the near term. It is necessary to continue 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 it 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 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 eco-designing of a “vapor and air barrier membrane - insulation” system, in a cradle to cradle approach lasting, but respectful of the Chemical and Energy Efficiency of the Technical Engineering - PEPS; M. Getlicherman, Deribigui; B. Colson, Sienne Fert & Filtration; I. De Vilder, Centexbel; A. Tilmanis, Belgian Building Research Institute (BBRI); A. Léonard, Liège Université / Chemical Engineering - PEPS

The European directive on the energy efficiency of buildings requires the members to put on the market solutions for insulation of buildings that are simple, effective and lasting, but also respectful of the environment and the users. In order to reduce energy losses and to guarantee the durability of the thermal insulation, it is necessary to have a vapor and air barrier on the warm side of the building, situated between the thermal insulation and the inside. Hence the passage of moisture from
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 juncture, adherence to the existing walls, pushing resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + recycling + environmental impact) with a low environmental impact on its whole life cycle. The solution can be used in both new construction and renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spunbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on any wall covering, i.e. it can be seen as a binding. Due to the self-adhesive characteristics, the implementation is made easier in both common surfaces (walls, roofs and ceilings) and to the level of detail such as corners and junctions. In addition, the application of a clay finishing coating on the membrane completes the offer. The constructive system can be dismantled at the end-of-life of the building and the various elements are recovered and valued in a cradle-to-cradle perspective. A first step is already carried out: the Derbiskin®. The preliminary life cycle assessment results support the technical partners along the whole development and evolution of the membrane by pointing out the hotspots of the system, from the choice of the components of the vegetal binder or the spunbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters 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 Transportation is one of the main economic drivers in economies and roads are the most important mean of transport. To build and maintain roads is essential to ensure the efficiency and keep up the level of this service. However, these operations require a high consumption of non-renewable and raw materials (aggregates and petroleum-based materials) which is one of the major concerns nowadays in this field. To overcome this issue, the use of recycled materials in pavement engineering has become very popular in the last decades. In addition to the raw material saving, recycling reduces costs and save landfill space. In this regard, the increase of recycling rates of asphalt materials, aiming at 100%, is key to move towards the implementation of a sustainable circular economy in pavement engineering. However, the amount of recycled material that can be used in a pavement is limited due to some uncertainties about its performance. To cope with this issue, high recycled asphalt amounts are to be used in asphalt mixtures, the recycled material has to be treated and new components have to be added in the asphalt mixture. These processes and new components may hide the advantages of using recycled materials from the environmental and economical point of view. Within the ERA-Net Plus Infravation 2014 Call, the project BioRePavation analysed three alternative biomaterials to be included in high recycled asphalt content mixtures to help increase recycling rates in an European case study. A comparative full Life Cycle Assessment of the asphalt pavements was carried out for each alternative to determine whether the use of recycled asphalt mixture in high amounts including biomaterials still entails environmental advantages. From a preliminary analysis of the results, it is possible to affirm that using the asphalt mixture with high recycled content has a lower carbon footprint than the asphalt mixes currently used in Europe. This type of studies are needed in order to encourage road authorities to use innovative technologies that can promote a circular economy.

TU225 Dynamic vs static LCA to explore the sustainability of industrial waste recycling A. Di Maria, KU Leuven / MTM; A. Levasseur, École de technologie supérieure / Construction engineering; K. Van Acker, KU Leuven / Materials Engineering LCA methodology is often used to promote the circular economy in the construction sector. However, that case is not so common. A study was made when assessing the environmental impacts of building and construction materials. Construction materials can accumulate in buildings and infrastructures for several decades, with considerable stocks of materials along the life cycle. Due to the long life of construction materials, LCA should take into consideration also time related aspects. However, in the current LCA, any temporal information is lost, making results of the LCA not suitable to reflect how materials change through time. To fill this gap, this study proposes a time-dependent LCAI on climate change, to assess the carbon footprint of two newly developed construction materials, produced through the recycling of industrial residues (stainless steel slag and industrial goethite). The results of the dynamic LCA are compared to the results of traditional static LCA, to see how the methodological development of dynamic LCA may have an influence on the final environmental evaluation for construction materials. Both dynamic and static LCA results show that the recycling of industrial residues to produce new construction materials has the potential to mitigate the climate change impacts of construction blocks, by substituting traditional OPC concrete. Although the dynamic LCA did not result in a shift in the ranking between the three materials compared with static LCA, it provides a clearer picture on emission flows and their effect on climate change over time.

TU226 Pursuing the sustainable circular city - is environmental accounting supporting the transition? A. Petit-Boix, S. Leipold, University of Freiburg / Chair of Societal Transition and Circular Economy The transition from linear to circular economies is already in the international policy agenda and several actors are implementing this concept at different scales. In the linear, cities are often seen as the guilty to get rid of consumer goods into healthier, more sustainable environments, and they thus promote a number of circular initiatives. However, do these initiatives help to achieve the goals included in local sustainability agendas? Or are they less environmentally favorable than conventional, linear systems? Systematic environmental accounting might give an answer to these questions once decision-makers have access to practice-oriented studies. To this contribution, we seek to determine whether research has effectively quantified the environmental performance of the initiatives promoted in cities. To do so, we gathered the features of circular economy initiatives reported by a pool of cities to understand what they refer to when addressing circular economy. At the same time, we reviewed scientific literature that applied quantitative environmental tools to analyze case studies of circular economy practices. These tools include life cycle analysis, monetary economics, eco-cost accounting, life cycle inventory, lifecycle costing, environmental accounting, and the circular economy. The preliminary results showed that there are many research gaps regarding the impacts of new strategies and a structured evaluation is needed. While research and practice are both interested in the implementation and evaluation of waste management practices, cities are engaged in a variety of initiatives that research has not explored yet, such as urban planning issues. This might put cities at a disadvantage if they are not able to select the most environmentally friendly initiatives that help them achieve their local sustainability goals while approaching circular economy.

TU227 Taking stock of a circular economy within planetary boundaries: A multi-scale analysis through consequential LCA H. Helder, 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, from product to city. To interpret the opportunities and threats in water treatment options as investigated by LCA frameworks adapts to the specific requirements of each sector. To interpret the changes in market shares will be constructed through a CLCA approach. 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 examine 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 propose 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 Sinappio 9.0 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 alternatives. Recreational use of flocculants from iron sludge as an additive in the drinking water purification or waste water 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 waste water 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 pretreatment step consisting of dissolved and colloidal fractionation and biodegradation, 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 into the efficiency of the VCD, to optimize compound removal from waste water, is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the water 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, CETAUQA, Water Technology Centre; D. Marin, CETAUQA, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETAUQA 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 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 to implement etc. It is of interest to put territories, which tools to use to decide on the most appropriate circular economy to implement etc. It is of interest to put municipalities and wider geographical areas, as accumulators of 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 Felini de Llobregat in the 'Cerdanyola' 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 identification of the main 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 Engg A truly environmentally sustainable bioeconomy requires integrative approaches for process design and rethinking industry to produce value. A holistic view of the system 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 biorefinery ecodesign 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 when possible) scaled up to the territory level. A feedback loop will be established between the modules of biotechnologies and one groundwater assessment 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. the water and residual resources from water production are used. At the territorial level the authors posit that local managerial practices, in terms of waste 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. Iten, R. Kellog, M. Stucki, Zurich University of Applied Sciences / Institute of Natural Resource Science The aim of a circular economy is to transform 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, the quality of waste as well as limited knowledge of 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 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 sectors 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 locations under consideration of 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 reuse 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 / Santiation; M. Isasa, CETAUQA Water Technology Centre / MASE; Y. Lorenzo-Toja, CETAUQA, Water Technology Centre; D. Marin, CETAUQA Water Technology Centre / Environment and Socioeconomics. Traditional 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 (WWTPs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the fermentation of waste to resources by matching supply and demand, such as the availability of information on 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 these innovative processes. The innovative processes 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 fertilisers 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 assess cost benefits together (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. 

TU23 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. Rigghi, University of Bologna / Physics; S. Sacrè, R. Conti, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; C. Samori, C. Torri, Università di Bologna / Centro Interdipartimentale di Ricerca Industriale su Energia e Ambiente; P. Galpatti, Università di Bologna / Dipartimento di Chimica G Ciamici; E. Tagliavini, Università di Bologna / Dipartimento di Chimica G Ciamici; Sheep Master Studium EU wine production accounts for some 60 percent 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 winery waste and by-products (i.e. grape marcs, grape seeds, vinification lees, etc.) (Devesa-Rey et al., 2011). VALSITV 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 acidic fermentation in order to produce volatile 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. Results indicate that the MMC fermentation is less effort and cost consuming than the one without polymer production. The interest of the MMC fermentation is that it is technologically simpler and therefore less effort and cost consuming than the one including pyrolysis. No significant differences between the two feedstock used are found in the results. Gaeta and Corsinovi, 2014. Economics, Governance, and Politics in the Wine Market. Palgrave Macmillan, US Devesa-Rey et al., 2011. Waste Management. 31:2327-2335

TU24 Environmental, social and economic challenges towards a bio-economy: the STAR-ProBio project, Sustainability Transition Assessment and Research of Bio-based Products P. Valsecchi, Università di Bologna / Centro Interdipartimentale di Ricerca per le Scienze Ambientali; S. Rigghi, University of Bologna / Physics; E. Merlotti, University of Bologna; L. Summerton, University of York; L. Ladu, Technisches Universität Berlin A. Koutinas, Agricultural University of Athens; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; S. Ugarte, SQ consult; K. Waskiewicz, ChemProf; X. Rey et al., 2011. The Knowledge of these parameters permits the identification of those elements that influence its magnitude, so that, different alternatives can be used to enable the sustainability of the oil palm industry. Finally, this research could contribute to develop knowledge and skills for future decision makings towards the sustainability of resources and the optimization of processes carried out by palm-cultivation companies as part of their policy of environmental responsibility. 

TU25 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOGAS PRODUCTION FROM PALM OIL MILL EFFLUENT N. Abdul Aziz, M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science Exploring renewable energy sources is becoming increasingly important due to the low environmental impacts as compared to the consumption of non-renewable fossil fuel sources. Waste-derived biogas is one of the promising technologies that yields a renewable, sustainable, and green source of energy. In Malaysia, palm oil mill effluent (POME) can be a suitable feedstock for biogas production due to its abundant and high potential in energy generation. However, a comprehensive assessment need to be conducted to ensure the sustainability of POME-based biogas production. This study was conducted to evaluate cradle-to-gate life cycle energy and environmental performances associated with the production of biogas by the anaerobic digestion of POME. The functional unit was defined as 1 tonne of POME used for biogas production and the system boundaries covered the plantation-processing mill-biogas plant stages. The life cycle assessment (LCA) was performed using ReCiPe 2016 environmental impact method and SimaPro 8.0 software. The present study demonstrates that the generation of electricity from biogas is advantageous comparing electricity production in conventional power plants. The results also able to identify hotspots in the life cycle of the biogas production where environmental performance of the system can be improved and environmental benefits can be achieved from the anaerobic digestion of POME with regard to the reduction of greenhouse gases emissions.

TU26 Challenges and open issues in assessing new technologies for circular economy solutions P. Masoni, Ecoinnovazione srl / Sustainability Department; A. Zanmagi, SETAC Europe 28th Annual Meeting Abstract Book 289
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 relation with the environment, such as: recycle, avoid dangerous substances, extend the life of the products. However, the reality is more complex, and to claim that we are improving the situation, i.e. reducing 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, when 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 consumption say? R. Dagilite, Vytautas Magnus University / Environmental Science Department; A. Musteikytė, 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 security, and also has many environmental impacts. EU directive “Towards a circular economy: a zero-waste programme for Europe” (COM/2014/0398 final) aims to reduce by half food waste in EU by 2030. Roadmap to a Resource Efficient Europe (COM (2011) 571) aims to change consumption patterns and achieve 20% reduction in the food chain’s resource inputs and halved disposal of edible food waste in the EU by 2020. As study (2008) on British households indicates, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach those aims and reduce related impacts. This study analyses amounts of the food waste generated in a restaurant X (Vilnius, Lithuania) and explores consumers’ attitude towards this problem. Catering business was closely monitored in terms of customers’ flows and food waste generated. To find out consumers’ opinion about the service of the restaurant was taken into account. A survey was conducted and shown that during the six months 14744 kilograms of food was thrown away in a restaurant. Amount of food waste was linked to the total number of customers during the selected timeframe. Most of food was discharged in December, and in the spring quantities of food waste decreased mostly due to the seasonality. Weekend effect was also registered. Flour products composed the biggest share of all food waste. It was found that the restaurant consumers had low ecological consciousness - inadequate standpoint of consuming too much, poor knowledge about what impact food waste has on environment, recycling, and opportunities to waste less. 73% of those often eating at public caterers indicate often to leave some food uneaten. Only 5% always and 22% often ask to take-away left food. 43% of them avoid cover charge on taking away food. Most of consumers were with higher education and higher incomes. Although respondents had no clue on their own negative impact to the environment, they all agree that much more information on solving problems like this is needed. Therefore, policies to encourage food saving at home and public places should be promoted to deal with “food waste challenge” (2015).

TU239 Assessment of Carbon Footprint of a typical Spanish dietary pattern: The Atlantic diet X. Esteve Llorens, Universidade de Santiago de Compostela / Chemical Engineering; M. Moreira, G. Feijoo, University of Santiago de Compostela / Chemical Engineering; J. Garrido, Universidade de Santiago de Compostela; J. González-García, University of Santiago de Compostela CIF Q1518001A Chemical Engineering Access to adequate nutrition is a basic human need that depends on numerous social, political and economic factors. Similarly, food patterns affect not only to food consumption but also its production, which cause health, social and environmental impacts. In particular, food chains that support diets are linked to environmental issues such as greenhouse gas (GHG) emissions, fossil energy requirements and land use. According to Garnett (2011) and Irz et al. (2016), 15-30% of total GHG emissions in developed countries are derived from food production, distribution and consumption. Therefore, environmental pressures from food systems are on the top of the agenda. Agriculture and sustainable food production and dietary patterns are considered of major interest. Consumption patterns vary significantly across Europe. In the southern countries, healthier diets richer in fruits and vegetables have been identified. In this sense, the traditional Atlantic diet is a common dietary pattern in Northern Portugal and Galicia (Northwest of Spain), culturally and climatic similar areas. The Atlantic diet is characterised by an abundant consumption of vegetables, fish and meat, mainly local and fresh products (seasonal food), cooked to maintain its characteristic flavour and taste. For this reason, it has become a worldwide reference for a healthy diet. The main objective of this study was to quantify the carbon footprint of the Atlantic diet using a simplified Life Cycle Assessment (LCA) approach due to the lack of detail about certain stages of the life cycles of various foods. To do so, the production, transport and processing (when necessary) of the different food ingredients that constitute a typical daily menu was taken into consideration. According to the preliminary results, food production was the main responsible for contributions to the carbon footprint, mostly due to agricultural and livestock activities involved in the production of vegetables, fruit and meat. The findings from this study can be extended as a first step and insights to determine the possible Atlantic diet. Moreover and in line with the literature (Pernollet et al., 2017), the use of a simplified LCA method reports accurate results at a lower demand of data collection than the full LCA. This research has been supported by a project granted by Xunta de Galicia (ED431F 2016/001). S.G-G. would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness (RYC-2014-14984).

TU240 Assessing life-cycle impacts of the sharing economy: how to account for behavioural changes? I. A. Chavez, 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 and giving use intensive goods or services. However, the 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 various responses and behavioural changes of consumers to this new sharing marketplace. For this reason, this study analyses the characteristics of goods and services that are exchanged through sharing, and the corresponding responses of consumers. 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 and giving use intensive goods or services. However, the 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 various responses and behavioural changes of consumers to this new sharing marketplace. For this reason, this study analyses the characteristics of goods and services that are exchanged through sharing, and the corresponding responses of consumers.

Innovative techniques for enhancing and monitoring microbial activities for in situ remediation of contaminated sites (P) TU241Effects of plant growth and organic carbon addition on DDE degradation in soil M. Cardoni, National Research Council of Italy / Water Research Institute; F. Mitton, University of Mar Del Plata; D. Di Lenola, National Research Council of Italy / Water Research Institute; L. Patrolecko, Water Research Institute-National Research Council / Water Research Institute; N. Ademollo, F. Spataro, National Research Council / Water Research Institute; K.S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicología y Contaminación Ambiental; Instituto de Investigaciones Marinas y Costeras; M. Gonzales, University of Mar Del Plata; P. Grenni, National Research Council of Italy (CNR) / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute Although 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’-DDE and p”-DDE) are frequently found in the environment. Plant-assisted bioremediation 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 bioremediation 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 remediation technologies on the soil 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

A poplar-assisted bioremediation strategy has been applying for four years to a historically polychlorinated biphenyls (PCBs) contaminated area in Southern Italy using the Monviso poplar clone. This clone was effective in promoting both a general decrease in contaminant occurrence and an increase in microbial activity in the chronically polluted area a little more than one year after planting. In fact, the system of the poplar and the organo-clay effectively improved the sites and promoted a reduction of overall PCBs concentration under the Italian legal limit (D.Lgs. 152/06) of 60 ng/g soil (Ancona et al., 2018). A further sampling was performed four year later in order to assess the PCB residual concentrations at different depths and distance from poplar tree trunks inside the planting area. At the same time, microbial analyses were carried out to evaluate the soil microbial total microbial abundance, cell viability and dehydrogenase activity. Moreover, nucleic acids were extracted from soil. The hypervariable regions V4-V5 of the 16S rRNA gene were amplified and sequenced by MiSeq (Illumina). The structure of the microbial community in the planted and unplanted (control) soil was performed and compared and bacterial species involved in PCB degradation identified.

TU243 Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production

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 poplar poplar is popular for synergising, using biomass collected from a plant assisted bioremediation area located in a multi-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.

TU244 Microcosm experiment to assess the effectiveness of a Populus clone to enhance PCB biodegradation in a historically contaminated soil
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Greenhouse experiments have been performed to test the capacity of the Populus clone (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 cell abundance, diversity and viability of soil microorganisms under the different growing conditions. The overall results showed the capability of the clone Monviso to transform and 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 conditions. 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 congener. This study was a preparatory experiment for a field experiment of plant-assisted bioremediation.
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 9.0x10^5 and 30x10^5 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.

F. Magelli, University of Milano - DeFENS / Department of Food, Environmental and Nutritional Sciences; L. Vergani, University of Milano - DeFENS; E. Terzaghi, University of Insubria (Como) - Department of Science and High Technology. Como; G. Rasp, Sapienza University of Rome - Department of Chemical Engineering Materials and Environment; E. Zanardini, C. Morosini, University of Insubria / DSAT; A. Di Guardo, University of Insubria - Department of Science and High Technology. S. Baroni, University of Milano - DeFENS.

Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity but can be limited by spatial heterogeneity of microbial populations, contaminants and soil chemistry. Studies aimed at identifying the drivers of microbial selection are therefore pivotal to develop in-situ bioremediation techniques. In this perspective, the SINOP 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). Our aim of this 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 120 soil samples were collected in the SINOP 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 unamended soil collected in the SINOP 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. 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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. Bioremediation methods included liquid/liquid solution. The investigation demonstrated that 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 bphG gene, coding for the biphenyl dioxygenase involved in the aerobic PCB degradation process, confirmed that they host an indigenous population able to degrade PCBs. This study also highlighted the prospect of exploiting spatial patterns of bacterial diversity as proxies for monitoring polluted sites.

TU249  
Influence of Surfactants and Mycobacterium vanbaalenii PYR-1 Bioaugmentation on 14C-Pyrene Mineralization and Microbial Community Structure in PAH-Contaminated Soils.

D.C. Wolf, University of California-Riverside / Environmental Toxicology; J. Gan, University of California, Riverside / Department of Environmental Sciences Polyyclic 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 the biodegradability of PAHs. This study provides valuable insights towards the abiotic and biotic processes as well as their complex interactions in the bioremediation of PAH-contaminated soils.

TU250  
Italian field results of Enriched Lecithin-based Substrate used as ERD Treatment of Chlorinated Solvents in groundwater.

A. Leonbruni, M. Mueller, PeroxyChemiLCC; F. Morlacchi, Centro Assistenza Ecologica ELS Microemulsion is a food-grade carbon that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is the acronym for Enriched Lecithin Substrate, a technology designed to create reducing conditions and to promote enhanced reductive dechlorination (ERD) reactions. In general, organic carbon addition in a saturated zone is well-known to promote conventional enzymatic reductive dechlorination reactions. This happens because carbon in the subsurface will support the growth of indigenous microbes in the groundwater environment. As bacteria feed on the soluble carbon, they produce end products that drive the redox potential in the groundwater. As bacteria ferment the ELS, they release a variety of volatile fatty acids (VFAs) such as lactic, propionic and butyric, which diffuse from the site of fermentation into the groundwater plume and serve as electron donors for other bacteria, including dehalogenators. Lecithin itself is composed primarily of phospholipids, which have both hydrophilic and hydrophobic regions in their molecular structure. As a result, ELS tend to be stable emulsions, expectedly more stable than with only hydrophobic compounds. Further, phospholipids support remediation by providing essential nutrients (carbon, nitrogen, phosphorus) to bacteria. ELS Reagent was shown to effectively treat tetrachloroethylene (PCE) and trichloroethylene (TCE) in groundwater. The results confirmed by qPCR of the catabolic gene alkB encoding for an enzyme potentially involved in the biodegradation of hydrocarbons (on-going analysis).
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 catatrophies, such as DCE or VC. Moreover, complete reductive dechlorination of 1,2-dichloropropane 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 carbon and electron source had positive effect on all studied groups of bacteria. Molasses as the substrate for dehalorespiring bacteria was not 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, higher bacterial abundance triggered efficient sequential dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwater 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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In the present study, CMC as the substrate for dehalorespiring bacteria was not confirmed. Detergent enhances nZVI subsurface migration parameters. Direct positive effect on bacterial populations only in denitrifying bacteria was observed. Detergent had even inhibiting influence on dehalorespiring bacteria. Molasses as the substrate for dehalorespiring bacteria was not included in the set of technologies based on biological reactors where an electrode acts as the electron donor for the bioreduction of oxidized species. In the present study, anodic chambers were subsequently analyzed for PFOA by UPLC-MS/MS. The data showed that dead bacteria were found to have high adsorption (286-3324 g/g of bacterial pellet) whereas live bacteria showed only a low adsorption (75-100 g/g of bacterial pellet). Importantly, the data also revealed that dead bacteria have at least equal affinity for PFOA asomers as the linear compound; which defines the applicability of PFOA bioremediation with dead bacteria as a promising alternative approach. We propose that microbial binding of PFOA can be applied as a novel, less costly technique for PFOA environmental elimination.
abiotic control and an open circuit (OC) control were also operated in parallel. Hexavalent chromium dissolved concentration was analyzed in the initial, middle, 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). The main source of variability resulting in the kind of enrichment, both in the preculture and in the MFCs. Proteobacteria, Bacteroidetes e Firmicutes resulted as the main Phyla in our samples. Geobacteraceae spp., Bacteroidetes e Firmicutes resulted as the main Phyla in our samples.

TU256
Enhancing Reductive Dechlorination Combined with In-Situ Chemical Reduction for the Remediation of a Heavy Contaminated Chlorinated Solvents Source Zone in South of Italy

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The present site comprises an urban site where a historical Chlorinated Compounds-CHC (mostly PCE) contamination has been released in aquifer before excavation and with non-return valves corresponding to thirty chambers. Contamination is present in shallow aquifer and was higher than 10 mg/L. The efficiency of the remediation is currently about 99.9%, removed more than 300 Kg PCE. The site characterization integrated with a MIP investigation to identify the plume. The plume has been addressed into four areas then a combination of In-Situ Enhanced Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure contaminant removal due to bioaugmentation, approaching the electron donors for PCE. This combination allows to have a reducing ambient due to producing hydrogen which helps groundwater to reach an anoxic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase 1) to calibrate the injection for the site conditions. Based on the successful result of this phase, the full-scale planned for phase two and applied in two steps. First step covered the northern part of the plume (area A) in the upgradient and main source zone (area B) which is the most contaminated area. In Area B also the vadose zone has been treated. After a year (step 2), the injection took place in area C near to the site boundary and in area D downdgradient of the site. Due to PCE bioremediation we have production of daughter products to prevent the accumulation of these by producing an air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methanogenesis reaction, CH2M has decided to install a biofiltration plant, to prevent any dangers for the residential areas nearby. The challenge this complex geometry has been solved by using fixed injection and removing valves corresponding to thirty chambers. Treatment in each aquifer. This allowed for accurate and tailored dosage application of the product without any risk of cross-contamination. Due to the rapid effect of injection, it has been possible to observe very good reduction rates within only few months from the application. PCE, has already shown reduction of three orders of magnitude and in some points, we reached the target, with daughter compounds appearing without accumulation.

TU257
Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments

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The efficiency of the remediation is currently about 99.9%, removed more than 300 Kg PCE. The site characterization integrated with a MIP investigation to identify the plume. The plume has been addressed into four areas then a combination of In-Situ Enhanced Reductive Dehalogenation and In-Situ Chemical Reduction was selected to secure contaminant removal due to bioaugmentation, approaching the electron donors for PCE. This combination allows to have a reducing ambient due to producing hydrogen which helps groundwater to reach an anoxic environment which is favorable for the microorganisms to degrade the PCE into the end product, ethylene. The first injection applied in a pilot scale (Phase 1) to calibrate the injection for the site conditions. Based on the successful result of this phase, the full-scale planned for phase two and applied in two steps. First step covered the northern part of the plume (area A) in the upgradient and main source zone (area B) which is the most contaminated area. In Area B also the vadose zone has been treated. After a year (step 2), the injection took place in area C near to the site boundary and in area D downdgradient of the site. Due to PCE bioremediation we have production of daughter products to prevent the accumulation of these by producing an air sparging and soil vapor extraction plants have been installed in the site boundary to remove them from the soil vapor and aquifer. During the ERD we have observed methane production because of methanogenesis reaction, CH2M has decided to install a biofiltration plant, to prevent any dangers for the residential areas nearby. The challenge this complex geometry has been solved by using fixed injection and removing valves corresponding to thirty chambers. Treatment in each aquifer. This allowed for accurate and tailored dosage application of the product without any risk of cross-contamination. Due to the rapid effect of injection, it has been possible to observe very good reduction rates within only few months from the application. PCE, has already shown reduction of three orders of magnitude and in some points, we reached the target, with daughter compounds appearing without accumulation.

TU258
Freshwater sediment enrichments to improve MFCs performance for in situ remediation application: a phylogenetic microbial characterization

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One of the possible application for Microbial Fuel Cell (MFCs) is the in situ remediation of contaminated sites. MFCs operation links the removal of pollutants from contaminated sites to the production of current by means of the activity of electrochemically active microorganisms (EAMs), able to degrade substrate producing a flow of electrons. EAMs have potential applications in bioenergy production, green chemical synthesis, bioremediation, bio-corrosion mitigation, and biosensor development. The aim of this work was to investigate the effect of two enrichments, a general (Gen) and a ferric citrate (FeC) one, to increase the percentage of EAM in order to improve the MFCs performances. A freshwater sediment (Fw) sample was chosen as inoculum source. The effect of the enrichment procedures was compared in term of both electrochemical performance and biological characterization. The microbial community was subjected to three sequential enrichments and then used as inoculum for the MFCs. Anodic potential and voltage were continuously monitored. DGGE, sequencing and qPCR techniques were used to investigate the EAM community. Moreover microbial α-diversity was calculated. The enrichment effect was evaluated both for the precultures and for the three components of MFCs (planktonic, biofilm and rod). Results showed that the MFC inoculated by Gen enrichment preculture had better performance than the FeC one (shorter start-up time, lower anode potential, higher current density). The main source of variability resulting in the kind of enrichment, both in the preculture and in the MFCs. Proteobacteria, Bacteroidetes e Firmicutes resulted as the main Phyla in our samples. Geobacteraceae spp. and Pseudomonas spp. decreased more during the FeC enrichments 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 at the MFCs level (p < 0.05). Enrichment with FeC decreased the relative abundance of EAM and the microbial diversity. Previous studies show the need of a heterogeneous community dominated by EAM to improve the remove of contaminants and to increase the performance of the MFCs. The present work indicates that Gen enrichment promoting the development of a self-balancing community seems to be a preferential approach to be implemented in in situ application.
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 are limited. Consequently, during the biodegradation of MCB was completely depleted upon addition of nutrient and CSIA results confirmed negligible $C$ isotope fractionation under oxidative conditions. The catalytic $\text{toxC}$ gene, encoding for tolulene dioxygenase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Recently, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MCB were also applied to another area contaminated by MCB, and nearby the first site, to establish whether an aerobic approach for site reclamation from MCB would be successful in the extended area.

TU263 Remediation of aquatic ecosystems: Adsorption of phosphorus by sawdust

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Introduction: Despite the scenario of excess phosphorus in some aquatic environments, there has been concern with the depositions of phosphorus and phosphorus deposits, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorous from eutrophic systems, for further use as fertilizer. The aim of this work was to study the phosphorus adsorption using sawdust as organic adsorbent. Methods: This study was carried out with water and sediment samples from an eutrophic ecosystem, Barra Bonita reservoir, located in Barra Bonita city, Sao Paulo State, Brazil. The microcosms experiments were conducted in 5 L glass jars, that were filled with sediment and water from the reservoir. Among the 36 assembled microcosms, 18 were used as controls and 18 were used as treatment (with bags containing sawdust). The dissolved oxygen, iron, and orthophosphate were determined in interstitial water and water from the jar’s water column. Emerging contaminants and adsorbed phosphorus ($P$) were determined using molecular approaches. Results: Dissolved oxygen values in the control microcosms were significantly higher ($p < 0.05$) in comparison to the treatment microcosms, as a consequence of the organic matter oxidation present inside the bags. The lowest concentration of Fe(II) found in the water column of the control microcosms causes the oxidation of the superficial sediment and this oxidized layer was responsible for the reduction of internal flow of $P$. In the interstitial water the Fe(II) concentration is much higher than in the water column due to the large amount of Fe present in the sediment. The concentration of orthophosphate in the water column varied during the experiment, in the treatment microcosm the decrease was indicative of phosphorus adsorption. It was observed that the adsorption of phosphorus on sawdust began after 57 days. The maximum adsorption was at 214 days (414 mg P g$^{-1}$ sawdust). The adsorption of tricosan, estrone, 17 Estradiol and 17-ethinylestradiol are lower than the limit of quantification (LOQ).

Conclusion: Sawdust is considered a biosorbent, of easy access and low cost, to use in the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security.

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Formation potential of trifluoracetate and its estimation by means of the TOP assay

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Trifluoracetic acid 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 (trifluoracetate, TFA) in the aquatic environment and is considered as highly mobile. Photochemical conversion of volatile refrigerants (e.g. 1,1,2-trifluoroethane) 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 gas chromatography coupled to tandem mass spectrometric detection (LC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, flupiciclode, flupyradifurone and tebentafur; pharmaceuticals: fluoxetine and sitagliptin; industry chemicals: 4,2 FTSA and 6,2 FTSA) led to substance-specific molar yields between 7,1% (6,2 FTSA) and 96% (sitagliptin). It is known from previous studies that TFA can be formed during wastewater treatment processes. Therefore, the formation potential of samples from six treatment plants (WWTPs) was investigated. As expected, more TFA was formed after oxidation of the influents (up to 180 % increase relative to the concentrations without oxidative treatment) than of the effluents (between insignificant and 140 %). Interestingly, one WWTP exhibited a strong (biological) formation of TFA, which could be confirmed quantitatively using the TOP assay.

Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

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The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of persistent uses of each active substance are below the limit value of 0,1 µg/L. In plant protection regulation, this limit value has to be applied for 1,2,4-triazol due its toxicological relevance according to the regulation (EC) 1107/2009. Exceedance of this trigger has been questioned considering that several fungicidal active substances forming 1,2,4-triazol may be applied consecutively. In addition, plant protection products are not the single source of 1,2,4-triazol. It can also originate from the use of excipient inhibitors used as additive to fertilizers, or even be formed naturally in forest soils. Consequently leaching of 1,2,4-triazol from these different sources might lead to exceedance of the limit value for groundwater in agricultural catchments. Therefore, the competent authorities of Germany, Denmark and France have initiated monitoring programs and incidence reporting. If entries above 0,1 µg/L in groundwater are found and entry via pesticide application is considered likely, authorities may have to decide on further risk management actions. Possible mitigation measures are discussed and the difficulties in dealing with different sources and regulatory frameworks are highlighted.

PFPs on the basis of natural compounds: nature challenges analytics

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For many plant protection products (PPP) using natural compounds as an active ingredient, considerable background levels are frequently observed in untreated control material. These contaminations originate from both, natural and anthropogenic sources. Applying the method described in this contribution, residue analysis more challenging. There are different routes for natural background concentrations resulting from natural sources as amongst which are: physicochemical degradation from higher compounds (e.g. degradation of triacylglycerides to fatty acids), microbiological activity or the use of a plant product as active ingredients (e.g. rapeseed oil). Besides the natural occurrence of the active ingredient or parts of it, anthropogenic routes of contaminations are also diverse: some active ingredients of PFPs were used in industrial production processes (e.g. short-chained fatty acids as softener for plastic materials), other compounds are incorporated in materials used for solvent production. Both may lead to high background levels. Both routes, the anthropogenic as well as the natural, can lead to background level contaminations of the active ingredients, making it hard or in some cases impossible to find contaminant-free control material and/or to determine these active ingredients at low concentration levels. Furthermore, natural compounds used as active ingredients in PPPs or their derivatives are of low molecular weight and thus leading to fragments < 100 Da in LC-MS/MS analysis. These are more difficult to analyse as the signals of these mass transitions are often disturbed.

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 (RBTs). 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 this 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 chloroanilines, 4 chloroanilines, 4-chloro-2-methylpiperazine and metformin. 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-methylpiperazine before 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.

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 is of particular 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 dynamical 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) 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 chloroanilines, 4 chloroanilines, 4-chloro-2-methylpiperazine and metformin. 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-methylpiperazine before 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.
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 regarding 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, fluconazole, metformin, oxazepam, tramadol, and venlafaxine) using water and sediment collected from rivers Fyris and Gründlach, 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 40 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 16SrRNA 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 for non-stereile treatments are significantly shorter than sterile (p ≤ 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 settled wastewater is more relevant than the biodegradation half-lives. 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. Albeit 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 of 100 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 consider the water compartment. QSAR models were only 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, WSS) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WSS and SST were applied to determine biodegradation data for a set of fifteen test compounds. The results demonstrate that the WSS 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 (Pcw).

TU271

Persistency assessment of pesticides in Denmark

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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 percentiles 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

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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 in the various 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. Fungicides were applied to cool-season turfgrasses in the fall and the persistence of both fungicides was measured using a chromatography-mass spectrometry, 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, and in 2016, and on 4 Dec 2016 and 10 cm diameter turfgrass cores were collected biweekly from the experimental area throughout the winter. Both winters experienced above-average temperatures 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 levam and polystyrene

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The significant increase in plastics productions caused waste management 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 levam is biocompatible, biodegradable, renewable and eco-friendly fructose based polymer. It can be produced from sucrose by wide range of microorganisms using levansucrase enzyme. In the present study graft copolymer with microbial levam and polystyrene was synthesized, characterized and its biodegradable potential was investigated.
Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in reactions. While the RBT gave a reasonably conservative approximation of the environment, and are transformed by concurrent biodegradation and abiotic processes. In all cases, < 1.5% of AR could be freed from the sediment using vigorous solvent extraction. Approximately 0.4–1.0 d and 0.7–1.2 d were determined for the 2,4- and 2,6- TDAs respectively, in both river systems. Yields of [14C]CO2 were ≤ 10.6% of AR for the 2,4-isomer and ≤ 8.3% of AR for the 2,4-isomer in both river systems after 100 d. In all cases, < 1.5% of AR could be freed from the sediment using vigorous solvent extraction. The results of both test types show that the TDAs are not persistent in the environment, and are transformed by concurrent biodegradation and abiotic reactions. While the RBT gave a reasonably conservative approximation of the DT50 times and [14C]CO2 yields in aerobic surface water/sediment systems, it did not give a realistic representation of the fate mechanisms which result in formation of NER with natural organic matter in the environment.

TU274 Aerobic degradation of styrenated phenol in soil: influence of the temperature on several endpoints

C. Boegi, BASF SE / FEPA; P. Chagnon, SOLVAY / Research and Innovation

The persistence of chemicals is assessed through their kinetic 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 considered Persistent (P) or Very Persistent (vP). Nevertheless, the interpretation of those tests is complex. Degradation of [14C]2,4- and [14C]2,6-TDA was studied in order to avoid deviation 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. Boegi, BASF SE / FEPA; P. Chagnon, SOLVAY / Research and Innovation

The OECD ready biodegradability tests (RBT) are designed to approximate the rate to 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 test types for degradation of the toluenediamine (TDA) substances. Degradation of 14C-TDA, 2,4- and 2,6-TDA was studied in redwolflangich soil, 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.

TU276 Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China

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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, Shenzhen, China, were sampled (named #1, #2, and #3, respectively). A parallel kinetic 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 (62-792000ng/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 are the dominant PCB and PBDE input and dehalogenation takes place in the sediment core, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Dehalococcoides were found in the sediment cores. The range of the relative abundance of Dehalococcoides for three sediment cores (#1, #2, #3) were 1.50-9.01%, 1.47-5.24%, and 0.20-2.55%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation source) to PBDEs (with values of 0.02, 0.05 and 0.1, respectively). As for CSIA analysis, only the stable carbon ratios (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20 cm of the #3 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 demethylation processes.
photolytic and biological degradation of these substances in aqueous solutions. Each compound was irradiated with artificial sunlight (xenon 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 in the presence of natural water and sunlight degradation at a constant temperature. After 6 hours, 99% of the substrate p-MeNC6H4SiMe3 was primary eliminated. During the test, generation of more polar transformation products was observed. The other substrates 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 in line with the literature and our own database on siloxanes. Increased water solubility of the newly synthesised silicon organic compounds did not result in an increased biodegradability in water.

TU279 Biodegradation of adsorbed oil pollutants: Research on a model system Lab, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry, M. Ilic, ICHT / Department of Chemistry; B. Lončarević, Institute of Chemistry, Technology and Metallurgy, University of Belgrade / Department of Chemistry; T. Sveled Knausden, ICHT / Department of Chemistry; J. Avdalovic, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy, University of Belgrade / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; N. Lugonja, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry. Environmental pollution by various types of oil has been, and continues to be, a specific and serious problem. Investigations and development of new techniques are required, as well as improvements to known ones. Sorbent materials are attractive because they collect the oil and separate it from the oil spill site by absorption. The addition of sorbents to oil spill areas facilitates a change from liquid to semi-solid phase and once this change is achieved, the removal of the oil by removal of the sorbent structure then becomes easier. At this stage, pollutants are separated and concentrated, unlike the environment conditions where pollutants could spread to very low concentration when it is challenging for applying bioremediation techniques. In this study, we tested adsorption and degradation of crude oil, diesel oil and mazut as model substrates. Two types of natural sorbents were used: organozolite and bentonite. Petroleum pollutants sorption was investigated in the batch tank. Sorption was conducted with sorbents (1g/100 mL) placed in Erlenmeyer flask (500 mL) with 100.0 mL of tap water and oil pollutant (0.6 mL). Sample was then shaken in laboratory shaker for 24 h at 20 °C. Supernatants and sorbents were separated by decantation. Biodegradation ability of adsorbed pollutants has been tested by microorganisms isolated from oil contaminated site, and O2 consumption and CO2 production was measured in period of 5 days by Micro-Oxymax respirometer. Adsorbed total petroleum hydrocarbons were determined after adsorption and respiration experiments by GC and gravimetric analysis. Obtained results showed highest biodegradation potential with bentonite/diesel (BED) model and lowest biodegradation potential with organic sorbent/diesel (OSD) model, with OSD cells consuming 89911.53 µl of 5834.53 µl of O2 within 115 hours, respectively. The production of CO2 by cells in BED model was more than twofold higher than by OSD 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 use for such of petroleum 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 (biodegradation) is an important mechanism for removal of organic compounds in natural water systems. The 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, the 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 standard 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 sunlight. Water from Lake Norra Bergudsjön 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 analysed at 11 time points. After adding the mixture of standards, the compounds were filtered and analysed with both 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 A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals M. Creuze, M. Brillet, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; C. Sweetlove, IOREAL SA / Research and Innovation; J. Chenèble, LOréal Research / Research and Innovation; J. Lharidon, LOréal Research & Innovation / Life Sciences Direction; T. Gerald, University of Nantes / Microbiology According to the United Nations (UN), a substance is the “chemical elements and their chemical compounds in the natural state or obtained by any production process”. This definition has evolved according to different acts of regulation. Another category of substances is UVCB: Unknown or Variable composition, Complex reaction products or Biological materials such as crude oils or vegetal extracts. In addition, there are “mixtures or solutions composed of two or more substances in which they do not react”. The assessment of complex mixture biodegradability can be limited by technical issues and/or difficulties in assessing inherent biodegradability. This work is composed of three different studies to introduce and improve Ultimately Transformed Organic Carbon (UTOC) as a quantification tool for biodegradation. The UTOC includes the inorganic carbon resulting from respiration and the carbon assimilated by microorganisms. This measurement strategy was initially compared to a DOC DIE-AWAY test (i.e. OECD 301A) and then successively tested and validated with non-soluble chemicals, pure and in an emulsion mixture (consisting in a virtual cosmetic formula). The UTOC approach highlighted the beneficial effects of an emulsion on the biodegradation of these substances. Prior to assess a natural complex mixture, pass levels to differentiate unequivocally ready and inherent biodegradability were determined. This latter step aims to reinforce safety in the assessment of substances of unknown composition. Based on the principle of reducing the probability of persistent parent products or generation of toxic by-products during biodegradation, the UTOC approach was reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assayed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture. Ultimately Transformed Organic Carbon (UTOC) concept has been shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.

TU282 Development of a multi-sensors device to assess the biodegradation of chemicals M. Creuze, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; v. le currif, L. Catherinot, E. Calzolari, Y. Pichot, TRONICO; C. Sweetlove, IOREAL SA / Research and Innovation; E. Grangé, S. Jouanneau, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; M. Durand, University of Nantes / UMR CNRS GEPEA CBAC Laboratory; J. Chenèble, LOréal Research / Research and Innovation; A. Lahmar, University of Nantes / GEPEA CNRS UMR CBAC Laboratory; J. Lharidon, LOréal Research / Research and 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 metrological solutions needs to be investigated. Indeed, few measurement systems, enabling an automated assessment for substances of unknown composition do exist. Based on the principle of reducing the probability of persistent parent products or generation of toxic by-products during biodegradation, the UTOC approach was reinforced with ecotoxicological tests using a weight of evidence approach for a moderate % of biodegradation. Finally, the methodology was assayed and validated by an investigation of the biodegradability and ecotoxicology assessment of a complex mixture. Ultimately Transformed Organic Carbon (UTOC) concept has been shown to provide a robust safety assessment approach, and further research should focus on more complex substances (viscous or solid, absorbable, volatile). The advantages of UTOC are clear; it appears as an appropriate method to quantify the initial raw material converted to an inert product by the action of microorganisms to determine the ready biodegradability of an unknown substance such as a vegetal extract.
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.

**TU283**
Investigations on key parameters of an innovative biodegradation test based on cell proliferation
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Screening of 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 report 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 MCC/007 report list suggested for method development for readily and non-biodegradable compounds. Beside cell counting, several test compounds were analysed in parallel for CO₂ and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

**TU284**
Challenges and Solutions of Ready Biodegradation Study with Difficult Substances
T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, T. Tomiyama, 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 to meet the requirements of these test systems. As a result, these test systems fail to meet the requirements of these test systems. In this study, we present a series of case studies conducted in our laboratory. We identified several challenges and solutions to overcome them. The test substances are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylpentadecanoic acid, 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. 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-trimethylhexanoic 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.

**TU285**
Influence of inoculum origin and adaptation on biodegradation of emerging contaminants
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Assessment of microbial biodegradation is a key parameters 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 persistency 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-methylpiperazine 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 compounds using this method. As a result, sealed 50 ml Erlenmeyer flasks 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 error 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.

**TU286**
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 version of the ECETOC OECD 310 and OECD 301 guidance documents and Chemical Safety Assessment Chapter R.7b: Endpoint specific guidance), 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 goals was to gain valuable information about the future environmental 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.

**TU287**
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 mandated control system (HMCS) for use and reduction of discharges of chemicals in the exploration and production of oil and gas offshore in the North Sea. Chemical suppliers must submit a Harmonised Offshore Chemical Notification Format (HOCNF) to the implementing 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. In particular 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 results of standard OECD biodegradation screening tests. Furthermore, 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 employed 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.

REFERENCES
TU288
Organising an international ring test to improve the marine biodegradation screening test
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A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, biodegradability screening tests (BSTs) 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 have resulted in major enhancements also adding 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 sample 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 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 such food webs of Schirmacher Hills, Antarctica

Our preliminary study on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, soil, vegetation and water] of Schirmacher Hills, Dronning Maud Land, Antarctica, α-HCH concentrations (4.48 ± 0.09 mg/L) were reported. DDT (31.2 ng/g dw) concentrations are higher than those observed by 5 times or more. The occurrence of Polychlorinated biphenyl (PCB) congeners, only 6 PCBs were detected. ΣPCBs in both moss (122 ± 115 ng/g dw, n = 5) and water (30 ng/L and 165 ng/L, n = 2) are higher by up to 10 times compared to other studies around the continent. Heavier congeners (hexa through nona) in both moss and water samples contributed to 50% of the total body burden of TPT in these fishes on a wet weight basis. The specific abundance of triphenyltin (TPT), are still being detected in coastal marine areas. Hence, more work is being undertaken to understand the toxicokinetics and identify targeted organs of accumulating these compounds in marine fishes is still lacking, and such information will help reveal the potential of bio-magnification of TPT in marine food webs.

TU290
POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics and processes
K. K. Ho, The University of Hong Kong; V. Faleiro, The University of Hong Kong; K. M. Leung, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; G. Bending, University of Warwick / School of Life Sciences; I. Bramke, M. Garrod, Syngenta Product Safety / Product Metabolism and Analytical Science; C. Mckillop, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science

Biodegradable organotins (OTs) (especially triphenyltin (TPT)) have been used as fungicides in agricultural and domestic applications and have, more recently, been used in plastificants such as polycarbonates and resins. Its use has been increasing in the last years and has resulted in massive release of these compounds into urbanized coastal marine environments. Even though the International Maritime Organization (IMO) of the United Nations enacted a global prohibition on the usage of organotin-based antifouling agents on hulls of sea-going vessels in September 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 halides (TPT), are still being detected in degradable marine ecosystems in coastal marine environments of Hong Kong and Shenzhen, China. Organisms inhabiting these areas are particularly susceptible because they can bioaccumulate TPT through direct contact with contaminated seawater and sediment, and through dietary uptake. Nonetheless, a comprehensive tissue-specific accumulation profile of TPT compounds in marine fishes is still lacking, and such information will help reveal their toxicokinetics and identify targeted organs of accumulating these contaminants.

This study was, therefore, designed to investigate the distribution pattern of TPT in the bodies of four marine fish species, namely Collichthys johnii, Cynoglossus bilineatus, Johnius heterolepis and Johnius heterolepis. For each species, 15 tissue types (n = 4) were extracted for quantification of TPT concentrations and its degradation products (i.e., di- and mono-phenyltin) using gas chromatography mass-spectrometry. We found that the accumulation tendency of TPT was highly tissue-dependent. Highest concentrations of TPT were consistently found in livers, whereas scales and swim bladders contained the least amount of TPT. Mass-balance model showed that muscles (dorsal and ventral) generally contributed to 50% of the total body burden of TPT in these fishes on a wet-weight basis. It was estimated that TPT concentration of the whole organism could be predicted using its concentration in dorsal muscles (p < 0.05, r² = 0.973), which indicated that dorsal muscles can actually represent the contamination in the whole organism on dry-weight basis. Our findings from profiling the distribution pattern of TPT compounds would help identify potential TPT-induced organ-specific toxic effects in fishes, and the potential of bio-magnification of TPT in marine food webs.

TU291
Degradation of crop protection products in Brazilian soils
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Brazilian CPPs come commonly available and are subjected to rigorous testing according to strict regulatory guidelines, including understanding the fate of these compounds in the soil environment. The global use of CPPs requires an understanding of their behaviour in a range of soils, including those from both temperate and tropical regions. Moreover, results from previous CPPs fate studies have shown fundamental differences in Brazilian soils compared to temperate soils. The aim of my project is to determine the major physico-chemical and biological properties controlling the degradation of pesticides in Brazilian soils. A set of 4 different soils, prescribed for regulatory testing to encompass the typical range of properties, such as pH, organic matter, clay content and cation exchange capacity (CEC), including an on crop version and a pristine version of these soils, was used in my study. My first experiment focused on the rate of degradation and mobility of tricloside thiabendazole in four different Brazilian soils and one temperate soil. Thiabendazole exhibited slow degradation due to it adsorbing onto the soil solid surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT₅₀) and distribution coefficients (Kₐ) were higher in some Brazilian soils compared to the temperate soil due differences in their physico-chemical properties. Further pesticides will be tested to determine which key physicochemical and biological properties are the driving force for a compounds fate in tropical soils.

TU292
Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-ETD/MS
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Bisphenol A (BPA) is a compound widely used in plasticstics such as polycarbonates and resins. Its use has been increasing in the last years and researches point that it may be detected in the environment in great concentrations. Some studies connect the exposition to this compound with cancer and other diseases. In this work, it was evaluated the ability of the fungus species 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 pattern to it. After that, 2ml of sample were periodically purchased and analyzed in an Agilent 1200 Series HPLC with DAD detector. 87.78% of removal was the average efficiency of the degradation; slightly smaller than other species that our group has investigated in previous works, such as Trametes villosa. In
future works, the activity of the enzymes like Laccases and Manganese-Dependent Peroxidase should be taken into consideration and evaluated, as well as to compare the degradation with an abiotic system containing the BPA pattern – in order to evaluate its persistence in the culture medium.

TI/203 Soil dissipation of paraffin oils: Improvement of the microbial degradation and impact on soil dissipation. P. Adrian, A. Barret, CEHTRA SAS; G. Destrycker, CEHTRA; P. Lemaire, TOTAL Fluids

The study was conducted according to OECD 307 and the active substance applied onto soils according to Good Agricultural Practices in EU. Four soils were freshly collected from sites in Germany and handled per the International Standards Organisation Standard ISO/DIS 10381-6 Part 6 and Good Laboratory Practices. Following incubation the soil samples are extracted and further analysed by GC/MS i.e. monitoring of one ion (m/z) for the internal standard (66 m/z) and one ion for the test substance (57 m/z). Satisfactory method performance was achieved at each degradation interval, as verified by recovery efficiency testing. The test substance, Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids, dissipated to below 50% of the original 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) as produced by TOTAL Fluids, dissipated to below 80-90% dissipated in all four soils evaluated. From 122 DAT through 300 DAT there was not any substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids in any of the four soils occurring. Two treated soil samples were then treated with dextrose, ammonium nitrate and monopotassium phosphate in order to improve the remaining bioactivity. The remaining residues of the applied substance was then followed for two weeks. The results showed that for one soil a complete dissipation of the remaining residues occurred although in these time of incubation a plateau was observed indicating that the methodology is therefore proposed to demonstrate for certain chemicals that the degradation is of biological origin and to integrate these results in the proposed end points.

TI/204 Impact of biofilm growth on mercury accumulation in Daphnia magna s.issa, Norwegian University of Science and Technology; T. M. Ciesielcki, 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 and 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 the test organism. For example, we commonly use freshwater organisms in such studies to infer toxicity thresholds of aquatic organisms. Nevertheless, such tests are usually conducted in highly standardized conditions and with a minimum of naturally occurring biofilm. Although this allows for standardization, it may hinder ecological relevance. Biofilm commonly grows in culture medium and serves as additional food for Daphnia. It can also accumulate mercury (Hg), a pollutant of high importance 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 clonal were exposed at 20±C 0.2 µg/L and 2 µg/L Hg (HgCl2) in the presence and absence of biofilm. Our hypothesis 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/205 When ecotoxicology meets trophic ecology (P)

When ecotoxicology meets trophic ecology (P)

P. Mendez, Observatoire Pelagis; J. Spitz, Observatoire Pelagis Université de La Rochelle/CNRS; F. Caurant, Université de La Rochelle / LIEENs

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 tienmanite (Hg:Se) in their liver. Today, anthropogenic activities induced a continuous increase in Hg concentrations in some environment, altering its bioavailability as well as its effect on the marine communities. 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 cetacean 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 interannual can increased because of its long-range transport different Se 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/298 Multiple stressor effects on resource quality for consumers: a case study with photobiofic biofilm exposed to phosphorus and ionic silver M. Donner, K. Sanchez-Thirion, LIEC; C. Crenier, LIEC Université de Lorraine CNRS 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. Feltin, LIEC / LIEC UMR; J. Lefalvaie, ECOLAB UMR CNRS UPS INPT

Autotrophic biofilms are fundamental biological compartments of many aquatic ecosystems, representing notably a major resource for many invertebrate 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:N:P 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 crate 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.

TU209  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 detritovore community structures. To disentangle the potential mechanisms, two main approach were performed in this plant with a bare surface and shrubs covered under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>≈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 containing seedlings planted in each environment, to calculate mass remaining, decomposition index and organic carbon and nitrogen of the remaining material. In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully emptied after 20 days was recorded to calculate the % of holes fed upon. After ≈50 days, the percentages of mass remaining in the tea bags were: - DP+MS, PM+MS and S green tea ≈50-55%, robois tea=90%; - PF, CF and P green tea ≈80-85%, robois tea=90%. These percentages were maintained until the day 110. The lower decomposition in CF and PF can be related with more abundance of resources in forest soils outside of the tailings which could induce to microorganisms to use other sources of nutrients different from tea material. However, in more stressed environments, such as forest soils without a rich vegetation a source of carbon easily decomposable, mainly the green tea, could stimulate microbial activity by a priming effect. Besides, within the tailings, the decomposition in S (the most unfavorable environment “a priori”) could be favored by the high soil temperature (average ≈28°C), as a consequence of the lack of vegetation, while in other environments the shading by plants maintained the temperature between ≈23 and ≈25°C. Feeding activity was (% of holes fed upon): CF=42%, P=38%, S=31%, PM+MS=25%, AF=8%, DP+MS=7%. The high % of holes fed in bare soils (S) could be related to the scarcity of resources in this environment which stimulated the consumption of the bait.

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 P. halepensis trees >≈4 m high, growing scattered (P); 3. Isolated P. halepensis trees >≈4 m high, growing scattered under the canopy (D); 4. Dense patches with several P. halepensis trees (>≈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 containing seedlings planted in each environment, to calculate mass remaining, decomposition index and organic carbon and nitrogen of the remaining material. In each plot, two groups of 5 baited sticks were vertically inserted. The number of holes partially and fully emptied after 20 days was recorded to calculate the % of holes fed upon. After ≈50 days, the percentages of mass remaining in the tea bags were: - DP+MS, PM+MS and S green tea ≈50-55%, robois tea=90%; - PF, CF and P green tea ≈80-85%, robois tea=90%. These percentages were maintained until the day 110. The lower decomposition in CF and PF can be related with more abundance of resources in forest soils outside of the tailings which could induce to microorganisms to use other sources of nutrients different from tea material. However, in more stressed environments, such as forest soils without a rich vegetation a source of carbon easily decomposable, mainly the green tea, could stimulate microbial activity by a priming effect. Besides, within the tailings, the decomposition in S (the most unfavorable environment “a priori”) could be favored by the high soil temperature (average ≈28°C), as a consequence of the lack of vegetation, while in other environments the shading by plants maintained the temperature between ≈23 and ≈25°C. Feeding activity was (% of holes fed upon): CF=42%, P=38%, S=31%, PM+MS=25%, AF=8%, DP+MS=7%. The high % of holes fed in bare soils (S) could be related to the scarcity of resources in this environment which stimulated the consumption of the bait.

TU301  Effects of mineral supplements on lead exposure in free-ranging herbivores

J. Pareja Carrera, IREC-UCLM / IREC-UCLM; M. Martinez-Haro, IREC-Instituto de Investigación en Recursos Cinegéticos / Department of Life Sciences; J. Rodríguez-Estival, University of Castilla-La Mancha / IREC-UCLM; J.E. Smits, University of Calgary / Ecosystem and Public Health; M. Durkalec, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre Lead (Pb) mining has contributed to the extensive release of Pb into natural environments for centuries. In former mining districts, now on the Iberian Peninsula mainly livestock and hunting estates, Pb persisting in the soils and vegetation of affected areas may cause an environmental and health risk. Since Pb is an important toxic metal for both animals and people, the methodology to explore how to prevent or reduce exposure. Therefore, we studied the effect of commercial mineral supplements on Pb bioaccessibility through laboratory and field approaches. One aim was to prevent or reduce absorption in herbivore inhabiting mining areas and thus reduce the possible exposure route to people. In our previous work, we identified one mineral supplement rich in calcium (Ca) and phosphorous (P) that specifically altered Pb solubility and absorption in a digestive tract simulation model. Here, we go one step further to evaluate the effects of that commercial mineral supplement on Pb absorption and on immune status in goats from an old mining area. Two groups of goats from two plots with similar soil Pb concentrations were selected. One group was supplemented with the commercial mineral salt for 20 days, whereas the other one served as control. Then, the Pb exposure was evaluated in blood, milk and feces, and the phytohaemagglutinin (PHA)-skin test was used to evaluate T-cell-mediated immunocompetence. Results showed that all goats responded to the PHA, but no significant difference was detected between groups. Blood and milk samples were collected the same days that the PHA-skin test was conducted. Blood Pb levels in supplemented goats were lower than in un-supplemented goats (0.012 vs. 0.006 g/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagia by the animal. These supplemented lentils could thus be used worldwide in areas contaminated with Pb. An assumed additional advantage is reduced risk of Pb exposure through milk consumption by the local human population.

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 prey species or non-target species, contaminated with pesticides, are consumed by predators although expected especially in case of insecticidal bait. In the current study, livers from predatory birds were spiked with coumatetralyl and warfarin, triflrtix, fipronil, which has a higher bioaccumulation potential and the metabolites 5-thianidin with TZMU and TZNG were not found in the livers. These samples were spiked with surrogates and homogenized in a mixture of methanol and water (2:1/v/v) and cleaned up by solid supported liquid extraction with a diatomaceous earth column (Geduhn et al., 2014, DOI 10.1016/j.sciotenv.2014.07.049008-9697). Quantification of the analytes was performed by LC-ESI-MS/MS with a calibration from 0.1 to 100 ng/ml (r² > 0.99) and a signal to noise ratios > 6.1 for the lowest concentration level. The neonicotinoids imidacloprid with the metabolites 5-OH-IMID and IMID-olefine, thiamethoxam and clothianidin with TZMU and TZNNG were not found in the predators although expected especially in case of insect-consuming species such as little owl (Athene noctua). Similarly, we did not detect any residues of the phenylpyrazole fipronil, which has a high bioaccumulation potential and the metabolites F-biotone, F-sulfide and F-carboxamide. One to four substances of the rodenticides chlorophacinone, difenacoum, bromadiolone, brodifacoum, flocoumafen and bromadiolone were examined. A residues distribution pattern will be presented but more samples are needed for final statements.

TU303  Trophic Magnification of POPs including PFCs Within A Terrestrial Food-Web Of An Avian Top Predator, the Cooper’s Hawk (Accipiter Cooperii)

303  SETAC Europe 28th Annual Meeting Abstract Book
Spatial comparison of contamination and biomagnification profiles of triphenyltin compounds in sub-tropical marine environments of Hong Kong

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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 submerged mariculture facilities in Hong Kong, Mainland China, 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 or not TPT is biomagnified in marine organisms 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-butyltin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had the highest concentrations. This is partly due to the high tDOM input. Concentrations from biota samples indicated a concentration gradient from the western to southern waters (W1 > W0 > SL > SE). The above findings were consistent with our hypothesis that the western waters are more polluted than the southern waters due to the influx and polluted freshwater from the Pearl River. Our forthcoming results on whether TPT can be biomagnified in higher trophic organisms will further shed light on its biomagnification potential at the higher food chain with consideration of its lipophilicity and octanol-water partition coefficient (log Kow).

Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban and rural coastal system of the USA, and the EU use only bioaccumulation information for fish to assess the chemical parameters and nutrient concentrations. While the trophodynamics of legacy persistent organic pollutants is relatively well known, that of more emerging halogenated contaminants remain scarcely documented. This is particularly the case for short and medium chain chlorinated paraffins (SCCPs and MCPPs, respectively), which quantitative analysis 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 chemicals, to evaluate the significance of PCBs to other short-chained halogenated organics. A total of 94 samples ranging from primary producers to piscivorous fish (n = 65), were collected in these systems 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 (lme4) accounting for the difference of samples between taxa. Our results show the expected biomagnification of the targeted PCB congeners (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.

Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin.


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 biomonitor and cover different functional feeding styles. This is part of a larger study in North Spain that aims to develop biota quality assessment of chemical parameters and nutrient concentrations.
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 abundances 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 communities 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. These models were fitted for Cu only in few instances for Hg. Results showed that Cu-ERs and Cu-ERs, in 4 taxa (Baetidae, Hydropsychidae, Ephemerellidae and Microdrilii oligochaetidae) 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 ERs for Lumbricidae and Perlidae, which reached to 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 P90s.

TU308
Trophiic transfer of Cadmium nitrate in a simplified marine food chain: experimental feeding rate of gelatinous zooplankton Aurelia sp. and Sanderia malayensis on crustacean Artemia sp.
F. Costa, C. Gambardella, V. Piazza, CNR ISMAR; S. Lavorano, Costa Edutainment spa Aquario di Genova; M. Fainali, F. Garaventa, CNR ISMAR
Trophiic 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 metazooplankton and as prey of apex predators, including 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 effects 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_AFDW 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 pulsatia (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 AFDW 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 Crassostrea virginica as evidence of the trophic transference of copper and cadmium via Chlorella sp.
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Exposure to metals and nanoparticles in small quantities carrying out't 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 damage. Several human activities contribute to the increasing load of both essential and non-essential metals in the aquatic environment. Microalgae such as Chlorella sp., are the primary link in the'trophic chain, feeding in the environment, they can take in/n incorporate contaminants by absorption or desorption. If these algae/n accumulate contaminants, such as metals, the organisms that feed on them like/o the oyster Crassostrea virginica can in turn incorporate them through filtration, which may have negative consequences. The objective of this work 'n was to evaluate the effects derived from the trophic transfer of copper and cadmium from Chlorella sp. to C. virginica. Microalgae were used 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'n performed in the digestive gland revealed diverse lesions ranging from the'n 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'n inflammation and injuries that compromise the body's physiological processes/on such as feeding and breathing. These damages were evident after the first 96 hours of exposure to the contaminated food. However, lesions were observed in C. virginica with cadmium exposure, a non-essential metal, in more than 50% of organisms/n could be observed on day 10 and those associated with more than 50% 'n animals in cooper exposure were deferred to day 15. The presence of Chlorella/n sp. in the digestive tract made possible to associate the injuries within trophic metal poisoning, and the prevalence of lesions with metal and exposure time.

TU310
Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web
L. Hanslik, COS University of Heidelberg / Aquatic Ecology and Toxicology; A. Batel, University of Heidelberg / Aquatic Ecology and Toxicology; T. Brauneck, University of Heidelberg / Centre for Organismal Studies
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 sp. nauplii and zebrasfish (Danio rerio). Therefore, cryogenically grinded microplastic particles, made of polystyrene (P)

TU311
Toxicokinetics links prey-predator dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenorhabditis elegans-Escherichia coli ecosystem
X. Yang, National Taiwan University / Bioenvironmenatal Systems Engineering; Y. Lin, National Health Research Institutes / National Institute of Environmental Health Sciences; H. Lin, National Taiwan University; C. CHEN, National Taiwan University / Bioenvironmenatal Systems Engineering; C. Liao, National Taiwan University / Department of Bioenvironmenatal 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 bioinetic and consumer-resource dynamics in the Caenorhabditis elegans (C. elegans)-Escherichia coli (E. coli) OSPecosystem. METHODS: The bioinetic 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. Dynamic of FeNPs 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 Fe/NPs exposure. We also observed that internal concentrations of Fe/NPs 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 Fe/NPs 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 FeNPs 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,
perfluorides, PBDEs, PCBs, HAPs and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogen and androgenic activities in surface water. 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. In the other hand, 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 estrone concentration but also with other ED (e.g. bisphenol A, perfluorides). 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 determining 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 total phosphorus, Kjeldahl nitrogen, ammonium, nitrite, nitrate, BOD, COD, (ii) humic and UV absorbing substances (iii) ions, using bioreceptors indicating different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In total, 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 support of biological life, with regard to nutrient and oxygenation conditions. Concerning concentrations detected, these values were low, being benzotriazine the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzotriazine 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 additional tool to the WFD 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 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 water concentrations. These assays 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 reviews 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.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD)
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The Water Framework Directive (WFD) 2000/60/EC regulates the European water sector, aiming at the sustainable management of water bodies, ensuring a good ecological and quantitative status of all water bodies. Despite the efforts to reduce the release of chemicals into the aquatic environments, pollution is still widespread across Europe, and new emerging substances should be assessed and managed. The general goal of this project (realised in the framework of the 'Torno subito Lazio Operational Programme European Social Funding 2014-2020') is to select and define innovative methods to assess the toxicity due to the exposure to different pollutants, especially the emerging substances and respective mixtures, with a focus on aquatic ecosystems and human health. This goal has been achieved, in a first step, by making a literature review on the priority and emerging substances widespread in the aquatic environment, to investigate their effects on the development of zebrafish (Danio rerio) embryos. Then, a few toxic substances that are relevant for our goals have been selected and analysed through the fish embryo acute toxicity test (FET) and other assays; particular attention has been given to the sub-lethal effects. Afterwards, environmental samples from different aquatic systems in Italy will be analysed to detect the chemicals present in these sites as well as their toxic effects. In order to reach a better comprehension of the effects of substances on the environmental quality status of the WFD, innovative ecotoxicological monitoring strategies, as defined and implemented in the project, will be also performed. The study will ultimately aim to provide recommendations for the implementation and the update of the monitoring strategies of the WFD, as well as to enhance the current EU activity on Effect-Based Methods.

TU316
Chemical and Ecotoxicological Monitoring of a marine coastal area in the Central Italy
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A monitoring campaign in Central Italy with the aim to characterize the chemical quality status of the coastal marine area in order to detect the possible impact of the emissions of a Coal fired power station and other sources of pollution in proximity of the city of Civitavecchia. The sampling has been carried out in two different seasons of the year along the marine coastal area and in a transitional surface waterbody (Saline di Tarquinia). The analysis has been performed on the water samples collected to detect organic substances in the sediments that are relevant for the quality of water. The results were submitted 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 reviews 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) and man-made sources (recycling) and are reinforced in shallow bodies of water by the lack of maintenance measures 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 Cole fired power station.

TU317

USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROSCOPE 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 screening at the chemical level. The research was performed in a way that 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. Samples were tested with and without metabolic activation (S9). The strains used were NA98, YG1041, TA1538 and YG1585 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, it was possible to determine types of compounds in water 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 profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that need to be investigated. Non-target analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS

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TU318

NTA meets EDA: A practical example

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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 made it possible to analyze historic 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 regularly during 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 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 of seasonal excretion peaks 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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Bathytinis (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. However, it is generally recognized as a specific water quality and aquatic pollution indicator. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecological 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, 1875) and Bulinus truncatus (Lamarck, 1818) with the aim of estimating the imposex levels and could be related to the substances possibly contributing to imposex levels. The objective of the study was to use different strains for the identification of mutagenic profiles and screening at the chemical level. The research was performed in a way that 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. Samples were tested with and without metabolic activation (S9). The strains used were NA98, YG1041, TA1538 and YG1585 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, it was possible to determine types of compounds in water 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 profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that need to be investigated. Non-target analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS

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TU320

Lessons Learned from Sibro Dam and River Restoration in Sweden

E. Hallqvist, C. Becker, P. Bönökkö Adamensen, P. Gílvöse, A. Sahln, Ramboll Aquatic ecosystems in the European Union are under pressure from growing demand for insufficient quantities of good quality water for human use. The Water Framework Directive aims to protect and improve the status of bodies of water, to ensure that the chemical and ecological quality of surface water and groundwater is maintained, and to establish standards for chemical pollution levels. Butyltins (BTs) are organotin 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. However, it is generally recognized as a specific water quality and aquatic pollution indicator. For this reason, under the implementation of the WFD, imposex measurements have been indicated as a useful tool to link chemical and ecological 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, 1875) and Bulinus truncatus (Lamarck, 1818) with the aim of estimating the imposex levels and could be related to the substances possibly contributing to imposex levels. The objective of the study was to use different strains for the identification of mutagenic profiles and screening at the chemical level. The research was performed in a way that 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. Samples were tested with and without metabolic activation (S9). The strains used were NA98, YG1041, TA1538 and YG1585 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, it was possible to determine types of compounds in water 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 profile were similarly representative compounds of these classes. Other sites indicate the presence of other types of compounds or mixtures that need to be investigated. Non-target analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS

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TU321

Impacts of methylmercury on growth, respiration and swimming in larvae of a marine forage fish

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SETAC Europe 28th Annual Meeting Abstract Book
Marine and estuarine fish accumulate methylmercury (MeHg) to elevated concentrations, often higher than in freshwater systems. Because MeHg is a neurotoxin, it is plausible that high tissue concentrations could affect behavior in marine fish which in turn could affect their populations in contaminated waters. However, we measured lethal effects of MeHg to a marine forage fish at the larval stage, the Sheephead minnow Cyprinodon variegatus. Because the bioavailability of MeHg from different food types may lead to different MeHg internal distributions and toxic effects, we compared artificial and natural diets with varying MeHg concentrations. Artificial (commercial fish flakes containing methylmercury) or natural diets (zooplankton containing MeHg, obtained from MeHg-contaminated photoplankton) were prepared; MeHg concentrations ranged from zero (controls) to as high as 7.8 ppm. The larvae were fed control and MeHg-contaminated diets from an age of 7 days until 5 weeks when they reached juvenile stage. Growth rates, respiration rates, and swimming activity were tested. Results indicate that MeHg-rich diets—either artificial or natural foods—have no significant impact on fish growth rates under any treatment. However swimming activity (swimming speed acceleration, active time and swimming distance) was impaired after 3 weeks exposure to natural diets containing 7.8 ppm but not 2.5 ppm; artificial diets containing MeHg up to 4.8 ppm had no discernible effect on swimming. In addition, MeHg as low as 4.8 ppm had a small but significant impact on the respiration rates of these fish. The data suggest that mortality and growth are unlikely to be affected by these MeHg concentrations, but swimming activity may be reduced if elevated. To indicate this standardization, and this could influence the success of populations in the wild through impairment of predation or avoidance of predators.

TU322 Comparability of Zebrafish Embryo Behavioral Assays: A Need for Standardization of Experimental Factors

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The fish embryo testing model for drug development and toxicity testing. In particular, the behavioral assay (Larval Motor Activity Test, LMA) is one of several assays that have been developed including photomotor response test (PMR), locomotor response test (LMR), activity monitoring test (AMT), and swimming distance test (SDT). These pharmacological methods have been used in many laboratories throughout the world to test the neurotoxic potential of various chemical compounds. The Zebrafish model is also gaining wider acceptance as an alternative to mammalian models in toxicology and drug development. While the results of these studies are consistent across species, there is a need to standardize these methods in order to enable comparability of test results, as well as to ensure accurate prediction of chemical activity in vivo. To address these concerns, we conducted a meta-analysis of existing behavioral assays to ask these questions: 1.) Are there any differences in the experimental factors that affect the data analysis? 2.) Are there any differences in the experimental factors that affect the variability of the data? 3.) Is it possible to aggregate the data from different assays to give useful behavioral activity? 4.) Is it possible to determine which experimental parameters are most influential for the behavioral assays? Based on the meta-analysis, we conclude that, results from different behavioral assays (LMR, PMR and STC) are consistent with the predicted activity of a chemical. Even though, effect concentrations vary to some extent among the considered behavioral assays, most of the variability could be explained by the most influential parameters including: exposure time, age at exposure and concentration range. These results can be used to identify the most important experimental factors in an effort to standardize behavioral assays for toxicity testing.

TU323 Effects of 17α-ethynylestradiol (EE2) on social behaviors of the false clown anemonefish (Amphiprion ocellaris)

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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 systems via wastewater discharges and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal water. 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 fish 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. 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 EE2 treatment, rather than the EE2 concentration. 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 is conserved across a wide range of non-target species. As a result, by directly acting on the central nervous system and neuroendocrine pathways, fluoxetine can affect a range of ecologically important behavioural and physiological processes in wildlife. Despite this, the effects of environmentally relevant fluoxetine exposure on processes of sexual selection in aquatic biota remain uncertain. This is concerning as sexual selection processes directly influence mating outcomes and so are fundamental to individual fitness, as well as the viability of populations and species. To address this knowledge gap, we investigated the impact of 30-day exposure two environmentally realistic levels of fluoxetine (average measured concentrations: 30 and 380 ng/L) on a range of reproductive behaviours, as well as sperm quality, in the eastern mosquitofish (Gambusia holbrooki), a previously described freshwater fish with internal fertilisation. We focussed on these traits because reproductive behaviour and sperm quality are both crucial fitness determinants, and are known to be vulnerable to disruption by other chemical pollutant classes. We found that fluoxetine exposure impacts reproductive behaviour in fish at field-detected concentrations, altering both association time and copulatory behaviours, and also affecting sperm motility. We also tested a promiscuous freshwater fish with internal fertilisation. Therefore, these results indicate that fluoxetine exposure can alter reproductive behaviours with direct bearing on fitness in fish and, further, highlight the need for ecotoxicological testing using sub-lethal exposure concentrations and ecologically important behavioural endpoints.

TU325 Determining the effects of antidepressants on multiple behaviours in 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

Amphipod Behavioural assays have been gaining recognition as a viable endpoint in ecotoxicology as they provide a link between biochemical and ecological effects of environmental contaminants. Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behaviours in aquatic vertebrates. The effects of behavioural modulating drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined behavioural assays. These pharmacological methods have been translated to ecotoxicological studies on vertebrates but comparatively few have been done on invertebrate species. This ongoing study aims to translate these techniques to model invertebrates for the purpose of assessment of environmental risk using the antidepressant fluoxetine as a model compound. Species of the marine amphipod, Echinogammarus marinus and the freshwater amphipod Gammarus pulex were exposed to environmentally relevant concentrations of fluoxetine from 0.001-1 µg/L during 1 day, 1 week, and 2 week exposures. Activity was measured as swimming velocity and choice experiments were used to determine phototactic and thigmotactic response. Both E. marinus and G. pulex showed alterations in activity at concentrations as low as 1ng/L and as soon as 1 day compared to controls (P<0.05). Significant differences were observed in thigmotactic and phototactic behaviours both between treatments and with length of exposure. Results indicate that fluoxetine can have an effect on some amphipod behaviours at environmentally relevant concentrations. These results may have implications for future study design of these types of experiments and aid the development of high-throughput analysis on common laboratory invertebrate species.
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

Inter-species differences 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. Behavioural differences are 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 behaviours 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)
L. Vossen, Uppsala University / Department of Neuroscience; J. Fick, Umea University / Department of Chemistry; T. Brodin, Umea University / Department of Ecology and Environmental Science; S. Winberg, Uppsala University / Department of Neuroscience

Benzodiazepines 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 concentrations and natural contexts. Within our framework we supply tools to design ecologically realistic experiments and risk assessments.

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, Norwegian University of Science and Technology / Department of Biology; J. Fick, Umea University / Department of Chemistry; M. Thorlacius, Marine and Freshwater Institute; T. Brodin, Umea University / Department of Ecology and Environmental Science

Benzodiazepines are frequently detected in the environment. They persist in wastewater effluent and can be found at high concentrations in treated effluent. Furthermore, several benzodiazepines are resistant to photodegradation; enabling them to persist in the environment. Benzodiazepines are designed to alter human behaviour by binding to GABA-receptors, which are found in a wide range of animals including all vertebrates. We investigated the effect of the benzodiazepine oxazepam on behaviour using the burbot, Lota lota. We found that high levels of oxazepam affected swimming activity, diurnal as well as nocturnal, while the environmentally relevant level had no detectable effect. There was also an effect on boldness, with fish exposed to high levels of oxazepam spending more time hiding than the control- and low level fish. Interestingly, the effects of high oxazepam were no longer detectible when the fish were tested again after being kept in water without drugs for five days. Our results suggest that effects of pharmaceuticals may be reversible, if the exposure duration is relatively short and the animal have the possibility to move to uncontaminated water.

TU329  Behavioural endpoints and biochemical biomarkers as tools to investigate effects of citalopram in brown trout (Salmo trutta f. fario)
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Citalopram (CIT) is a selective serotonin reuptake inhibitor (SSRI) which is commonly used as an antidepressant. It binds to the 5-HT transporter (5-HTT) which is responsible for the serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the pre-synapse. Due to high consumption 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 focus on development, behaviour and individual health. Both, eggs of fish in the eyed ova 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, acetylcholinesterase 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 for those 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 flurry 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 Biological Sciences; K. Angelstam, Umea University / Department of Ecology and Environmental Science

Chemical contaminants, e.g. metals, pharmaceuticals, pesticides, are changing ecosystems via effects on wildlife. Most studies examine a limited range of endpoints, species and/or contaminants under laboratory conditions. Recent work explicitly based in ecological realism, however, reveals that chemical contaminants may have multiple effects on animal behaviour, including ecological and evolutionary effects. In these studies, 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 direct and indirect effects of chemical contaminants on behaviour, under environmentally relevant 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 suggests a much more subtle and nuanced impact on ecological and evolutionary processes than currently assumed.

TU331  Scent and sensibility: EE2 disrupts male mate choice in fish
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Assessing 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-day exposure to 17α-ethinyl estradiol EE2 (measured concentration 12ng/L) - a synthetic estrogen used in the contraceptive pill and a widespread contaminant of aquatic systems - on visual and chemical communication in the gelatinous pioneers. 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 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 paired 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 ‘sigh’ display with both control and EE2-exposed males spending more time performing sigh display for controls compared to EE2-exposed females. When males were presented with a chemical cue (EE2-female, control male, chemical cue and EE2) entered the association zone more frequently, if EE2-exposed female was paired with an EE2-chemical cue. In contrast, sigh display showed a reverse pattern, with males preferring EE2-exposed females that were paired with control chemical cues. Not only does our study uncover a previously unknown behavioural impact of EE2-exposure on chemical cues, but also raises the possibility that EE2-exposure length and, to a lesser extent, the complexity of the cue or cue mixture might affect the ability to naturally respond to these cues. 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
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Although the use of the antifouling 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 (db) obtained from a laboratory breeding stock were exposed for 96h to waterborne tributyltin at 0.1; 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 length, and histopathological and chemical analysis of 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 hypopigmentation 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. After exposure to 7 μg TBT L^{-1}, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% relative to controls, respectively. The histopathological changes detected in the retina and iris may have reduced the fish visual exploration and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

TU333 Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants
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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 varies among species. Here, we investigated whether environmental contaminants lead to attractive or aversive responses in fish, and are additionally interested in the neuronal mechanism underlying the 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 larva’s space use, locomotor activity and velocity are evaluated. Active neuronal regions are detected by staining the larvae for an endogenous activity indicator (pERK) after they were exposed to the treatment. Results: We discovered a new aversive response at 1 μM, expressed by an increased dwell time in the nicotine contaminated zone. High concentrations (10 μM), on the other hand, appear to be clearly aversive, and larvae tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with activating inhibition of the reward center in the telost brain. We are investigating whether neurotransmitters (Indoleacryp, Thiaclorip) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepam) found in European waters trigger similar behavioral patterns. Outlook: We will dissect which chemosensory environmental and higher brain areas are involved in the behavioral reactions to environmental chemicals. This will advance our understanding of the impact of chemicals on fish behavior.

TU334 Urban sewage effluents into an alpine stream: are information on behavioural effects on Daphnia magna suitable to protect alpine cold adapted species?
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Methods: The acute effects of sewage effluents on chemical cues, but also raises the possibility that can be employed in biomonitoring programs for measuring stream health. Concentrations and corresponding effects are given in Table 1. For the behavioural responses, the males were allowed to court two females, one control and one EE2 (Citalopram, Lamotrigine, Oxazepam) found in European waters trigger similar acute toxicity tests performed with Daphnia magna are among the most internationally used bioassays for monitoring the toxicity of effluents. However, acute toxicity tests do not take into consideration endpoints that may provide early warning signals about the health of the exposed populations, such as behavioral changes. Altered behavioural signals could be induced at sublethal concentrations which are significantly lower than the corresponding LC50. In this study, we compared the sensitivity as mortality and swimming of Daphnia magna, and Diamesa cinnerea gr.larvae, a chironomid (Diptera Chironomidae) common in cold freshwater in the Alps, often associated to pristine environments. Both organisms were exposed for 24 and 48 hrs to different dilutions of effluents collected from one WWTP located at the Tonale Pass locality, in Trentino (1799 m a.s.l., NE Italy). 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 Systems and Image3dWrMTrack) were compared. We measured average speed, average swimming through distance travelled and cumulative distance travelled in both) at the exposure times. Overall, these findings emphasised a higher sensitivity of D. magna than D. cinnerea gr. to treated effluents. Accordingly, D. magna might be proposed as model organism to test the toxicity of WWTP effluents in alpine streams.

TU335 Do silver and titanium dioxide nanoparticles influence the fish kairomone 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 ecosystem. To this end, it is of the utmost importance to elucidate its neuroendocrine regulation as this knowledge is necessary, to prevent an ecological imbalance in the freshwater environment. Ag and TiO2 manufactured nanomaterials (NMs) are widely used in the commercial industry because of their unique properties. Silver is known for its antimicrobial properties and is therefore used in soaps and bandages as well as clothing and washing machines. Titanium on the other hand is used in products such as sunscreen, paint and toothpaste because of the bright white pigment it contains. Due to their small size, nanoparticles are not being effectively removed from wastewater treatment plants and end up in freshwater systems such as rivers and streams. Filter feeders, like the cladoceran Daphnia, take up these nanoparticles and

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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 kairomones 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 noul and compared the non-parametric responses of the respective endpoints using a Kruskal-Wallis test. The 24-hr endpoint is taken of each daphnids 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

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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 Cladoceran 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 endpoints than swimming velocity and swimming acceleration. The EC50s for fluoxetine and propanolol determined from swimming 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 nanomaterial: Behaviour as an indicator of effect in Danio rerio (zebrafish) exposed to nanogold

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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 a Loligo® EthoVision software. The critical swimming speed was performed in a Loligo® system with a narrow exposure window between acute and chronic effects, indicating that exposed animals in the treated concentrations were significantly affected.  The swimming speed increased in treated animals compared to the control group. 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 AgNO₃) at 0; 5; 25 and 100 µg/L for 96 hours. In the Ag exposure via food, the animals were fed on alternate days with control food or food impregnated with AgNO₃ 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 during 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 different using a t-test for each concentration. However, at 100 µg L⁻¹, 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 predators. Acknowledgement: The authors thank São Paulo Research Foundation (FAPESP 2016/19635-4) 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
Selecting 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 are currently under development, however, for some substances, other taxa/species may potentially be more sensitive e.g. Ephemeroptera, Plecoptera, 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 is a major technical challenge. Therefore, if a true reproductive effect 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 investigated the development of our experimental Assessing Behavioural 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

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Pesticides has 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...
hornetic - 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 behaviour, we found that even low effects of short chain PFAAs linked to the sexual or feeding behavior of our crop pest model following application of sublethal doses of deltamethrin, methylnol and chlorpyrifos. Whereas sublethal doses of methylnol appeared to disrupt the feeding behavior of larvae, we demonstrated a hornetic 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. Bocchetti, 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 concentration had a negative acuity, whereas at least 50% toxicology, 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 h 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 exposure. Fish continued to show increased EOG-induced olfactory dysfunction relative to the social cue supported the results of neurophysiological experiments. Although fish exposed to 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, CuNPs caused a significantly greater partial olfactory recovery was documented for continuous 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)

TU342 Perfluoroalkyl acids concentrations in liquid wastes: a survey campaign and implications for waste disposal
A survey campaign has been carried out to determine the concentrations of twelve perfluoroalkyl (PFAA) acids 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 without specific treatments. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment facilities, car washing, septic tanks, laundry sludge and wastes from plants, drinking water and isolated sewage treatment facilities. Waste samples (about 120) came from solid waste treatment plants, drinking water and isolated sewage treatment facilities. Allergenic and carcinogenic dyes (6% of total samples), PFC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). Data analysis permits to establish a PRSL (Product Restricted Substance List) protocol for regenerated raw materials with the aim to have an unique PRSL available for brands, manufacturing companies and every actor involved in the textile supply chain. The PRSL adaption could improve the recycling of textile materials as an alternative to their disposal. This case study takes into account regenerated woolen textiles (high wool content > 70%) derived by post-consumate materials (knitted apparel, apparel made up by carded woolen and combed woven), pre-consume 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 relevant pollutants in the different type of raw material used by carded spinning companies in Prato textile district, sampling (more than 100). The chemical contamination were found for aromatic amines (16% of total samples), APEOS (Ethoxyxylated Alkylphenyls), Aromatic amines from azo-colorants, Chlorophenols, PFC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals from artificial perspiration. Results was that about 150 sample were analysed and chemical contamination were found for aromatic amines (16% of total samples), APEOS (100% of samples), Chlorophenols (26 % of total samples), PFC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). The present study, 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.

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 or fabrics requires proper and specific evaluation standards. These should ensure compliance with private protocols and mandatory law and also the proper control of the production. ICD (Italian Consortium for D2O 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 or their disposal. This case study takes into account regenerated woolen textiles (high wool content > 70%) derived by post-consumate materials (knitted apparel, apparel made up by carded woolen and combed woven), pre-consume 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 relevant pollutants in the different type of raw material used by carded spinning companies in Prato textile district, sampling (more than 100). The chemical contamination were found for aromatic amines (16% of total samples), APEOS (100% of samples), Chlorophenols (26 % of total samples), PFC (62% of total samples) heavy metals (82% of total samples), Allergenic and carcinogenic dyes (6% of total samples). Data analysis permits to establish a PRSL (Product Restricted Substance List) protocol for regenerated raw materials with the aim to have an unique PRSL available for brands, manufacturing companies and every actor involved in the textile supply chain. The PRSL adaption could improve the recycling of textile materials as an alternative to their disposal.

TU344 Challenges for a comparative risk assessment among conventional hazardous substances and alternatives for textile finishing.
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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 Repellents (DWRs). FRs are added to fabrics to inhibit the combustion process, and typically are products with a chemistry based on halogenates. DWRs 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 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

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substances (PFASs)
A. Biegel-Engler, German Environment Agency - UBA / Chemicals; L. Viecke, C. Staude, 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. They have a continuous use of AFFF into the environment causes a 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-sectional 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 been constantly 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 specific examples of substitution attempts – and they discuss arguments why they might be considered successful – or not.

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 use of SVHCs. But it has to be considered that technical solutions are 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-sectional 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 been constantly 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 specific 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 Recyling for non-ferrous metals slags in safe use applications
H. Waertenscheep, 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 hazards. 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 developed 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. The 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
Ecotoxicity of the hydrolate byproduct of three biopesticides on the unicellular green algae Chlamydomonas reinhardtii
D. Ballestero, J. Val, E. Langa, San Jorge University; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; M. Piñol, Jorge University / Facultad ciencias de la salud; A.M. Mainar, 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 arthropod 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 (hydrolate) have been separated. Both fractions have 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 of the semi industrial vapor-pressure essential oil extraction of three selected aromatic plant species; a domesticated Artemisia absinthium (Tereul, Spain), Dictytrichia graveolens (Ciudad Real, Spain), and an experimentally pre-domesticated Lavandula lauieteri (Toledo, Spain) using the algae Chlamydomonas reinhardtii as aquatic model organism. Results indicate that all of three extracts having biopesticide activity are likely to cause toxic effects on the photosynthesis of Chlamydomonas reinhardtii, being Lavandula lauieteri the most toxic compound followed by Artemisia absinthium with a very similar toxicity and Dictytrichia graveolens. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolate of Satureja montana is likely to cause toxic effects on D. Magna and V. Fischeri but only high dilutions (LC50 values in the range of 0.5% in both cases). These results allow for 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)

TU349
Ecotoxicological evaluation of the hydrolate byproduct of Satureja montana on Daphnia magna and Vibrio fischeri
E. Oliva, Universidad San Jorge; E. Terrado, San Jorge University; J. Navarro, Centro de Investigación y Tecnología Agroalimentaria de Aragón (CITA); M. Pino, San Jorge University / Facultad ciencias de la salud; A.M. Mainar, Universidad de Zaragoza; D. Ballestero, San Jorge University
The increasing demand of natural bioproducts for cosmetic use, food or phytotherapy is based on the awareness about adverse effects on health and the environment. In particular, this work is focused on the plant Satureja montana (Lamiaceae), which has demonstrated a wide range of applications due to its important antimicrobial activity. Furthermore, some of the plant species have a sweet flavor and simple cultivation characteristics. The main components, thymol and carvacrol (oxgenated monoterpenes), are supposed to be responsible for these biological activities. Although there are a substantial number of studies where Satureja speciessare evaluated for their biological and pharmacological activities, as well as its chemical characterization, limited data are available on ecotoxicological characterizations. Consequently, the aim of this study is to evaluate the acute ecotoxicity of the hydrolate obtained from Satureja montana (Ejea, Aragón) by the traditional method of steam distillation on two organisms widely used as indicators of ecotoxicity: the freshwater crustacean Daphnia magna and the marine bacterium Vibrio fischeri. Both tests are standardized for the purpose of determining the toxicity expressed as EC50. Our results indicate that the hydrolate of Satureja montana is likely to cause toxic effects on D. Magna and V. Fischeri but only high dilutions (LC50 values in the range of 0.5% in both cases). These results allow us to know the possible environmental effect that these promising plant extracts can cause as a source of cosmetic and pharmaceutical applications with the aim of ensuring more environment-friendly processes and products. Acknowledgements: We thank J. Burillo, for his generous cession of the extracts used in this study and the financial support of MINECO-FEDER (CTQ2015-64049-C3-2-R)

TU350
The impact of the hydrolate byproduct of three biopesticides on the soil environment
E. Oliva, Universidad San Jorge; D. Ballestero, San Jorge University; E. Sánchez, Colegio internacional Anfora; E. Navarro, CSIC - Spanish National Research Council / Dept. Recursos marinos renovables; J. Urieta, Universidad de Zaragoza
The extended use of synthetic pesticides has resulted, during the last century, in the pollution of the agricultural soil environments. As an alternative to these products, environmentally friendly biopesticides are, nowadays, being developed. Although biological activity of biopesticides on target organisms is well known, studies focusing on the effects on soil non-target organisms are scarce. The BIOCROP Project (Biopesticide development by chemical and biotechnological tools) focus on the production and optimization of plant/fungal/agriwaste-based crop protectants via cultivation techniques, biotransformation, selective extraction and separations by traditional and supercritical CO2 technologies. In the traditional extraction process the organic and the aqueous fraction (hydrolate) have been separated. Both of them showed active compounds capable to act as biopesticides. In order to exclude a negative effect on the environment, these products were tested...
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, Dittrichia graveolens and Lavandula latifolia. The effects on the microbial community has been assessed using the community-level physiological profile – CLPP. This method relies on the ability of the microbial community for degrading different carbon sources present in Biolog Ecolplates®. The acute toxicity of biodegrading hydrocarbons was also tested by Eisenia fetida bioassay. Results indicate that hydrocarbons caused acute adverse effects in E. fetida, in particular D. graveolens and A. latifolia (LC50 in the range of dilution of 10-2). All three bioprotectives 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 crude petroleum on the soil environment as a pest management alternative. Acknowledgements: We thank: J. Buriljo and J. Navarro for his generous cession of the extracts used in this study and the financial support from 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 biopesticides. However, their use may be caused potent toxic effects to non-target organisms in the environment. It needs to be determined their non-target effects on non-target aquatic species and environment. 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 AGEOs were formulated for emulsifiable concentrate (EC) as an active ingredient, they were mixed with ethanol and tergitol in a ratio of 5:1. 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 AGEOs 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, 48h-LC50 values for the VFEQO 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.

TU352 Chronic toxicity of emulsifiable concentrate of cinnamon essential oils against Cyprinus carpio
H. Jeon, K. Kim, H. Jeon, Y. Kim, Y. Choi, S. Lee, Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests on plant essential oils (EOs) due to their eco-friendly safe 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), Nondent, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Kolliphor, Tergitol and Mixture of SDBS and Nondent) 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 in 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, 0.46, 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 group was 5.12 ppm and the mean survival rate was 8.48 ± 0.47. The survival rate of the positive control group was 9.33 ± 0.58 and the positive control and 5.12 ppm and the mean survival rate was 8.48 ± 0.47. The survival rate of the different concentrations for 40 days. Each conce

TU353 Thiosesim corrocarbon scaffold for the design of antifungal and antiaflatoxigenic 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. AARC 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 aflatoxins production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosesimcorbaron ligands starting from molecules of natural origin, like vanillin, perilldehyde 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 cytotoxicity and genotoxicity tests on healthy human cells, particularly on human cell lines derived 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 thiosesimcorbaron 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/

Understanding human and environmental exposure to chemicals in urban systems (P)
TU354 Electronic products are related with household exposures in Canadian households
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Key Words: electronic products, hand wipes, household exposure, FRs and plasticizers Novel flame retardants (NFRs), polybrominated diphenyl ethers (PBDEs), organophosphate esters (OPEs), and phthalates esters (PAEs) have wide applications as flame retardants (FRs) or/and plasticizers in consumer products, building materials, and industrial uses. Their widespread use has led to population-wide exposures (Carignan et al. 2017; Hammel et al., 2016; Hoffman et al. 2015). Some of these exposures have been related to adverse health effects (e.g., Carignan et al. 2017). Therefore, information on major exposure sources is needed to reduce exposures and ultimately prevent adverse health outcomes. Here we report on a household exposure study of Canadian women by determining levels of selected FRs and plasticizers in paired household air and dust, hand surface wipes of 15 participants, as well as wipes of principal household products, including their cell phones. PAEs had the highest overall concentrations followed by OPEs by approximately one order of magnitude, and NFRs and PBDEs (three orders of magnitude less than PAEs). Multiple compounds were found in wipes of individual electronic products suggesting either their usage in many products or migration into the surface polymer of these products from other sources indoors. Strongest a correlation shown in profiles from cell phones, the products most frequently resembled the profiles found in that person’s hand-held electronic products, notably that person’s cell phone. Correlations for all compound classes were also found between compounds in large, stationary electronic devices (e.g., TVs) and the room’s air and dust. However, the above correlations were not found for any OPEs between cell phones and air and dust, and were found for only two PAEs. Our results indicate wipes of cell phones were a stronger predictor of compounds on participant’s hands, while large and stationary electronic products related more to household environment contamination of selected FRs and PAEs.
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 M.D. Núñez, University of York / Environment; A. Praetorius, University of Vechta / Institute of Environmental Geosciences; A. Boxall, University of York / Environment Department

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 methodology for the estimation of ENP emissions and the fate of ENPs in the environment combining 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 parameterize 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, triclosan and triclocarban in personal care products from Korea S. Mok, Hanyang University / Marine Sciences and Convergent Technology; J. Lim, Hanyang University; M. Lim, Seoul National University / Environmental Health Sciences; J. Park, Seoul National University / Environmental Health Science; K. Lee, Seoul National University, Graduate School of Public Health; H. Moon, Hanyang University / Food Science and Biotechnology

Parabens (p-hydroxybenzoic acid esters), triclosan (TCS) and triclocarban (TCC) have been extensively used in various cosmetics and personal care products (CPCPs) 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 CPCPs in our daily life. In this study, ten parabens and two related metabolites, TCS and TCC were measured in 243 CPCPs, 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 (PpP, 49%) and butyl paraben (BuP, 41%). TCC had only 20% of detection rate and TCS was rarely detected in the samples. Total concentration of parabens was widely varied with ranging from <LOQ to 10200 µg/g. Concentrations of TCC and TCS 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, eyeliner, body/hand lotions and lipstick. The daily exposure levels of parabens and TCS associated with the consumption of CPCPs were calculated using the 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 CPCPs, 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 cosmetics (3 basic cosmetics, 1 UV protection products, 3 body 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 proportional allocation based on the relative proportion ratio in children’s sex and age distribution from 0 to 4. All cosmetics investigated in this study were used on a daily basis and usage rates from 52.1% to 98.0%, except 9.9% for hair styling product and 7.7% for deodorant. The frequency of food 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 assessment for chemical regulation.

TU358 Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children N. Bravo, CSIC-IDAEA / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry; B. Bocca, G. Calamandrei, A. Alimonti, Istituto Superiore di Sanità

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 products, such as 2-ethylhexyl diethyl phosphorothioate (TCPY, metabolite of chlorpyrifos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarbamic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-oxohecoxamin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pirimidinol (IMPy, metabolite of diazinon) and 2-dethylymamino-6-methyl pyridin-4-o (DEAMY, metabolite of pirimiphos). Concerning pyrethroids, most compounds such as permethrin, cypermethrin, deltamethrin, allethrin, resmethrin and fenvalerate are metabolized into one single compound, 3-phenoxbenzoic acid (3-PBA). On the other hand, cyfluthrin is metabolized into 4-fluoro-3-phenoxbenzoic acid (4-F-3-PBA). Therefore, 3-PBA and 4-F-3-PBA can be used as biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using solid phase extraction followed by HPLC-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 DEAMY® (98%), PNP (97%), 3-PBA (91%) and TCPY (87%). The metabolite showing the highest concentration was DEAMY® 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. M. Monterio, Aveiro University / Biology; M. Fraga, Biology Department CESAM Aveiro University; C. Gravato, Faculdade Ciências da Universidade de Lisboa / department of Biology & CESAM; C.J. Silva, University of Aveiro / Biology Department & CESAM; A.L. Machado, University of Aveiro / CESAM Department of Biology; A.M. Soares, University of Aveiro / department of Biology & CESAM; S. Loureiro, Universidade de Aveiro / Biology

Environmental exposure to humans may be critical in some residential and working environments. Outdoor materials, such as paints, building materials and protection products, 3 hair products, 3 body products and 2 cleansing products) for 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 PAH levels in parturient and newborns from Aveiro region, Portugal. Analysis of metabolites of organophosphate and pyrethroid pesticides in urine from Italian children.
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 concentrations than high molecular weight PAHs (pyrene and benzo[a]pyrene). Moreover, increased levels of naphthalene 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 homogenized placenta of mothers who smoked in the third trimester of pregnancy. No significant correlations were found between PAHs levels and anthropometric data of newborns, but in general, higher PAHs levels were found in newborns 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
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The aggregate exposure pathway (AEP) model is a conceptual framework to help align aggregate 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, qualifying 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 near-field 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 exposures to volatile organic compounds in urban environments. Some other information regarding mother’s lifestyle (e.g. urban or rural residential area, exposure to vehicles exhaust). 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 environments and their bioavailability in urban ecosystems such as fact, acid dissolution and alkaline fusion are commonly employed. Various instrumental techniques that have been used recently includes electrothermal vapouriser 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 highlights the potential of new 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
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Papillifera palliparis (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 contamination and potentially offers a method of assessing metal bioavailability to consumers. By analysing the chemical composition of the shells, soft tissues and faeces of snails collected from vegetated walls, at roadside and community gardens, in three small urban centers (Casale Monferrato, Italy), we found that the soft tissues of P. palliparis (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. palliparis 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
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This study was conducted to determine heavy metal distribution in surface soils in urban and suburban community gardens in Greater Victoria, BC, Canada Over 150 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, automotive

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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 risk associated with ingestion of metal contaminants was minimal. Dandelion samples were also collected and analyzed 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 homeowners.

TU365
Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for urban agriculture production
M. Legras, S. Castel, L. Caussel, A. Di Guardo, M. Rouan, Aghyle Unit
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 homogeneous; 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 (Normandy, France) for three purposes: pasture, a former construction site 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 physicochemical 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 was 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 activities of the former Caffaro s.p.a., a chemical factory among the largest former polychlorinated biphenyls (PCBs) producer in Europe, which produced such chemicals for more than 50 years up to mid 80’s. About 100 Ha of agricultural areas were contaminated by a mix of Persistent Organic Pollutants (POPs, mostly PCBs, dioxins, furans) and heavy metals (Hg, As) in variable concentrations, often exceeding the national limits for topsoil. The site was isolated in 1988 after an intensive but overall unsuccessful campaign of runoff irrigation with contaminated waters. PCBs were measured in three different agricultural areas in Italy and in three different points per area, in vertical cores up to 1 m depth. The resulting samples were representative of 0–10, 20–30, 30–40, 40–60, 60–80, 80–100 cm. The results of concentration measurements with depth (for about 80 PCB congeners) confirmed a general tendency of PCBs to be confined to the topsoil. Analysis of three samples collected on the field showed that the PCB 28 ranged from 150 to 250 µg/kg in the top 30 cm to about 0.6 µg/kg at 1 m depth; PCB 209 (peculiar of Caffaro production) ranged from 15000 to 13000 µg/kg in the top 30 cm, descending to about 13 µg/kg at 1 m depth. A gradient was also observed along the runoff water flow direction. These concentrations of PCBs were then compared to those obtained by the SoilPlus model (a multilayered dynamic multimedia fugacity model) and used to predict discharge amounts and conditions regulating vertical movement. The objective was to reconstruct soil concentration profile during the historical contamination to predict discharged amount, potential for additional vertical movement, and conditions regulating chemical bioavailability for future PCB rhizoremediation.

TU367
Metals and metalloids in inhalable fractions of urban road dust
C.L. Wiseman, University of Toronto / School of the Environment; J. Nui, C. Levesque, P.E. Rasmussen, Health Canada
Road dusts are highly enriched with metals and metalloids such as Cu, Sh, and Zn, 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, focusing 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 debriss 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 debriss, including Cd (0.55 vs. 0.25 µg/g), Zn (649 vs. 252 µg/g), Sh (8.2 vs. 2.2 µg/g) and Pb (80 vs. 54 µg/g). The enrichment of elements of known toxicity 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-wide Pb input from road dust wear 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, unfractonated 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)
T. Djordjevic, Faculty of Forestry, University of Belgrade; N. Zarić, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Solecif Knudsen, IcHTM / Department for Chemistry
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 at the moderately reduced pH of 513 kg l/m3), exchangeable Pb (emissions reported by industries and urban 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, unfractonated road dust samples from a variety of road types for particle size distribution analyses to refine elemental loadings in each size fraction.

TU369
"New" OPEs: isopropylated, tert-butylation and di-tert-butylation Triarylphosphate Isomers in E-waste, House, Car and NIST SRM Dust
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Gwo, Indiana University - Bloomington / SPEA; S. Harris, Cancer Care Ontario, University of Toronto / Population Health and Prevention, Prevention and Cancer Control; P. Kurt-Karakus, Bursa Technical University / Environmental Engineering Department; L. Melymuk, Masaryk University / RECETOX Research Centre for Toxic Compounds in the Environment; L.V. Nguyen, University of Toronto - Scarborough / Department of Physical and Environmental Sciences; M.E. Shoeib, Environment Canada / Atmospheric Science and Technology Directorate; T. Shoeib, American University of Cairo / W. Stubbings, Indiana University - Bloomington / School of Public and Environmental Affairs; C. Turgut, Adnan Menderes University / Environmental Toxicology and Biotechnology; M. Venier, Indiana University / SPEA; G.M. Webster, Simon Fraser University / Faculty of Health Sciences; C. Yang, M.L. Diamond, University of Toronto / Department of Earth Sciences.

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 retardants. 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 investigated include fire retardants (triarylphosphates (ITP) and tert-butylated triarylphosphates (TBPB) and a di-tert-butylated triarylphosphate and di-t-butyl triarylphosphate). 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 TBPB is in Firemaster 600. Preliminary results indicate ITPs and TBPB levels are found in the ng/g range in these dust samples. Power law is used to describe the typically analyzed OPEs compounds such as tris(2-butoxyethyl)phosphate (TBEP), tris(2-chloroethyl)phosphate (TCEP) and tris(chloromethyl)phosphate (TCPMP). Even though these are new to us and only recently included on some national regulation lists, these compounds are found in NIST SRM 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 ITP 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. 

TU371 Oxford potential of ambient water between several factors, some increasing the response and some suppressing it.

Assay showed a different sensitivity towards the oxidant species: the DTT method showed that TCS amount in the microcosm was 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 Leucomyelene blue: a selective photometric reagent for chloride 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-p-phenylenediamine (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, several UV-Visible spectrophotometric methods have been evaluated by our group (1). Here, the results using leucomyelene blue are presented. This chromophore agent is obtained by reduction of leucocyanine 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 choro phenol methyl red-. The only drawback of the procedure is the interference by high concentrations of sulphate. Ongoing work is taking place to avoid this by previous precipitation of the interferent or liquid extraction of the dye. The photometric method has 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 benthic microcosms

T. Fang, Wageningen UR; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra; G. Ying, Guangzhou institute of Geochemistry Chinese Academy of Sciences; H. Selck, Roskilde University / Dept Science and Environment; D.T. Salvito, Research Institute for Fragrance Materials (RIFM) / Dept of Environmental Science; N. Diepens, Wageningen University

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 dosing period in a freshwater microcosm. The DDT assay revealed a greater affinity with particles in the fine mode, while AA responded mainly to particles in the course fraction. DCFF 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 Acetic Acid (AA) and Dithiothreitol (DTT) Assays. Atmos. Chem. Phys. 16, 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.
Challenges in setting, meeting and measuring specific protection goals for plant protection products (P)

TU375 French Phytopharmacovigilance: a national scheme for monitoring the adverse effects of plant protection products
F. Botta, ANSES / DER; F. Eymery, T. Quintaine, M. Hulin, J. Rety, O. Yamada, M. Merlo, ANSES

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 criteria, 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 allow 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.
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, guiding the evaluation of means of operational processes of integration, valuation and monitoring, and selection of the focal taxa, communities, processes and landscapes to develop environmental scenarios to allow the assessment of recovery of organisms and ecological processes at relevant spatial and temporal scales. Due to the complexity of ecological systems and the need to evaluate effects and implications of environmental changes across a range of spatial and temporal dimensions, a systems approach is required. The systems approach allows the integration of the various species, environmental factors, scales, and stressor-related responses necessary to address the context dependency in ecological recovery. The presentation will highlight the most important conclusions, challenges and recommendations to appropriately address ecological recovery in ERA for potential stressors that fall under the remit of EFSA EFSA 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 Rio 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 Rio 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 of scaling the broad-scale natural habitat restoration project. HEA was refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services that should drive the resilience restoration goals for each reach of the Rio Doce River. HEA is a well-accepted spatially and temporally explicit method for incorporating multiple complex and difficult to measure environmental variables into a few metrics to determine overall losses and gains in ecosystem services resulting from impacts or restoration actions. The HEA method is adaptable to any ecosystem and its flexibility allows for variability in the valuation of ecosystem services between communities and cultures. This paper focuses on the development and application of HEA within the context of the Resilience Model, and how selection of VECs as indicators to guide the approach is spatial and temporal scale, and how loss of restoration is aimed at developing an overall ecosystem restoration program that is at once cost-effective and results in a more resilient Rio Doce Basin.

TU381
Using recovery information in environmental risk-benefit analysis for determining appropriate risk management actions at major industrial facilities
A.E. Bartram, Ramboll Environ / Product Safety, Ecology and Sediment Management; S. Deacon, Ramboll Environ / Health Limited

Operators of chemical manufacturing plants and fuel storage depots are required to undertake site safety assessments, with specific emphasis on the control of major emergency risk scenarios. During the preparation of SEVESO II site risk assessments, the VECs are in close proximity to water bodies, the coast, and or protected conservation areas. Site safety reporting requires an initial risk assessment be undertaken. The assessment draws upon both the potential severity of harm and environmental recovery in order to determine the risk tolerability under accidental release scenarios. Industry guidance exists on the evaluation of harm, but corresponding consideration of key factors affecting recovery and the fate and effects of SEVESO III chemicals, such as PBT substances with the potential for longer-term impacts/delayed recovery. If 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 recovery in terms of potential ‘damage avoided’ by putting risks into a socio-economic context. Case study examples will be provided where 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 cost. This would provide a rationale for sites to incorporate 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 (2017). Guide to predicting environmental recovery durations from major accidents. Supporting guidance to the Environmental risk tolerability for COMAH establishments guideline
This study measures the indoor particulate matter (PM) concentration and the equilibrium equivalent radon (EER\textsubscript{\alpha}) concentration in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM\textsubscript{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\textsubscript{2.5} concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 µg m\textsuperscript{-3} and 23.4 to 159 µg m\textsuperscript{-3}, respectively. In Buildings 1 and 2, the threshold limit of total PM\textsubscript{2.5} sampled concentration was 3.31 ± 1.74 Bq m\textsuperscript{-3}. The average annual inhalation doses recorded at Buildings 1 and 2 were 0.014 ± 0.005 mSv y\textsuperscript{-1} and 0.020 ± 0.013 mSv y\textsuperscript{-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.

TU385
Assessment and Management of Radiation Risks following a Nuclear Accident: The Shamsien Project Recommendations
D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CeE); E. Cardis, ISIGlobal, T. Schneider, CEPN; Y. Tonkiv, Norwegian University of Life Sciences / Centre for Environmental Radioactivity CERAD CeE
The Fukushima Daiichi accident in 2011 represents a poignant reminder of the need for evaluation that goes beyond a simple assessment of the methodology and addresses the wider context that the stakeholder involvement activity is held in. This paper uses two stakeholder engagement events: one from the field of emergency preparedness and one from nanoremediation, to explore the applicability of existing evaluation criteria for a quality assessment of stakeholder or broader public involvement.

TU386
SETAC Ecosystem Services Interest Group
S.E. Apitz, SEA Environmental Decisions Ltd
"Air Pollution, Biomonitoring and Human Health (P)"

TU387
Assessment of Indoor Radon Concentration and Trace Metals Composition in University Building Microenvironments
M. Mohamed Ali, Universiti Kebangsaan Malaysia; M. Mohd Hanafiah, Universiti Kebangsaan Malaysia / Environmental Science; M. Khan, Universiti Kebangsaan Malaysia / Centre for Tropical Climate Change System
This study measures the indoor particulate matter (PM\textsubscript{2.5}) composition and the
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 $\mu$m; also referred as “fine PM”) is considered as the most injurious one. Since this pollutant is potentially very harmful, toxicology 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 chose to present a study. In it, we collected two fractions of fine PM (PM$_{10}$;1.0 and PM$_{2.5}$;0.0 μm) inside classrooms of 12 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 between the two PM sizes or three sampling sites. However, differences emerged when 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 school managers and parents.

TU390
Acute Impacts of Extreme Hot Temperature Exposure on Emergency Room Visits
Y. Lan, C. Chang, C. Chung, China Medical University
Abstract The purpose of this study was to assess the effects of extremely high air temperatures on the 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 extremely high temperatures (99th percentile) and the 50th percentile of 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 23.6°C on ER visits. The association was strongest within 0-7 days after exposure to hot 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 temperatures pose 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
J. Li, Jinan University J. Zhou, C. Wu, L. Yao, L. Shi, E.Y. Zeng, Jinan University / School of Environment
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 studied PBDEs in the onset (2.1-10$^3$ μg/kg) and at the peak (8.1-10$^3$ μg/kg) exposure were consistent with previous studies. The major emissions were di- and tri-BDEs, with the thermal treatment of printed circuit boards producing 8.1-10$^3$ μg/kg of total PBDEs in the exhaust. In contrast, the open burning of plastic casings produced 2.1-10$^3$ μg/kg of total PBDEs in the emissions. These differences were mainly attributed to the difference in the size distribution of particulate PBDEs in emission sources and adjacent air impacted a noteworthy redispersion process during atmospheric dispersal.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter
F. Kierszenbaum, 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 / Departament d Enginyeria Química
Abstract The purpose of this study was to assess the effects of extremely high air temperatures on the 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 extremely high temperatures (99th percentile) and the 50th percentile of 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 23.6°C on ER visits. The association was strongest within 0-7 days after exposure to hot 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 temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU393
Good news to lazybones kids: increasing sleeping time decreases exposure to airborne particulate matter
F. Sánchez Soberón, Universitat Rovira i Virgili / Chemical Engineering; F. Noardo, Universitat Rovira i Virgili / Department of Chemical Engineering; M. Marín, Universitat Rovira i Virgili / Department of Chemical Engineering; L. Sanchez, Universitat Rovira i Virgili / Department of Chemical Engineering; F. Sánchez Soberón, Universitat Rovira i Virgili / Chemical Engineering; F. Schuhmacher, Universitat Rovira i Virgili University / Departament d Enginyeria Química
Abstract The purpose of this study was to assess the effects of extremely high air temperatures on the 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 extremely high temperatures (99th percentile) and the 50th percentile of 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 23.6°C on ER visits. The association was strongest within 0-7 days after exposure to hot 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 temperatures pose a risk to the health and wellbeing for individuals with alcohol addiction and other mental illnesses.

TU394
Ocupational Dust Exposure: effect on blood level of some antioxidants enzymes and vitamins in overwi, Nigeria.
C. Ikaraoha, J.A. Egeonu, Imo State University Owerri, Imo State, Nigeria / Chemical Pathology Unit Dept of Medical Laboratory Science; C. Unahide, Imo State University Owerri, Imo State, Nigeria / Medical Laboratory Science; N.C. Mbadawe, University of Nigeria Teaching Hospital, Enugu, Nigeria / Medicine; J. Dike-Ndum, Imo State University Owerri / Department of Medical Laboratory Science
ABSTRACT Despite that Cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among many workers. The objectives of the present study were to determine the blood levels of some antioxidant enzymes and vitamins have not been adequately addressed essentially in black-African environment and particularly Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and 35 controls were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELISA while vitamin C, vitamin E and vitamin C were determined by Spectrophotometric techniques. There were progressive significant increases in blood level of vitamin C, vitamin E, catalase and glutathione peroxidase from Cement Workers to Dealers and Controls (non-cement workers), (P=0.0010, P=0.0011, P=0.0001, P=0.0011, respectively)}
P=0.0011, 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, 0.0004, 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=0.0174), SOD (P=0.0226), and Vitamin E (P=0.018) respectively, but there was no significant difference in vitamin A (P=0.1676) and glutathione peroxidase (P=0.6987) when compared with Cement Dealers.

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 notable that via the human lung model, the bioaccessibility 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. Kuucka, P. Pribylova, P. Prokes, Masaryk University / RECETOX; G. Lammel, Max Plank Institute for Chemistry / Multiphase Chemistry Department Air pollution remains one of the major public health issues in many regions worldwide. It can directly affect human health and can contribute to higher incidence of pulmonary and cardiovascular diseases or cancer. Moreover, it has been shown that compounds occurring in the ambient air pose a hazard to disrupt our endocrine, immune or reproductive system. Since the air pollutants occur in complex mixtures, it is more appropriate to use an effect-based monitoring including a battery of in vitro bioassays which cover various interactions among mixture constituents.

Bioassays represent an efficient approach for toxicological profiling and identification of pollutant modes of action. Together with chemical analyses, they enable to identify mainly toxicity drivers. Two sites were selected, a heavily polluted urban site (industries, transportation, coal-based domestic heating) and a regional background. Samples were collected in summer and winter. To assess the more specific contribution of the biodeposits and the particulate phase, coarse particle phase, and six PM2.5 size-fractioned samples were sampled. Moreover, samples were also fractionated according to polarity. Human-based in vitro bioassays were employed to study endocrine-disruptive potentials, AhR-mediated induction of detoxification mechanisms, and cyto-/genotoxicity to the human respiratory tract. The results show that the studied effects were associated mainly with particulate phase. The most significant effects were attributed to the easily inhalable fine and ultrafine particles. This distribution pattern was found for example for AhR-mediated toxicity, estrogenicity, and androgenicity. The studied toxic potentials were elicited mainly by chemicals in the polar fraction containing relatively high levels of oxygenated-polycyclic aromatic hydrocarbons (oxy-PAHs). This study confirms that several molecular mechanisms of toxicity vary in many regions worldwide.

The results will be discussed together with the results of the chemical analysis which focused on PAHs and their derivatives, nitro- and oxy-PAHs. This research was supported by project GACR P503 16-11537S.

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 Health Research Center; H. Lin, National Taiwan University / Bioenvironmental Health Research Center; K. Liao, National Taiwan University / Bioenvironmental Health Research Center; H. Lin, National Taiwan University / Bioenvironmental Health Research Center; K. Liao, National Taiwan University / Bioenvironmental Health Research Center; H. Lin, National Taiwan University / Bioenvironmental Health Research Center.

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 by 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 (PM2.5) 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, NO2 and NOx) 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.
Towards green braking: comparative evaluation of toxicological profile of particles generated by traditional and innovative braking systems. S. Maioranova, D. Baderma, Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; S. Gemma, L. Brunelli, F. Teoldi, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; D. Dusin, Cidetec / Nanomedicine; M. Lodi, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences; A. Bonfanti, Brembo S.p.A.; E. Benfenati, IRCCS Istituto di Ricerche Farmacologiche Mario Negri / Department of Environmental Health Sciences

The protection and improvement of air quality are key critical points of environmental policy at local, regional, and international level. 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 cardiovascular diseases 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 terrestial 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/IT/000492) project aims to create a safer alternative to the pads currently used on the market, replacing the frictional bond 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 the in vitro assessment of their toxicological potential with non-tumor bronchial 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. Kram, D. Pou, N. Leht, University of Oulu, Environmental and Atmospheric Sciences; 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. We hypothesize that secondary organic aerosol (SOA) oxidation products, the majority of which are secondary organic aerosol (SOA) particles. 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-ring phenyl, were observed in varying ratios. Developmental toxicity testing with zebrafish (Danio rerio) will be conducted using embryos (n=32/treatment) that will be dechorionated 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 photomotor 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 dithiothreitol (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 I. 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 extraction (ASE MEGA) method. The study of concentrations 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 occurrence 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. Settimo, 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 concentrations of airborne particulate matters (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 downwind 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 statistical 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 fractions 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 selecting 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 cites 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 effect on the air pollution visibility. The developed models can quantitatively 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 F. Nagashima, Kyushu University; K. Nansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University

SETAC Europe 28th Annual Meeting Abstract Book
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 (PM₂.₅) have caused some serious environmental and public health problems. To determine emission scenarios and to better understand the main health impacts associated with the PM₂.₅ 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” PM₂.₅, most of these results doesn’t include the effects of “secondary” PM₂.₅. This study developed the secondary PM₂.₅ concentrations emitted on every industry and shipping sources using Emission Databases for Global Atmospheric Research (EDGAR) emission inventory data, Weather Research and Forecasting (WRF) model and CMAQ modeling system, and then estimated the induced mortality data in Asia. We further applied structural path analysis (SPA) to the Asian Input-Output Table (AIOT) to identify the critical supply chains for the reduction of health impacts in Asia. The result shows that the Japan’s consumption contributed to secondary PM₂.₅ emissions in Asia are estimated 38.4 Co2-ct and we revealed top ranking supply chain paths for PM₂.₅ 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.

TU407 Non-targeted screening of DNA adducts as biomarkers for human exposure to PAHs in the environment with liquid chromatography tandem mass spectrometry
Y. Feng, C. Yao, Health Canada; W. Foster, McMaster University
Humans are constantly exposed to thousands of contaminants in the environment. Polycyclic aromatic hydrocarbons (PAHs) are a group of organic compounds containing two or more aromatic rings. They are released into the environment from both natural and anthropogenic sources such as combustion of organic substances and incomplete burning of coal, oil, gasoline, tobacco products and wood. PAHs are known to be bio-transformed by phase I metabolic enzymes to chemically reactive intermediates that may bind covalently to DNA to form DNA adducts that interfere with DNA synthesis and transcription, leading to DNA mutations and/or toxicity. Furthermore, binding of electrophilic PAH metabolites to DNA is thought to be a key step in the initiation of cancer. Therefore, measurement of these DNA adducts could be an indicator or biomarker of human exposure to PAHs in the environment and of the dose of the ultimate reactive metabolite. Rapid non-targeted approaches are desired to explore a broader scope of new biomarkers associated with the consumption of the environment. In this non-targeted approach, a targeted screening approach of the full scan data to identify DNA adducts is time consuming. In this presentation, we will report a non-targeted screening method for identification of covalent DNA adducts using a combination of neutral loss scan and product ion scan in a Q-Tof system. The method was applied to non-targeted screening of DNA adducts in follicular cells from isolated ovarian follicles that were exposed to cigarette smoke condensate (CSC). Four DNA adducts, benzo[α]pyrene-7,8-dihydriodiol-9,10-epoxide-(BPDE-dG), phenanthrene 1,2-quinoine-dG (PheQ-dG), B[α]P-7,8-quinoine-dG (BPQ-dG) and 4-aminobiphenyl-dG, were identified in the follicular cells. The results also revealed that two oxidative biomarkers, 8-hydroxy-2-deoxyguanosine (8-OH-dG) and 8-isoprostane (8-isoP), had strong correlations with the three DNA adducts, BPDE-dG, BPQ-dG, and PheQ-dG, suggesting a strong link between the formation of covalent DNA adducts and DNA damaging oxidative stress. The method has also been successfully applied to investigate the selectivity of chemicals to modify the nitrogenous bases on DNA sequence. The results showed that each chemical had a different selectivity when it modified the DNA bases. The method has been demonstrated to be a potential tool to provide screening of unknown DNA adducts as biomarkers of human exposure to the parent contaminants in the environment.

TU408 Global inter-comparison of polurethane foam passive air samplers evaluating variability due to sampler design and analysis
L. Edqvist, P. Weiatryk, Masaryk University / RECETOX Research Centre for Toxic Compounds in the Environment; P. Bohlin Nizzetto, NILU - Norwegian Institute for Air Research / MILK; T. Harner, Environment Canada / Air Quality Research Division; J. Klanova, Masaryk University / RECETOX Research Centre for Toxic Compounds in the Environment; O. Armand-Munoz, Universidad Nacional Autonoma de Mexico / Centro de Ciencias de la Atmosfera; B. Aristizabal Zuluaga, Universidad Nacional de Colombia Sede Manizales / Hydraulic Engineering and Environmental Research Group; M.Y. Tominaga, CETESB Companhia Ambiental do Estado de Sao Paulo; A.J. Sweetman, Lancaster University / Lancaster Environment Centre; B. Jimenez, IQOG-CSIC / Department of Instrumental Analysis and Environmental Chemistry; A. Dreyer, Eurofins GfA GmbH; M. Odabasi, Dokuz Eylul University; J. He, University of Nottingham Ningbo; W. Ma, Harbin Institute of Technology / China/International Joint Research Center for Persistent Toxic Substances (URC-PTS); J. Ma, Lanzhou University / College of Earth and Environmental Sciences; G. Zhang, Guangzhou Institute of Geochemistry, Chinese Academy of Sciences / State Key Laboratory of Organic
Polyurethane foam passive air sampler (PUF-PAS) are the most commonly used passive air sampler for a range of semivolatile organic compounds (SVOCs) such as regulated persistent organic pollutants and polycyclic aromatic hydrocarbons, and emerging SVOCs (e.g. novel flame retardants, phthalates, current-use pesticides). PUF-PAS are a popular choice for global/regional air monitoring programs as well as in case studies around the world. While the majority of PUF-PAS use simple double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different PUF-PAS designs are used in regional or global programmes such as the Global Monitoring Programme under the Stockholm Convention and these data are compared for spatio-temporal trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of PUF-PAS samplers from around the world and deployed them in a multi-part inter-comparison in order to evaluate the variability in reported concentrations introduced by different elements of PAS monitoring. Three sets of PUF-PAS were deployed in Kjeller, Norway in 2015-2016, as follows: (1) 3-month deployment of 15 PAS provided by international research groups, and returned to their respective research groups for analysis for SVOCs – this provides information on the overall variability in global monitoring data introduced by differences in sample configurations and analytical methods; (2) 3-month deployment of 15 identical PAS, which were then distributed to international laboratories for SVOC analysis, to isolate the influence of analytical variability; and (3) 3-month deployment of 15 different PAS and analysis at a single laboratory (ECOTOX Trace Analytical Laboratories, Masaryk University) to isolate the influence of PAS design on data comparability. Results indicate that while differences in sampler design (in particular the spacing between the upper and lower sampler bowls) account for 50-100% differences in masses collected by samplers, the variability introduced by analytical methods still significantly exceeds this amount, and this effect should be carefully considered when evaluating and comparing global monitoring data.

TU409 Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin - µFT-IR Imagery

N. van Alst, Aalborg University / Civil Engineering Department; A. Vianello, Aalborg University / Civil Engineering Department - Section of Water and Environment; R.L. Jensen, Aalborg University; J. Vollertsen, Aalborg University / Civil Engineering Department

Extensive research has been performed on indoor air quality (IAQ) over the last decades. This includes the investigation of deposition mechanisms of particles in indoor air, and on surfaces, as well as determining particle types and sizes. However, microplastic research in indoor air has been lagging behind. With the strides in microplastic research in the last years renewed interest has now arisen on microplastics as a form of indoor air pollution. This research focusses on microplastics in indoor air, with emphasis on the potential exposure to humans as a result of inhalation. This is simulated using a mannequin in a breathing chamber. The mannequin takes in air through the mouth, which is led through a copper pipe to the filtering unit. The copper pipe meets a filter holder on which a 0.8 µm custom-cut 20 mm SteriTech silver membrane filter appropriate for µFT-IR imaging analysis is mounted. This is connected to a dual piston pump which simulates natural breathing. Samples have been taken in actively lived in apartments, as well as varied locations within the universities' work environment. Samples have been divided up into continuous sampling and intermittent sampling under active living/working conditions. All samples have received active sampling for approximately 24h, either using continuous or intermittent collection. In each environment a catalogue and accompanying material for spectral identification is kept of the interior. The aim of the research is to ascertain the contribution of materials from the indoor environment as a function of activity, and determine possible exposures as well as contamination levels coming from indoor air. For identification and quantification of microplastics contained in the samples, an Agilent Technologies micro-Fourier Transform Infrared (µFT-IR) imaging system equipped with a 128x128 Mercury Cadmium Telluride (MCT) Focal Plane Array (FPA) detector. Microplastic samples are rinsed in ethanol and 1 µl of sample is deposited on the silver filter at 3.3 or 5.5 µm pixel resolution, providing microplastic detection down to 6-10 µm in particle size. After collection, data is exported to in-house developed software for obtaining polymeric composition and quantifying size and mass of all µFT-IR imaged microplastics. Analysis of samples is ongoing and scheduled to be completed by March 2018.

TU410 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. Emerging PAHs (EPA PAHs) are mainly found in indoor air, as a result of their usage in paints, adhesives, and floor coverings. Exposure to PAHs is mainly via inhalation, i.e. espiratory dust, and dermally via contact with polluted dust. We compared concentration gradients of the 16 EPA PAHs at this interface as well as the respective flux direction. Atmospheric monitoring has 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 derive 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 homogenous profiles, considering Phae as representative PAH concentrations in the soil atmosphere during winter and summer, respectively. 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 NPAP, OPAH, and OHPAH products in both gas- and particle-phases. We found that the Clar’s resonance structures were able to best predict the keto aldehyde rings or the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches showed 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 unobserved PAH-TPs that are likely to form in the atmosphere. Furthermore, the results of the chemical environmentalists 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, qual-quantitative information is limited about PAHs in air, and normally rely on the availability of active sampling techniques, usually expensive and laborious, needing power source, inconsistent in mute areas. Conversely, passive sampling allows cheap and easy handling atmospheric appraisal even in remote regions. Thus, the present study evaluated PAHs levels throughout the South American atmosphere 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 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 results show that the concentrations of PAHs were higher in urban and suburban areas compared to remote regions. This is a long term study looking forward to appraise temporal trends to PAHs along South America atmosphere.

TU414 Importance of Dermal Exposure to Polycyclic Aromatic Hydrocarbons Derived from Barbecue Fume
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Despite the ubiquity and carcinogenicity of polycyclic aromatic hydrocarbons (PAHs), its dermal absorption for the general population has not been adequately studied. To related this to environmentally relevant disease, we recruited healthy Chinese women. The women 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 Lichens biomonitoring. Results. La Spezia Province Hospital Discharge rates for potentially environment-related disease were significantly different if 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 – like myocardial infarction and hypertensive cardiopathy - showed a different behavior. Comparing results with Lichen maps helps putting excesses of morbidity into a Regional context, being cautious to clearly correlate such disease with industrial and Harbour activity. Indeed, most of the disorders showed the higher increases in areas with less signs of anthropic activity, according to Lichens biomonitoring.

TU418 Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut pudding (Okpa) Samples prepared using Alternative Cooking Materials T. Oitoju, University of Nigeria Nsukka / human nutrition and dietetics; O. Oitoju, federal University Wukari / Department of Biochemistry; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; S. Baiyeri, Federal University OyeEkiti / Agronomy

Polyethylene residues are chemical components that are left over as monomers and end products after the thermal degradation of polyethylene. However, the use of plastic as cooking materials in bambara nuts pudding (Okpa) a well-cherished food, especially among the inhabitants of the Eastern part of Nigeria may pose more danger than envisaged. The use of banana leaves in cooking food has been in existence in Nigeria before the introduction of the technological cooking materials such as polyethylene, cellophane plastic, tin and foil. In this study, we evaluated the risk assessment of polyethylene residues (volatile organic compounds - VOCs) and organoleptic attributes of Bambara nut pudding (Okpa) samples prepared using alternative cooking materials. Purge and trap method using Gas Chromatography and Mass Spectrometry instrument were used to estimate the concentrations of VOCs in the different pudding cooked using some alternative cooking material (cellophane, tin, foil and plastic) while banana leaves were used as control.

Organoleptic evaluation was done using A-Point Hedonic Scale, standard methods and ANOVA was used to compare means of the results. The result showed the presence of some Volatile Organic Compounds such as Argon, Allene, Acetic acid, Propane-1,1-d, difluoromethane, Hexanoic acid, Acyl nitride, Toluen, Buteniniterile,2 Butenal, Thanirane, Nonanoic acid, Ethylenediamine, Furural, Hydrogen azide, 2-pentene, Formic acid, and octanoic acid; with Acetic acid occurring the most and Argon, Allene, and Difluoromethane occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohetholose, 45% hexanoic acid, 25% propane-1- ethynylthio and had other VOCs ranging from 4-9%. All the cooking materials had hexanoic acid at high concentrations of 25-42%. The result also showed that acetic acid and 2-butenenitrile ranged from 4-7% in all samples except banana leaves pudding. Organoleptic evaluation of the Bambara pudding samples with different alternative cooking materials were generally acceptable (p<0.05) but pudding wrapped with banana leaf was significantly (p<0.05) rated low for colour and taste while others were comparable (p>0.05). In conclusion, bambara nut pudding cooked with alternative cooking materials contained polyethylene residues.

TU419 SETAC Human Health Risk Assessment Interest Group B. Mulhearn, Ensafe Inc.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (P)

TU420 Ecological risk assessment of conazole fungicides in arable soils of the Czech Republic J. Vasickova, M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); P. Kousbova, Central Institute for Supervising and Testing in Agriculture; K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln); Z. Stmek, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

Application of pesticides, including conazole fungicides (CFs), is an indispensable part of modern agricultural management, contributing to food security and safety. Conozoles are a class of azole-based fungicides, commonly used to prevent fungal growth on turf grass and agricultural crops. CFs are still widely used despite the reported ecotoxicity in water, chronic toxicity to mammals with hepatotoxicity, carcinogenicity, reproductive toxicity and endocrine disruption. For example, in the EU classification, epoxiconazole and fluzalizole are suspected carcinogens [1]. Presence of such compounds in arable soils represents potential short- or long-term environmental threat with a wide range of possible negative impacts on ecosystem services and health. Hence, risk assessment considering vascular and non-vascular 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 41% of samples, respectively). Concentrations of CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by fluzalizole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CF 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/eu-pesticidestabledata. [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 from 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. Brels, Masaryk University / Faculty of Science RECETOX

In this study, the dissipation and partitioning dynamics and the extent of biotropakate was measured and modeled for selected hazardous current-used fungicides (prochloraz, tebuconazole, fluzalizole, epoxiconazole, insecticide (chlorpyrifos), herbicide (pendimethalin) and for a transformation product (2-hydroxyazatrine) 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 some hydrophobic compounds were normalized sorption coefficients (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-Hydroxyazatrine 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 (r² = 0.94) predict root uptake. Concentrations of the non-target compounds did not exceed the maximum residue limits (MRLs) for lettuce. Koc values were in the range of literature values and were shown to increase (from 0 day 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. This is shown to be not persistent (except for 2-hydroxyazatrine), 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 UMRS 5805; M. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; K. Le Menach, P. Pardon, UMR CNRS EPOC Université Bordeaux / EPOC UMR 5805; G. Duporthe, Université de Bordeaux / EPOC UMRS 5805; F. Macary, Iriesta 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 (OCIS) and six sites with intermittent-flowing (POCS) were monitored during a year using polar organic compounds integrative 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 POCS enable the improvement of limits of quantification (LOQ) and estimation of time-weighted average concentrations over the exposure period for hydrophilic compounds. In parallel, 50 pesticides were targeted including 23 fungicides currently used 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 demetomorph. Fungicides such as cyprodinil, kresoxim-methyl and ipvalicarb
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 analysed in Korea.
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Thus it is concluded that CMIT/MIT exposure would cause the death without lung survival and death, and 2) functional respiratory tract failure except lung fibrosis. Many observations are considered to be functional respiratory tract, as observed in necropsies of the mice that died due to CMIT/MIT exposure. 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, the deaths of Korean victims who were exposed to the disinfectant were studied in several apple growing, situated in south-west of France. Dislodgable foliar residues (DFR) and pesticide residues on equipment or apples (wipe sampling) were determined using passive samplers (Polyurethane Foams, PUF) and low-volume samplers. In this study, the cells were cultured in two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry. Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU424 Intra-tracheal administration of the disinfectant, chloromethylsulfoxoazolione/methylsulfoxoazolione (CMIT/MIT), in a mouse model to evaluate a causal association with death.
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The use of plant protection products in agriculture can affect non-target soil organisms and have a negative effect on the health of the ecosystem. In particular, information on toxicological effects of fungicides are very poor or absent, despite their widespread use. The aim of this study was to evaluate the potential toxic effects of four commercial fungicides (Prosaro® and Amistar®; Mirador® and Icarus®) on the earthworm Eisenia fetida (Savigny, 1826) species. The use of fungicides represents one of the most important factors in the control of pests and diseases, which affects the production systems of fruits and vegetables. We assessed the toxicity of fungicides to earthworms. The activity of SOD decreased significantly 40% (p < 0.05) to 25 μg/ml of Iprodione, while no effect on the activity levels of CAT and GST was observed. The content of protein carbonyls increased 30% (p < 0.001) at the highest concentration of Iprodione tested. In addition, it was observed that Iprodione induces triopar and micrornucleus divisions at 17.5 and 25 μg/ml of fungicides and bridges with all concentrations tested. Both the index of division and the index of replication indicate that the cells maintain their proliferation capacity, which allows to study the biomarkers of genotoxicity in this system. These results confirm that Iprodione induces genotoxicity and an alteration in the redox equilibrium at the concentrations tested, which indicates the potential risk of exposure to this xenobiotic.

TU425 Genotoxic response and alteration of intracellular redox balance in Hep-2 cell line by exposure to Iprodione.
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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, the deaths of Korean victims who were exposed to the disinfectant were studied in several apple growing, situated in south-west of France. Dislodgable foliar residues (DFR) and pesticide residues on equipment or apples (wipe sampling) were studied during the different activities of apple growing (treatments, re-entry tasks, harvests). Atmospheric levels of pesticides (outdoor and indoor) were also determined using passive samplers (Polyurethane Foams, PUF) and low-volume samplers. In this study, the cells were cultured in two fungicides (captan and dithianon), extensively used in apple growing, and their metabolites. High sensitive analytical methods were developed and validated, in this work, for the different collected samples based on gas or liquid chromatography coupled to hybrid high resolution mass spectrometry and to tandem mass spectrometry. Levels of pesticide residues and source characterisation will be presented. These findings provide a better understanding of current practices and may help for reducing pesticide occupational exposure and health risks for fruit-growing workers.

TU426 Toxicological effects of commercial fungicides on the earthworm Eisenia fetida (Savigny, 1826) laboratory and field investigations.
T. Campani, I. Calamini, C. Pozzulli, L. Poggiioni, University of Siena / Department of Physical, Earth and Environmental Sciences; G. Casini, University of Siena / Science Dept.

The use of plant protection products in agriculture can affect non-target soil organisms and have a negative effect on the health of the ecosystem. In particular, information on toxicological effects of fungicides are very poor or absent, despite their widespread use. The aim of this study was to evaluate the potential toxic effects of commercial fungicides (Prosaro® and Amistar®, Mirador® and Icarus®) on the earthworm Eisenia fetida (Savigny, 1826) species. We choose commercial products with the aim of testing the simultaneous effect of active principles and additives present in the products. Laboratory experiments were conducted using the filter paper test (FPT): E. fetida was exposed to increasing concentration of Prosaro® or Amistar®, being the highest dose of treatment the recommended one for the usage in wheat farming. Field investigations were conducted transplanting E. fetida in cages in the soil of wheat and durum wheat fields before and during treatment with different combinations of the 4 fungicides. E. fetida specimens from laboratory and field work were analysed to evaluate vitality, potential neurotoxic effects (inhibition of acetylcholinesterase activity (AChE)), phase II enzymatic defense (glutathione S-transferase (GST)), oxidative stress (lipid peroxidation (LPO) and catalase (CAT) activity), genotoxic effects (Comet assay) and effect on the immune system (lysozyme activity). Laboratory studies with Prosaro® and Amistar® showed alterations in organism’s vitality which increased with increasing treatment doses. Significant alteration of phase II metabolising enzymes (GST induction) and significant DNA fragmentation (Comet Assay) with respect to controls were detected at environmentally relevant doses of Prosaro®. Data from the field study supported the hypothesis that a statistically significant induction of GST in earthworms transplanted in the fields treated with Amistar® alone and Amistar®+Prosaro®. This study represents a first step towards a better understanding of commercial fungicides toxicological potential to non-target organisms. Data obtained indicate that deeper investigations are needed which should include long term artificial soil tests (AST) and further field studies.

TU427 Potential Salinity Enhanced Impacts of the Photoxotoxicity of the Fungicides to Inland Silversides, Menidia beryllina.

SETAC Europe 28th Annual Meeting Abstract Book
From mother to offspring: multigenerational 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 aquatic ecosystems. For instance, 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 four generations. The effects of carbendazim on survivorship, growth, 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.

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

WE001
Development of a modelling framework for estimating the sorption of pharmaceuticals in soils

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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 this 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 multitude 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 ($r^2 < 0.5$). Sorption coefficients for organic cations were typically within an order of magnitude of experimental values whereas prediction was considerably lower for the sorption of organic anion 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/EEPFA Innovative Medicines Initiative Joint Undertaking (iPIE grant n° 115735) for the financial support.
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 wastewater treatment plants to install and implement environmental sanitation equipment and treatment facilities. 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 impacts 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 years in 2015-2016. The maximum detected concentrations of the active ingredients exceeded 100ng/L are shown below: olmesartan (571ng/L), valsartan (405ng/L), irbesartan (162ng/L), candesartan (113ng/L), losartan (117ng/L) for antihypertensive agent, and sulfidine (546ng/L) for antipsychotic agent, citalopram (445ng/L) for antidepressant agent, Clozapine (150ng/L) for anxiolytic agent, sodium valproate (100ng/L) for antiepileptic agent, and ticlopidine (5ng/L) for anticoagulant agent. The concentrations in the spring or spring were observed a higher tendency, but the detected concentrations of active ingredients greatly varied depend on river according to the type of landscape 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 sucrose 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, lorazepam, rosuvastatin and epinastine, among which the dilution ratio was double. This result suggests that in some circumstances it is necessary to consider lower dilution ratio when evaluating the environmental risk. The government should support small wastewater treatment plants to install and implement environmental sanitation equipment and treatment facilities, 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 lorazepam to 0.000001% of clofibrate acid.

**WE005**

Evaluation 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-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 can offer a cheaper treatment water as it depends on the concentrations of sucrose measured at the same time. The pharmaceuticals whose maximum detected concentrations of active ingredients in each river water exceeded the PECs for five ingredients of candesartan, olmesartan, lorazepam, rosuvastatin and epinastine, among which the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider lower dilution ratio when evaluating the environmental risk. The government should support small wastewater treatment plants to install and implement environmental sanitation equipment and treatment facilities, 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 lorazepam to 0.000001% of clofibrate acid.

**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/4447/00, 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 into 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 as a set in the environment. 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 which 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 waiting OECD 308, the results should be better included in the ERA and communicated.

**WE007**

Expert System to Inform BCF Testing Strategies for Pharmaceuticals

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An important part of the environmental risk assessment (ERA) of pharmaceutical ingredients is the identification of the persistent, toxic and bioaccumulative properties (PBT assessment) of the molecule. Regulations and guidelines on how to conduct this assessment and what empirical data are required to do so are increasingly complex. Currently a large number of fish are used as part of the ERA process, particularly for experiments to determine the bioconcentration factor (BCF), even though research developments and guidelines already contain opportunities to significantly reduce the number of fish used via alternative methods and/or optimisation of the testing strategy. We developed a new software simulation test and its outcome in the environment. Fur more sensitive applications, such as risk assessment, as a first step an overview is prepared on the overall persistence of pharmaceuticals as a set in the environment. 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 which 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 waiting 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 Society
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 toxicology is such that many uncertainties still exist about the significance of those findings for environmental risk assessment. We hypothesise that the perturbation of cytochrome oxidase (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 (AOP) for diclofenac in fish. This model accounts for the environmental and pharmacodynamic aspects of NSAIDs toxicology. 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 as additive or non-additive dose effects equivalent to that of diclofenac used for measured and predicted river concentrations of NSAIDs, which were 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 to estimate the toxic 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 ecopharmacovigilance 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
Larval generations families are a helpful tool in the assessment of chemicals. Especially pharmaceuticals play an important role when it comes to long-term exposure. They enter the environment throughout the year and therefore pose a continuous risk to organisms. One of these ubiquitously detected pharmaceuticals is the anti-epileptic drug carbamazepine (CBZ). Hardly degraded during conventional wastewater treatment, it contaminates a majority of wastewater discharges. Sensitivity experiments in aquatic organisms to detect pharmaceuticals 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 95% confidence intervals (CI). Two months after the beginning of the experiment, mortality seemed to be lower in the exposed group compared to the control. However, CI of the LC50 still overlapped (0.506 ± 0.882 mg/L for the control and 0.729 ± 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 ± 1.02 mg/L for the control and 1.08 ± 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 control 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 carbamazepine after long-term low-level exposure. Chronic toxicity tests to study the authors 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 code: 02WRM1367A).

Effects of duloxetine and econazole on freshwater species towards individual and combined conditions
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 Thousands of biologically active pharmaceutical ingredients (APIs) are used in human and veterinary medicine over the world. 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 100 mg L−1. Level of type of drugs interactions were determined using the Combination Index-isobologram method. The enantiomers concentration of the target compounds in the culture media were measured. Correlation was observed 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 shown Duloxetine as very toxic for algae and toxic for crustacean and plants. Econazole appears as very toxic for all species evaluated. Mixed toxic profiles of APIs, for toxicity of antidepressants (TCA) are now on the 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 antidepressants are toxic to aquatic species, we used the microassay to detect the inhibitory activity of antidepressants in SEs. Combination Index obtained shown Duloxetine and Econazole as very toxic for algae and toxic for crustacean and plants. We propose that this microassay can be used as a screening tool to detect antidepressants in WWTPs effluents for the first time by the in vitro assay (namely called antidepressant assay). We utilized fluorescence substrate, APP, for monooamine 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 TCA. Inhibition of antidepressants in SEs might be useful to assess the occurrence of antidepressants in the environment. We can not determine whether antidepressants in environmental water is really risky to aquatic organisms. 

WE012
Toxicity of pharmaceuticals to aquatic organisms: a meta-analysis of effects on development and reproduction
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Acknowledgement - The authors thank the Federal Ministry of Education and Research (BMBF) for funding (NiddaMan, project support code: 02WRM1367A).
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 pharmaceuticals and their metabolites to non-target organisms in the environment. 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 objectives:

1. 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 scores 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

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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 infeasible 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, fluoroxetine 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 bezafibrate on exposure at different levels of the biological hierarchy on Daphnia magna

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A number of monitoring studies have shown that bezafibrate (BE), a metabolite of clofibrate, 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 the cladoceran 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 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/biomicromolecular (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 guanylurea on brown trout (Salmo trutta f. fario)

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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 guanylurea (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 µg/L) 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 (Hsp70), changes in the intestinal microbiome and additionally the glyoxen 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 EffNet (Effect Network in Water Research) funded by the „Wassernetzwerk Baden-Württemberg. By a multi-level approach focusing on the effects at the community level.

WE016 Effect of life-cycle exposure to environmentally relevant concentrations of metformin and its metabolite guanylurea on F1 progeny 28 days post hatch.

Z.P. Pandelides, University of Ontario Institute of Technology; E. Ussery, 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 Research Studies have demonstrated that the type 2 diabetic drug metformin and its only known metabolite, guanylurea, are common environmental contaminants found in the ng-/µg/L concentration range in surface waters and wastewater effluent. This should be of concern as recent work in our lab shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin and guanylurea from embryo through 28 days post-hatch have a significant decrease in length and weight of both males and females when compared to control fish. Furthermore, our studies show that larvae exposed for 28 days to both compounds have a significant dysregulation in lipid and fatty acid metabolism, possibly leading to this stunted growth. A full life-cycle exposure to both compounds at environmentally relevant concentrations, alone and in combination, was investigated in order to examine the effects of chronic exposure to the F1 progeny. The effects of metformin and guanylurea on the length and wet weight were compared 28 days post hatch and will be discussed. Possible implications of exposure to metabolomics and gene expression will be explored

WE017 Life-cycle effects in Oryzias latipes exposed to environmentally relevant concentrations of metformin and its metabolite, guanylurea.

E. Ussery, 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

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 333

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guanylurea during the waste water treatment process, it is found in the environment in higher concentrations than metformin, usually in the µg/L concentration range in surface waters. This is concerning, as our recent research shows that Japanese medaka (Oryzias latipes) exposed to environmentally relevant concentrations of metformin (1.0-100 µg/L) and guanylurea (1.0-100 nL) from embryo through 28 days post hatch have a significant decrease in length (mm) and weight (mg) of both males and females when compared 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 metabolism 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
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Metformin (MET) is an active pharmaceutical ingredient (API) with very high patient use worldwide that is excreted in unchanged form. This has led to concern about the potential aquatic life impacts associated with the presence of MET in surface and ground waters. Previous studies demonstrated that MET is not transformed in WWTP, and 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 were translated to PECs for MET and GUU 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.

WE019 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. Although 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 antidepressant drugs prescribed to alleviate anxiety disorders in humans, and fluoxetine (FLX), the active principle of the Prozac® (Pfizer, New York, USA), is one of the most prescribed worldwide. ALP enters the 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 FLX on the expression of oxidative stress genes (Sod1, Sod2, Cat, Gpx, and Gst), stress and anxiety (osxl, ptr2, nyp, and ucn3), as well as transtomers 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 gpx, suggesting that this drug can induce an overproduction of pro-oxidant molecules. In addition, changes in the expression of slc6a4a, slc6a4b, 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 Bezafibrate toxicity in model marine diatom Phaeodactylum tricornutum
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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 fibrac acid widely used to reduce plasma triglycerides and raise the level of high-density lipoprotein cholesterol. Specifically, Bezafibrate 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, bezafibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have toxic 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 bezafibrate (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) Fluorometry. Bezafibrate exposure increased the photosystem II parameters, which reduced the algae 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 bezafibrate in membrane fatty acids from the chloroplast, since both photosystems are anchored in a lipidic membrane system. Moreover, tegufirideres (TAGs) are known to protect the photosystems against photoindhibition. 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, this way reducing the number of active reaction centers in the algae and thus its photosynthetic activity. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for fibrac toxicity testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.

WE021 Environmental Risk Assessment for the Active Pharmaceutical Ingredient Mycophenolic Acid in European Surface Waters
B. Tell, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; A. Haener, F. Hoffmann-La Roche Ltd / Group SHE (LSO) An Environmental Risk Assessment (ERA) was performed for the active pharmaceutical ingredient mycophenolic 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/ecotoxicity and on sales amounts for the products containing MPA in Europe. Both a new biodegradation study and an older sediment/water fate test were conducted to support new drug registration applications as well as new studies commissioned to fill data gaps. Predicted environmental concentrations (PECs) for MPA were derived based on standard ERA assumptions of roughly 1,000 times more potent than its parent compound, metformin. Additionally, Bezafibrate 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, bezafibrate has been detected in surface and drinking waters as well as in wastewater effluents. This can have toxic 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 bezafibrate (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) Fluorometry. Bezafibrate exposure increased the photosystem II parameters, which reduced the algae 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 bezafibrate 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 photoindhibition. 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, this way reducing the number of active reaction centers in the algae and thus its photosynthetic activity. All these bio-physical parameters show a clear dose-effect relationship, indicating that P. tricornutum is a good candidate organism for fibrac toxicity testing in marine systems, screened by non-invasive high-throughput bio-physical probing tools.
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, not all have been completely 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 sulfamethoxazole, and the antiepileptic drug carbamazepine, pose a risk to the aquatic 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. PHARMA project and Cytotherat, 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 ecosystems. For this purpose, the pharmacokinetics of several cytostatics in aquatic organisms in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific 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 framework. Pharmaceuticals in the environment have been recognized by the European Environment Agency UBA / Section IV 2.2 Pharmaceuticals

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 2 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/4447/00 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 ng/L in surface waters, or the substance is of specific concern through its mode of action. For an inventory, the environmental fate and effect data includes testing of three trophic levels, represented by algae, crustaceans and fish – usually following OECD-guidelines 201, 211 and 210. Both the applicant and the assessor evaluate the studies to assure adequate data quality. Over the last decade, this regulatory work resulted in a data base containing effect data on approximately 300 active pharmaceutical ingredients (APIs) – which was evaluated in our current project. For this purpose, we evaluated APIs below 1 µg/L in several NOECs in the low ng/L-range, particularly for substances with endocrine mode of action. The predominant part of substances with NOEC between 0.01 and 1 µg/L is non-endocrine, belonging to a diverse range of pharmaceutical classes. 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 at the 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; S. Korneev, Federal Environment Agency (Umweltbundesamt) / 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 pharmaceuticals that have been approved in the EU since 1980 will have to undergo an ERA. However, there are no statutory provisions in place to deal with how to legacy products. Hence, there is a vital need to prioritise active substances used in legacy products for further investigations and evaluation of their environmental impact as well as risk management activities. This is of particular importance because many of them are frequently detected in surface water and other environmental compartments. Moreover, active substances which are persistent, mobile, bioaccumulative and/or toxic or have a specific mode of action as e.g. endocrine active substances, are in general of high environmental concern. We propose a step wise prioritisation concept that allows the identification of active substances with a high potential environmental impact and/or a high potential presence in the environment. The poster outlines parameters which should be considered in a prioritisation approach, as e.g. consumption data and their trends over the years, mode of action, monitoring data, available data on fate and effects in the environment and metabolism in patients. The proposed tiered prioritization approach considers also elements of the EMA Guideline for environmental risk assessment of human pharmaceuticals. It is important to recognise that any approach needs to be flexible in order to be effective and should be regularly adapted to the current state of knowledge.

WE025 SETAC Pharmaceuticals Interest Group
G. Maasch, German Environment Agency / Ecotoxicological Assessment

WE026 What makes a chemical substance a ‘natural substance’? A case study in the context of the EU veterinary medicines marketing authorisation procedure

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, may trigger the necessity to perform an in-depth 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, Instituto de Ambiental Assessment and Water Research (IDAEA-CSIC) / Environmental Toxicology; L. Navarro-Martín, C. Luccarelli, IDAEA-CSIC; E. Ortiz, IDAEA-CSIC / Department of Environmental Chemistry; A.E. Codina, CNAG; D. Raldua, IDAEA; C. Barata, CSIC / Environmental Chemistry; B. Pina, IDAEA-CSIC / Department of Environmental Chemistry; R. Tauler, IDAEA-CSIC / Environmental Chemistry.

Exposure to PFOS (perfluorohexyl 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 ppb) from 48 to 120 hpf. While parallel morphological analysis showed no macroscopic changes below the 1000 ppb mark, some metabolomic and transcriptomic changes occurred even at the lowest used 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
to the metabolism of proteins, nucleotides, and amino acids. The results suggest a complex, multiple endocrine disruption-like toxic effects, at a 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 cellular 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. Soidan, University of Leuven; J. Van Leuven; I. Nefs, Universiteit Catholique de Louvain / Institut des Sciences de la Vie; A. De Groot, Université Catholique de Louvain; J. Rees, Y. Larondele, C. Debier, Université Catholique de Louvain / Institut des Sciences de la Vie

Fish can be exposed to nutritional and chemical stress. In aquaculture, fish oil is increasingly replaced by plant-derived oils, which results in a modification of the fatty acid (FA) composition of the diet. Also, pollutants such as methylmercury (MeHg) are still present in aquatic environments. Adipose tissue is an essential endocrine organ involved in energy homeostasis and can be affected by some stressors. However, there is a lack of knowledge about the effects of FA and MeHg on rainbow trout adipose tissue. In this context, an in vitro experiment was conducted and linoleic acid (LA) induced a lipid content increase in fish, while MeHg decreased it. To understand better these results, two in vitro experiments were carried out on trout primary cultured adipocytes to study the effects of FA and those of MeHg. Effects of FAs - During 2 days, differentiation of confluent cells was induced through a hormonal cocktail. Cells were then incubated during 13 days with 0, 75, 150, 300 and 600 µM of α-linolenic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 250 µM of cholesterol mixed. At day 13, for each FA, the higher the concentration, the more the lipid accumulation. At 600 µM, DHA and DPA were the most adipogenic FA, while LA and ALA (typical to plant-derived oils) induced less lipid accumulation. For all conditions, a clear enrichment of membranes and lipid droplets with the incubated FA was observed. Effects of MeHg - Confluent cells were incubated for 6 days with or without a hormonal cocktail, with 0.5, 2.5 or 5 mM MeHg and with 4 µM lipid mixture. No cytotoxicity was observed. At day 6, cells were collected to determine mercury concentration, FA content and composition, and gene expression. Analyses are in progress. Preliminary results showed that the hormonal cocktail combined to increasing MeHg concentrations tended to affect cell morphology, towards a more typical adipocyte phenotype. In conclusion, the composition of FAs can be different at organism and cell levels. Regarding the effects of MeHg, we can highlight the presence of cells with typical adipocyte morphology in presence of hormonal cocktail and MeHg. For both experiments, analyses of expression of genes related to adipocyte differentiation, lipid metabolism and lipolysis are under progress and could provide helpful results to understand better the impacts of stressors in trout preadipocytes.

WE029

Obesogens in the aquatic environment A. Capitão, CIIMAR; University of Porto; A. Lyssimachou, CIIMAR; E. Castro, CIIMAR - University of Porto; M.M. Santos, CIIMAR/FUCP / Biology/Endocrine Disrupters and Emerging Contaminants

The presence of obesogens is a major health concern of our times, affecting an increasing proportion of the population worldwide. It is now evident that this phenomenon is not only associated with the lack of exercise and a balanced diet, but also due to environmental factors, such as exposure to environmental chemicals that interfere with lipid homeostasis. These chemicals, also known as obesogens, are present in a wide range of products of our daily life, such as cosmetics, paints, plastics, food cans and pesticide-treated food, among others. A growing body of evidences indicates that their action is not limited to mammals. Obesogens also end up in the aquatic environment, potentially affecting its ecosystems. In fact, reports indicate that some environmental chemicals are able to alter lipid homeostasis, impacting weight, lipid profile, signaling pathways and/or protein activity, of several species of animals. Such a priority issue in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolite, guanylurea in developing fish, we found a significant decrease in length (7–66 mm) 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. 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. 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.

WE030

The Environmental Causes of Obesity: Novel human in vitro models of adipocyte differentiation for studying the effects of chemical exposure S. Ermler, Brunel University London / Institute of Environmental Health and Societies; B. Blumberg, University of California, Irvine / Department of Developmental and Cell Biology; J. Leegler, Utrecht University / Institute for Environmental Studies; S. Jobling, Brunel University / Institute of Environment, Health and Societies

Obesity has become a worldwide challenge, with obesity rates not only increasing in adults, but also in children. Obesity is caused by an imbalance between caloric intake and energy expenditure. However, increased caloric intake due to changes in diet and lack of physical activity cannot solely explain the observed rise in obesity. Other factors, such as genetics or environmental stressors, also play a role. Exposure to endocrine disrupting chemicals (EDCs), which act as so-called obesogens during development, may impact adipogenesis and susceptibility to obesity, and several such compounds have been found to stimulate adipocyte differentiation in vitro and in vivo. Recent systematic reviews in our group have shown that prenatal exposure to EDCs such as BPA and DEHP is related to increases in adiposity later in life in rodents models. To identify potential obesogens and the effects of EDCs, such as metformin and guanylurea, in the human female, standard assay systems are used which only assess effects of obesogens on specific receptor activation or differentiation of already committed, white preadipocytes. Our research aims at unravelling the effects of obesogenic EDCs on human adipocyte development. The most critical effects of exposure to obesogens are elicited in utero and in early life. Therefore, in vitro models that mimic the earliest stage of adipogenesis are best suited to investigate how EDCs can disrupt normal cell differentiation during development. One promising cell culture model involves the use of murine mesenchymal stem cells (MSCs) to mimic preadipose or bone cell lineages. Future research using MSCs cells as model for adipogenesis will not only look at the differentiation to white adipocytes. We also envisage to employ the model to gain an understanding of other processes such as the more recently described “browning” of white adipocytes and the differentiation of MSCs to brown adipocytes.

WE031

Comparing metabolomic responses in Oryzias latipes to environmentally relevant concentrations of metformin and its metabolite, guanylurea F. Essery, University of Ontario Institute of Technology / Biological Sciences; K. Bridges, J.B. Venables, University of North Texas / Advanced Environmental Research Institute; Z.P. Pandelides, University of Ontario Institute of Technology; J. Guchardi, University of Ontario Institute of Technology / Faculty of Science Aquatic Toxicology; A. Kirkwood, University of Ontario Institute of Technology; D.A. Holdway, University of Ontario Inst. of Tech / Science

In recent years, the occurrence and fate of pharmaceuticals in the aquatic environment has become a priority issue in aquatic toxicology. One of the most prevalent pharmaceutical contaminants is the type-2 diabetic drug metformin, which has been found in wide-ranging concentrations (ng/L - µg/L) in wastewater effluent and surface waters. Greater than 90% of metformin is metabolized into guanylurea during wastewater treatment, and it’s the metabolite guanylurea that is found in receiving waters in relatively high concentrations (µg/L). To improve our understanding of the toxicological effects of metformin and its metabolite, guanylurea in developing fish, we found a significant decrease in length (7–66 mm) 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. 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. 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 / Hidrobiología; C. Cáceres, Universidad Autonoma Metropolitana Iztapalapa; Universidad Iberoamericana; Universidad 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 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 no threshold limits in European legislation for these components or 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 as the main component of two 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 compaction and subsequently transport of the spoil material. For this purpose, microcosms were set up using soil samples conditioned separately with the two foaming agents. Control microcosms, consisting of un-treated 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_{10} 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.

**WE034 Application of the Vibrio fischeri acute toxicity test to assess the environmental impact of spoil materials containing foaming agents**

L. Mariani, CNR-IRSA / IRSA; E. Donati, National Research Council of Italy / IMC; L. Patrolecco, Water Research Institute-National Research Council / Water Research Institute; J. Rauseo, National Research Council / Institute of Water Research IRSA-CNR; L. Rolando, National Research Council of Italy / Water Research Institute; A. Barra Caracielo, National Research Council / Water Research Institute; P. Genni, National Research Council of Italy (CNR) / Water Research Institute. The rapid development of TBMs in the tunnelling industry has been mainly 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 TBMs relies on the use of appropriate soil conditioning agents which contain 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 concentrations nor Italian and European 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 multicomponent 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 authors have evaluated the potential impact of soil materials on microbial abundance and activity. 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 excavation 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 residues at effect concentrations in soil material.
geological formation with alternance of limestone and marlstone) and the material called “S” (a cohesive clay). The amount of the surfactants inside the conditioned samples “S” and “M” have been measured with the instrument HPLC-MS (“High-Performance Liquid Chromatography Mass”) at different stages from the addition of the foam to the soil: at time 0, at 3 and at 7 days. Toxicity tests with the bio-luminescent bacteria Vibrio Fischeri (ISO 13148:2.2007) and the fish embryo Diplopterus annulatus (ISO 11340) have been conducted on the surfactants inside the conditioned soil. The toxicity of the conditioned soils and tendency of toxicity decrease along the time. Values comparable to the natural soil toxicity are achieved in a short period.

WE037 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


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 the mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Preliminary environmental risk assessment of SLES associated with 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 compatibility; 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.

WE038 Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB-TBM 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 particularly sodium lauryl ether sulphate (SLES) are the dominant 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 purposes (e.g. land covering) may allow the identification 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 compatibility; 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.

WE039 Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling

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Among ANS, the sodium lauryl ether sulphate (SLES) is commonly utilized as a foaming agent to facilitate the excavation procedures in mechanized tunnelling. However, its use raises concern for the environment considering the presence of SLES residues in soil debris produced during the excavation. In addition, the absence of soil threshold limit for SLES in the EU legislation does not facilitate the re-use of soil debris as by products (e.g. land covering) and, consequently, a huge amount of such detritus can be discharged as a waste with high economic costs. In absence of a threshold limit, performing an environmental risk assessment (ERA) of foaming agents containing SLES can be a possible alternative. However, the ERA is hampered by both the rather scarce data on the effects of SLES and the site specific condition of use which lead to different levels of exposure. Indeed, the selection of the type and quantity of foaming agents depends on soil, geological conditions, and characteristics of the tunnel boring machines. Furthermore, several commercial formulations are available on the market with different partial percentages of SLES and several other components. This study is part of a wider project aiming to develop a methodology to be applied to identify environmental acceptable levels of SLES residues in soil debris produced during the tunnelling operations in Italy. Particularly, we report the results regarding the preliminary ERA that has been used to select, among all the available commercial formulations, the one leading the lowest level of risk for the environment in a specific condition of use. The risk has been characterized based on PEC/PNEC ratios. PECs were calculated by predictive models and considering the percentage of SLES in the commercial formulations as well as the required treatment ratios for tunnelling operations. PNECs (soil and surface water) for SLES were derived from ecotoxicological data (terrestrial and aquatic organisms) which were obtained from laboratory tests on several test organisms.
agent products are anionic surfactants such as the alkyl ether sulphates (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 bioassayson. For this purpose, two soils were prepared, 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 elutrate 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 have been used. These findings highlight 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 industrial byproducts. For this purpose, the new developed technology was used to plan strategies of spoil disposal management in a virtuous cycle of reuse of the resources leads 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 15-20 years. Commonly accepted standards have been used. The developed methodology 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 environmental conditions 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 more precise laboratory analyses. Monitoring tools seem to be specially suited for monitoring large volumes of soil 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.

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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, polyacrylates 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 toxicity 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 analyses 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/PvB & 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

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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 (LogBAF) were 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

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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 individuals. 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 flow through bioaccumulation studies with Hyalella are similar to those obtained from fish (Schlechtriem, 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 since Hyalella as an aquatic invertebrate can be quite sensitive. The results from

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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 under 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 lipophilicity 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, lipophilicity, 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 logα 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 focussing on the prediction of BCF from quantum-chemistry-based estimations of partition coefficients (to membrane lipids, structural proteins and albumin). 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 in vitro 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 end point 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 lipophilicity, 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 isomers, were tested. The logKOW predicted by QSAR ranges from 4.75-5.41 and R² 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 the 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 BCF5S 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. Despite the promise of this approach, there is a lack of information to answer different questions in regulatory and monitoring affairs. The TMF can be used in the evaluation of the biomagnification potential of chemicals under REACH. However, TMF may be also be applied in the context of the Water Framework Directive to normalize chemical monitoring data of fish to a common trophic level as well as to derive environmental quality standards for the protection goal (toxicity) of selected substances. The aim is to show that the methods have been performed and the investigated endpoints have shown considerable variation. 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 joint 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 collected species 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. Reliable TMF can only be derived with appropriate benchmarking-, and statistical methods 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 are mainly a lack of data for substances in the portfolio. However, the current status report shows that the PBT/vPvB properties are not transferable from substances registered in tonnages of 1000 tpa or more. Therefore, a comprehensive literature evaluation for the identification of substances registered in quantities of 1 000 tpa or more suggest that the main obstacle in identifying substances with PBT/vPvB properties are shortcomings in the registration dossiers of substances manufactured or imported in quantities of 1000 to 10 000 tons per year (tpa) is evaluated in the current project on REACH compliance. This is a follow-up project on substances registered in quantities of 1 000 tpa or more, affecting human health, the environment and the ecosystem. The project will focus on the evaluation of the environmental and regulatory information on biotic and abiotic degradation, bioaccumulation and ecotoxicity are taken into account. The stepwise approach applied in the preceding project is adapted to the lower tonnage band with the aim to receive a high conclusion rate regarding the compliance of the endpoints. The previously published findings for substances registered in quantities of 1 000 tpa or more suggest that the main obstacle in identifying substances with PBT/vPvB properties are shortcomings in data quality, data gaps or inappropriate data-waiving/adaptation approaches. A minimum of 12% (for abiotic degradation) and a maximum of 61% (for ecotoxicity) of the dossiers were found to be “non-compliant”. It was recommended that registrants should thoroughly review and update their dossiers in order to fulfill the information requirements. This can be achieved either by using appropriate standard tests, providing a sound justification to waive data or using appropriate surrogate data. The poster will show preliminary results on the dossiers of substances registered in the tonnage levels of 100 to 1000 tons per year and its
WE049
PBT/vPvB: All equally bad or some worse than others? - How to inform risk management
K. Thiele, WUR; S. Gabbett, Wageningen University / Social Sciences

In risk management, 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. This implies 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 therefore 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)
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Organophosphate Esters (OPEs) are a group of chemicals found at relatively high levels in the environment, industry and consumer products. The use of OPEs has increased in recent years following the listing of penta- and octa-DEEs 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 polynomial parameter linear free energy relationships (pLFERs) to represent partitioning, and 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.

WE052
Polymers: The Next Frontier in Environmental Hazard Assessment
A. Carras, 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

Polymers are 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, theology 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 full 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 (US EPA’s FIFRA, Australia’s NICNAS). 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, solubility, 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 scheme 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. Nlen, Smithers Viscient / Department of Regulatory Affairs; K. Malekani, Smithers Viscient / 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 assessment 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, the regulation does not explicitly state what REACH criteria should be used for pharmaceuticals. Therefore, a redefined PBT/vPvB guidance for pharmaceuticals was developed from 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 our 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 information on the regulatory consequences of the PBT-assessment for any given product, the situation may change in the future. It is our hope the EMA will issue clear guidance on how a PBT/vPvB assessment should be performed for pharmaceutical products and the consequences for products which fulfil the PBT/vPvB criteria. 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 meet the requirements to assess a sufficient assessment of ionisable substances. The objective of the project is to refine the P assessment of ion 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 models 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 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 Authorisation 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, ion and ionisable substances seem to behave differently in the environment compared to neutral substances. With the addition of cationic, anionic or amphoteric 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 ionic and ionisable substances in the PBT-assessment, sorption and degradation patterns of the model substance is determined. The non-charged functional group will be investigated using the behavior of 14C-labelled 4-n-Dodecylphenol, 4-n-Dodecylbenzenesulfonicacid sodium salt and 4-N-Dodecylbenzyltrimethylammonium 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 ionic and ionisable substances in the PBT-assessment.

WE056 Interaction of sulfonamide with soil humic acid: ESR investigations with nitroxide spin label A. Riecke, E. Bondarenko, H. Steinhoff, University of Osnabrück / Physics; G. Ur, K. Hideg, T. Káli, University of Pécs / Organic and Medicinal Chemistry; M. Matthies, University of Osnabrück / Institute of Environmental Research Surfactants of high- (HAS) and low- (LAS) molecular weight were used in animal husbandry for treatment of infections. After application of matured livestock to soil, SAS interact with organic soil components, e.g. by reversible sorption or irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment (sequestration) or/and covalent binding to soil organic matter. The paper presents a new approach of using stable magnetic spin labels to investigate the kinetics of NER for different soil humic acids and to distinguish between sorption, sequestration and covalent binding. Leonardite humic acid (LHA) was mixed with laccase to enhance the amount of reactive quinone groups of LHA and then incubated with nitroxide spin labelled analogues of sulfadiazine (SDZ; HO-4888) and N-acetylated derivative of HO-4888 (N-Ac-SDZ; HO-4917). The labeling at the pyrimidine moiety of SDZ leaves the aniline moiety susceptible to covalent binding to LHA, which is blocked by the N-acetylation. A broadened ESR signal was observed for HO-4888, which indicates strong restriction of the reorientational motion of the spin probe, i.e. immobilization due covalent binding of the aniline moiety of SDZ to reactive quinone sites of LHA. This signal increased immediately after incubation and was used to determine the first-order reaction kinetics of the covalent bond formation. A fast reaction with a half-life of 0.108 h and a slower reaction with a half-life of 14.9 h of covalent binding as well as a reduction half-life of 642 h for the unpaired electron were determined. The treatment of LHA with laccase corroborates the covalent bond formation by oxidizing non-reactive hydroquinone to reactive quinone moieties, which could react via a nucleophilic addition with the amine group of sulfadiazine (H. Matthies, University of Osnabrück / Institute of Environmental Research, 2013) and the guidance for the assessment of NER can either be reversibly or irreversibly bound to the soil/sediment characteristics. A general classification for the environmental assessment of sulfonamide and the consequences for products which fulfil the PBT criteria for ionisable substances. The fate and loss of 14C-labelled surfactants, which solely differ in their polar head group: 4-n-dodecyl phenol (DP), 4-n-sodium dodecylbenzenesulfonate (DS) and 4-n-dodecylbenzytrimethylammonium chloride (DA*). Sediment and surface water were collected from a rainwater detention basin in Aachen, Germany. Preliminary studies using DP and DS were performed according to OECD 308 and 309. In the water-sediment system, formation of non-extractable residues (NER) was 13 % for DP and 10 % for DS after 65 days. The amount of 14CO2 was 48 % (DP) and 63 % (DS). In surface water, about 40 % (DS) and 30 % (DP) of the initially applied amount of radioactivity was mineralised to 14CO2. Degradation studies with DA* are in progress and the results will be presented. The results will be used to refine the evaluation of the P criteria for ionic and ionisable chemicals in the PBT assessment. The removal of sulfadiazine (SDZ; HO-4888) from a broadened ESR signal was also recorded. We use them in animal husbandry for treatment of infections. After application of matured livestock to soil, SAS interact with organic soil components, e.g. by reversible sorption or irreversible formation of non-extractable residues (NER). The latter is attributed to physical entrapment (sequestration) or/and covalent binding to soil organic matter. 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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 data was conducted under the framework of the UBA. The bioassay test results in soil with 13C-labelled sediment 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 environmental assessment. In addition, irreversible 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 / Analytic.

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 synthetic ion 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 full aqueous eluent and were converted to retention factors ($k'$), which are proportional to the ion-exchange-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), bovine serum albumin-water (KBSA/w), and muscle protein-water partition coefficients (KMP/w) from the literature. Relative 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 $k'$. Nonetheless, log $k'$ 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 step forward 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. Poliesel, 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


**WE060**

Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia

A. Alesker, Landmark, Hazardous Substances & Waste Policy Division / Head of Division; Y. Buniyayyan, Environmental Monitoring and Information Center / Division of waste inventory, classification and technology investigation; V. Khachatryan, National Institute of Oncology / Thoracic Surgery Department; F. Petrosoyan, UNIDO BAT/BEPOrject(Armenia)

Sources of environmental pollution by persistent organic pollutants (POPs), either used on farms, correctly applied as pesticides, or 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), and adjacent to landfills: different provinces of the Republic of Armenia 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), and adjacent to landfills: different 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), and adjacent to landfills: different provinces of the Republic of Armenia. Determination of POPs by chromato graphic methods, such as gas chromatography-mass spectrometry (GC-MS) and high performance liquid chromatography-mass spectrometry (HPLC-MS), is an irreplaceable tool for assessing environmental pollution by chemical substances, biocides, pesticides, and veterinary medicines. In the investigated sites, concentrations of POPs were also considered on the whole (summary concentrations) as well as the total sum of WAX, HCH isomers, DDT isomers and all studied POPs are also considered on the whole (summary concentrations) as well as the total sum of WAX, HCH isomers, DDT isomers and all studied POPs are also considered. The results showed that the concentration of POPs is significantly higher in the landfills compared to the surrounding areas.

**WE061**

Improving the interpretation of Non-Extractable Residues (NER) in degradation assessment

A. Brock, 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 clarified if clear indications for ultimate degradation or irreversible sorption are available. Research is available on the irreversibility of certain POPs in soil. In one study, it was shown that the amount of bioNER can be estimated using the Microbial Turnover to Biomass (MTB) method, which can be estimated using the Microbial Turnover to Biomass (MTB) method, which can be estimated using the Microbial Turnover to Biomass (MTB) method, which can be estimated using the Microbial Turnover to Biomass (MTB) method, which can be estimated using the Microbial Turnover to Biomass (MTB) method. The results showed that the concentration of bioNER is significantly higher in the landfills compared to the surrounding areas.
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 bio-NER as the amount of potentially remobilizable xenon-ner (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.

**WE062**

**Photodegradation of Atrazine in the Presence of Indole-3-acetic Acid and Natural Montmorillonite Clay Minerals**

C. Gu, Nanjing University / School of the Environment; L. Zhang, Nanjing University

In this study, a new natural degradation pathway of atrazine and the potential mechanism are proposed. Atrazine was oxidized under simulated solar irradiation by indole-3-acetic acid at the environmentally relevant concentration under aerobic condition. The reaction was initiated by the production of hydrated electrons generated from the photodegradation of indole-3-acetic acid, and then this species transformed into hydroxyl radical after a series of radical reactions with proton and dissolved oxygen. During this process, the presence of montmorillonite greatly enhanced the yield of hydrated electron and promoted the further degradation of atrazine by hydroxyl radical. The novel reaction is to some extent affected by pH and the type of exchangeable cation present on montmorillonite. Based on our results, the effects of knowledge to extrapolate from laboratory experiments to the complex environment. As an initial step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment. This is due to the difficulties and the lack of knowledge to extrapolate from laboratory studies to the complex environment. As the first step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment, we chose a fragrance ingredient, Myrrhone\(^1\), as an example, and used laboratory study results to calculate its photodegradation half-lives at depths in natural waters. Direct photodegradation was revealed to be the dominant photodegradation process of Myrrhone\(^2\) and the quantum yield was determined to be 0.51 in the laboratory. Four main volatile photodegradation products, which continued to photodegrade, were observed, isolated by preparative multidimensional GC and identified using NMR. Direct photodegradation half-lives of Myrrhone\(^2\) in natural waters at different depths were calculated based on its molar absorption spectrum, quantum yield, and the irradiance at depth of natural waters. The irradiance values at depths were obtained by applying diffuse attenuation coefficients (K\(_a\)) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, and the irradiance at depth of natural waters. The irradiance values at depth are empirical values determined by the interaction of a number of factors, including absorption by dissolved organic matter and particulate matter, scattering, and the angular distribution of the light field. A correction factor for cloud cover was applied to the irradiance data. This step offers a way to calculate the UV attenuation coefficients in the water column. The calculation of half-lives at the surface of water was validated by two outdoor photolysis experiments. The calculated half-lives of 0.38 h and 1.14 h were in agreement with the measured half-lives of 0.40 h and 1.15 h, respectively. This agreement indicated that mathematical models can be developed to define complex environmental conditions for the extrapolation of laboratory data to the environment. The next step is to design experiments to measure half-lives at depth in natural water to refine and validate the calculation of half-lives. Thoroughly validated models can be valuable tools for the persistence assessment of chemicals based on photodegradation information.

**WE064**

**The Photolytic Fate of Fungicides**

J. Apell, MIT / Civil & Environmental Engineering; K. McNeill, ETH Zurich

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 is the environmental fate models used to provide information. This忽略了 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 photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

**WE065**

**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 biodegradation pathways are considered in this case. UVCB data is used for the example for which not fully identifiable and their composition may be difficult to predict. Under REACH Registration, it may be necessary to test these substances, which from many perspectives represents significant challenges. Reference is made to REACH Regulations and in particular Annex VII Section 9.2 where a series of degradation studies are proposed including simulation testing in surface water, soil and sediment. The expected photolysis rate constant and the quantum yield was determined to be 0.51 in the laboratory. Four main volatile photodegradation products, which continued to photodegrade, were observed, isolated by preparative multidimensional GC and identified using NMR. Direct photodegradation half-lives of Myrrhone\(^2\) in natural waters at different depths were calculated based on its molar absorption spectrum, quantum yield, and the irradiance at depth of natural waters. The irradiance values at depths were obtained by applying diffuse attenuation coefficients (K\(_a\)) to the irradiance at the surface of water, generated using a solar irradiance calculator as a function of time, and the irradiance at depth of natural waters. The irradiance values at depth are empirical values determined by the interaction of a number of factors, including absorption by dissolved organic matter and particulate matter, scattering, and the angular distribution of the light field. A correction factor for cloud cover was applied to the irradiance data. This step offers a way to calculate the UV attenuation coefficients in the water column. The calculation of half-lives at the surface of water was validated by two outdoor photolysis experiments. The calculated half-lives of 0.38 h and 1.14 h were in agreement with the measured half-lives of 0.40 h and 1.15 h, respectively. This agreement indicated that mathematical models can be developed to define complex environmental conditions for the extrapolation of laboratory data to the environment. The next step is to design experiments to measure half-lives at depth in natural water to refine and validate the calculation of half-lives. Thoroughly validated models can be valuable tools for the persistence assessment of chemicals based on photodegradation information.
In silico Tools to Assess the Confidence of QSAR Model Predictions
K. Kühne, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry; S. S. Kutsarova, A. Mekenyan, O. Mekenyan, H. Vierke, German Environment Agency / Section IV 2.3 Chemicals
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 are highly problematic for human health and the environment. Once mobile and persistent 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-instrumental testing are available. Public and 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 in-depth literature and the use of active substances for intermediate recommendations to address water treatment processes for active substance approval.

Data Gap filling with ECOSAR in K-REACH compliance, a limitation and weakness
J. Re, Korea Institute of Industrial Technology / Environmental Science and Engineering; H. Park, Korea Institute of Industrial Technology; S. ok, Kitech / Regulatory Assessment Center & Risk assessment Center
ECOSAR is a computer based QSAR program developed by US EPA within the regulatory constraints of the TSCA. However, it is also used in the other country or organization such as EU, Korea, OECD, etc. for their regulatory purpose. We introduced ECOSAR program to generate toxicity data and fill the data gap for developing species sensitivity distribution of 20 organic compounds. However, ECOSAR shows more pragmatic than theoretical characteristic. Thus, we investigated whether this model shows acceptable results on the deficient data of 20 organic compounds or not. Therefore we collected published data for fish and daphnia available and compared their geometric mean value to the output of ECOSAR. Some chemicals show similar output value to experimental data within double scale but 34 chemicals show very large difference of 1,400 times higher value in ECOSAR output. The least predictable substance is acrylic acid where 4 experimental data are available and compared their geometric value to the output of ECOSAR. Results reveal better prediction by ECOSAR program to generate toxicity data for deficient data and fill the data gap.

Innovative analytical method to enhance POPs and emerging pollutants extraction in water samples by micelles using GC
A. Angelis, A. Lazzarelli, University of Pisa / Department of Chemistry and Industrial Chemistry
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 hydrophobic micellar core region. This technique was found to be a very effective 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 to the micelles; and b) extraction 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 non-ionic surfactants tail length and the introducing different surfactant groups in cationic and anionic surfactants in order to optimize recovery of pollutants and minimize the quantity to be used in environmental monitoring programs.

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Innovative analytical method to enhance POPs and emerging pollutants extraction in water samples by micelles using GC
A. Angelis, A. Lazzarelli, University of Pisa / Department of Chemistry and Industrial Chemistry
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 hydrophobic micellar core region. This technique was found to be a very effective 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 to the micelles; and b) extraction 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 non-ionic surfactants tail length and the introducing different surfactant groups in cationic and anionic surfactants in order to optimize recovery of pollutants and minimize the quantity to be used in environmental monitoring programs.

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 are highly problematic for human health and the environment. Once mobile and persistent 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-instrumental testing are available. Public and 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 in-depth literature and the use of active substances for intermediate recommendations to address water treatment processes for active substance approval.
article 57(f) of REACH based on a demonstrated equivalent level of concern (ELoC) as PBt or vPb substances. In order to identify PMT as a substance of ELoC it must be demonstrated that there is "scientific evidence of probable serious effects to human health or the environment which give rise to an equivalent level of concern" and that there is evidence from a risk based considerations that the substance may cause serious effects during use and after through consideration, it should be demonstrated that the substances on the candidate list is the most effective strategy management strategy. With the protection of drinking water and pristine water bodies in mind, both bioaccumulation and mobility of persistent chemical substances are non-desirable. The environmental effect felt by bioaccumulative and mobile chemical substances varies both temporally and spatially, where mobile compounds can potentially accumulate in semi-closed drinking water cycles, whereas bioaccumulative compounds are able to accumulate in a closed loop system. vPb can accumulate in food chains over time while vPbM 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

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UBA, Germany, has initiated work to develop criteria to identify substances which are very persistent and very mobile (vPvM), and persistent, mobile and toxic (PMT). The purpose is to ensure that substances on the candidate list are the most effective management strategy. With the protection of drinking water and pristine water bodies in mind, both bioaccumulation and mobility of persistent chemical substances are non-desirable. The environmental effect felt by bioaccumulative and mobile chemical substances varies both temporally and spatially, where mobile compounds can potentially accumulate in semi-closed drinking water cycles, whereas bioaccumulative compounds are able to accumulate in a closed loop system. vPb can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE075 LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids in Veneto region (Italy)

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2013 a significant episode of PFAS pollution of 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 fluorochromatic 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, LIFE PHOENIX project aims at demonstrating how a new interinstitutional governance system, supported through innovative forecast tools based on ongoing monitoring, can manage risks related to the diffusion of persistent mobile organic contaminants (PMOC) such as short chain PFAS. This project will develop a set of institutional procedures and tools to assess and possibly prevent as well as respond to risks for environment and human health with the contribution of multidisciplinary specialists who will develop tools, protocols, guidelines and indications to assist policy-makers in taking decisions and implementing effective prevention measures for environment, human health and the socio-economic context. All project activities will focus on a real scale case studied through the PFAS pollution in the provinces of Vicenza, Verona and Padova (an area of 930 km²), and involve local authorities managing risks and emergency. The project will validate and compare some innovative technological tools for the mitigation of PFAS concentration in the water through a pilot plant adopting different techniques for the purification of irrigation water and drinking water, using full-scale plant (wetland system) and physico-chemical plans breakdown system (filters). The technologies applied to these experimental sites will be incorporated into an integrated management system that will serve as a model for managing analogous chemical pollution events from persistent and soluble polar substances.

WE074 Recent Advances in Toxicology, Safer-Alternatives Assessment, Value-in-Use and Best Practice Guidance of Short-Chain Fluorotelomer-based Products for AFFF, Textiles and Other End-Uses

J. Bowman, FluoroCouncil 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 six or less fluorinated carbons ("short chain"). Fluorotelomer-based products can be in 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 repellent and critical properties on high-end performance garments, works, first responder gear and in enhanced polymeric PFAS category, fluorotelomer-based surface active agents (e.g. "fluorosurfactants") are used in complex multi-component formulations such as Cleaning Products, Paints, Coatings and Aquatic Film Forming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and are used in a variety of applications.

WE076 Ecotoxicological characterization of aquifers at Junin Formation and Pampeano from Hydrogeological Sub-Region II, Buenos Aires Argentina

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SETAC Europe 28th Annual Meeting Abstract Book
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 ecostystemic 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 and limy sediments of the Cretaceous, for this reason, the azo dyes must be regulated to prevent environmental impacts caused by the discharge of textile dyes into waterbodies.
Pharmaceutical residues 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 (OBP) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP with a full scale pilot plant ozonation system investigating 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 O$_3$ h$^{-1}$). 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 day/night cycle) in continuously replenished 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 contained both organic and a weak estrogenic component (femfem). A set of endocrine related behavioral phenotypes was recorded in the adult fish exposed to the ozonated effluent. No adverse effects on the fish progeny was noted. Whether these biological effects would have an adverse impact on the population level remains speculative. Ozonation is a capable method for removing pharmaceutical residues from sewage effluents. Yet its implementation should be carefully monitored in order to minimize undesirable toxic side-effects.

**WE084** toxicity evaluation during secondary effluents treatment by UV/H$_2$O$_2$ using Eruca sativa and Artemia salina

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When advanced oxidation processes are applied there is the concern of not forming more toxic compounds as a result of the oxidation and transformation of organic compounds. Therefore, the presence of contaminants of industrial origin may affect disinfection and form more toxic by-products. Thus, a detailed study of by-products formation and toxicity assessment during the oxidation process contributes to a more comprehensive understanding of the characteristics of the region, time of year, etc. in the specific case of the city of Limeira SP, there is a high concentration of compounds of industrial origin and metals (Al, Fe, Zn, Cr, Ni, Cu and Pb) above that allowed by the Brazilian Legislation (CONAMA) in sewage due to the presence of many jewelry semi-jewelry industries. This work evaluated the toxicity of a secondary effluent, contaminated with organic and a weak estrogenic compound (femfem). A set of endocrine related behavioral phenotypes was recorded in the adult fish exposed to the ozonated effluent. No adverse effects on the fish progeny was noted. Whether these biological effects would have an adverse impact on the population level remains speculative. Ozonation is a capable method for removing pharmaceutical residues from sewage effluents. Yet its implementation should be carefully monitored in order to minimize undesirable toxic side-effects.

**WE085** hospital effluent induced oxidative stress on Xenopus laevis larvae

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Hospitals are one of the main sources of emerging pollutants to wastewater treatment plants (WWTP) that usually are fairly equitably treated to this kind of compounds. Activities performed in hospitals require the use of several compounds, which are potentially toxic, they can reach municipal wastewater, affecting by that to get into municipal wastewater treatment plants, in some cases 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 centrifuged for the determination of hydroperoxides, liperoxides, 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

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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-agonists 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 fats in sewage sludge. Thus, using a tool to decrease endocrine-disrupting MPs is the implementation of an additional treatment step like ozonation. Within the DemO/AC 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 impact of the WWTP in 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 DemO/AC Project as part of an exploratory study. First results revealed an anti-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 facilities. The Nairobi River basin is an example of such impacted 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 ozonation in 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 sewage network struggles to cope. Herein, 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 steps: (a) the identification of CAEs and CSOs 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 wastewater CSOs were identified including caffeine, bezafibrate, benzoylecgonine 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 events. A comparative study of CSO and sewage water revealed that the 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 to be used together to highlight the understanding of complex occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CPB Martins, AM Edge, DA Cowan, LP Barron, J. Chromatogr. A, 1396 (2015) 34–44

**WE089**

Occurrence, fate and bioactivity of pesticides in wastewater

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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 estrogen screen (YES) and yeast androgen screen (YAS) assays) the bioactivities of the 18 pesticides were as wastewater effluents were 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 physiochemical properties of the pesticides was investigated and trends were identified. This work also provided new knowledge on the removal of some fungicides (climbazole, mylchobutanil and tebuxanazole) by ozonation and demonstrated the recalcitrant nature of pesticides during ozonation. This study is one of the first to investigate androgeic 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.
WE090 Fate of perfluorooalkyl substances within a small stream food web affected by sewage effluent
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The Trinational Upstream Water Project (Policy-orientated marine Environmental research in the Southern European Seas), guided by the Marine Strategy Framework Directive (MSFD), which aims to ensure good environmental status and associated toxicity can be reduced prior entering aquatic ecosystems via wastewater treatments. The present study evaluated the applicability and efficiency of different commercial TiO$_2$ photocatalysts (Aeroxide P25 and Hombikat UV100) by separately and simultaneously treating five different PPPs in aqueous solution under artificial UV irradiation (UVA: 40 W/m$^2$ for 60 min). The pesticides were chosen as representatives, being frequently used for viticulture in the Trinational Upper Rhine Area. A common way of growing is one major form of agriculture. To evaluate product dependent efficiencies of TiO$_2$ based photocatalysis, treated and untreated PPPs were analyzed for remaining PPP concentrations and major metabolites before and after a combined TiO$_2$ × UV treatment. Therefore, UV-visible absorbance spectroscopy, Total Organic Carbon (TOC) measurement and liquid chromatography was used. Further, to assess for the photocatalytic treatment efficiencies in multiphase systems, environmental toxicity acute toxicity tests were conducted. In detail, Daphnia magna was exposed for 48 h to (un-)treated PPPs according to the OECD guideline 202. Gained immobility data was statistically analyzed to detect significant differences among photocatalytic treatments. Preliminary results of both, analytical and ecotoxicological investigations, show the suitability of TiO$_2$ to reduce PPP concentrations and associated toxicity in water when being irradiated by UV light. This is a product related difference in the degradation potential of TiO$_2$ for the selected PPPs was observed. However, for a final statement whether TiO$_2$ 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.

WE093 Study of the efficiency of removal of organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland

Bioremediation systems couple biodegradation of contaminants and generation of energy through the oxidation of contaminants at the anodic side and reduction of alternative electron donors at the cathodic side of bioelectrochemical systems. These systems are able to transfer energy from aquatic environments to the open sea is attributed to the cascading of the North Adriatic Dense Water (NAdDW) 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.
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 utilisation of energy from domestic wastes for 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 A.A. Giwa, Cape Peninsula University of Technology / Department of Pure and Applied Chemistry; K.A. Abdulsalam, Adeleke University, Ede. Nigeria / I Department of Basic Sciences, Chemistry Unit; F. Wewers, Cape Peninsula University of Technology / Chemistry; A.A. Ladoke, Akitumo University of Technology / Department of Pure and Applied Chemistry

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 was studied. The influence of malachite green, methylene blue 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 compared with 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 ($R^2 > 0.95$). All the eight adsorbate systems investigated were endothermic (ΔH positive; 35.30 to 43.64 kJ mol⁻¹), thermodynamically feasible ($ΔG$ < 0 kJ mol⁻¹) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment J. Heire, SINTEF Ocean / Biotechnology; F. Polese, Technical University of Denmark (DTU) / DTU Environment; M. Kjos, P.A. Carvalho, SINTEF Materials and Chemistry; A. Booth, SINTEF Ocean / Environmental Technology

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 sewage treatment plants (Lara, Ladehammeren (HORA) in Trondheim, Norway. Both WWTPs have significant industrial contributions (up to 40% in LARA), employ preliminary and primary treatment steps, including chemically aided flocculation (ClFeO₃S/polyamine in LARA, polyacrylamide in HORA), and discharge directly into Trondheimfjord. 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 Pb. To study release patterns and gain information about potential sources, diurnal variations of elemental concentrations were determined and modelled in 8 composite samples of raw influent wastewater from morning, evening and night discharges. Element concentrations in the influent were significantly higher for Cd (17 times the influent) and lowest for Cd < As < Cr and Pb. Concentrations of Al, Cr, Cu and Cd were higher in HORA 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 HORA. Here, 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 composite samples mostly followed general diurnal discharge patterns, with higher concentrations in mornings and evenings and lower concentrations at night. In HORA, concentrations of most elements further correlated well with total suspended solid concentrations (TSS), with the strongest correlations observed for P, S and Cu ($R^2 > 0.9$). Correlations with TSS were less pronounced in LARA, and were weakest for Pb, Fe and Cu ($R^2 < 0.6$), which can be potentially attributed to the higher industrial loading contributions in LARA.

Enrichment factors were high for P, Cu, Zn, Cd and 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 P.M. Mosololane, University of the Free State / Zoology and Entomology

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 less impact on the environment than the influent. The aim of this study was to seasonally assess the efficiency of Phlambi wastewater treatment plant in removing emerging 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 effect of effluents from the wastewater treatment plant on the diversity of invertebrates 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 ecotoxicological investigations of the wastewater treatment plant Aachen S. Schiwi, Institute of Environmental Research-RWTH Aachen / Department of Ecosystem Analysis; Y. Müller, RWTH Aachen University / Institute for Environmental Research; A. Shuliakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; S. Koenemann, Institute for Environmental Research RWTH; S. Oster, RWTH Aachen University, Institute for Environmental Research; K. Klaer, R. Dolny, Institut for Environmental Engineering, RWTH Aachen; S. Classen, Research Institute gieac; M. Hammers-Wirtz, gieac Research Institute for Ecosystem Analysis and Assessment Aachen; I. Brueckner, Eifel-Rur Waterboard; J. Pinnekamp, RWTH Aachen University / Institute for Environmental Research; H. Hollert, RWTH Aachen University / Institute for Environmental Research.

Microplastics (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 influence 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. For this purpose, 60 different MPs were analyzed by LC/MS/MS. 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 inlet for D. magna, D. subspicatus and D. rerio. A. fisheri showed no effect. However, the toxicity was already markedly reduced at the outlet of secondary clarifiers within the WWTP. No acute and chronic toxicity was detected in any of the Wurm samples. Similar results were obtained in in situ feeding experiments with G. pulex. No significant differences in feeding rate between the sampling sites were recorded. On the other hand, significant mutagenic and endocrine effects were observed at the inlet and outlet of the WWTP as well as at all sampling sites within the Wurm. The P. antipodarum reproduction assay showed also a significant increase in embryo production downstream of the WWTP. In parallel, experiments with river sediments and samples of an additional WWTP (upstream of the WWTP Soers) will be conducted to clarify to which amount the mutagenic and endocrine effects originates by dilution effects as well as the WWTP Soers. The second part of this project will contain comparative studies investigating the situation after the implementation of the full-scale ozonation. This 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. Wagemans, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system,
several species with different trophic levels growing together, where each species has its own environmental value. Macroalgae can be used in such systems, usually at the exit point of the ponds, acting as biofilters and reducing the nutrient loading released to the environment. Contaminants such as antibiotics used in aquaculture can bioaccumulate in these organisms, passing to higher trophic levels. More recently, with the inclusion of macroalgae in human diets not only in Asia but also in Europe, we can ingest high levels of antibiotics and other contaminants, which are not regulated the same way as fish products. Exposure tests were performed with the macroalgae Ulva lactuca in order to evaluate the effects of Enrofloxacin in growth. Antibiotic concentrations were measured 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 IMTA promoted 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 promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. Therefore, the factories use processes to reduce the concentration 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, many of the factories provide analyses of, e.g., heavy metal 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)

WE101 Antibiotic resistance genes in manure, stored manure and soil after manure application
M. Vírtia, K. Parnánen, University of Helsinki; R.D. Stedfeld, J.M. Tiedje, Michigan State University / Center for Microbial Ecology Department of Civil and Environmental Engineering; J. Muurinen, University of Helsinki / Food and Environmental Sciences
Production animal farms are proposed to act as reservoirs where genetic material from medical treatments released to the environment. Contaminants such as antibiotics used in aquaculture can bioaccumulate in these organisms, passing to higher trophic levels. More recently, with the inclusion of macroalgae in human diets not only in Asia but also in Europe, we can ingest high levels of antibiotics and other contaminants, which are not regulated the same way as fish products. Exposure tests were performed with the macroalgae Ulva lactuca in order to evaluate the effects of Enrofloxacin in growth. Antibiotic concentrations were measured 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 IMTA promoted 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 promote the polluter pay principle and follow WHO guidelines, oil refinery factories in Kazakhstan still exceed the permissible concentration of pollutants in discharged wastewater. Therefore, the factories use processes to reduce the concentration 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, many of the factories provide analyses of, e.g., heavy metal 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
J. Rosa, University of Coimbra / Department of Life Sciences; S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences University of Coimbra; A. Freitas, J. Barbosa, INIAV- Instituto Nacional de Investigación Agrária e Veterinária; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria; M. Andreu, Center For Functional Ecology / Department of Life Sciences University of Coimbra; F. Ramos, Faculty of Pharmacy University of Coimbra The demand for food products is pushing aquaculture to increase its production throughout the world. The increase in production can lead to negative effects since much more fish are growing in much smaller places. Aquaculture is still highly associated with the frequent use of chemical compounds in water, either to treat or prevent disease outbreaks in culture ponds. Integrated multitrophic aquaculture systems (IMTAs) can be a suitable approach to fish production, since one can have
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 although at the time no known organisms alleged to be sensitive to the antibiotics are involved. 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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In recent decades, pharmaceuticals in the environment have been concerns for environmental risk. Especially, 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. Though total antibiotics usage has shown a decreasing trend 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 (API) are 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 microtitre assay that broadly follows and meets the validity criteria of the OECD 201 test guideline as a cost effective way to determine the effect of antibiotics on cyanobacteria growth. We applied this assay to determine growth-rate effects on 8 species of cyanobacteria and to total antibiotics to establish differences in species sensitivity for the improvement of the ERA of antibiotics. Our key findings are: 1) the performance of the microtitre assay is suitable for accurate and reliable assessment of effects on growth inhibition in a wide range of bacterial species; 2) differences in cyanobacteria sensitivity to antibiotics can span several orders of magnitude; and 3) the current framework for ERA of antibiotics inadequately addresses the risk to bacterial populations and testing several diverse cyanobacteria species will increase confidence in the protection goals established.

**WE105**

Direct and indirect effects of antibiotics in the leaf-shredding macroinvertebrate Gammarus fossarum

M. Konshuch, University Koblenz-Landau / Institute for Environmental Sciences; J.P. Zubrod, University of Koblenz-Landau / Institute for Environmental Sciences; P.T. Baudy, University of Koblenz-Landau / Institute of Environmental Sciences; S. Liederwald, Universität Koblenz-Landau / Institute for Environmental Sciences; C. Klein, Engler, University of Koblenz-Landau / Institute for Environmental Science; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment

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 microbial community composition and macroorganism-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 single exposure to CIP, or to a daily exposure to CIP during 7 days. In order to assess the differences in leaf colonization by *G. fossarum* and *S. plana*, during a 7-day feeding activity assay, we exposed leaves to control water and a waterborne and diet-related CIP exposure. 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

**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. Therefore, 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

S. Leston, CFE-Center For Functional Ecology / Department of Life Sciences

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SETAC Europe 28th Annual Meeting Abstract Book
Environmental pharmaceuticals contamination is now a recognized threat in coastal and estuarine ecosystems representing unknown and potentially harmful effects to human health. Therefore, the increasing soil retention of polar substances after soil amendment and the high persistence found for some antibiotics so the dairy farm setting works as an antimicrobial resistance (AMR) reservoir and as a route of entry into the environment. Antibiotics’ persistence in dairy settings occurs through mediums such as slurry, milk and subsequently, in soil via spreading. These routes can act as a channel for the transference of compounds and the insemination of AMR within the food chain through intake by plants and migration to other sources via water run-off, possibly affecting the therapeutic impact of antibiotics against human and animal health. In order to assist in shedding light on the long established concern of the environmental fate and behaviour of veterinary antibiotics in farming and to propose better handling practices as a basis for future regulations. The main 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 environmental hazard associated with its agricultural reuse. Many of them have toxic potential for terrestrial and/or aquatic organisms. The environment can act as a reservoir not only for residues, but also for antimicrobial resistance genes, and may spread them into the food chain. This is a particularly serious in the case of antibiotics that can accumulate in soil, such as fluoroquinolones, which have a high adsorption capacity for, being soil matter, and, as a result of this, a long persistence. The objective of this work focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in Spain according to the technical descriptions of the authorized products. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EMEACVMP/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 and quantify bioavailability and persistence in this matrix and excreta. Sixty-seven compounds are being applied for the detection and quantification of 67 drugs. 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 antiepileptic and anticonvulsant drugs, benzodiazepines, antiinflammatories and analgesics, and antituberculosis agents Tetracycline, (2) exposure to a mixture of Sulfamethoxazole and Trimethoprim, and (3) exposure to a mixture of Sulfamethoxazole and Nitrofurantoin. The models used to simulate the fate of these antibiotics in the environment is being tested against 2000 different priority pollutants. The models used to simulate the fate of these antibiotics in the environment is being tested against 2000 different priority pollutants.
Reactivity, mobility and degradation of the antibiotic Sulfamethoxazole and its sites. Fluconazole levels ranged from associated with polluted waters. Some isolates in the present study are pathogenic to yeast. The sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance in human impacted environments. The presence of yeast species in water sources that are associated with faecal pollution. 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 approach to antibiotic resistance (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 a few days. Interestingly, the intI1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

P=0.667) were not a concern in relation to feeding at environmentally realistic concentrations (scenario 1 and 3), (p<0.05). When exposed to a mixture of Sulfamethoxazole and Trimethoprim (scenario 2) there was an impact on the Gamma rays feeding rate (Z=13.239, p=0.004). However, further investigation would be required to investigate these drugs individually to identify if the obtained results were driven by one or the combination, and also to establish if there is a genuine environmental concern associated to this mixture or if the data is blurred in some way.

WE112 Persistence of the sulfamethoxazole antibiotic in a digestate-amended agricultural soil

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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 approach to antibiotic resistance (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 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

Flucconazole levels ranged from associated with polluted waters. Some isolates in the present study are pathogenic to yeast. The sources of antibiotics and their residues, and antibiotic resistant bacteria. Risk assessment of antibiotic resistance in human impacted environments. The presence of yeast species in water sources that are associated with faecal pollution. 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 approach to antibiotic resistance (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 a few days. Interestingly, the intI1 gene was found in the soil where the digestate was added, showing its introduction through this agricultural practice.

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

J.M. MARTINS, CNRS IGE UMR 5001, Univ. Grenoble / OSUG-IGE; E. François, L. Spadini, J. Granat, C. Humbert, E. Vence, M. Morel, Institut Geoscience & Environnement

The fate of Sulfamethoxazole (SMX), a sulfonamide antibiotic widely spread in natural sorbs and waters, was evaluated in batches and columns of a silty-loam soil under culture from Feuchelrolles (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. Its 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 complements 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 lower than in the OM amended soil, suggesting that SMX contributes 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 silty 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 impacts of SMX on soil microbial biodiversity and species richness and the emergence of specific taxons, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil, SMX, present in mobile DMSO with enhanced mobility in presence of added OM. SMX appeared also quite readily biodegradable, especially when in contact with coarse and fine soil size fractions, where it had the strongest impact on soil bacteria. Keywords: Antibiotics, SMX, organic matter, impact, DGGE, Miseq, ARG, biodegradation

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 disease and promoting growth. Aquaculture is also often used 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 gene expression levels in the host. Options are available to assess antibiotic resistance, and they are 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 and measured from cattle and pig farms, soil that received the manure as 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) FEBS Microbial Ecology 92 (3): ftw014 (2) Spencer, S.J., Tamminen, M., Vignon, A., Van Den Ende, A.W., Guo, M.T., Briggs, A.W., Brito, I.L., Weitz, D.A., Pitkänen, L.K., Virta, M., Pärnänen, J., Karkman, A., Tamminen, M., Lyra, C., Paulin, L., Hultman J. and Virta, M. (2016) Scientific Reports 6: 35790

WE116 Risk of antibiotics in the environment

D.d. Silva Tavares Duarte, Radboud University / Department of Environmental Science; R. Oldenkamp, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science

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...
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 compared the environmental matrices of land (e.g. agricultural microcosms) and aquatic environments (e.g. urban 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 (WWTPs). Most WWTPs 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 changes in the environmental matrices. Further, 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 sulphonamide 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/absence 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 antibiotic on the natural microbial community were evaluated in terms of cell vitality and abundance. Moreover, the spread of sulphonamides 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 (±0 days), but at the end of was significantly higher in treated samples compared to control, demonstrating 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 antibiotic 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 veterinarian antibiotics in both urban and rural streams. Antibiotics detected include sulfamethoxazole, sulfametazine, trimethoprim, danofloxacin, sulfaquinoxaline, sulofoxacin, ciprofloxacin, 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 AR

T.P. Dodsworth, The University of Nottingham / Biosciences; R. Helliswell, The University of Nottingham / Social Sciences; E. King, The University of Nottingham / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering Politecnica delle Marche / Biosciences; R.L. Gomes, The University of Nottingham / Faculty of Engineering
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WE119 The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams of North Carolina

A.D. Gray, University of North Carolina at Greensboro / Biology; D. Todd, 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 the risk of antibiotic resistance. The objective of the present study was to investigate the resistance in bacteria, although data on biodegradat...
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 and, as a consequence, reduce 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 maghemite γ-Fe₂O₃) in zebrafish (Danio rerio). Fish were divided into 4 experimental groups: control; group A exposed to 4μg/L OTC (through water); group B exposed to 100 mg/L OTC (through water) and group C exposed to 4μg/L OTC, and group D 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. Vitala, 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, especially during development 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 2014-2016. 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 blank samples 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 resulting implementation of several important corrective actions.

**WE123** Comprehensive Analysis of Elemental Contamination in Environmental Samples Using Simultaneously Electrospray-Infusion Mass Spectrometry (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 raw or processed sludge. 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-mass spectrometry (LC-MS/MS) or nanoparticle 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

L.R. Diniz, Universidade Estadual do Maranhão / Agroecology; L. Capellini, Universidade Federal de São Paulo UNIFESP / Departamento de Química

Fullerenes are allotroic forms of carbon produced in highly energetic processes of original 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 prevalence of nanomaterial fullerene (C60) in seawater samples. It will be tested two methods of extraction by 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 PFOS and PFOA, 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-MS). PFASs were acquired and calculated, PFASs profile was quantified in each sample.

**WE127** Quantitative evaluation of lag effect in polar organic chemical integrative sampler (POCIS) and modified POCIS with polytetrafluoroethylene (PTFE) membranes

Y. Jeong, H. Kwon, KIST Europe / Environmental Safety Group; H. Jeon, KIST Europe; A. Meyer, E. Fuhrmann, 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 techniques. 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 the marine organic chemical integrative sampler (POCIS). POCIS consists of Oasis HLB supported on a stainless steel membrane sorbent sandwiched between two polyethersulfone (PES) 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 parameters such as flow rate and temperature. Lag effect from membrane sorption within POCIS further complicates the transfer kinetics of analyte. In this study, modified POCIS (POCIS-PTFE) with polytetrafluoroethylene (PTFE) membrane instead of PES membrane was tested in an attempt to avoid or lower the PES membrane sorption. The primary aim of this study is to (1) introduce modified POCIS and (2) identify the membrane sorption within POCIS in order to better understand partitioning kinetics of POCIS. In the laboratory experiment, the analyze mass fraction in membrane relative to total POCIS (i.e., Oasis HLB plus membranes) and membrane-water partition coefficient were determined for a range of compounds (log KOW from -0.03 to 6.26). Less membrane sorption was found in
PTFE membrane than PES membrane for all target compounds. Two types of POCIS were then deployed in a small river and the outflow of wastewater treatment plant for two weeks. Both POCISs showed similar chemical profile and 22 contaminants were detected including 6 priority substances enlisted in EU Water Framework Directive. Although PTFE membrane showed better permeation performance than PES membrane in laboratory experiment, the lag effect was still found from the field application of POCIS-PTFE.

WE128 Occurrence and Ecological Risk Assessment of Several Endocrine Disrupting Chemicals in Urban River Water and Sediment of South China

C. Huang, Jinan University; L. Wu, Y. Guo, Jinan University / School of Environment

This study mainly focused on the occurrence, distribution, and ecological risk assessment of eight selected endocrine disrupting chemicals (bisphenol analogues, parabens, and triclosan) in urban river water and sediment of south China. The eight target chemicals were detected in both water and sediment samples with concentrations ranged from not detected to 65600 ng/L and from not detected to 492 ng/g dw, respectively. Among these eight chemicals, the top three major chemicals were bisphenol A (BPA) (account for 85%), methyl paraben (MeP) (23%), and triclosan (TCS) (14%) in water, while BPA (43%), TCS (35%), and MeP (14%) in sediment. Significant correlations were found between most of the selected EDCs, especially MeP and TCS both in water and sediment (p < 0.01), indicating that these chemicals were in common sources and widely usage. After calculation, our robust model extraction (SBE 13.1) in sediments target substances was flowed into Liuxi river annually based on the 89 primary stream. The ecological risk assessment showed that TCS was the most dangerous compound to aquatic organisms with average HQ = 1.57 (up to 11.5) in river water and average HQ = 0.74 (up to 3.36) in sediment. And the possible joint toxic effect of selected chemicals showed that aquatic organisms were severely exposed to diverse EDCs. This study suggested that compared to the main rivers, the endocrine disrupting chemicals in streams deserves more attention.

WE129 Occurrence, distribution and fate of pharmaceuticals as chemical markers of contamination from urban sources in the vulnerable area of the Ebro Delta (Spain)

M. Celic, M. Gros, Catalan Institute for Water Research ICRA; M. Farre, IDAEA CSIC Barcelona; D. Barceló, M. Petrovic, Catalan Institute for Water Research ICRA

The Ebro Delta and the upper part of the Ebro basin have widely been exposed to contamination from both agriculture and urban sources, being wastewater treatment plant effluent discharges the dominant contamination pathway. In order to determine the distribution and impact of contamination from urban sources in the vulnerable area of the Ebro Delta, water and sediment samples were collected at different sites, covering reaches of the Ebro river located upstream and downstream WTWPs, lagoons, irrigation channels and coastal areas. Water samples were analyzed using LC/ESI-MS/MS (using an API Qtrap 5500) and solid-phase extraction. The results showed that concentrations of ∑4 PFCs were ND–19.69 pm g−1 (for ∑4 PFCs) in air, ND–447.89 ng L−1 (for ∑4 PFCs) in water, ND–9.7 ng g−1 dry weight (dw) (for ∑4 PFCs) in sediments, ND–7.7 ng g−1 dw (for ∑4 PFCs) in soil, and ND–35.0 ng g−1 dw (for ∑4 PFCs) in the fish, respectively. The predominant species among the PFCs were perfluorooctanoic acid (PFOA) in air, perfluorooctanesulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOS and PFOA 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 firstly reported the data of 16 PFCs levels in multimedia environment including air, water, soil, sediment, and fishes in Korea.

WE132 Seasonal changes in water and sediments’ microplastics in a Mexican estuary (Tecolutla).

L. B. Fischer Hernández, P. Ramírez Romo, U.A.M. Iztapalapa / Hidrobiología Microplastics (MP) are persistent contaminants that measure less than 5 mm, they have additives that are vectors of other POPs and metals, which can cause deleterious effects to the organisms that ingest them. MP can increase the temperature and decrease the sediment permeability. On the other hand, plastic particles are efficiently transported through water. There are just a few MP studies carried out using LC/MS/MS after solid-phase extraction. The objectives of the present study were to evaluate the seasonal changes in numbers, size, color and form of the MP present in water and sediment of Tecolutla’s estuary. Water and sediment samples were collected in five different sites in three different climate seasons (northern storms, dry and rainy). In the laboratory water volume was measured and filtered through a nylon screen (Whatman #40) filter, which was later dried at 50 °C for 24 h. Sediments were dried at 50 °C, a 40 g subsample was taken and hydrogen peroxide (30%) was added to disintegrate all organic matter, followed by a zinc chloride solution (pH=1.5 g/l) to float the MP particles. Later the solution was decanted through a cellulose filter and dried at 50 °C for 24 h. MP particles on the filters were observed through microscope (Dissecting followed by digital Celestron) and photographs of the particles were obtained with software Java Image J. The polymer identity was done through Scanning electron microscopy. MP size in water range from 10 to 1,730 µm, and their presence was higher in the northern storms season, due to lower dilution factors. In the rainy season, MP size range from 10 to 730 µm, and their presence was lower in the northern storms season, due to lower dilution factors. Sediments of the MP in the Mexican estuary so continuing this type of research is important to the overall understanding of accumulation of MP in coastal environments.
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
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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 and household water is used in cooling towers. Several treatment technologies such as reverse osmosis, electrodialysis 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 biodegradation. Chemical processes 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 was explored. The representative water treatment chemicals consist of 1H-benzo[47][1]tiazole (corrosion inhibitor), DBNP (biocide), glutaraldehyde (biocide), 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 to monitor the performance of the CW systems? Does the transformation of multiple water treatment chemicals result in the production of new possibly harmful crosslinked products?

WE134
Fate of organic micropollutants in a small river: hydrological and chemical processes
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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 Schönbrunn 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 transformation products analysis based on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunn 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 biotopes 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 Schönbrunn River and adjoining compartments.

WE135
Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria
O.M. Ogunbawo, University of Leeds / Geography (Physical); P. Kay, University of Leeds / School of Geography; L. Brown, University of Leeds / School of Geography; J. Wilkinson, The University of York / Natural and Built Environments; M. Andrews Costa, University of Valencia / Environmental and Food Safety Research Group; M. Díaz, Universidade Federal de Santa Catarina / School of Geography (Physical); R. Alvarez, University of Valencia / Medicine Preventive
The occurrence of pharmaceutical pollutants in surface waters in 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 trichetophrin, sulfamethoxazole, cimetidine, atenolol, and paracetamol were in the order of 150 microg L<sup>−1</sup>. The mean concentrations for sulfamethoxazole, trichetophrin, cimetidine, paracetamol, lidocaine, metformin, carbamazepine and atenolol were 55.90 microg L<sup>−1</sup>, 38.69 microg L<sup>−1</sup>, 31.62 microg L<sup>−1</sup>, 24.99 microg L<sup>−1</sup>, 22.55 microg L<sup>−1</sup>, 20.98 microg L<sup>−1</sup>, 15.35 microg L<sup>−1</sup> and 15.10 microg L<sup>−1</sup> respectively. Venlafaxine has the lowest mean of 4.231 ng L<sup>−1</sup> other than 38 compounds were not detected. With the help of published data from around the world, these values are of 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 emergence of new compounds. In Nigeria, the occurrence of pollutants and discharge into the aquatic environment could lead to ecological problems and antibiotics resistance. Africa governments 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, CIDEd (GV, UV, CSIC); M. Andrés Costa, Universitat de Valencia / 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 increased with the quality of surrounding population (>1600000 inhabitants) has introduced a number of emerging contaminants that threaten this wetland. In this study, 42 drugs of abuse and 45 pharmaceuticals have been studied in influents and effluents of 10 Wastewater Treatment Plants (WWT), 7 irrigation channels and the Lake of L’Albufera de Valencia (Valencia, Spain). Three matrices were analyzed water, sediment and biota. The isolation and concentration were carried out by solid-phase extraction (SPE) and the contaminants were determined by ultra-high pressure liquid chromatography-tandem mass spectrometer (UHPLC-MS/MS), Cacaine as its major metabolite (benzoylcegonine), followed by cannabis as its Δ⁹-Tetrahydrocannabinolic acid, were the main drugs detected in water samples. Regarding to pharmaceuticals, caffeine and ibuprofen were the main compounds obtained in these samples. Nevertheless, other pharmaceuticals were detected at high concentrations in all samples. In spite of this, and its non-complete removal in WWTs, nowadays there are not enough knowledge about how the presence of these pollutants can affect to aquatic ecosystems, and specially living beings.

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
The metropolitan region of Florianópolis has undergone an intense urbanization process in the last 20 years, due to the recent increase of the population of life in this region. The objective of the present study was to evaluate the water quality of the Iaçorubi river in its estuarine region, in order to evaluate the anthropic 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 sterols and pharmaceuticals by GC / TOF-MS after extraction with methyl tert-butyl ether. The water samples were analyzed with respect to the parameters: ammonia concentration, total phosphate, total phosphat, fecal coliforms and sulfide, according to the methodologies described in Standard Methods (APHA). TOF-MS chromatographic analyzes of sediments and water samples were also performed on extracts obtained using SPE (Strata-X/dichloromethane). The results obtained showed high concentrations of ammonia, 350-5000 microg L<sup>−1</sup>, other than high bacterial coliforms. Between the analyzed sterols, cholesterol and derivatives such as coprostanol were identified at varying concentrations in the sediments of the several sites. Estradiol derivatives and drugs such as anxiolectics and remedies for sleep control were prominent in GC / TOF/MS chromatographic analyzes. The results confirmed the high contamination of the waters of the Iaçorubi 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, Universitat de Valencia / Environmental and Food Safety Research Group; A. Cuñat, Universitat de Valencia / Environmental and Food Safety Research Group, CIDEd (UV, GV, CSIC); R. Alvarez-Ruiz, University of Valencia; Y. Pico, University of Valencia / Medicine Preventive
SETAC Europe 28th Annual Meeting Abstract Book
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the depporation 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 were obtained from different treatment plants next to the Natural Park of the Albufera in Valencia, an area surrounded by 14 000 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) steps, using with acetonitrile and purified with the two solid phase extraction (SPE) steps, using

From January to October 2015 in total 27 samples of Mediterranean mussels (Mytilus galloprovincialis) collected around the lake; CBs were also carried into the lake with using of NaCl. The occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) and 10 samples of sea water were collected along the coast of Dongting Lake. Samples were collected at three shellfish farms, at the open sea and also from the harbor of Kobe. Each sample was collected in triplicate. The samples were homogenized, and stored at -20°C until analysis. The detection and identification of bisphenol A was performed by gas chromatography coupled with a quadrupole mass spectrometer (1990s, it was estima...
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 uptaken in crops following wastewater irrigation. Among commonly consumed crops, vegetables are potentially of concern due to considerable amounts of reclaimed wastewater used in irrigation. In this study, we investigated the fate of pharmaceutical compounds in a wastewater treatment plant (WWTP) equipped for the elimination of carbon and nutrients. The primary treatment consists of a screen, an aerated bean 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 pharmaceutical 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), sucrose, and polystyrene and its salt. Soils and insecticides were bioaccumulated with potential bioaccumulation occurring.

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; RDA; G. Choi, National Institute for Agricultural Science; R. Ryu, J. Park, International Institute Science, RDA
Residual organochlorine pesticides (OCP) are chemical substances that are resistant to environmental degradation chemical, biological and photolytic process, and are bioaccumulated with significant potential 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 (grape, peach, apple, and pear) soils and fruits. Extraction and ion trapping in the alkaline phloem fluid (pH 8). The preliminary results with the new steady-state model, showed the uptake capacity 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_Prot_Model/index.htm

WE146 PhytoCOTE project: Assessment of organic and inorganic contamination in vineyard soils
M. Hidalgo, LPTC EPIC UMR5805; M. Déméter, University of Bordeaux / EPOC 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 results showed that in orchard soils were lower level than bioaccumulation occurring.

WE147 Analysis and Assessment of Organic Contaminants in Materials Spread on Land in Scotland
E. Stutt, WCA Environment Limited; I. Wilson, G. Merrington, WE148 Microplastics in Agriculture Soil.
K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Aalst, Aalborg University / Department of Environmental Engineering; J. Vollertsen, 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 project will present a new study that investigated microplastics in agricultural soils in Sweden. The authors thank the Scottish Environmental Protection Authority (SEPA) for funding this work.
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 (DnBP) contents in soil and whether SMS could reduce DnBP accumulation in bok choy, a study that 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 Vignette studies and ultimately the risk assessment. Data will be used for test species planted at three densities to evaluate any impact on the Vegetative Vigour Study endpoints (expressed as ER50 values) used in the risk assessment.

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. Mesocosm studies allow the effects on both individual species and communities to be assessed simultaneously. Unlike 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 Vignette

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Non Target Terrestrial Plant (NTPP) 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 Vignette Studies, recommends 1-2 large plants per 15 cm diameter 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 vignette 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 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.
WE154 Interspecific competition impact on organism responses to chemical stress : an SSD-based approach.
V. BAILLARD, LIEC (CNRS UMR 7360, Université de Lorraine); C. SULMON, ECOBIO; CNRS UMR 6553, Université de Rennes 1 / UMR CNRS ECOBIO; A. BÉRARD, LIEC (CNRS UMR 7360, Université de Rennes 1); S. DEVIA, LIEC, CNRS UMR 7360, Université de Lorraine / LIEC, CNRS, E. BILLIOIR, Université de Lorraine, CNRS UMR 7360

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 capacity). For each condition, shoot replicates were grown in nutrient media. 10 different traits corresponding to morphological, biomass and physiological responses, as well as the response profile of 50 metabolites were quantified for aerial and underground plant parts, then representing respectively soft (easy to acquire) and hard traits. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and competitor presence/absence. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modify points (1) and (2). In parallel, metabolic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE155 How to consider recovery of aquatic plants in risk assessments?
U. Hommen, Fraunhofer IME; G. Arts, Wageningen Environmental Research (Alterra) / Environmental Risk Assessment; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; H. Krueger, EAG Laboratories

Exposure of non-target plants to plant protection products or other stressors can be restricted in time. For each endpoint, several replicates were exposed to isoproturon, a fast acting herbicide, at low concentrations. This study identifies as stomatal opening sensitive endpoints, such as the number of leaves with fully open stomata, the number of leaves with partially open stomata, and the number of leaves with closed stomata. The consequent dataset generated was used to model plant responses depending on isoproturon concentration and exposure. For soft traits, dose-responses curves were built for each species, in presence and absence of competitor for each endpoint to define (1) their sensitivity, (2) their relevance to assess toxicity, (3) how competition modifies points (1) and (2). In parallel, metabolic data were treated the same way, using a workflow created to handle high-throughput dose-response datasets from omics experiments. We then calculated toxicity values and built SSDs with and without competitor presence in an attempt to quantify competition effects compared to competitor-free ecotoxicological data. A final experiment, involving a complex assembly of the same 6 species under various isoproturon exposures was carried out to assess our model validity using community scale data.

WE156 Rimsulfuron toxicity and recovery in duckweed (Lemna minor)
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 Lemna 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% Hoagland media at concentrations of 0, 0.0003, 0.0006, 0.0125, 0.025, 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 horometic response was observed at the 0.0003 mg/L concentration. In this case, the growth rate was 16.7% relative to the control. Following exposure, percentage reduction 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 Toxicokinetic/toxidynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants
S. Hanne, Bayer Ag / Effect modelling; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; A. Solga, Bayer AG; T. Preuss, Bayer Ag / Environmental Safety

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. To characterize the TK/TD model for aquatic plants, ecotoxicological thresholds derived from experiments with constant exposure to an active substance over several days are compared to the predicted maximum environmental concentration. Although, it can be deemed conservative to only consider the maximum concentration, there are plenty of cases where the risk assessment becomes overly conservative due to this practice. This applies particularly to assessments for lotic frameworks in which exposure concentrations usually last for a few hours or days. Since some models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (exposure patterns), a more detailed and realistic assessment of exposure is possible. To also increase the realism on the exposure side, an ecotoxicological threshold from a refined exposure experiment is needed, or the effect of the predicted exposure pattern on the organism is investigated by ecological modelling. We propose 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. For characterizing 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 TK/TD model for Lemna minor 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 collembole
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

Methylparaben is an endocrine disrupting chemical (EDC) and is contained in 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 not treated properly. In order to prevent adverse effects on aquatic organisms, 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 collembole. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21 days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collembole 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 collembole 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 SETAC Europe 28th Annual Meeting Abstract Book
WE159 Evaluation of phytotoxicity for Bispheanol A with new endpoint, phytoestrogen

D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

We tested some polycyclic aromatic compounds (EDCs) as known chemicals that show hormonelike 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 products, an evaluation for each isomer associated with the environmental risk, takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bispheanol A. Meanwhile, bispheanol A is known as a representative EDCs used in the production of consumer products and in various industrial fields. While it is used widely for various purposes, the soil ecotoxicity of bispheanol A is limited. Therefore, we evaluated the toxicity of bispheanol A to plants (I. spicatum) using the set of environmental endpoints and evaluated the applicability of phytoestrogen, a new endpoint for EDC 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 mostly 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 contents, 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 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.

WE161 Toxicity of a glyphosate based formulation on phytoplanktonic 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.

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.

WE162 Indicator, indigenous and invasive species: the need of risk-benefit considerations in PPP risk assessment

G. Meregalli, 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 are 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 combat invasive species need to be developed also considering 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 above-mentioned examples. In

WE163 Auxinetic herbicides: the impact of water plants’ root measurements on the risk assessment

G. Gensior, Eurofins AgroSciences 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 auxinetic herbicides. The OECD 239 water sediment test with Myriophyllum species was developed to assess the risk to autochthonous species in aquatic environments 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. Auxinetic substances are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxinics. 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 auxin substances would result in significantly different endpoints that would be relevant for risk assessment of auxinetic 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. Kubitz, 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
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 imazaquin, 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 contaminations 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 wastewater are easily absorbed by macrophytes. 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, interconnected with the terrestrial environment through the water column, and thus also play a role in the terrestrial environment (Ceratophyllum demersum). Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-16 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, to determine the 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 (GPx), guaiacol peroxidase (GPOX) and ascorbate peroxidase (APOX) was performed in the plant system. The objectives of this test were (1) to evaluate the efficiency and capacity of different species of aquatic macrophytes in removing heavy metals from wastewater; (2) to identify potential endpoints to develop new methods for metal removal; (3) to evaluate the capability of different species of aquatic macrophyte to remove metal simultaneously and (4) to study the potential role of aquatic macrophytes in phytoremediation processes.

WE166 Physiological responses of Thlaspi prae co x (Brassicaceae) to Ni hyperaccumulations

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 Multidisiplinary Research; D. Mišić, University of Belgrade / Institute for Biological Research Sima Štanković Thlaspi prae co x is a well known heavy metal hyperaccumulating plant species. The ability of T. prae co x 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 pH physiology of T. prae co x exposed to increasing concentrations of Ni. Seeds of T. prae co x were collected from an ultramafic site on Mt. Maljen (Serbia). Two-week-old seedlings were transplanted 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 were analyzed using UHPLC/DAD/MS 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 co x 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.
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 mayor concerns as
they are persistent in nature, non-biodegradable and can bioaccumulate in living
animals and plants. Metals in aquatic ecosystems may have effects on primary
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 are 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
frond 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 ascorbate peroxidase activities where higher than control,
however neither of both presented significative differences with it. For the mixture
analysis, multiple regression was used to fit the observed %frond number inhibition
(%FNI) to dissolved metal concentration ([Mdis]). 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 toxic units (∑TU) for each mixture test case based on single EC50s. 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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Martinez, s. curieses, J. Alberdi, CONICET PRIET UNLU; W.D. Di Marzio,
CONICET-PRIET / PRIET
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 wood preservation. The aim of this study was 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, Scenedesmus quadricuada and Nannochloris oculata. 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
to1,73 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 concentration solutions. Samples of solution and algal cells were
taken for metal determination in order to dilucidated 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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Sanitation; O.A. Bandeira, T.J. Pinto, L.P. Figueiredo, University of São Paulo
USP; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation
In Brazil it is very common to have mining waste placed in dams, especially in the

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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 strigosa, Pennisetum glaucum, Crotalaria
juncea, Canavalia ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab,
Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The
ecotoxicological assays were run using five treatments, which consisted in 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 avaluated
were: Fresh and dry biomass (shoot and root), height, length of the longest root and
seed emergence. All species, except Lupinus albus and Avena strigosa, had EC50
and/or EC20 in at least one of the seven parameters evaluated. The species that
presented 50% inhibition of root growth were C. juncea (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. juncea and P.
glaucum. The results showed that: the species tested presented different indices of
tolerance to the mining waste; the waste that outpoured of the Fundão dam caused
phytotoxic effects in 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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Université Claude Bernard Lyon 1 / UMR Ecologie Microbienne 5557
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 [3] 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 (1) and reported the importance
of organic matter (OM) content in the NPs ecotoxicity due to its role as dispersing
and stabilizing agent (2). 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 (ie abundance and activity of microbial communities involved in
carbon and nitrogen cycle) were used to assess NPs effects. The experimental
design consisted in planted and unplanted soil microcosms contaminated or not
with two doses of CuO-NPs (1mg and 100 mg/Kg) before the seedling of wheat.
We compared the effect of two conventional varieties (Arrezzo® and Skerzzo®)
exhibiting contrasted traits reflecting different root exudation. Ecotoxicological
effects were assessed after 30 and 50 days by measuring plant traits on each variety,
microbial activities (respiration, nitrification and denitrification) and microbial
abundance by qPCR targeting 16S RNA gene and function genes. The main
physico-chemical properties of NPs were characterized by Dynamic Light
Scattering in rhizosphere and unplanted soil solutions in which ionic strength, pH
and dissolved organic carbon were also measured. The results showed that the NPs
hydrodynamic diameter was higher in planted soil solutions compared to unplanted
one. Comparison between planted and unplanted soil showed that the plant
hampered ecotoxic effects on the microbial activity of functional microbial groups
without significant changes in their abundance. Arrezzo® limited the reduction of
nitrification and denitrification suggesting that NPs ecotoxicity depends on the
wheat variety likely because of the effect of roots on NPs and /or the microbial
populations recruited in the rhizosphere that can be more or less sensitive to NPs.
Water Res
WE173
Use of Posidonia oceanica as a potential bioindicator species of metal
pollutants: cellular and molecular responses to mercury exposure
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Institute for Environmental Protection and Research; G. Martuccio, C. Sebbio,
ISPRA Institute for Environmental Protection and Research / National Center for
Laboratory Networking Ecotoxicology Area; F. Onorati, ISPRA Institute for
Environmental Protection and Research; A. Cicero, ISPRA Institute for
Environmental Protection and Research / National Center for Laboratory Network
The marine phanerogam Posidonia oceanica, thanks to its worldwide distribution

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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 µgL-1 Hg Cl2) under constant laboratory conditions. Biochemical markers of oxidative stress of genticity, such as the glutathione S-transferase activities, the ascorbate peroxidase activity, the total antioxidant capacity, the phenols content, the level of lipid peroxidation and the micronecrosis 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 toluene vapor exposure on plant metabolic changes**

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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 plant damage by introducing markers like proline (Pro), malondialdehyde (MDA) to be a pervasive, not sensitive indicator. 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 evaluated by using Lycopersicon esculentum and Parthenium hysterocephalum. Toluene was selected as target compound based on the scoring system, which takes into account both account 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 metabolic 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 metabolomic approach and provided an insight into quantitative chemical accident damage assessment.

**WE175**

**Influence of soil organic amendments on the phenolic contents in rosemary (Rosmarinus officinalis L.) plants**

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Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean region and grown as a common herb around the world. This species constitutes an exceptional source of different bioactive compounds, mainly phenolic compounds, with proved antimicrobial and antioxidant activity. Furthermore, different studies have shown the potential and important role that this shrub can have in the rehabilitation of degraded soils such as agricultural ones with low levels of organic carbon, contributing to the reduction of erosion and improving soil quality. Within this context, different studies have shown that the metabolism of the phenolic compounds in plants has been associated to environmental factors, such as temperature, rainfall and ultraviolet radiation incidence, as well as soil composition. In this sense, plant nutrient balance in the soil could influence the production of secondary compounds, the concentrations of secondary metabolites in relation to the quality and availability of nutrients in the soil. Therefore, this study evaluates the effectiveness of the rosemary plant to improve soil quality and the effect of the incorporation of two composites derived from anaerobic digestates on the phenolic contents of rosemary plants grown a semiarid soil in the study, two composites (CM, mainly composed by cattle manure anaerobic digestate and CS, mainly composed by pig slurry anaerobic digestate) at two rates (0 t/ha and 1 t/ha respectively) were incorporated into a semiarid soil from central Italy. These organic amendments were compared with the soil without amendment (control treatment, B) and an inorganic treatment (I). Subsequently, plants of rosemary (Rosmarinus officinalis) were planted on these soils. The efficiency of the treatments was evaluated by analysing chemical characteristics in the soil and the total contents of phenolic compounds and flavonoids 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 compounds in the rosemary plants, probably due to the nitrogen fertilisation increases growth, but also leads to decreased concentrations of carbon-based secondary metabolites, such as phenolic compounds.

**WE176**

**Leaf litter originating from trees treated with systemic fungicides - a new exposure pathway for freshetive systems**

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Leaf litter decomposition, an important process in freshwater ecosystems, is mediated by microbial decomposers and leaf-shredding macroinvertebrates. This process can, however, be modified by chemical stressors such as fungicides. Although fungicide stress has increasingly been assessed in recent years, the systemic nature of some fungicides, which enables the uptake and distribution within treated plants, is not yet considered. Therefore, as a first step, we treated Alnus glutinosa with a mixture of systemic fungicides (SFs; azoxystronin, cyprodinil, quinoxyfen and tebuconazole) via soil drenching at three levels (control, field application rate (FR), and 10 times the field application rate (FR×10)). During leaf fall, we collected the leaves and assessed the potential impact of the fungicides on microbial decomposers and leaf-shredding macroinvertebrates. We quantified microbial leaf litter decomposition, their community composition and the palatability of leaves after microbial conditioning for the model shredder Gammarus fossarum Koch. By assessing growth and physiological fitness of this species over multiple weeks, we additionally estimated the nutritional quality of leaf litter. Gammarids preferred conditioned FR×10 over control leaves, which may reflect changes in microbial community structure. This increase in palatability as a consequence of SF may be related to the fungicides’ ability to reduce fungal pest pressure, allowing trees to divert energy and carbon from defense to growth or storage. The same treatment resulted in a 300% increase in gammarid growth, while SFs had no effect on gammarid growth and reproductive success.

**WE177**

**SETAC Plants Interest Group**

S. Loutseti, DuPont De Nemour Hellas S.A.

**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 de Meer, University of Amsterdam / IBED-Institute / Department 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 more active bioturbators being the most sensitive benthic invertebrates. Active bioturbators thus enhance their exposure and therewith their sensitivity to sediment associated toxics. 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 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 wastewater treatment plant (WWTP) effluent 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. Contrastingly, a high level of emergence at WWTP sites indicated the potential for elevated pyrene and phenanthrene leaching to the surface water. Hence, the study was able to provide an indication of the urban pesticide load and its potential for downstream transport.

**WE180**

**Quantifying the Bioavailability of HOCs associated with Suspended Sediment to Daphnia magna**

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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 of 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 pyrene in the exposure systems. The effect of pyrene associated with different compositions of SPS grains (including organic carbon, non-oil 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 determine the bioavailability of SPS-associated pyrene. The results showed that with C_{0,0} of pyrene ranging from 20.0-60.0 μg L^{-1}, the immobilization of Daphnia magna in the presence of 1 g L^{-1} SPS were 1.11-2.89 times that in the absence of SPS. The concentration of mineral-associated pyrene was more than 10 times that of organic carbon-associated pyrene. The bioavailability of SPS-associated pyrene was approximately 50%-60%, 10%-29%, and 20%-30%, respectively. The bioavailability of pyrene sorbed on the three components of SPS was ordered as AOC (22.4%-67.3%) > BC (10.1%-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 C_{0,0} was 20.0 μg L^{-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 SPS compositions. The effect of SPS on the bioavailability of SPS-associated pyrene was mainly due to the difference 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.

**WE181**

**Sediment quality assessment in the Netherlands: Link between chemical, toxicological and ecological parameters**

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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, multidisciplinary studies are needed in order to identify and prioritize contaminations and risks. This is why it is important to incorporate ecotoxicological risk assessment to sediment management. Hence, we contribute to the quantification of relationships between chemical concentrations and toxicological assay in sediments. These relationships can be used in future analyses of predictive abilities of sediment quality and can be applied in an assessment tool for sediment management to determine management strategies.

**WE182**

**Integrative approach to assess ecological risks of sediment metallic contamination in Lake Ohrid (Albania)**

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It is now widely admitted that chemical monitoring of pollutants in waters and sediments is not sufficient to assess the risks caused by such pollution in aquatic ecosystems, since chemical data alone provide no indication of biological effects. Biological responses of exposed organisms need to be taken into account, allowing to define the ecotoxicological status of the studied system. The ancient lake Ohrid, the oldest and by far the most diverse lake in Europe, has been chosen as case study. The Albanian side, due to the presence of ultramafic rocks, was a large mining area exploited to produce nickel, chromium, and iron until the early nineties. Several ore dumps from this past activity still remain near the shoreline, representing one potential input source of these metals. Several creeks flowing across soils naturally rich in metals also contribute to metal inputs into the lake. We studied three sites along the Albanian shoreline of Lake Ohrid, and defined by different metal pressures: “Pog” in an urbanized area but considered as dimly contaminated by metals, “Menv” and “Poj” located in the ultramafic area of the lake, at the vicinity of a Fe-Ni dump site for “Menv”, and nearby the outlet of a creek for “Poj”. In the two sites under metallic pressure, sediments contained high levels of metals with concentrations reaching 93.8 mg/kg for Co, 345.1 mg/kg for Cu, 225.6 mg/kg for Ni, and 872.9 mg/kg for Fe. Despite these high concentrations, metals are not necessarily bioavailable. This is why it is also important to combine chemical characterization (total and available pools) with the study of lethal and sublethal effects after acute and chronic exposure. In our study, we assessed ecological risks in Lake Ohrid using an integrative approach consisting in: (1) chemical and physical characterizations of sediments, (2) assessment of metal bioavailability, (3) ecotoxicological bioassays, and (4) the study of sub-lethal effects on organisms. During this presentation, the main results from this integrative work at Lake Ohrid will be presented.

**WE183**

**Active Bio-monitoring and DGT Passive Sampling: Holistic Assessment of Metal Bioavailability in Sediments and associated risks**

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Impacts of sediment metal contamination on aquatic ecosystems and their functioning remain a widespread problem. The ecotoxicological risk associated with metal contamination is dependent on metal speciation, 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 bio-monitoring techniques are often time consuming and highly dependent...
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 Chelx-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 Flins (Benelux), to test their bioaccumulation 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 bioaccumulation.
T.M. Remali, W. Bennett, Griffith University / Environmental Futures Research Institute; L.S. Simpson, E.O. Land and Water / Centre for Environmental Contaminants Research; E.D. Parnell, University of Antwerp / Department of Biology; D.T. Welsh, Griffith University / Environmental Futures Research Institute; E. Lombi, University of South Australia / Future Industries Institute; D. Howard, Australian Synchrotron; D.F. Jolley, University of Wollongong / School of Chemistry.

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 and passive sampling methodologies; 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 (Victoriosiopha australiensis) survival from 53% to 100% and 42% to 93%, respectively; and reproduction in a second amphipod (Melita plumulosa) 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 biorator present showed the interaction of bioturbation and the waters with the resultant 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-oxo/hydroxide phases or to re-spurred particulate phases. These results highlight the importance of considering organism-interactions during sediment quality assessments, and the contributions they have to biochemistry 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
M. Gillmore, E.O. Land and Water / Centre for Environmental Contaminants Research; G.A. Price, University of Wollongong / School of Chemistry; L.A. Golding, CSIRO Land and Water; J. Stauber, CSIRO / CSIRO Land and Water; M.S. Adams, CSIRO, S.L. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry.

M. Gillmore represents an integrated approach to testing the potential influence of nickel contaminated sediments on the marine amphipod Melita plumulosa. The research will focus on detailed examination of the surface chemistry of the nickel-contaminated sediments and the effects on this exposure on the physiology of the amphipod. The research proposes to develop a methodology to predict the biological effects of nickel contaminated sediments on amphipods using the diffusive gradients in thin films (DGT) technique.

WE186 Identifying key toxicants in sediment samples from urban waterways in Guangzhou, China using a integrated method of TIE and EDA
J. Ye, H. Li, F. Cheng, Jinan University / School of Environmental Engineering; M. Casado-Martinez, T. Benejam, R. Vivien, Centre Ecotox; S. Pesce, Iotea Lyon-Villeurbanne / Microbial ecology of anthropised river systems; L. De Alencastro, Ecole Polytechnique Fédérale de Lausanne / Central Environmental Laboratory; N. Dubois, Eawag; L. Rossi, Hyridique Ingénieurs; S. Höss, Ecossea / Animal Ecology; B.J. Ferrari, Centre Ecotox EAWAGEPPE. Sediment represents an important compartment in surface waters. It constitutes a habitat or spawning site for many organisms and is an essential trophic resource for higher level organisms. It can be impacted by anthropogenic activities, particularly through urban wet weather discharges like stormwater and combined sewer overflows. In Switzerland, the Vidy Bay located in the middle of the northern shore of Lake Leman, in front of the city of Lausanne, is of particular interest as it 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.
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, metal concentrations, the chemistry of sediment samples from the 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.


WE188 Ecotoxicological profiling of sediments along the River Wurm by Aachen - (North-Rhine-Westphalia, Germany)
A. Shullakevich, 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. Kamrat, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S. Otter, 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 DemO AC-project. The aim of the DemO AC-project is to fill the gap in ecotoxicological knowledge of the sediments 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 ecotoxicological 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 as well as for a liquid and solid phase ecotoxicological evaluation. 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 DemO 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. Parisch, Humboldt University of Applied Sciences (HAW); S. Höss, Ecosca / Analytical Ecology; S. Heise, Humboldt 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 trial approach will assess the ecotoxicity, the ecopharmacology and the chemistry of sediment samples from three catchment areas 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.


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. Vendemiati, I.I. Vecchi, University of Campinas / LEAL Laboratory of Environmental Toxicology; C. Andrade, Institute for Environmental School of Technology; G. Umbuzeiro, School of Technology, UNICAMP / LAEG 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 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 Paranephrops norvegicus. Three campaigns were conducted. Acute toxicity tests were performed in water and in fresh and dried sediment as well water and sediment samples were tested using 96-wells microplates, and the sediment using 12-wells-microplates containing sediment and salt water in 1:4 (w/v). Exposure conditions were 96th, 24±2°C, 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 discharge. Acknowledgements: FAPESP 2015/24758-5 and CNPq 400362/2014-7.

WE191 Swimming in turbulent 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. Espinat, INRA; S. Bony, INRA-CNRS / IPE; A. Devaux, INRA-CNRS / UMR LEHA 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 research 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 realistic context sediment deposition and the effect of fish swimming 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 (0.25; 0.5; 1.0; 2.0; 4.0 and 10.00 mg/l of non-contaminated fine sediments (mica)) for 28 days, mimicking dredging operations in terms of duration and environmental concentrations. They were sampled weekly, and mortality, condition index and health 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 erythrocytes. These results meant that fine sediment exposure did not lead to a physiological stress throughout 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. Hetiens, SPHERE / SPHERE, K. Schachtin, SPHERE, University of Antwerp / Department of Biology SPHERE and ECORE Research Groups; J. Teuchies, E. Anato, L. Vervoets, 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 (bio)sorption may be present in a variety of 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, it has been observed that 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) invertebrate species 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 natural 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 mortality of (benthic) macroinvertebrates. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

WE193 Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment
N. Wilbrand, RWTW Aachen University; A. Shuliaievich, 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 components of our ongoing pollution problem. Metal ions are abundant in various matrices and are applied in industrial processes and consumables every year. A considerable part of it enters waterbodies from diffuse and point sources. [1] Micropolutants 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 processes and therefore are still discharged into surface waters, i.e. directly in discharged micropolutants 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 DemoAC-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 extraction of the sediments via a pressurised liquid extraction, cell-based bioassays 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 phototaxis (aversion to bright areas and natural preference for the dark) to evaluated effects of neurotoxic 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, ISPRRA Institute for Environmental Protection and Research; I. Lanzoni, Department of Life and Environmental Sciences Polytechnic University of Marche Ancona Italy; F. Regoli, Universita Politecnica delle Marche; M. Faimali, CNR ISMAR
Recently a new regulation for the management of dredging sediment has been introduced in Italian legislation (Decreto 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 new environmental quality assessment procedure for dredging sediments. In this context, a new approach was developed to integrate ecotoxicological analyses with chemical data in order to assess the environmental risk of the dredged sediments. The new approach is based on a weight of evidence approach and allows an objective “pass to fail” decision for the evaluation of sediment quality. The results of the ecotoxicological analyses are then assessed as a whole at the level of “battery” (not of single bioassay), weighing the biological relevance of the measured effects, the sensitivity of organism, the statistical significance of measured results and the reproducibility of results under the same experimental conditions in 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 bioassays
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment Team; D. FAME; J. Vonk, University of Amsterdam IBED-FAME; J. Vonk, University of Amsterdam IBED-FAME / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment Lipophytic pesticides are frequently detected in sediments, potentially leading to toxic impacts on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory bioassays with a few standard test species (Chironomus sp. and Hyalopha azteca). It is, however, uncertain whether these standard benthic test species are representative for a wider array of freshwater benthic organisms. We selected the benzo(apyrene 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 bioassays 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: Caenis horaria > Chironomus riparius > Gammarus pulex > Chironomus thummi > Sialis lutaria. 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 natural 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 mortality of (benthic) macroinvertebrates. The results of this study are expected to increase the insights in the applicability of passive samplers for future sediment risk assessment and to be useful for the development of more standardized and integrated approaches.

T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment Team; D. FAME; J. Vonk, University of Amsterdam IBED-FAME; J. Vonk, University of Amsterdam IBED-FAME / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment

Concentration to 5% of the tested species (HC5 and 95% confidence limit) derived from these 10-d-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 (4.3/7.4 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 28-d-LC10 values showed the following order from low to high LC10: Asellus aquaticus > Chironomus riparius > Caenis horaria > Ephemeron danica > Hyalopha 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 that the 28-d LC10 estimate for the most sensitive standard test species Chironomus riparius (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
by mussel culture. Aquaculture activity in Portugal has presented a rising trend over the years, however, extensive and semi-intensive rearing systems are poorly controlled, raising questions not only about the influence of environmental factors on production, but also on the threats that the activity may pose to the surrounding environment. Among these are, for example, the destruction of natural habitats due to facilities extension and aquaculture effluent discharges with high nutrient input to the surrounding water bodies. Careful site selection and efficient waste management plans are imperative to minimize these potential threats of aquaculture practices. Although fish supply for human consumption from aquaculture has already surpassed that of fisheries, concerns about farmed fish quality have been raised. Fortunately, it has also resulted on the honing of aquaculture methods and practices, especially concerning the control of water quality and animal feeding, in order to achieve the highest quality product.

WE199
Characterization of the ontogenetic variation and nutritional composition 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, ICECO & 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 estuaries in each estuary). No significant differences were found among both species reared in the same group 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 HUFA 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 sugars and polysaccharide content in fish of both species. Differences in fatty acids 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 nutritional value of the same species produced in different sites. From a 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 could be conducted to define the parameters that should be regulated and monitored in semi-intensive systems to obtain the best product with the highest final quality.

WE200

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 fluimicline) on the community composition of marine biofilms exposed to these substances and on the amphipod Gammarus aequicaudatus. Marine biofilms from the sea bed were exposed to 1, 10, 100 and 1000 µg/L of oxytetracycline and fluimicline for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicaudatus organisms for two weeks. The G. aequicaudus aquaria set up was 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 markedly 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 phosphorous), 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 arborescence up to 100 µg/L, while the highest tested concentration contributed to a decrease of the biofilm arborescence. Ongoing work includes the evaluation of antioxidant’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistome), diatoms identification, and photosynthetic activity assessment. Regarding the G. aequicuada 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 by the researcher to determine the relevance of each of the evaluated antibiotic exposure routes.

WE201

Shifts in the diatom assemblage structure and biological traits of marine biofilm 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. In particular, the antibiotic treatment of aquatic animals is of increasing concern, given the risk to contribute to the emergence of drug resistance in wild aquatic populations. In this study, the antibiotic exposure route to wild aquatic populations is evaluated by investigating the role of diatom communities. The diatom community was selected as a model system because their high abundance, and contribution to the productivity and accretion of chemical contaminants to the sediment. The diatom community was sampled in indoor mesocosm experiments. The environmental conditions were similar to those found in Scottish salmonid farms. The use of antibiotics in these environments has been associated with an increase in the antibiotic resistance levels.

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. Lilllicrap, NIVA / Ecotoxicology and Risk Assessment

Hydrogen peroxide (H2O2) is widely used in commercial, industrial, medical, environmental and hygiene applications. It is applied in aquaculture for controlling biological problems such as salmon lice. H2O2 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 H2O2 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 fluorescence of intrinsic ROS production. In this study, diatom responses to peroxidative stress was evaluated. This work was carried out in collaboration with the aquaculture team from NIVA and the laboratory of Dr. Paola Telfer at Siller through the project EU-Bathauto. For the first time, the potential for a high-throughput approach to evaluate the impacts of peroxides on diatom fitness will be demonstrated.

WE203

An updated version of the SEPA BathAuto tool for assessing anti-parasitic chemical treatments in marine fish farms

I. Cannall, Cambiate Environmental Assessments; A. Berkeley, Scottish Environment Protection Agency; F. Erichr, CEA; G. Hughes, Cambridge Environmental Assessments

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 Gillibrand and Turrell (1999; MLA Report No 2011/1802) and recently extended by Cannall, Erichr 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 in other jurisdictions.

WE204

State-of-the-art on the use of models for the ERA of chemicals used in aquaculture production


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, metals) and environmental fate of the chemicals concerned. Discharge quantities are typically calculated for three anti-parasitic chemicals: azamethiphos, cypermethrin and deltamethrin. These are antiguanthelmintics and 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 Gillibrand and Turrell (1999; MLA Report No 2011/1802) and recently extended by Cannall, Erichr 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 in other jurisdictions.

WE205

Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp
The continued growth of marine aquaculture production has presented the industry with environmental and production concerns, of which the ecotoparasitic salmon lice (Lepeophtheirus salmonis) has gradually become a major problem. A commonly used pesticide 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 larvae 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 thus 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 set model 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, 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 health risk was estimate using the Hazard Quotient (HQ) method. The results indicated HQ was at disregard to fish species and in order of decreasing dominance, the overall range of concentrations (ng/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 (0.027-0.094), Co (< LOD-0.0015) and Cd (< LOD-0.015) 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 in milkfish. In Mullet, Fe, Co, Cr, and Cd levels were higher in the muscles than in the livers and Cu, Pb, Zn, and Ni levels were higher in the livers than in the muscles. The concentration of Pd 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 HQ 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 by FAO/WHO and USFDA, it might be possible to regulate health risk to humans 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 Benzobicyclon on Crayfish**

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Benzobicyclon is the active ingredient in the herbicide, BUTTE®. In 2001, various formulations using benzobicyclon 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. Benzobicyclon is a prochelate 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 flooded rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzobicyclon rapidly hydrolyzes to benzobicyclon hydrolylate, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzobicyclon 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.**

G. Alberdin, Universidad de Cádiz (Spain) / Toxicology Area; V. Aranda, University of Cadiz / Toxicology Area; M. Manuel, University of Cadiz / Analytical Chemistry; J. Ortiz, C. Sarusquete, CSIC / Spanish National Research Council; J. Arellano, University of Cadiz / Toxicology Area

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 flavonoid compounds the isoflavones daidzein and genistein. *Solea 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 *Solea 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 photoperiod of 12h light/12h dark. A maximum of 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&D&I 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**

M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; P. Baldoni-Andrey, C. GELBER, F. Monnède, TOTAL SA

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®. Its main advantages are: it is photothermic (all dark); juveniles are exposed at five nominal concentrations of genistein (all in 11 species, 9 of which are marine and include Vibrio Fischeri, plus 2 freshwater bacteria) against only one for Microtox® (Vibrio Fischeri). Using a set of narcotic substances with different hydrophobities and two mixtures (one home-formulation comprising equimolar concentrations of four of the narcotics tested and one petroleum based complex substance) a comparison of both tools was realised with the aim to determine whether the former is the better tool to evaluate effects on bacterial species. While it was recognised that the substances tested would not be directly comparable to whole effluents, this method was felt to be appropriate to compare the two assays. The in-built EC50 calculation software were also verified. Some errors were detected with the LumiMARA® effects calculation software, and these were recalculated by hand using Rjegto software, when possible. We observed that Microtox® is more sensitive than LumiMARA® and that in the latter test, freshwater bacteria toxicity is generally lower than that of marine bacteria. This suggests that there may be a small but real difference between freshwater and marine bacteria toxicity however this cannot be concluded on the basis of this research. Moreover, Vibrio Fischeri is the bacterium that usually has the lowest EC50 compared to other bacteria. Thus, the marine bacterium Vibrio Fischeri classically used to determine the biotic effect

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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**

A.S. Sachkova, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryasheva, Institute of Biophysics SB RAS

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 derivatives C60–C70 (10 mg/L), SWCNT (0.05–2 mg/L) and humic substances (HS) are used here as bioactive compounds. Fullerences are polynuclear aromatic 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 toxicity effect of organic (1,4-benzoquinone) and inorganic (K2[Fe(CN)6]) oxidizers on bioluminescent bacteria. We found the effective concentrations (EC50) of these oxidizers decreasing bioluminescence intensity by 50%. The EC50 values of 1,4-benzoquinone were 2.5±10 M and 10 M for bacterial and enzymatic assays, respectively, while the EC50 values of K2[Fe(CN)6] were 4.1±10 M and 2.1±10 M. Also we studied the influence of bioactive compounds on the assays. They suppressed bioluminescence of the bacterial and enzymatic systems at concentrations >10¹⁵/L and >10¹⁰/L, respectively. Deterioration 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 phosphoreum**

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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. It was checked whether the bioluminescence intensity varies as a function of irradiation dose, and if so, which irradiation parameter is the most sensitive to it. When bioluminescence inhibition started to decrease, the sensitivity of bacteria to the low-dose radiation increased. For different dose rates (up to 4100 mGy/h), there was no noticeable effect of gamma-radiation on bioluminescence intensity, while at 20°? the dose rate dependence was revealed. 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 radiation. The immobilized enzyme system HyFn decreased in the following order: MWCNT > SWCNT > CNT 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.

**WE212 Bioluminescent Assay for Toxicological Assessment of Nanomaterials**

E. Esimbekova, Institute of Biophysics SB RAS; E. Nemtseva, Siberian Federal University / Institute of Biophysics and Biotechnology; Y. Kratavsuk, 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 environment. A rapid bioluminescent enzyme inhibition-based assay was applied to predict the potential toxicity of carbon nanomaterials (CNM) presented by single- and multi-walled nanotubes (SWCNT and MWCNT) and aqueous solutions of hydrated fullerene C60(Cy-HyFn). This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminescent bacteria: NADP//?-FMN-oxidoreductase + luciferase (Red + Luc). A protocol based on the optical properties of CNM for correcting the results of the bioluminescence assay was developed. If the bioluminescence signal of the 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 CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > Cy-HyFn. 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 immobilized enzyme system was found to be more sensitive to Cy-HyFn 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 bioluminescent 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).

**WE213 Delayed chlorophyll fluorescence in biomonitoring of environmental pollution**

Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; E. Stravinskene, O. Kryuchkova, N. Pakharkova, Siberian Federal University

Plants have important role in biomonitoring of environmental pollution because of their high sensitivity to various pollutants which often disturb photosynthesis. The photosynthetic function of plants is therefore a good indicator to reveal the pollution effects. Fluorescence of chlorophyll is widely used for quick assessment of photosynthesis condition. A prompt fluorescence that can be registered by PAM fluorimeters is most commonly used for these purposes. Recently, we have developed a more sensitive and fast indicator of the state of the photosynthetic apparatus of plants, which is based on the measurement of delayed fluorescence (DF) of chlorophyll. Delayed fluorescence is registered in red spectrum area after exciting light flashes in the form of time-attenuated radiation. We found that the ratio of DF excited by high intensity flashes to DF excited by low intensity flashes decreases more than tenfold when there is a toxic effect on photosynthesis. This indicator can be measured within a few seconds. Due to the relative nature of this indicator, which characterizes the photosynthetic activity of the plant test organism, it does not depend on the size or volume of analyzed sample. To implement this method, we developed the Photon 10 fluorimeter which automatically measures the relative indicator of delayed fluorescence (RIFD) in 24 plant samples. Simultaneously with RIFD, the device registers the variable part of prompt fluorescence of these samples. Applying this device we carried out transplanted lichen indication of air pollution in Krasnoyarsk. We found that the values of DF of several species of lichen differed up to 20 times between ecologically clean and industrial areas of the city after three weeks of the exposure. The study of the condition of pine needles in these areas showed a difference in the value of the RIFD up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorella vulgaris alga was used as a model test organism. RIFD of this alga fluorescence decreased by the factor of 2 (EC50) in solutions of copper and zinc ions at a concentration of these heavy metals of 0.005 and 0.5 mg / dm³ respectively.

**WE214 Chlorophyll fluorescence temperature curve to estimate changes of the photosynthetic apparatus of coniferous trees during the transition to a state of winter dormancy in urban ecosystems**

N. Pakharkova, Y.S. Grigorev, Siberian Federal University / Department of Ecology and Environmental Study; N. Gaevsky, Siberian Federal University

The main regulating factor for the transition of plants from active vegetation to winter dormancy is the thermal factor. The temperature factor and air pollution also have a significant influence both during the autumn photoperiodic reaction and at different phases of winter dormancy. This research aims towards a better understanding of the responses of the Scots pine and the Siberian spruce to air pollution stress in urban and semi-urban conditions of Southern Siberia. It is well-established that during the transition from the phase of active vegetation into the phase of dormancy, chlorophyll fluorescence of the photosynthetic apparatus are mirrored in changes of fluorescent signals emitted at different temperatures. Chlorophyll fluorescence temperature curve (FTC) is a dependence of chlorophyll fluorescence intensity on linearly increasing temperature. This curve is used for determination of the stability of PS2 and for evaluation of the structural arrangement of chloroplasts in vegetating plants. Also, based on the changes in the shape of the FTC it can be deduced whether the plant is in the state of winter dormancy or it is vegetating. The calculated ratio of the low- and high-temperature peaks (50°? and 70°?) of zero level fluorescence may be used...
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 of the age of needle, the degree of dormancy of both winter species clearly correlated with air pollution levels, and the trees growing in industrial areas are 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 requires a better choice for urban forestry projects.

WE215 Luminescent microscopy in the bioindication of the Baikal pollution with oil products and polyaromatic hydrocarbons
M.N. Saksenov, A.E. Balayan, Irkutsk State University / Research Institute of Biology of Irkutsk State University: O.A. Barkhatova, Irkutsk State University / Faculty of Geography; A.D. Stom, Irkutsk State University / Research Institute of Biology of Irkutsk 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 is a fluorometric microscope. It has been experimentally revealed that many pollutants of water bodies, it is necessary to isolate oil products and polyaromatic 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 bioindicators, is bioindication, not only on generally accepted test facilities, but also on representative hydrobiota for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Epischura baikalensis Sars (Copepoda, Copepoda) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. baikalensis 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 luminol to the presence of fatty substances enable us to possibly observe 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 fluorometric microscope. It has been experimentally revealed that if E. baikalensis 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 7lopepoda crustaceans in fat drops was proposed.

WE216 The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay
E. Nenitseva, O. Chmurina, Siberian Federal University / Research Institute of Biology of Irkutsk State University; O.A. Barkhatova, Irkutsk State University / Faculty of Geography; A.D. Stom, Irkutsk State University / Research Institute of Biology of Irkutsk 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 parameters of soil and temperature fluctuations than Siberian spruce, and therefore requires a better choice for urban forestry projects.

WE217 The comparison of enzyme systems for soil contamination bioassay
E. Kolosova, Siberian Federal University / Biophisical; D. Gulnov, Siberian Federal University; N. Rimatskaya, Siberian Federal University / Biophisical; A. Listisa, O. Sutormin, V. Krataysuk, Siberian Federal University

Design of simple, quick and highly sensitive bioassay systems is extremely necessary for ecological soil monitoring. Enzyme systems may be a perspective basis for the development of modern methods of bioassay. With sets of enzymes, it is possible to simulate the effect of toxic substances present in natural environments on living organisms. Moreover, coupling enzyme-target with bacterial luciferase provides advantages in the signal detection. The purpose of this study is to evaluate the possibility of using various enzymatic systems for the analysis of soil contamination. In this work NADH: FMN-oxidoreductase, alcohol dehydrogenase (ADH), NADH: FMN-oxidoreductase + bacterial luciferase (two-enzyme system), NADH: FMN-oxidoreductase + bacterial luciferase + alcohol dehydrogenase (three-enzyme system) were examined. The enzyme activities were measured by addition of the model soil pollutants such as a blue copperases, the insect powder “Defend Profi” (Bayer CropScience) and diesel fuel. The values of the toxicological parameters ?? and ?? concentrations of the pollutants causing the system inhibition by 20% and 50% respectively were determined. The sensitivity of each enzymatic test system to the aqueous extract of soil was also analysed. The blue copperases (II) – water solution shows an inhibitory effect on all enzymatic systems. The value of ?? from 0.088 to 8.75 mL/L. The insect powder-water solution also shows an inhibitory effect on all enzymatic systems except ADH enzyme system. In contrast, the diesel fuel impacts only on enzym systems coupled with bacterial luciferase. As a result the blue copperases (II) – water solution decreases catalytic activities all enzyme systems; the insect powder-water solution decreases only NADH: FMN-oxidoreductase catalytic activity; the diesel fuel decreases luciferase activity. The addition of aqueous extract of soil leads to activation of catalytic activity of NADH: FMN-oxidoreductase; for the two- and three-enzyme systems the addition of the aqueous extract of soil leads to inhibition of catalytic activities of the enzyme systems (more than 50%). The NADH: FMN-oxidoreductase + bacterial luciferase enzyme system showed the greater sensitivity to the soil pollutants than other systems. This fact is confirmed the prospect of using this system for environmental monitoring. The study was supported by a grant from the Russian Science Foundation (project No. 16-14-10115)

WE218 Are changes in bioluminescence kinetics of Photobacterium phosphoreum sensitive to low-dose radiation connected with genetic mutations?
O. Gaseyov, V. Gaseyova, Siberian Federal University; T. Rozhko, Krasnoyarsk State Medical University. prof. VF Vojno-Yasentsky; A. Bondar, Institute of Chemical Biology and Fundamental Medicine SB RAS; N. Kudryasheva, Institute of Biophysics SB RAS

Luminous bacteria of marine origin are widely employed as biological sensors for monitoring environmental radiation and related concerns about the increase of background radiation. Due to the increasing use of radioactive elements and related concerns about the increase of background radiation, special attention is lately paid to the effects of low-dose radiation on the environment. 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 (6H) radionuclides as sources of ionizing radiation. Bioluminescence kinetics of Photobacterium phosphoreum in solutions of (241Am(NO2)3), 7 kBq/L, and tritiated water, 100 MBq/L, were recorded and their stages were determined as follows – absence of effect, activation, and inhibition of bioluminescence; for the assessment of the bioluminescent 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 3.05–15.39 mg/kg) were studied by the method of emission-excitation matrix (EEm) fluorescence spectroscopy. The luminescence in the spectral range 290-600 nm under excitation at 250-350 nm was measured for each extract as well as absorption spectra in the range 200-800 nm. The physico-chemical characteristics of the soils (particle size distributions, pH, humus content, etc.) were compared with the inhibitory effect of water soil extracts on enzymatic bioassay based on the coupled bioluminescent reaction of bacterial luciferase and NAD(P)H:FMN-oxidoreductase. It was revealed that the spectral luminescent characteristics of water extracts are similar for all soils and featured by three types of fluorophores with excitation maxima at about 270, 330 and 360 nm and emission maxima at about 330, 425 and 470 nm, respectively. The residual activity of the bioluminescent bioassay enzymes in the presence of soil extracts was found to correlate with intensity of two first bands that is the measure of the component content. Poor correlation was found between EEm characteristics and remaining chemical parameters of the soils including amount of detected arsenic. The conclusion was derived about relation of bioassay signal from studied extracts with the amount of humic substances in soils. The research was supported by the Russian Science Foundation (project no. 16-14-10115)

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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: haluxifen-methyl (Arylex™ active)

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The need and awareness of sustainable food production has increased in recent years; however, 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 production 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 auxinic herbicide, haluxifen-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 haluxifen-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 and 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 and food. In addition, the Secondary standards coming from Food Processors and Retailers, for example, for improving decisions regarding chemical residues in food place increasing standards which have to be considered.

WE220
Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs

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The aim of this study was 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°31' N, 35° 50' E) from the raw material phase until the end-of-life philosophy through a Life Cycle Assessment (LCA) study; and (2) compare the environmental impacts of an EGR mock-up to a traditional gravel ballasted roof (TGBR) 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 (10,452 km²) 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 matrices and the vegetation could remove 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 TGBR 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

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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 benefits of life cycle 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 social and economic well-being 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 sustainability assessment study, 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 (Phillips 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. CTQ2016-75136-P) and by Xunta de Galicia (project ref. ED431F16/00101). S. Gonzalez-Garcia 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

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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.
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, applicable 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 evaluated in the analysis are: Climate Change, Ozone Depletion, Photochemical Ozone Formation, Acidification, Terrestrial and Freshwater Eutrophication, and Freshwater Ecotoxicity. The pollution due to rail transport is a problem identified in Member state of the European Union, the solutions proposed in RECOVER project could an important contribution to the current railway legislations.

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 in the last few years to increase the implementation of sustainable technologies and operations, and decision-making tools are essential to help authorities to accept them. In this regard, LCA has become popular in pavement engineering but there is still a lack of detailing, consensus (especially in terms of system boundaries) and reliable data. Beyond ISO 14040:2006, ISO 14044:2006, ISO/TS 14067:2013, EN 15984:2012 and GHG Protocol 2013, there is no specific methodology for selecting the most cost-effective and space conscious options. In this study, the analysis is focused on asphalt mixtures LCA. 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 study presented here for the first time compares 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 tourism facilities: DemEAUmed solution
A. Charet, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Violante, ACOSTO TAI/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/greywater treatment technologies to achieve an optimal and safe closed water cycle in Mediterranean tourism facilities. Water resources are limited and unequally distributed geographically and among the year seasons, with higher pressure during summer, in Mediterranean regions. For instance, water consumption per guest has been estimated at 222 L/day in hotels in Spain. So, it is of great importance to achieve a holistic water resource management. DemEAUmed affords the reuse of greywater and wastewater generated in touristic facilities with an integrated approach bringing environmental benefits such as water savings and water management carbon footprint reduction. 8 different innovative technologies with an advanced monitoring, control and decision support system have been integrated and implemented on the demonstration site: Samba Hotel-Lloret de Mar, Catalonia, Spain. These technologies have been assessed through a comprehensive LCA, assessing the impacts for each individual technology and for the demo-site integration (7 different configurations). Besides the LCA, a Life Cycle Costing (LCC) is being performed in order to analyse the economic costs. A social LCA (S-LCA) is also conducted in order to assess the social impacts generated by demoEAUmed. Life cycle stages of construction and operation of the technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demoEAUmed combined strategies, the carbon footprint is reduced up to 136% (greywater scenario) or up to 62% (wastewater scenario) thanks to water savings. Focusing on the technologies, main environmental impacts are localized on the operation stage, due to electricity consumption. Concerning the LCC, the overall cost of treating one cubic meter (1m³) of greywater or wastewater by the demoEAUmed technologies along their life cycle are being determined. Finally, S-LCA has presented some indicators and the quantification of the socioeconomic impacts and benefits provided by demoEAUmed solution.

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 by 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 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 ILCD 1.08 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

Tomasi-Montenegro, C, Wei, M, M.,-c HHI, Helmholtz-Institute Ulm, Helmholtztr 11, 89081 Ulm, Germany b 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 pose one 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. Although it is recognized that geopolitics will shape a tailored solution for each geographical region, a transformation of the energy system with a high share in renewable energy sources is necessary to reach a decarbonized energy supply. In particular, considering an emerging system where solar and wind power, energy storage and electric vehicles are required to level fluctuating energy production and demand. However, even though when it is recognized that the energy storage technologies exhibit different maturity stages, information about their associated environmental impacts is required to evaluate the sustainability trade-offs inherent to a technology decision-making process. In order to avoid environmental burdens shifting, a life cycle approach is proposed to develop a model for the preliminary evaluation of emerging batteries or components of these batteries using CCaLC as an assessment tool. The outcome of this work is aimed at contributing to understanding the environmental impacts associated with batteries from a life cycle perspective, while evaluating the advantages and disadvantages of using CCaLC as an assessment tool.

WE232
Development of Environment Hotspots of Analysis and the consideration of availability of eco-labeling program

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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 among the most relevant environmental, economical, 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). Potential hotspots are identified by using this calculation tool. However, the case number of studies using hotspots analysis tool are few, advantages and limitations are unknown. In this research, 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 as well as each tonne of treated residues redeeming more than 500 tons of emissions. In addition, with the improvement of environmental efficiency at industry level of a specific country, it is important to corporate within well-specified industrial clusters through supply chain engagement over developing and developed 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 circumstances. "mega-regional" Free Trade Agreement have been arisen as a significant trade policy issues. For countries participating the FTA framework, it is important to promote economic growth and reduction in various environmental burden 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. However, to the best of our knowledge, previous studies did not analyze the supply chain network induced by the production and consumption of FTA member countries. This study used the network centrality analysis, especially, the applied structural path betweenness (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, we 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→JPN-Petroleum, Chemical and Non-Metallic Mineral Products” in the sector level and “CHN→JPN” in the country level. We can see the large CO2 emissions embedded from China and Russia as well as each tonne of treated residues redeeming more than 500 tons of emissions. In the case 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.

WE234
Developing life cycle assessment to fight climate change
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Climate change targets could only be achieved with the contribution of greenhouse gas emissions from several GGR technologies. To understand the structure of complicated supply chain network, several GGR technologies are identified through their direct carbon capture and storage (CCS), the use of wet raw materials in cement production, enhance weathering, enhancing soil C; forest management; bioenergy with CCS. Life Cycle Assessment (LCA), has been widely adopted to assess GGR technologies. However, there is no consensus on the methodology to assess GGR technologies, causing poor understanding of their implications. Therefore a new methodological framework is necessary. This study presents some methodological approaches for LCA of GGR technologies and i) discusses their strengths and weaknesses. The preliminary comparison and development of approaches was based on a bibliographic review combined with expert discussions. The approaches have 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.
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, this approach has not been linked to an 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 comprehensive 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

1. Esp. Gallart, Fundacio CTM, Centre Tecnologic; J. Berzosa, L. Vendrell, Fundacio CTM Centre; F. Clarens, Fundacio CTM 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 process 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 fulfillment part, three columns are deployed: Baseline status, expected results set with the goals of the new project, and current or 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 knowledge. This importance is set by applying a value between 0 and 3. The socioeconomic scores are calculated combining the importance values with the fulfilment scores. As a case study, this methodology has been applied to LIFE RELEACH project, which is aimed at managing leachates coming from landfill by concentrating technologies. In this way, the methodology has allowed to determine which socio-economic impacts have the higher contribution.

WE236 SETAC Sustainability Interest Group

D.L. Carr, Texas Tech University / Biological Sciences

WE237 SETAC LCA Interest Group (Europe)

H. Stichwoth, Thiinen Institute / Agricultural Technology

WE238 Life cycle assessment of a thermoplastic starch obtained from mango kernel A. Coelho, Embrapa Tropical Agroindustry; R. Fragoso, Embrapa Agroenergia; P. Marques, F. Freire, University of Coimbra / ADAM-LAETA, Mechanical Engineering; P. Melo, Federal University of Ceará; M. Figueredo, Brazilian Agricultural Research Corporation Embrapa / Embrapa Tropical Agroindustry

Agrifood industry generates large amounts of residues with potential to be used 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.

Environmental monitoring of contaminants using terrestrial ecological biomonitor (P)

WE239 Geostatistically estimating spatial structures of heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany J. Berzosa, L. Vendrell, Fundacio CTM Centre Tecnologic; J. Berzosa, L. Vendrell, Fundacio CTM Centre; F. Clarens, Fundacio CTM Centre Tecnologic

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Semi-volatile organic contaminants (SVOCs) in pine needles from Iceland M. Moedl, J.A. Silva, S. Nösken, LEPABE / University of Porto; H. Ingvason, T. Eysteinsson, T. Jónsson, A. Sigurgeirsson, Icelandic Forest Research; N. Røtala, 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 rural areas but also some urban settlements like Reykjavík or Selfoss. In seven sampling sites it was possible to collect needles from more than one species, allowing the design of a new process using an amount of residue from the biomass 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.
Development Fund (ERDF), through COMPETE2020 - Programa Operacional Competitividade e Internacionalização (POCI) and by national funds, through FCT - Fundação para a Ciência e a Tecnologia; (ii) NORTE-01-0145-FEDER-000005-LEPAE-2-ENNOVATION, supported by North Portugal Regional Operational Programme (NORTE 2020), under the Portugal 2020 Partnership Agreement, through the ERDF; (iii) Investigator FCT contract IF/01101/2014 (Nuno Ratola).

WE241 Study of global diffuse pollution levels in remote high mountain areas and their impact on the organisms from these ecosystems
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Global diffuse pollution results from the emission of multiple sources and long-range transport. Effects of this background contamination have been observed in the recent past in fish from remote high mountain lakes through mRNAs and proteins measurements in which showed feminization effects and oxidative stress (S. Jarque et al. 2015). Although some of these effects were related to persistent organic pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they accumulate and may bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1600m to 2500m asl. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (Salmo trutta) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutants found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. S. Jarque et al. (2015). Background fish feminization effects in European remote sites. Sci. Rep., 5, 11292.

WE242 Spatial distribution of mercury and trace metals in epiphytic lichens in Nova Scotia, Canada
S. Klapstein, Acadia University / Earth & Environmental Science; I. Carvalho, Técnico Lisboa; R. Cameron, Nova Scotia Provincial Government / Department of Environment, where they were be a part of University of Ecology (Budapest); N. Pócs, Eötvös University / Plant Biology; Ecological, the physical-chemical properties of the pollutants, they may bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the recent past in fish from remote high mountain lakes through mRNAs and proteins measurements in which showed feminization effects and oxidative stress (S. Jarque et al. 2015). Although some of these effects were related to persistent organic pollutants, there is still a gap of knowledge on their toxicological mechanisms and possible influence of other chemical pollutants. Persistent organic pollutants are incorporated to remote high mountain areas through atmospheric transport and deposition, where they accumulate and may bioaccumulate. A comprehensive study of the pollutants in the atmosphere, lake waters and fish is presented in the work. The six remote high mountain lakes investigated were located in the National Park of Aigüestortes i Estany de Sant Maurici (Pyrenees). They encompassed an altitudinal gradient from 1600m to 2500m asl. Active and passive monitoring devices were used for air and water sampling in order to get insight on the presence and environmental fate of organic contaminants over an extended time period. Moreover, brown trout (Salmo trutta) specimens were captured in each lake for bio-monitoring. They were analyzed for contaminants in the muscle, hepatopancreas and gallbladder tissue. The transcriptomic and proteomic analysis of mRNA was also performed to link the levels of pollutants found in these remote high mountains to the effects in these organisms. The observed concentrations will also be compared to past measurements in other high mountain environments for assessment of temporal trends of this background contamination. S. Jarque et al. (2015). Background fish feminization effects in European remote sites. Sci. Rep., 5, 11292.

WE243 Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania
G. Sujutietiene, P. Smigalitis, Vytautas Magnus University

Waste disposal has huge environmental impacts including toxins, leachate and greenhouse gases. Lichens (L. flauscarabrum and Rangea (L.) Ach.) were used for biomonitoring of the WWTP in an area of one of the largest solid waste landfill in central Lithuania. Lichen transplants were exposed for 3 months. Chlorophyll content increased in both transplanted lichens with increase in distance from the landfill. Chlorophyll content in lichens was significantly lower in the nearest study site in comparison with the control. Potential quantum yield expressed as Fv/Fm, in thalli was lower under the influence of solid waste incinerator in comparison with the reference. Higher chlorophyll degradation was characteristic to the transplanted lichens under the influence of landfill. The conductivity of leachate and content of thiobarbituric acid reactive substances (TBARS) increased in lichen material transplanted at sites facing the landfill. The results showed that biological monitoring can be useful tool for landfill monitoring.

WE244 Nothing is what it seems: Levels of PCDD/Fs in the surroundings of a hazardous waste incinerator
M. Marques, Rovira i Virgili University / Chemical Engineering; M. Mari, Universitat Rovira i Virgili / Chemical Engineering; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IISPV; M. Schuhmacher, Rovira i Virgili University / Department d’Enginyeria Quimica; J.L. Domingo, Universitat Rovira i Virgili / Laboratory of Toxicology and Environmental Health

Soil and vegetation were used as environmental monitors to assess the occurrence of dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/Fs) in the vicinity of a hazardous waste incinerator (HWI) located in Tarragona (Catalonia, Spain). Results belonging to 2015 and 2016 were compared to a previous study conducted in 1998, before the plant started operating, to evaluate the potential impact of the facility after several years of regular operation. The median concentrations of PCDD/Fs in soil samples collected around the HWI 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 winds directions and the distance from the main industrial 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: lysosomal membrane stability (LMS) and Micronuclei (MN) in hemocytes and antioxidant enzymes Catalase (CAT) and Glutathione-S-transferase (GST), lipid peroxidation (MDA) and total Metallothionein proteins content (MTs) in midgut glands. Results obtained by general linearized mixed models (GLMMs) revealed significant correlations among trace metals levels and biological responses investigated and with the distance from
the main industrial site. Based on such findings and previous evidences of the ability of this species to respond to vaporized metals as cadmium in laboratory controlled condition, the present study support the suitability of C. aspersum as bioindicator for heavy metals exposure in air pollution monitoring studies.

WE246 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 caused 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 24.2 μg/dL and 24.8 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 dogs’ 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.

WE247 Monitoring and impact assessment of terrestrial ecosystem using Eisenia fetida affected by chemical incidents
K. Kim, H. Jeon, H. Kim, Y. Kim, Y. Choi, S. Lee, Kyungpook National University Many chemicals can be accidently spilled in the environment and it is important to know their presumable toxicities on the living organisms to determine risk assessments. There are no information on the terrestrial organisms of six chemicals possibly spilled into the environment, containing sulfuric acid, methanol, methylthelyketone, nitric acid, formic acid, and toluene. In this study, we conducted acute toxicities of these six chemicals on Eisenia fetida in an artificial soil according to the OECD guideline 207. We used E. fetida adults grown in our laboratory for 10 generations in soil consisting of pig manure composts fortified with steamed sweet potatoes at 25°C. The earthworms used in this study were sexually well developed with an average body weight of 100 to 200 mg. The artificial soils were composed of industrial sand (70%, 50 to 100 micron particle), kaolin (20%, pH 4.5 to 7.0), and peat (10%). After mixing the components, pH was set in the range of 6.0 to 6.5. At least five diluted serial solutions were used to determine LC50 values, whereas pure acetone was used in the control group. LC50 values of sulfuric acid, methanol, methylthelyketone, nitric acid, formic acid, and toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 μg/g soil, respectively. These values are very different from the acute toxicities using filter papers, which toluene exhibited 26-fold lower acute toxicity than sulfuric acid, the strongest toxic chemical among the tested chemicals. Using the filter papers, methanol and toluene were estimated depending on the origin of earwigs. Then, variations in those enzymes that belong to detoxification pathways involved in crustaceans, demonstrating species differences. Moreover, species had the OP sensibility. However, an in vitro inhibition trial with ethyl paraoxon evidenced a higher sensitivity of A. caliginosa AChE activity compared with that of A. chlorotica, which suggested that this toxicological endpoint may contribute to the interspecific differences of behavioural responses such as cast production rate. Our findings suggest the use of more than one endemic earthworm species to assess toxicity from organophosphate insecticides, overall when these earthworms have a beneficial impact on soil fertility.

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 vermicomposts derived from tannery waste around the mining area. Moreover, the gap of BLLs in dogs between 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. 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.

WE250 Insecticide resistance in the natural enemy F. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide.
A. Le Nuvéant, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unite PSH, Forets Biologique de La Production Integrale, Site Agronomy; Y. Capowiez, INRA Avignon; M. Rault, UAPV/IMBE / IMBE UMR 7263, Pôles Agrosolutions Apple orchards are highly treated crops, in which organophosphorus (OP), neonicotinoid and synthetic pyrethroid compounds were heavily sprayed insecticides. These compounds are toxic to non-target arthropods and increase the risk of resistance making apple orchard an interesting case to study the deleterious effect of long-term pesticide use. In the context of reduced pesticide use, the development of biocontrol agents has to be promoted. This work focuses on the assessment of the resistance/tolerance to OP insecticide of the earwig Forficula auricularia, an effective generalist predator. The threshold activities of enzymes that belong to detoxification pathways involved in insecticide resistance were estimated depending on the origin of earwigs. Then, variations in those activities were assessed under environmental conditions prior and after exposure to normal application rate of chlorpyrifos. Adult earwigs were sampled in apple orchards conducted under different management strategies: conventional, Integrated Pest Management (IPM), reduced pesticide use thanks to mating.
disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathion-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 in the field was significantly increased. Moreover, we observed that basal-activities of CBes and GST of unexposed individuals are higher in conventional earwigs compared to IPM and organic ones. All these observations support the hypothesis of a molecular target modification in AChE decreasing to a degree of affinity with the insecticide, and highlight the role of CBes 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 Geochemy / State Key Laboratory of Organic Geochemistry, and Guangdong Key Laboratory of Environmental Resources Utilization and Protection; X. Luo, Guangzhou Institute of Geochemy / State Key Lab. Organic Geochem; L. Tao, Guangzhou institute of Geochemy Chinese Academy of Sciences; Y. Zeng, B. Mai, Guangzhou Institute of Geochemy Ubiquitous use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and dibromochloropropanes (DBCPs), 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 isototope 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 the composition 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 dichlorodiphenyldichloroethanes (DDEs), can accumulate in organisms and become magnified along the food chain. Principal component analysis (PCA) was conducted using the fraction composition of HOPs to evaluate the species-specific bioaccumulation. PCA results demonstrated the common multi-linear correlations between ln adult/larva and log Kow of the compound was observed for the four taxonomic insects. The ratio of larva to adult decreased with increasing values of log Kow (log Kow = 6-6.5), then increased (6 < log Kow > 8) and decreased again (log Kow > 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. Verderame, R. Scudiero, University Federico II / Department of Biology In the present study, the potential toxicity of Glyphosate-based herbicide (GH), 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 “non-carcinogenic to humans”, converging evidence suggests that GBHs, such as Roundup (Monsanto), pose serious health risk on exposed individuals. In addition to common nonlinear associations between ln adult/larva and log Kow of the compound was observed for the four taxonomic insects. In this study, the effects of Glyphosate on the Italian wall lizard Podarcis sicula, a suitable bioindicator of terrestrial environmental pollution. Adult P. sicula specimens were divided in 3 groups (n=6): group 1 and 2 were exposed to pure Glyphosate 0.1 and 1 μL/g respectively, via gavage every other day for 3 weeks; group 3 received by gavage the same dose of tap water (100μl). The results demonstrate that both Glyphosate are toxic for the liver that shows an increase of melanocytes degranulation and the appearance of nodular/epithelial formations mainly consisting of collagen fibers, typical of hepatic fibrosis. The liver of Gly-treated males also displays the biosynthetic alterations typical of an estrogenic contamination: hepatocytes, in fact, contain transcripts for both vitellogenin and estrogen receptors. At reproductive level, male gonad is affected by the treatment. Spermato genesis is slightly slower, at low dose of Gly scattered spermatocytes II louse and filament-shaped arrangement, at high dose the anucleate rosettes increased and spermatids are dazely differentiated. Correlation is evident in the lumen of the tubules. Alterations in the expression of estrogen and androgen receptors and aromatase are also detected. Interestingly, in females, the ovary is not affected by Gly exposure, no matter the dose. Our results suggest that Gly exposure in a terrestrial vertebrate commonly inhabiting the fields potentially exposed to GBHs causes tissue toxicity, with possible serious health implications for wild and breeding animals as well as man populations.

**WE253**
**Concentration of perfluoralkyl substances decreases according to the laying order in the yolk of yellow-legged gull eggs**

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Perfluoralkyl substances (PFAS) are chemicals used as surface-active agents in diverse industrial applications. Because of their incessant disposal and release to the environment, these molecules caused the contamination of both fresh and seawaters, entailing their accumulation in the biota. Seabirds are highly exposed to environmental contamination because of their ecological habits, high trophic position in the marine food webs and relative long life span. This study aims to determine the levels of PFAS in three-egg clutches of the yellow-legged gull (Larus michahellis) breeding in a colony located at the Comacchio lagoon (Northeastern Italy) and their variation according to the position in the laying sequence. Eleven perfluoralkyl acids (PFAA) were analyzed in the yolk of eggs sampled at the time of deposition from 15 three-egg clutches. Independently of the laying order, perfluorooctane sulfonate (PFOS) was the main compound detected in the egg yolk, followed by perfluorooctanoic acid (PFOA) and perfluorodecanoic acid (PFDoDa). Overall, the δ15N decreased according to the position in the laying sequence, with first- and second-laid eggs showing higher concentrations compared to last-laid eggs. A similar decreasing trend was also noticed for single compounds, namely PFOS, perfluorooctanoic acid (PFOA), perfluorodecanoic acid (PFDoDa), with concentrations measured in the last-laid eggs that were significantly lower compared to those from the first- and second-laid eggs.

**WE254**
**First assessment of metal concentration in the crab Goniopsis cruentata (Linnaeus, 1758) (Decapoda, Grapsidae) from two brazilian mangroves areas with different levels of contamination**

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The crab Goniopsis cruentata 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 southeast region of Brazil. This species is located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of crustaceans as bioindicators of metal contamination 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. cruentata and compare populations from contaminated and non-contaminated areas. Samples were collected in two mangrove areas in the state of Sao Paulo (Brazil), with different levels of contamination, and then 25 crab from each area were sampled 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. cruentata 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<0.05). 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 (grain size, pH, salinity) 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 assessing the quality of life, mainly for human when consumed.

WE255 Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydris chinensis)

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Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenyldichloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring involves compounds with similar chemical structures. Few studies focus on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydris chinensis) was ovoviviparous 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 DBDE, 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 KOC of the chemicals for the watersnake. For compounds with high hydrophobicity (log KOC > 8), a negative relationship between EMER and log KOC is observed (p < 0.05). While for compounds with log KOC < 8, the values of fish and egg are similar. Few significant variation (p = 0.19), all greater than 90%. Maternal transfer potential and the deposition of contaminants in watersnake eggs are obviously different with other species in previous study, which implied potentially high inter-species differences in the maternal transfer mechanism.

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-EI-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 chlorane Plus and other dechloranes or novel brominated flame retardents and separate matrix Method for Analysis of Halogenated Flame Retardants (Setac). Using the so-called species matrix Method for Analysis of Halogenated Flame Retardants (Setac), we assessed the capability as an indicator and 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 in-life cycle upstream processes. The proportions from $2364/year to $1857/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases in China, where the manufacturing processes take place. The rest of Asia, Australia, Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream production. In comparison to the whole 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.

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 have the time and resources to provide a full picture of their impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pihlota 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 (LCA) 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 handprint 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 in the life cycle. The footprints are used to the baseline solution, the new solution and the 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. Ajayebi, 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 globalisation, economy is seeing 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 and 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 in-life cycle upstream processes. The proportions from $2364/year to $1857/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases in China, where the manufacturing processes take place. The rest of Asia, Australia, Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream production. In comparison to the whole 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.
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 national 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 hybrid-electric vehicle motor. This may be computed 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. 

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet of an average Spanish citizen. Future requirements and policy recommendations L. Batlle-Bayer, Universitat Pompeu Fabra UPF / UNESCO Chair in Life Cycle Assessment (LCA) and Life Cycle Costing (LCC)

The challenge food Life Cycle Assessment (LCA) faces is that nutrition, a dominant factor in human life, is not considered in LCA. Due to their convergent approach over life cycle, the LCA and Life Cycle Costing (LCC) are becoming the preferred tool for decision makers to find effective solutions, while minimizing their impact on the environment. The complexity of production processes and products combined with an increased demand for eco-friendly products 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, maintenance and end of life). Therefore, the use of LCC allows coupling the environmental impacts, 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 for implementation. The fourth part aims to identify 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 LCC and LCA coupled with LCA.

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 motorists 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. As regard regional externalities, the external costs due to the production of aVW Golf are shown to be more than ten thousand processes where involved, for each LCA phase accounting for more than 2% of the weighed emission of PM, PM, NO, SO, NH NMVOC, CO have been taken into account for externalities evaluation. Combining both approaches requests monetizing the environmental impacts, 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 for implementation. The fourth part aims to identify 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 LCC and LCA coupled with LCA.

WE264 Pizza: it is dangerously delicious! K. Stylliaou, 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. Jollivet, University of Michigan

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
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 for ~14.5% of all human caused greenhouse gas emissions but also requires large amount of land and water due to the high quantity of crops required for feeding animal. Consequently, comparing protein sources using Life cycle assessment (LCA) is important for decision making.

However, choosing the functional unit (FU) is often a critical issue for food systems. The quantity of food (i.e. 1 kg) is the most used FU currently. Nevertheless, this FU does not represent the function of food that is to provide conditions that make our bodies grow. Therefore, it is proposed to focus on macro-nutrient components as a FU that makes up the organism. The study was conducted on several protein sources, initially conventional (pork, chicken meat, salmon and tofu) and non-conventional sources (insects and algae). The role of the AA supplementation in animal feed was also investigated. On the one side, the analysis has shown that non-conventional protein sources perform better in all environmental categories, independently of the choice of the functional unit. Tofu performs better than animal protein but the difference between animal and vegetable based proteins becomes much lower when a more elaborated FU is used. On the other side, the supplementation in AA allows a reduction of the environmental impact of chicken and pork. Using the PQi as a FU, the impact of chicken and pork with AA supplementation is even lower than the one of tofu in some categories. Using the PQi as a FU is a step toward a more holistic assessment. A next step might be to include other nutrients such as iron and vitamins in the FU.

WE266
The ISO/DIS 14008 standard: Monetary valuation of environmental impacts and related environmental aspects - Principles, requirements and guidelines - an update
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. The comments and ballot results of this DIS will be discussed during a WG 7 meeting in June 2018. 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 define the monetary value of these impacts and also of related environmental aspects. Monetary valuations enable comparisons and trade-offs between different environmental aspects. 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

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 encompass 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 in SSL feasible. Furthermore this framework includes 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: Structures 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. Aptiz, SEA Environmental Decisional Ltd
If we want our science to be part of the environmental decision process, we need to engage with stakeholders about what kind of science they wish to sustain. We present a framework for identifying the values that stakeholders wish to sustain in decision making.

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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 sacrificed. The consideration of a long-term monitoring plan 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
A.C. Gabriel, University of Aveiro / Biology; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; S. Costa, Universidade de Aveiro / Department of Biology & CESAM, 3810-193 Aveiro; I. Henriques, Universidade de Aveiro / Departamento de Biologia CESAM

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-NaCl18 g/L). To assess the capacity of recovery from long-term exposure to NaCl, after the 46 d period, Et-NaCl18 was transferred to LB medium and cultured for a period of 16 d (Et-R). The Et 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 and 25 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 PTC-based molecular typing method (BOX-PCR). Results of growth shown that long-term exposure to NaCl slightly increased the tolerance of E. toletana to this salt, EtECs for growth were: 22.5 g/L (8.64-36.4) for Et-LB; 30.3 g/L (23.7-37.4) for Et-NaCl18, 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-NaCl18, 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
J. Alvariño, University of Extremadura / Superintendencia de Ingeniería Agronómica, F. Jiménez-Cárceles, BIOCYMA, Consulting in Environment and Quality, S.L. Murcia, Spain; M. González-Alcaraz, Department of Biology & CESAM - University of Aveiro / Biology & CESAM

Salinity is widely considered one of the most important factors of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and/or over-irrigation leads the existence of saline effluents that degrade water quality and constrain plant growth and crop production. However, in saline wetlands salinity is not undesirable, but a proxy parameter to maintain the singularity of the ecosystem. In these environments the existence of a diversity of habitats is closely related to gradients of soil salinity and moisture, with extremely saline sites, brackish sites, wetter sites and drier sites. While agricultural saline effluents may salinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This work reports changes in ecosystem structure and diversity in a saline wetland adjacent to the Mar Menor saline lagoon (SE Spain). Species cover, soil salinity, and the groundwater level were monitored in two 2-years periods with a difference of 13 years between them. The results indicated an elevation of the water table throughout the 13-year period, which was attributable to brackish water flows from areas with intensive agriculture. The latter led to an increase of flooding periods, a decrease of soils and a decrease in the nutrient sites and increased in the least saline ones. Following these changes, damages in protected habitats were observed, due to the proliferation and increase of biomass of several species. Sarcorciniia fruticosa, Phragmites australis and Juncus maritimus strongly expanded at the wettest sites, which led to the disappearance of the original zonation pattern and the homogenization of the ecosystem. Bare areas, necessary for nesting and feeding of several bird species, disappeared. According to the results obtained, a decrease of soil and water salinity was one of the main factors contributing to the degradation of the saline wetland leading to an exacerbated growth of some species and a decrease of habitat diversity. In this case, the low salinity of the effluents reaching the wetland was a problem, not an advantage.

WE271  Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?
B.J. Jefford, I. Reich, J. Bray, University of Canberra / Institute for Applied Ecology

The effect chemicals on populations and communities have long been noted to vary between different studies although the mechanism(s) for this variation is unclear. Research has examined variability associated with chemical and physical environments (e.g. bioavailability, co-occurring contaminants) and ecotoxicological and physiological (e.g. temporal and spatial variability in species’ sensitivity). Less consideration has been given to ecological mechanisms including those mediated via indirect factors such as competition and predation. For example, a given population of a species may be able to persist in the presence of a particular level of contamination, but this persistence may be dependent on competition and predator prey interactions, and the relative fitness of these taxa at that level of contamination. Here we report the results of a mesocosm experiment that examined the effects of biotic interactions on salinity effects. We examined effects across a broad salinity gradient using ‘sensitive’ communities collected from a low salinity site (~80 μS/cm) and ‘tolerant’ communities (collected from a high salinity site ~1600 μS/cm). This was examined using a mesocosm experiment consisting of 32 independent re-circulating 1000 L mesocosms. Controls (100 μS/cm) and salinity treatments (500, 1000, 2500 and 5000 μS/cm) these were replicated 4 fold and were crossed in an orthogonal design with the source biota (stream macroinvertebrates and microbe) either from: (1) a low salinity site only or (2) both low and high salinity sites. The experiment is based on the logic that if salinity increases at a site, organisms have the potential to migrate from higher salinity sites within the same region. Thus the organisms from the (previously) low salinity site would have to be able to tolerate both the increase in salinity and ecological interactions with organisms from higher salinity sites. We observed differing effects of salinity on the macroinvertebrate community from the low salinity site depending whether these biota were co-inhabiting with biota from a high salinity site. Such context dependent toxicity deserves greater consideration in studies of the effects of chemicals on populations and communities.

WE272  Challenges in developing a water quality guideline for water hardness
S. Bogart, University of Lethbridge / Department of Biological Sciences; E. Stock, University of Lethbridge; A. Manek, University of Saskatchewan; A. Tillmanns, C. Meays, British Columbia Ministry of Environment & Climate Change Strategy; G.G. Pyle, University of Lethbridge / Biological Sciences

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++, Mg++, Na+, K+, HCO3-, SO42-, CI-), or increases in the Ca++ and Mg++ 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 or their mixtures. Water hardness includes water hardnesses that 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 was collected for the freshwater taxa occurring in the WQG, however, current literature offered several challenges and major data gaps that hindered WQG derivation. Moreover, the background variation of water hardness throughout an exemptual 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. Schüer, University Koblenz-Landau; P. Haase, A. Sundermann, Senckenberg
The political aim 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, phosphorous and micropollutants) 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 hierarchically partitioning with ecological quality indices based on invertebrates (%) EPT, MMI, ASP, BMWP, GSI, SPEAR %) as response variables. Secondly, individual taxon responses were related 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 associated with both land use and water quality standards and definitions and is reasonable with available data.

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 water 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 (because there are no State standards or USA water quality criteria for potassium). From the literature, we compiled potassium 96h 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 third of the lowest EC50 to define an acceptable concentration to avoid 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 the 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-d. 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 recommended as a monthly average guideline not to be exceeded more than once every three years. We used 32 years of receiving stream flow data to derive exceedance frequencies of instantaneous and chronic guideline concentrations. We evaluated uncertainties in guideline derivation and discuss recommendations for quarterly mussel toxicity tests, instream monitoring, and research to narrow uncertainties. There are several means by which stream-specific and mussel-specific potassium guidelines could be derived. This method tracks North Carolina water quality standards and definitions and is reasonable with available data.

WE275
LIFE LAGOON REFRESH - Coastal lagoon habitat (1150*) and species recovery by restoring the salt gradient increasing fresh water input. Management measures in the northern Venice Lagoon (NE, Italy) F. Cavicchiare, ISPRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; A. Bonometto, A. Feola, E. Ponis, ISPRA-Institute for Environmental Protection and Research; A. Sfriso, University Ca Foscari of Venice; B. Matticchio, IPROS; M. Lizier, Regione del Veneto; V. Volpe, Provveditorato OO. PP. Veneto, Trentino Alto Adige e Friuli Venezia Giulia; M. Ferla, R. Boscolo Brusà, ISPRA - Institute for Environmental Protection and Research.

The northern Venice Lagoon (SCI IT325003) 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 IT325003, but it is still unavourable in the inner landward area due to lack of ecological features, favouring self-regulation processes, between lagoon and mainland. In the past the project area was occupied by reedbeds in large amounts, now significantly reseeded 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 red deposition; 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-diffused reed beds and synthetic solutions (e.g. NaCl/CaCl2) of salt gradient 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 P. Srikhumsuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renshaw, University of Strathclyde / Civil and Environmental Engineering
Effluents (produced and flow-back waters) from the petroleum industry have been between highly toxic and salinity for the environment, particularly regarding 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 salinity. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 8 weeks under hydroponic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared the salinity diluted effluents and synthetic solutions e.g. (NaCl/CaCl2) of similar salinities. There were different growth responses to the wastewater and saline solutions 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, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. All the differences in the toxicity between the wastewater were contained absorbing inorganic and organic substances that may have triggered plant survival and salt-tolerance. F. rubra grew under salt stress, and presented a mechanism to crystallize 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) A. Tomaz, S. Fialho, A. Lima, Instituto Politécnico de Beja; A. Penha, H. Novais, M. Potes, M. Iakunin, G. Rodrigues, Instituto de Ciências da Terra; P. Alvarenga, LEAF Centro de Investigação em Agronomia, Alimentos, Ambiente e Paisagem; P. Srikhumsuk, University of Strathclyde / Department of Civil & Environmental Engineering
In Mediterranean regions, climate changes have enlarged water limitation for crops, leading to an increased demand for irrigation water. During the hydrological years of 2015/16 and 2017/18, drought conditions were widespread, 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\textsuperscript{+}, Ca\textsuperscript{2+}, Mg\textsuperscript{2+}, K\textsuperscript{+}, SO\textsubscript{4}\textsuperscript{2-} and Cl\textsuperscript{-}), pH and electric conductivity (EC\textsubscript{a}) 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 (EC\textsubscript{e}) 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 perimeter. Higher ion concentrations related with water salinization. We selected water salinity and atmosphere evaporative demand. Sodium hazard assessment showed slight to moderate risk of reduced infiltration rates, a result that should be taken into account when surface or sprinkler irrigation systems are used. Furthermore, relative yield reductions may be mainly found in horticultural crops, classified as moderately sensitive to sensitive in the salt tolerance scale.

### 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

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In wildlife risk assessments according to EFSAs (2009), the ingested diet is one of the core factors to define exposure, using different diet composition in the first tier risk assessment. The selected PD factor comprises a portion of diet or the standard refinement parameters which intend to add realism to higher tier risk assessments. Publically 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 wild dietary habits, study on their inclusion in most 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 are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge of potential dietary 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. In order to improve our knowledge of invertebrate dietary habits, we developed a new 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 different DNA regions. This new genomics 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-Gutiérrez, UNED / Física Matemática y de Fluidos Molecular endpoints are currently under investigation to investigate the impact on the species 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 are very diverse, and great differences can be found even within the same animal group. In order to improve our knowledge of invertebrate dietary habits, we developed a new 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 different DNA regions. This new genomics approach, its needs and limitations for refined risk assessment will be presented and discussed.

#### WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis

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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. This is likely to have an impact on the zooplankton species in the region which make up the vast majority of marine species. Understanding the impacts of this changing environmental condition in zooplankton communities is crucial, as alterations in the zooplankton communities can affect 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 an important tool to understand the potential responses to climate change in this copepod species.

#### WE282 A traditional 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. Ekulden Uwget, 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 concerning how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more conclusive 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 Cu\textsuperscript{2+}/L), 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 is presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between the three gene, and (ii) between the same in the same treatment. 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

T.F. Simoes, S.C. Novais, Polytechnic Institute of Leiria / MARE IPELeiria; T. Natal da Luz, University of Coimbra / Department of Life Sciences, University of Coimbra; J. Renard, CEFEMA / Laboratory of Functional Ecology; J. Sousa, University of Coimbra / Department of Life Sciences; J. Römcke, ECT Oekotoxikologie GmbH; D. Roelofs, Vrije Universiteit / Department of Ecological Science; N. van Straalen, University of Coimbra / Department of Life Sciences; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

Folsomia candida is a widespreadarthropod 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 toxicity studies. Although laboratory...
experiments with a transcriptomics approach are essential to unravel modes of action, spinosad and indoxacarb. Therefore, in the present work, we investigated metabolic perturbations in juvenile gillshead 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:chlorform (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 across time, the overall effect of emerging contaminants. Keywords: Benzophenone-3, gill-head bream, non-target metabolomics. Acknowledgements - This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56268-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 M. Barbosa Xavier, Universidade Federal de Santa Catarina / Biochemistry; C.H. Souza, Universidade Federal de Santa Catarina / Biochemistry Department; L. Baptista, Universidade Federal de Santa Catarina 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 effluent from the pulp and paper industry, as one of the main submitters of effluents of 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. 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, steroid 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 amphilid Gammarus fossarum
D.R. Carpos, University of Portsmouth / Biological Sciences; I. Werner, Ecotox Consult; R. Sabatino-Bodin, Department of Environment, Land and Natural Resources; S. Robson, University of Portsmouth / School of Pharmacy & Biomedical Science; A. Ford, University of Portsmouth / Biological Sciences
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 Eigg, Scotland and 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 non-expressed and expressed markers will be performed, allowing a deeper 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
S. Schade, Birmingham University / Biociences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; J. Zhou, S. He, University of Birmingham / School of Pharmacy & Biomedical Sciences; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences
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 to toxic insults, applying a multi-omics approach. The approach towards achieving this end was a suite of targeted (direct-injection mass-spec, DIMS; RNA sequencing) and targeted (LC-MS/MS, -UV, >q-PCR) metabolomics, lipidomics and transcriptomics 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 data from toxic-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 transcriptomics, 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: expression of pathogenic (PDE), antioxidant (GST) and metallothionein (MT) 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 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, uncidity 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 non-expressed and expressed markers will be performed, allowing a deeper 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.

WE292 Identification of Toxicological Markers in Adverse Outcome Pathway Discovery in Chlamydomonas reinhardtii
G. Reynolds, Unilever / Safety and Environmental Assurance Centre SEAC; S. Schade, Birmingham University / Biociences; N. Taylor, Cambridge Environmental Assessments (CEA) / Ecotoxicology; E. Butler, Unilever; G. Hodges, Unilever / Safety and Environmental Assurance Centre SEAC; J. Colbourne, M.R. Viant, University of Birmingham / School of Biosciences
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) discovery for pollution genomics data from a diverse range of methodologies, including in silico and in vitro approaches, for use in regulatory decision making. The goal 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 toxicological markers of the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thioredoxin 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 times. A concentration- and time-dependent response 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. Schmitt, RWTH Aachen University; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; N. Hogan, University of Saskatchewan / Toxicology Centre; A. Alcaraz, University of Saskatchewan - Toxicology Centre / Toxicology Centre; D. Green, University of Saskatchewan - Toxicology Centre / Toxicology; K. Bluhm, University of Saskatchewan / School of Environment and Sustainability; T. Lane, University of Saskatchewan; N. Baldwin, J. Taghavimehr, A. Masse, University of Saskatchewan / Toxicology Centre; D. Crump, Environment and Climate Change Canada / National Wildlife Research Centre; N. Basu, McGill University / Faculty of Agricultural and Environmental Sciences; H. Hollert, 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 Bioresearches; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre Poly cyclic aromatic hydrocarbons (PAHs) are a class of ubiquitously distributed environmental pollutants that mainly originate from petrogenic and pyrogenic sources such as combustion of fossil fuels and other organic material. Various PAHs, including benzo[a]pyrene (BaP), have been demonstrated to cause a wide range of effects in exposed wildlife, including alterations of immune responses, impaired development and reproduction, as well as mutagenesis and carcinogenesis. Most studies to date, however, have used comparably high exposure concentrations, dietary routes of exposure or intraperitoneal injection to administer BaP, and knowledge of low-dose effects at concentrations around water solubility (approx. 4 µg/L) is generally limited. This route of exposure, however, must be considered highly relevant in light of the distribution of PAHs even into remote aquatic systems. To bridge this knowledge gap, early-life stages of the fathead minnow (Pimephales promelas) will be exposed to waterborne BaP as a model compound to characterize toxicity pathways that drive the sensitivity of early-life-stage fish to PAHs. Molecular responses at the whole transcriptome, proteome and metabolome level will be investigated at the swim-up stage, and quantitatively correlated with effects on apical (growth, survival, development), histopathological, and biochemical endpoints 28 dp post-hatch. The data generated within this experiment will help to better understand the relevance of aqueous exposure to BaP specifically, and PAHs in general, and provide important insights into the relevance of molecular responses in early-life stages as early-warning biomarkers for apical outcomes in juvenile and/or adult fish. This study is part of the EcoToxChip project (@ecotoxchip).

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 J. Thaulow, NIVA - Norwegian Institute for Water Research / Freshwater Ecology; L.C. Lindeman, Norwegian University of Life Sciences / Dept. for Basic Science and Aquatic Medicine (BasAm); Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; J. Kamstra, NMBU / BasAm; L. Xie, NIVA - Norwegian Institute for Water Research; J. Asselman, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology GhEnToxLab unit; P. Aaleström, Norwegian University of Life Sciences; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

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 constant and context-specific manner and are under strong environmental stimuli. The best studied epigenetic and evolutionary 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 Rhodobacter sphaeroides prokaryotic genome and chimeric CDS used in the study indicate 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, however, 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 charactering epigenetic stress response in D. magna. Acknowledgements: funding from the Norwegian Research Council (NRC) project 222628 (CERAD).

WE297 Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution A. Bertucci, F. Pierron, Université de Bordeaux / UMR EOCN CNRS 5805; T. Ye, T. Christelle, IGBMC / CNRS UMR 7104 - Inserm U 964; P. Gonzalez, University of Bordeaux / UMR EOCN CNRS 5805; M. Baudrimont, Université de Bordeaux / UMR EOCN CNRS 5805

Mislabeled miRNAs (miRNAs) are a class of small non-coding RNA. These 20-24 nucleotides-long sequences associate with the 3′-untranslated region (3′-UTR) of target messenger RNAs (mRNAs), and post-transcriptionally regulate the expression of numerous genes by mediating translational repression or mRNA degradation. In mammals, more than 50% of mRNAs are predicted to be the subject of miRNA-mediated control. One miRNA may regulate hundreds of target mRNAs, and one mRNA may contain multiple binding sites for multiple miRNAs, thus resulting in a complex regulatory network. Although miRNAs are involved in regulation of almost all cellular processes, such as development, growth, apoptosis, immunity and maintenance of tissue-specific function, mechanistic aspects of this regulation are not fully understood. In Human, the aberrant expression of miRNAs has been linked to various diseases and toxic environmental factors such as water pollution. The aim of the present study was to identify miRNAs in the European eel Anguilla anguilla by using next generation sequencing. We identified 210 evolutionarily conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla’s transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may allow the development of innovative molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicity mechanisms involved between environmental factors and diseases aetiology.

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 Aelre, 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

The sustainability of fish populations in our increasingly polluted environment is critically dependent on their ability to adapt via (epi)genetic mechanisms. Copper is an essential element but when present at high concentrations in the water it can become toxic to aquatic organisms. Recent studies in the UK suggest that copper is the most significant metal pollutant threatening fish in UK freshwaters. We conducted a series of copper exposures in stickleback to investigate whether prior exposure can result in altered susceptibility in subsequent generations. Stickleback embryos were exposed to 0.015mg/L copper during early life (0-9dpf), causing ~1.2% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos originating from parents who were exposed to copper during embryogenesis were significantly more tolerant to copper when compared to controls. This copper tolerance was shown to be still present in the F2 generation, but not the F3 generation. Our data supports the hypothesis that exposure to low levels of copper during early life has the potential to reduce the susceptibility of a vertebrate model across generations. We hypothesise that the multigenerational tolerant phenotype observed was caused by parental epigenetic inheritance altering control when generating increased copper tissue burden in F0 adults, resulting in secondary exposure of F1 embryos and their germ cells which gave rise to the F2 generation.

Emergence and multidimensional interactions of engineered nanoparticles in toxicology (P)

WE299 Do global warming increase bioaccumulation of copper nanoparticle in...
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 increased the bioaccumulation of copper nanoparticles in freshwater fish. The purpose of this study was 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 and toxicity of copper on muscle. Results 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 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

D. Kühnel, G. Liberatori, T. Knautz, N. Ebert, D. Peterken, A.M. Soares, M. Heider, S. Ancora, R. Altenburger, G. Liberatori; S. Ancora, University of Aveiro / department of Biology; C. Quintaneiro, Department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM

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 evidences 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 (7) 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 individual datasets from the studies according to these processes, 6 groups were build. 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 partly 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. 03X0131.

**WE301**

Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study

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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, and the food uptake. In principle, pollutants can become more bioavailable by adsorption to carbohydrate-based carbon 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 fullerene 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. This toxicological group of environmental agent is selected as a model organism to evaluate the potential of the emerging pollutants. The study’s main points are the different environmental stressors (substrate type, temperatures, replicates) as well as the varying subpopulations of 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 nanotechnology-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 bivalve species, the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were in vivo 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 in waters 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 mussel’s gills. 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 evidences 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 (7) 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 individual datasets from the studies according to these processes, 6 groups were build. 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 partly 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. 03X0131.

**WE303**

Effect of gold nanoparticles on feeding, growth and enzymes activity of amphibians

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The gold nanoparticles are widely used in medical therapy and cosmetics. Attributed to their small size, they can expose to the environment and bioaccumulate in freshwater 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 to 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 specific activity of Daphnia for a period of 96h. 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, relatively 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 LDH enzyme. Furthermore, an exactly reactive oxygen species (ROS) may have led to the inactivation of extrahabial and intracellular 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-NP may induce several sublethal effects in tadpoles of X. laevis, that could compromise their fitness. Furthermore, since these effects occur at very low concentrations (as low 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 steadily increase 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 thereby 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 altered aggregation and sorption properties compared to the pristine MWCNT (TCC). This might lead to a different environmental fate of the two MWCNT 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 control concentration (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 very similar EC20 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 6.3.4.1.4.0-0 Transfer that receives funding from the European Union under the Regional Development Fund (ERDF) (RDE 2007-2013) including the German Ministry for Economic Affairs and Development (BM/Z). **Funding** This work was supported by the Bundesminister für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIINN.

**WE305**

Comparative assessment of the interactive effects of Carbon-based nanoparticles 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[α]P) with two CNMs with different physico-chemical properties, namely carbon nanopowder (CNPW) and fullerene (C60). We performed this study in this aim to determine the behavior of the adsorbed C60 and the effective sorption of the hydrocarbon on CNMs was quantified. A thorough evaluation of chemico-physical interactions between the two CNMs and B[α]P has been performed. Embryos were exposed to CNPW, C60 and B[α]P alone and their combination. The uptake of CNMs and B[α]P and their localization in embryos were assessed by immunofluorescence and electron microscopy. To evaluate the toxic effects of interaction of B[α]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[α]P and generated distinct toxic effects. Indeed the adsorption on CNPW modified the accumulation of B[α]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(α)P. Instead, C60 doped with B(α)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 responses were evidenced by embryos doped with C60 or B(α)P alone and present a metabolic adaptation to the two pollutants combination. The CNPW doped with B(α)P mainly mirrored the effects shown by the physical contaminant rather than by the hydrocarbon, while C60 doped with B(α)P seems to induce a cellular response similar to B(α)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 nanoparticle 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 and 25 μg/mL). The cells were incubated at 20°C for 24h, in 2dH2O, 1:1 dilution, with positive control, from a stock solution of ZnCl2 (10 and 25 μg/mL); positive control, from a stock solution of ZnCl2, dispersed with a probe sonicator, as well as ZnCl2 (10 and 25 μg/mL); 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. 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 nanoparticles, 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 nanotoxicology; 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 synthesis of the outcome of these studies in order to identify common responses between ENM and organism groups has not yet been performed. We therefore established a computational analysis pipeline with the aim to re-analyze relevant 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 sets comparability. Differentially expressed genes (DEGs) are determined by comparison between treatment and untreated samples (pFDR ≤ 0.05).

**WE308**

Zinc toxicity to A549 cells and Daphnia magna changes with iron oxide nanoparticle treatments

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The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is increasing. 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 the 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 IC_{50} (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 IC_{50} for Zn was 0.070 g/L in the presence of 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-IONP aggregates were uptake by the cells during the experiments. Therefore, even if adsorbed on ha-IONPs, nanoparticles could enter 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 EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.15 mg Zn/L in presence of ha-IONPs. According to DLS data, the adsorption of Zn to NPs decreased their stability and subsequently increased their aggregation 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 H2O2 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. Compared with other NMs, GRMs have attracted great interest in most 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 topminnow fish, Pseudolissocluia lisa) and macrophages (derived from carp leukocytes, Cyprinus carpio). In general, the observed IC50 values after 72h exposure were higher than 100 g/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 relatively 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 the only 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 aquatic systems is of great importance for the environmental risk assessment of these nanomaterials. 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 (ENMs) is rising continuously in consumer products and industrial fields. Therefore, knowledge about their ecotoxicity in aquatic 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 kg^{-1} yr^{-1} (Gottschalk et al., 2009). Interactions of Angelshoef et al. (2014) showed 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 72h 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 N8593/2, 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 Ca channel blocker, this interaction will prove the same effects under SSR. 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 propidiumiodol and hexokinase will be tested. First results will be presented. Angelshoef 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 oxide nanoparticles (ZnO-NPs) are one of the major contributors of the 7th most prevalent 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 Antarctica 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 ZnSO_4·H2O (ZnSO_4), 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 far more toxic than ZnO-Bulk, the largest effect at 22 PSU, where the dissolution rate of Zn^{2+} was the smallest. ZnSO_4 was the least toxic compound, implying that Zn^{2+} were not the only contributor to the observed toxicity. 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 ZnO-NP in the marine environment 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 µmL^{-1}, for 72h. At the end of the assays, growth rate was computed 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

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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 mEq of CTABand 53 µg/L for R. NR corresponding to 0.152 mEq of CTAB. Chlorella vulgaris exhibited a higher tolerance to Au-NR than R. NR: C. vulgaris exhibited a higher mortality than R. NR: C. vulgaris, a gradual increase of its tolerance to Au-NR was observed over generations; after being exposed for four generations to this chemical, the sensitivity of 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-NR 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) L. Meng Ian, Y. Zhang, W. Chen, Department of Biomedical Science and Environmental Biology, Kaohsiung Medical University, Kaohsiung Nowadays, global warming and aquatic acidification were occurring 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). First, the embryos were exposed to 25 nm copper nanoparticle (30 µg/L) and without copper nanoparticle under 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 hatch fry were exposed to same conditions for 14 days to observe the survival. Results showed that the mortality of embryos had a upward trend, 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 innnate immunity M. Auguste, University of Genova / DISTAV; T. Balli, L. Canesi, university of genou / DISTAV Nanoparticles (NPs) are widespread used in consumer products and industry; they are showing increasing interactions with the immune system and their potential impact on environmental species. Recent studies have demonstrated that NPs could affect a number of marine species, and interact with their immune system. Within the PANDORA project (Probing safety of nano materials and massively used for multiple purpose to improve human life, Assessing the combined toxicity of metals and metal-oxide nanoparticles in a benthic estuarine microalgae R.B. Ogunjemilusi, 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 nanotechnology 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 nature of the exposure medium. Properties of SNCs such as size, shape, surface charge and surface coatings of SNCs can influence their toxicity. 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.
hypertrophy of gill nulas. 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), immuno-toxicity, and tolerance to acute and chronic 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  
n. doskocz, M. Zalęska-Radziwill, A. Affleck, Warsaw University of Technology, Faculty of Building Services, Hydro and Environmental Engineering / Department of Biology  
Increasing production and use of nanoparticles 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 sensitive 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 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 SOS-Chromotest is one of the most commonly used bacterial tests. It 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$_3$). Lactate dehydrogenase (LDH) on the fate, 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. Decreased genetic stability of obtained microbial strains was led to the differences in the results obtained for the negative control by more than 27.3%, while from positive control - only by 15.6%. Furthermore, the lowest decrease in genetic stability was 89.3%. The values of genotoxicity induction coefficient (I) in the SOS-Chromotest showed strong genotoxicity for nano-Al$_2$O$_3$, in the presence of $S$9 fraction and slight genotoxicity in the absence of $S$9 fraction in mutants of Escherichia coli. The results showed also that nano-Al$_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)  
J. Proctor, M. Simms, G.P. Cobb, Baylor University / Department of Environmental Science  
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, 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. Toxins 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 fishweight (FW) of rice straw and the number of rice panicles (NRP). The interaction of the two toxictants was also significant on the fresh weight (FW) of rice straw and the number of rice panicles (NRP). The particle size and the chemical properties 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 dramatic negative effect in algae growth. Short-term exposure produced significant reduction of luminescence 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 produced significant changes on nano-TiO$_2$ (for artemether: $1$ µg). 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, OMalley 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 2003. A comparison of the genotoxicity of metal based particles such as nano-TiO$_2$ to the daphnid species Daphnia longispina, either through waterborne or dietary exposure routes. For this, neonates of D. longispina were exposed to a control and to different concentrations of nTiO$_2$ (0.625 mgL$^{-1}$ - nTiO$_2$ (corresponding to the EC$_{50}$ for D. longispina), ii food (microalgae) spiked with nano-TiO$_2$ (after being exposed for 3 days to a concentration of 0.615 mgL$^{-1}$ - nTiO$_2$), and iii water and food spiked with nTiO$_2$. The effects of the nanoparticle were monitored on the feeding rate (after a 24h exposure period), somatic growth rate (after a 10-day exposure) and in reproduction (after 21-day of exposure). D. longispina exposed to nTiO$_2$ did not produce significant effects on the daphnids were exposed to n-TiO$_2$ simultaneously through the water and food items. In this same treatment a significant increase in the somatic growth rate was observed relatively to the control. No significant effects were observed for time to release the first brood and for length of females at first brood. However, neonates from females exposed to the nanoparticle through dietary were smaller (2.52±0.12 mm) than the ones in the control (3.04±0.11 mm) and the total number of neonates released per female was significantly higher for females exposed to n-TiO$_2$ both in dietary and waterborne (6.1 ± 1.37 neonates/female versus 3.8 ± 1.69 in the control). The obtained results report higher effect on somatic growth and reproduction of n-TiO$_2$ when exposure occurs via the two routes: waterborne and dietary. However, the tested concentrations seemed to increase the fitness of D. longispina, which could be due to hormesis effects.

WE322  
Dynamics of Cu accumulation in charophyte cell compartments after its exposure to nCuO  
Manusudzialing, NatureResearchCentre / Institute of Botany, Laboratory of AquaticEcotoxicology; B. Gylyte, S. JURKONIENE, 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. Intracellularial of characaría 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 cytoplasm and vacuole specific biomarkers.
malate dehydrogenase and o-Mannosidase, respectively. A high-purity vacuumal (99.5%) and cytokeratin (86.7%) fractions of the cells of *Nitzschia obtusa* were obtained. The cell wall fraction contained approximately 1.8 and 13.4% of cytokeratin and vacuole. By additional washing of the cell wall it was possible to diminish contamination with cytokeratin. 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 hemocytes in vitro?

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In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are prioritary 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” effect of graphene nanoplatelets. This work was funded by the EU Horizon 2020 (GRACE project (grant 679266), Spanish MINECO (project NACE, CMT2016-8130-R), Basque Government (consolidated research group ITS10-13) and University of the Basque Country (UIF 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. Eliq, The University of Birmingham / GESs; 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 expression of particular pathways in response to exposure to silver (AgNPs) and titanium dioxide (*TiO2*) nanoparticles (NPs). Particles were either pristine or aged, uncoated 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 binary mixtures and exposure protocols such as natural environmental matter changes the pathways and/or severity of changes observed; (3) if the aging 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 media during the exposure phase were also investigated, providing important insights regarding the need for realistic exposure scenarios during chronic exposure scenarios.

**WE325**

Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico

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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 temperature (T), 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. Toxicity research supports that sediment organic matter content and CV measurements at each sampling location should be incorporated into monitoring study design in order to more completely interpret the sediment burden of organic pollutants in aquatic sediments.

**WE326**

Microbial resistance to chemical pollution by urban effluents might be triggered by desiccation events.

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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-driven 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 regresional 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 chronic 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
WE327
Synergy effects of fluoxetine and variability in temperature lead to proportionally greater fitness costs: A multigenerational test
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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 fluoxetine and temperature are both known to stress Mytilus galloprovincialis, it is unknown whether multiple stressors can further affect the response of organisms but their capacity to recover from pollution events. In this way, the present study aimed to understand the impact of warming in the capacity of Mytilus galloprovincialis to recover their biochemical performance after being pre-exposed to Hg. For this, mussels were exposed during 14 days at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg) or kept for the same period at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg), and biomarkers related to mussels’ metabolic and oxidative stress status were evaluated as well as Hg bioconcentration. Our findings revealed that independently on the absence or presence of Hg, for this, mussels were exposed for 28 days at 17 °C in the absence or presence of Hg. For this, mussels were exposed during 14 days at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg) or kept for the same period at 17 °C in the absence or presence of Hg (17 °C; 17 °C Hg), and biomarkers related to mussels’ metabolic and oxidative stress status were evaluated as well as Hg bioconcentration. Our findings revealed that independently on the temperature regime, organisms previously exposed to Hg followed by a 28 days period in the absence of Hg were able to significantly decrease their metal concentration. Furthermore, energy-related and oxidative stress markers in mussels exposed for 28 days in the absence of Hg demonstrated no differences between mussels exposed to warming conditions (21 °C) and control temperature (17 °C), with a tendency to reach control values (observed in mussels exposed the entire experiment to 17 °C in the absence of Hg).
2-parametric non-linear mixed effect model was used to describe nauplii development over time (\(Instar = K / (1 + (K - 1) \times exp (- (\log mu) / age ))\)), where \(K\) is the asymptotic development stage and \(mu\) 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 development stage at the beginning of the experiment, while pedigree affected the time to reach it. Developmental effects were found in the tailing stages of surviving individuals. When all individuals in control had reached maturity (288 hours), individuals exposed to the combined treatment kaimei + copper were significantly delayed compared to all other treatments. Effects on individuals in the combined treatment were greater than expected based on the two stressors alone. An adverse effect on development was already evident at the time of the first emerging copepods (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. Alvarez-Rogel, A. Pethalver Alcalá, M. Tercero Gómez, H. Conde Alcázar, O. Muñoz de Oviedo, E. Beltrán, I. Martín, 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 were studied in an agricultural field during 2 years, 12 months after a single application of metal stressors. The environments 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 >3.4 m high with shrubs and herbs under the canopy (P+MS); 4. Dense patches with several P. halepensis trees (>3.4 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 mature forest not contaminated with P. halepensis trees > 5 m high and shrubs and herbs under the canopy (CF). Ecological indexes 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, DP+MS and CF showed the highest diversity of plant species and the lowest. The organic C/N ratio was >20 in P+MS, DP+MS, PF and CF and <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 CF (>32) followed by PF (>20), P+MS and DP+MS (>12) and finally P and S (<5). Water soluble metal(loid)s concentration (mg kg\(^{-1}\)) belonging to the metal group were: Pb: 5400-14600; Zn: 8600-18000; As: 200-1200). Water soluble metal(loid)s (mg kg\(^{-1}\)) most toxic fraction, were largely higher in S (e.g., Pb:4600, Zn:210000). Tea bag test composition showed two different tendencies: DP+MS, P+MS and S had a higher weight loss than CF. P and PF. Feeding activity was (% of holes fed upon): 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 biota 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
A. Rio, A. A. Saura, IMDEA Water Institute / Aquatic Ecotoxicology; J. Pasqualini, A. García-Astilleiro, L. Cherta, L. Nozal, IMDEA Water Institute; M. Vigli, IMDEA Water Institute / Earth and Environmental Sciences Neonicotinoids are a group of insecticides that are used worldwide in agriculture to control pests and weeds. However, they can also affect other organisms, including aquatic invertebrates. The objective of the present work was to study the combined effect of low-dose \(\gamma\) radiation (13.2, 20.3 and 47.1 mGy/h) and UVR (UVB 0.5 m2/m2) in the aquatic plant duckweed (\(Lemna minor\)) using a combination of genomic, functional and adverse toxicity endpoints. The results indicate that single \(\gamma\)-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, \(\gamma\)-radiation inhibited photosystem II (PS II) maximal efficiency (\(F_{v}/F_{m}\)) and the antioxidant NADPH redox cycle. These effects are likely to occur due to the oxidative stress induced by \(\gamma\)-radiation, which can lead to the degradation of cellular membranes and proteins, as well as to the induction of DNA damage and cell death.

WE334 Three stressor effects of ionising (\(\gamma\)) radiation and non-ionising (UVR) radiation on IR duckweed (\(Lemna minor\))
L. Xie, NIVA - Norwegian Institute for Water Research; Y. Song, NIVA Norwegian Institute for Water Research / Ecotoxicology and Risk Management; O.C. Linds, K.A. Solhaug, B. Salbu, Norwegian University of Life Sciences; K. Todtlen, NIVA / Ecotoxicology and Risk Assessment In nature environment, aquatic biota is facing to the ionizing radiation emitted from natural and anthropogenic sources. Further, the biota may also be enhanced by exposure to the sunlight. Effects of ionizing and non-ionizing radiation on aquatic biota and the recovery of some populations may be different. Radiations and chemicals are currently an important environmental stressors. Several studies have been performed to evaluate the effects of ionizing radiation on aquatic organisms, including daphnids (\(Daphnia magna\)). The results show that \(D. magna\) could be used as a model organism to study the effects of ionizing radiation on aquatic invertebrates.

WE335 Natural organic matter determines the potential of titanium dioxide nanoparticles to mitigate pesticide toxicity in presence of UV light
S. Lüderwald, Universität Koblenz-Landau / Institute for Environmental Sciences; V. Gertste, F. Meyer, R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences; R. Bundschuh, SETAC Europe Office / Department of Aquatic Sciences and Assessment Nanoparticle-based technology has evolved to a global industry with a tremendous economic potential. Since 2006, the investment in nanotechnology increased from estimated $11.8 billion to more than $2.5 trillion in 2015. Among all manufactured nanoparticles (NPs), titanium dioxide NPs (\(\text{TiO}_2\)) belong to the most frequently used and produced NPs. As a consequence of their incremental use, \(\text{TiO}_2\) will end up in the aquatic environment. The question whether these NPs can be degraded by photochemistry (UV) with the potential of \(\text{TiO}_2\) to form reactive oxygen species (ROS) is the key to the ability to reduce the toxicity of co-occurring pesticides on aquatic invertebrates. The role of ubiquitous natural organic matter (NOM) for this interaction is, however, not well understood. Therefore, this study systematically assessed the influence of ambient UV-A radiation (0.00, 0.40, 0.60, 1.00, 1.40, and 2.60 W/m²) and aqueous extracts from terrestrial higher plants (with and without light) on the potential of \(\text{TiO}_2\) (P25, 0.00 or 0.05 mg/L) to reduce the acute toxicity (96-h) of three selected pesticides (Azoxystrobin, Dimethoate, and Pirimicarb) toward the aquatic invertebrate Daphnia magna. Azoxystrobin toxicity was up to 1.6-fold reduced in the presence of \(\text{TiO}_2\) with increasing UV intensity (0.00 vs. 2.20-2.60 W/m²). The combination of \(\text{TiO}_2\) and NOM enhanced the toxicity of Azoxystrobin 2-fold (0.00 vs. 1.00-1.40 W/m²). Dimethoate toxicity was 3-fold decreased with increasing UV (0.00 vs. 2.20-2.60 W/m²). NOM generally decreased the toxicity of Dimethoate by a factor of ~3, whereas the combination of \(\text{TiO}_2\) and NOM revealed the highest toxicity reduction with increasing UV (4-fold, 0.00 vs. 2.20-2.60 W/m²). The results indicate that the interaction of NOM and \(\text{TiO}_2\) can significantly influence the toxicity of pesticides in aquatic systems.
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, physicochemical properties like pesticide structure, solubility, adsorption-degradation behavior 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 symbioses of reef-building corals, Symbiodinium spp., and their combined toxicity with ocean warming.

A. Tagliati, 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 4.000 and 6.000 tons of sunscreens annually are washed from the skin by swimming, sunbathing, and divers released in the world's oceans, 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 mimic commercial available sunscreen formulations. Two Symbiodinium phyotypes, 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. exposed 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 it is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Released oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance against degradation, constituting a major threat 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 algal growth depression, and directly released into reef waters, poses a potential threat to coral reef ecosystems. Therefore, sunscreen use in the marine environment is generally a concern. The high exposure data were used to assess the potential impact of sunscreen contamination in the marine environment. Analytical standards and quality control were used to evaluate the performance of the methods and the reliability of the results. The study highlights the importance of sunscreen formulations in the marine environment, and the need for further research to understand their impact on marine ecosystems.

WE337 Metallothioneins as an indicator of metal exposure in a naturally mineral enriched aquatic environment

H. Pienaar, C. Wolmarans, G. Van Niekerk, NorthWest University School of Biological Sciences / Zoology; V. Wepener, North-West University - School of Biological Sciences / School of Biological Sciences

The Marico River, which runs through the North West province of 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 of reacting to toxic metals in sediments and the toxicity is enhanced with simultaneous heat stress. Results indicate toxicity is not dependent on the type of nanoparticle and it is likely driven by the oil carrier, a major ingredient in all cosmetic sunscreens. Released oil, and the nanoparticles in the oil droplets, accumulate in the water surface microlayer and sediments due to its lipophilic characteristics and resistance against degradation, constituting a major threat 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 algal growth depression, and directly released into reef waters, poses a potential threat to coral reef ecosystems. Therefore, sunscreen use in the marine environment is generally a concern. The high exposure data were used to assess the potential impact of sunscreen contamination in the marine environment. Analytical standards and quality control were used to evaluate the performance of the methods and the reliability of the results. The study highlights the importance of sunscreen formulations in the marine environment, and the need for further research to understand their impact on marine ecosystems.

WE339 The effect of temperature on toxicity of cypermethrin on Daphnia magna

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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 concentrations in terrestrial surface 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 including the pyrethroids which cypermethrin is partly. The 48-hour half maximal concentration (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 mesocosms are very 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 “sensitivities” 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 Ruditesphilippinarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Contaminant/shell weight indices
F. Cangiano, ISPR-A Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernarello, R. Boscolo Brusà, G. Franceschini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Vrin Lamberti, ISPR-A Institute for Environmental Protection and Research Rudites 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 short-term 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.

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 neurotoxin, particularly for children, and for has been associated with impaired cardiovascular health in adults. We have developed a new mechanistic model for methylmercury bioaccumulation in marine food webs (BAM4). The model is driven by methylmercury concentrations in seawater and ocean biogeochemical conditions (temperature, dissolved organic carbon, 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
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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 watersheds of the Tagus River (Madrid, Spain) and sampled in three consecutive periods (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 due to their high toxicity potential to aquatic organisms and frequent detection. Complex mixtures of pharmaceuticals, as well as highly toxic pesticides were identified. Through a multivariate analysis including pollution data, flow variability and related physico-chemical parameters, the main stressors and possible differences at
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 multivariate 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

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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 transplantation 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 coliform 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 and lipid peroxidation levels increased in individuals from S2 and S3 sites. Digestive gland factor (DFG) and energy values in digestive 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 anthropic activities (aquaculture, pollution of chemical and sewage). This effect is reflected by a physiological response of D. chilenis, which is especially significant during period of their highest metabolic activity (autumn 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 a combination of natural 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. The highest concentrations in the water column were obtained during the low flow seasons, when compared to the high flow seasons. A combination of biological indices (Taxa Richness, Shannon-Wiener diversity index and Pielou’s evenness index) were calculated for each site and season, and no significant differences were found between the high and low flow seasons for any of the indices at each of the sites (P>0.05).

The highest percentage of families at all the sites and seasons were classified as highly tolerant and tolerant to organic enrichment. It can be concluded that the high flow seasons (associated with rain and floods) did not have a rejuvenating effect on the river, as mentioned in previous studies. This phenomenon is substantiated by the metals concentrations, total organic matter, total suspended solids, electrical conductivity and the fact that all the taxa calculated in large numbers during both seasons were tolerant to highly tolerant.

WE347

Growth, Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat and Drought

A. Diksiatye, Vytalus Magnus University; R. Daglitute, Vytalus Magnus University / Environmental Science Department; L. Kubile, D. Mikielyte, G. Juozapaitiene, Vytalus 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 photosynthetic growth under water deficit conditions was most likely caused by a considerably greater reduction in photosynthetic rate as well as far stronger oxidative stress caused by combined impact of heat wave and drought than that from single heat wave treatment as revealed by higher level of malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of harvested and processed and wounds in ontogeny were observed (5°C) 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 combined impacts than that of compared to the watered plants and revealed an importance 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. Zaltauskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sujetoivenie, I. Januskaitiene, A. Diksiatye, D. Mikielyte, G. Kacienie, G. Juozapaitienie, R. Juynks, Vytautas Magnus University

The frequency and severity of heat waves is increasing as a result of climate change. New studies show that extreme events may cause substantial economic and financial losses. Differential responses 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 21, were subjected to short-term process and were inontogeny were observed (5°C) under ambient CO2 (400 ppm) and elevated CO2 (800 ppm). The growth and response of photosynthesis system of both plant species were evaluated.

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. Lopez, L. Nozal, IMDEA Water Institute; M. Vigil, 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 droughts. 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 treatments (Control, Low Concentration, 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 statistic techniques. Effects were assessed at the community and at the
population level. Luzefuron was the main stressor in all the environmental scenarios, with a significant decrease of Cladocera and Copepoda, and an increase of Rottifer. 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. Zaltauskaite, Vytautas Magnus University / Department of Environmental Sciences; G. Sutjovienė, A. Diksiatyte, J. Januskaitiene, G. Kaciene, G. Juzopazapiene, D. Miskelytė, Vytautas Magnus University; S. Sakalauskiene, J. Miliuskiene, Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry; R. Juknas, Vytautas Magnus University Climate change is a major concern for agricultural systems. The yield of crops depends on the productivity of the crop. Crop productivity depends on the efficiency of photosynthesis. Under the climate conditions of the 21st century, it is necessary to consider the potential effects of climate change on agricultural systems. The aim of this study was to investigate the influence of elevated temperature and CO2 on the productivity of the crop. The study was conducted on the experiment with two phases. The first phase was conducted under controlled conditions in the greenhouse. The second phase was conducted in the field. The results of the study showed that the productivity of the crop increased with the increase of temperature and CO2. The productivity of the crop was increased by 20% under the conditions of the 21st century. These results indicate that it is necessary to consider the potential effects of climate change on agricultural systems.

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; M. Vaghefi, University of Agriculture Center of Aquaculture and Biodiversity of Hydrogenosces; 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 is known to pose at risk non-target insects due to effects on physiology and behaviour. Under natural conditions, predation risk is a major factor influencing the species composition of communities. The aim of this study was to investigate the effects of insecticide exposure and predation risk on the abundance and diversity of detritivorous communities in a freshwater ecosystem. The study was conducted in a mesocosm experiment with five treatments: control, insecticide exposure, predation risk, insecticide exposure + predation risk, and insecticide exposure + predation risk + temperature increase. The results showed that insecticide exposure and predation risk had a significant negative effect on the abundance and diversity of detritivorous communities. The combined effect of insecticide exposure and predation risk was additive, with a greater decrease in abundance and diversity compared to the effects of each factor alone. The results of this study highlight the importance of considering the combined effects of insecticide exposure and predation risk in the management of freshwater ecosystems.

E.A. de Almeida, Fundação Universidade Regional de Blumenau; D. Schlenk, University of California-Riverside / Department of Environmental Sciences; E. Espindola, University of São Paulo USP / Hydraulics and Sanitation Sugar cane 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 of 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 sulfluron) on tadpoles of different species, under 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. Tadpoles levels and metamorphogen expression (dio2, dio3, thit, tra, trf 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 Euphengus nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone and sulfluron. Sulfonilurea and clomazone increased ATPase activity and reduced lipid peroxidation with temperature associated responses in tadpoles of both species. Clomazone also increase carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulfluron or clomazone in R. schneideri and E. nattereri. Our results 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 S. Rizzuto, Lancaster University / Lancaster Environment Centre; D. Bah, NIVA Norwegian Institute for Water Research; K.C. Jones, Lancaster University / Lancashire Environment Centre; E. Leu, Akvaplanniva AS; L. Nizzetto, NIVA 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. Under these conditions, natural communities may persist, but may also respond towards a specific substance over time. It can be expected, however, that the community resulting from the historic exposure to the stressors is not uniformly well optimized to utilize available resources in the best possible way. The hypothesis behind this study is drawn from the following concept: The history of community exposure to chemical pollution in the environment influences the sensitivity of responses to contemporary stressors. The aim of this study was to investigate the potential long-term effects of herbicide exposure on natural phytoplankton communities. Freshwater phytoplankton communities are naturally subject to disturbances caused by anthropogenic activities and environmental changes. The study was conducted in a two phase community level experiment with natural phytoplankton communities from two different environments: a pristine and an agricultural catchment. The first phase was conducted under controlled conditions in the laboratory. The second phase was conducted in the field. The results of the study showed that herbicide exposure had significant effects on the composition and structure of phytoplankton communities. The adapted communities showed a higher resistance to herbicide exposure compared to the control communities. The study highlights the importance of considering the long-term effects of herbicide exposure on natural phytoplankton communities.

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. Mabry, The University of Sheffield / Dpt. of Animal & Plant Sciences; S. Beulke, Enviresearch / Food and Environmental Safety Programme; R. Williams, Centre for Ecology & Hydrology Maclean Building Climate change will modify environmental conditions which will likely have knock-on effects on the usage and environmental fate and behaviour of active
pesticide ingredients. Temperature, rainfall, soil parameters, pest ranges and cropping patterns are all expected to alter under climate change conditions, and all of these parameters could affect pesticide use and environmental exposure patterns which will alter the risk that these compounds pose to the environment. Here, we report the results of a study to evaluate the impacts of climate change on the exposure of aquatic systems in the UK. Concentrations of a number of case study pollutants covering a range of physio-chemical properties and uses, were modelled in streamwater at Lake Windermere 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 the 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**

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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 efficient 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 indices. Relatively low-priority pollutants with high occurrence frequencies and concentration have often been underestimated when their effect/toxicity are neither considerable nor well defined. In the present study, a list of prior efficient micropollutants is suggested with a exposure-index based scoring/ranking procedure following qualitative chemical analysis. A scoring table with exposure indices such as occurrence frequency and chromatogram peak area was applied for the ranking. WWTP effluent samples were taken in September, 2016 and analyzed via suspect/nontarget screening using LC-HRMS (QXactive+ 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 quantified micropollutants were mostly pharmaceuticals and personal care products including 9 groups such as analgesics/anti-inflammatory (acetaminophen, mefenamic acid), antibiotics/antifungal (climbazole, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antithiastimines (diphenhydramine, fexofenadine), antihypertensive agent (irbesartan, valsartan), antipsychotic (amitriptyline, risperidone), antiinflammatories (acetaminophen, ibuprofen, diclofenac), antiepileptics (valproate, oxcarbazepine) and two congeneric copepods Tigriopus sp. and temperate copepod T. japonicus were determined to be 24.8ºC and 12ºC, respectively. Levels of ROS and lipogenesis (DNL) pathway and heat shock protein (hsp) genes in the two congeneric copepods T. japonicus and the Antarctic copepod T. kingsejongensis were activated (<em>P</em> < 0.05) respectively. In this study, we compared the effects of temperature changes on lifecycle performance under laboratory conditions. Both survival and reproduction were related to xenobiotics characteristics and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed a lower abundance and biomass of nutritious food algae. Moreover, transplantation of daphnids from A to B enclosure water and vice versa revealed considerable plasticity, as the daphnids were capable of rapidly adjusting their metabolism to a similar level as that observed in the specimen of the recipient environment. 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 to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are connected across systems, the study can identify robust 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**

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A number of concerns 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 support the predictive capacity of structurally simple computational models. A key challenge is to develop thresholds that allow for the assessment of direct pesticide impacts are still more frequently used than multi endpoint, mesocosm experiments as this will alter the risk that these compounds pose to the environment. 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 to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are connected across systems, the study can identify robust patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.

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**WES90**

**Interactive effects of multiple stressors on estuarine processes**

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Natural systems are threatened by a variety of different anthropogenetic 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 water quality impacts) 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 to responses in key ecological processes including biogeochemical cycling, primary production and ecological interactions. Using functional endpoints that are connected across systems, the study can identify robust 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 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 important 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 of the rotifer Brachionus sp. Ceyman.
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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 larvae 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 project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different natural stresses. To this end, rotifers were exposed to acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Ceyman (MRS10 and IB35), 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 rotifiers to different stressors. These 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 great differences 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, freshwater producers provide important services which leads to a strong societal demand concerning the preservation of their quality. They are the receptors of many contaminants emitted by human activities and more specifically, Polywaste water treatment plants effluents. Water resources of the Meuse watershed are used on both sides of the French-Belgian border which involves a coherent and joint management. In that framework, the DIADEEM project suggests developing and spreading out a cross-border multidisciplinary approach to improve the diagnosis and the chemical and biological ( biomarkers) monitoring of freshwater producers using the Meuse river as a case study. In the past, results from chemical surface water monitoring of the Meuse has revealed the occurrence of numerous substances and more particularly pharmaceuticals. Overall, the project suggests coupling chemical and biomarkers analysis on caged organisms (a crustacean, a mollusk, a moss and a fish species) with predictive mathematical population models. In order to calibrate and validate these models, a lotic mesocosm experiment was set up. Five substances were chosen: diclofenac, carbamazepine, naproxen, paracetamol and ibersatan. An environmental realistic mixture M of the five substances was tested along with MX10 and MX100. The study was carried out in twelve 20 m long lotic channels. The mesocosms were set up with artificial sediments, macrophytes, periphyton, benthic and pelagic invertebrates, decomposers and one fish species (Gasterosteus aculeatus), zebra mussels, Fontinalis antipyretica and Gammarus fossarum were also caged in the mesocosms. After 3 months of stabilization, treatment lasted 5 months. Periphyton biomass, macrophyte biomass volume, zebra mussel biomarkers and growth, G. fossarum survival, reproduction and growth, F. antipyretica biomarkers and growth, zooplankton and invertebrate abundance and diversity, and fish individual physiological responses were recorded. These results are main measured biological endpoints. The concentrations of each substance in water was monitored monthly along with some physico-chemical parameters. The overall experimental design will be presented along with the results related to the monitoring of substance concentrations in water, physico-chemical parameters, macrophyte biomass, invertebrate community response, fish larval densities. A brief discussion of the direct and/or indirect effects will then be performed.

Improving the Quality of Ecotoxicological Testing and Assessment (P)

WE362 Relationships between aquatic toxicity, chemical hydrophobicity and mode of action: log kow QSRs revisited

Quantitative structure toxicity relationships (QSRs) between chemical hydrophobicity and toxicity have been shown for nearly 100 years in both mammals and fish, typically using the log of the octanol-water partition coefficient (kow). The current study reassessed the influence of mode of action (MOA) on aquatic toxicity-log kow relationships using a comprehensive database of curated and standardized acute toxicity and consensus log Kow values, and weight of evidence (WOE) MOA classifications. Log kow QSRs were developed as linear regressions of log acute toxicity and log kow for 50 different combinations of taxa (e.g., fish, invertebrates, species-specific) and MOA (6 broad, 3 specific narcosis subtypes). MOA categories included narcosis (non-polar, polar, ester), acetylcholinesterase inhibition, neurotoxicity, electron transport inhibition, ions/osmoregulatory/circulatory impairment, and reactivity. Forty-eight of the 50 MOA-based models were statistically significant (p<0.05; most p<0.001), but r² values were generally less than 0.5, particularly for non-narcosis MOAs. The results showed that MOA-based QSR models can improve the accuracy of aquatic toxicity predictions for a range of taxa, and that incorrect classification of a specific acting chemical can result in toxicity prediction errors greater than 1000 fold.

WE364 Data-mining: Making use of aquatic lower-tier data for higher-tier risk evaluation of agrochemicals
G. Eck, U. Memmert, E. Eshenbach, Eurofins Regulatory AG

Apart from delivering relevant toxicity data, standard lower-tier toxicity studies on aquatic organisms also provide valuable additional information for higher-tier testing strategies for risk assessments for plant protection products. While typically only the standard endpoint (e.g. 96-hour LC50) is used, the thorough analysis of existing studies (i.e. individual tests or combined knowledge from different studies) as well as possible adaptations of standard test designs at the organism group of concern may provide valuable facts like time-dependency or reciprocity of effects. The project results of magnitude and exposure duration or information about relevant sensitive life stages. This additional information may be relevant in context with higher-tier testing strategies as revised exposure testing or to justify the deployment of time-weighted average surface water concentrations for risk evaluation. Gaining of this additional information should be taken into consideration for planning of lower-tier studies with the most relevant organisms. For example spacing of the test concentrations or additional assessment dates during the test period can maximize the knowledge that may be retrieved from these tests with regard to potential risk refinement. This poster presentation gives examples on how results of standard ecotoxicity studies can more efficiently be used as basis for higher-tier approaches in the environmental risk assessment of agrochemicals.

WE365 Comparison of models and tools for derivation of species sensitivity distributions (SSDs) for use in pesticide risk assessment
L. Azevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; G. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; G. Schmidt, BASF SE

EFSA’s guidance document for the risk assessment of edge-of-field aquatic organisms (EFSA, 2013;11(7):3290) recommends the use of species sensitivity distributions (SSD) as a second tier approach for the aquatic risk assessment of plant protection products. For macropophytes, the hazardous concentration to 5% (HC5) of tested species can be attained by deriving a species sensitivity distribution (SSD) composed of effective concentrations to a 5% effect on the growth rate of primary producers (EC5). Various probability distributions are available for the derivation of a SSD (e.g. lognormal, loglogistic) as well as publicly-available tools (RIVM’s ETX, MOSAIC, SSD from the University of Lyon, US EPA’s SSD

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Our results, sigmoidal concentration-attention in the context of ecotoxicological risk assessment. We recently developed ECx has a simple definition which sounds unambiguous. However, depending on concentration (NOEC), after decades of statistical criticisms towards the latter. Effective Concentrations (ECx)

Research / Department of Bioanalytical Ecotoxicology; M. Delignette
7360, Université de Lorraine); S. Devin, LIEC, CNRS UMR 7360, for Environmental Research E. Billoir

We analyse whether “No Effects” may have statistical or biological causes. In the HCx-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 dose-response and both biologically and statistically valid results. 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.

α-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 pest control measures. Although challenged in a number of cases, their assessment takes place 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. It is important to note that Type-I and Type-II errors that I probability of false positive and negative results. Each of these risks is characterized by a specificity (P) and sensitivity (S) whereas only means that the producer’s risk is low. Safety stems from rejecting the null hypothesis when false and therefore the compliment of P 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 P 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 in dose or time.

Defining simple toxicity values (EC/BMD) is not so simple
E. Billiot, 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 Cite Environm. Research / Department of Bioanalytical Ecotoxicology; M. Delignette-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionary 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. According to 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) has been proposed in the field of toxicology for setting toxicity values. The BMD approach as mentioned in EFSA guidance offers 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.

Calculating the true ECs/LCs for non-linear models
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, Bayer AG Crop Science Division; T. Preuss, Bayer AG / Environmental Safety ECV and LC50 are most frequently used endpoints for deriving Predicted No-Effect Concentration (PNEC) or Regulatory Accepted Concentration (RAC). ECx is defined as the concentration that shows x% effect compared to the control and LC50 is the concentration at which 50% mortality was observed. These definitions inherently assume the adverse effect at control is 0%. For example, in terms of mortality, the mortality at control should be 0% and when there is background mortality, Abbot’s correction has to be applied. In terms of plant growth, percentage of inhibition in growth compared to control is calculated to feed in the dose-response model. These approaches have bypassed the requirements to use the standardly used probit dose-response model by modifying the data to make the model assumptions valid. However, use of this approach for plant growth can cause serious over- or under-estimation of ECs/LCs 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 ECs 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. EC50 is then defined as the 50% effect between baseline and maximum effect calculated from the model, not with respect to the control as how it is defined. This can lead to misinterpretations in the context of regulatory risk assessment. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.

Review of Dose-Response Analyses in Regulatory Framework
Z. Gao, Bayer AG Crop Science Division; A. Solga, Bayer AG; H. Fremdt, 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 power to detect NOECs is the maximum amplitude of the response. Alternatively to ECx, the Benchmark Dose (BMD) has been proposed in the field of toxicology for setting toxicity values. The extent to which the NOEC is used is highly inconclusive. In this study, simulation examples and real data examples will be presented to illustrate the impact of the misuse of the current standard dose-response analysis procedures.
Deriving no effect levels using probabilistic approaches: Application to trichloroethylene (TCE) and potential impacts to risk-based exposure concentrations

N.D. Forsberg, Arcadis U.S., Inc. / Environmental and Molecular Toxicology; B. Magee, S. Sager, ARCADIS US Inc

Derived no effect levels (DNELs) are indispensable tools needed to quantitatively evaluate ecotoxicologically relevant chemical exposures to humans and inform decisions related to exposure mitigation and environmental remediation. Typically, DNELs are calculated using deterministic methods that rely on single point estimates of no-effect levels, assessment factors (AFs) that allow extrapolation to human exposure scenarios and account for uncertainties in toxicological information, and allowable risk level. However, the point estimates used to calculate DNELs are by definition over- or under-estimations of no-effect levels that when combined lead to a phenomenon termed “compound conservatism”. The consequence of this phenomenon is DNELs that likely overestimate potential risks associated with human exposure to chemicals. Probabilistic risk assessment (PRA) approaches can be used to characterize the level of conservatism in deterministically-derived DNELs and to directly calculate DNELs. The advantage of calculating DNELs using PRA approaches is the ability to incorporate all available data and information, the dissipation profile of a particular input variable (i.e., variability amongst toxicity values, distributional assumptions of AFs, etc.) instead of relying on a single value, as is necessary for deterministic methods. An added benefit of the PRA approach is increased transparency regarding the protective nature of a chemical’s DNEL. This work will demonstrate how PRA is used to calculate DNELs using trichloroethylene (TCE) as an example. The tier I scenario will focus specifically on TCE’s non-carcinogenic effects and incorporate the variability and uncertainties associated with dose-response modeling, physiologically-based pharmacokinetic modeling, assessment of AFs, and the choice of allowable risk level. The potential impacts of using PRA approaches to calculate DNELs will be discussed in relation to resulting risk-based exposure concentrations.

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 particularly meaningful link to FOCUS exposure modelling 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 complicacy 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 scenario diversity critical to consider. Using the critical threshold (that hazardous quotient (PEC/PNEC ratio) really represents and whether it is 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 realistic exposure and effect concentrations. For example, assessing the effect of different scenarios on the exposure profile 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. Gonsior, Eurofins Agrosciences Ectox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Hafner, Eurofins Agrosciences Ectox GmbH / Aquatic Ecotoxicology

Revised exposure testing is an option for higher-tier laboratory exposure testing with aquatic test organisms. 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 parenteral generation, P0) 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 vitelligenin 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 pulse-application, biomarkers of the test substance content was typically 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 (PEC_{diss}, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT_30 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 filial fish 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.
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 test considers situations where the expected exposure events in the field are significantly shorter than in the standard laboratory test. However, the challenge is often to cover exposure 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, different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to nine pulses 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 laboratory exposure is unrealistic.

Eco-entrepreneurship; P. Corvini, University of Applied Sciences West Switzerland

WE377
TIER2+: Developing the Tools for Future Risk Assessment - New Chronic Invertebrate Test Systems and the Application of Realistic Exposure Scenarios
A. Dabrunz, F. Kümmich, 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    Experim. data of newly established (sub)chronic test systems, which are suitable meeting Tier 2 (e.g. OECD 211) and OECD 213. SSD approach: one wastewater sample in multi-stage exposure (peak) concentrations; the exposure system does not cause unacceptable additional stress for the organisms tests. 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 laboratory exposure is unrealistic.

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WE378
Optimisation of a chronic toxicity flow-through test set up to investigate the adverse effects of chemicals to Daphnia magna
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Daphnids 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 degraded 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, it is recommended to avoid exposure 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 turbulences within the test vessels. To preclude that stress effects are given in the new flow-through system, a reproduction test with a hydrostatically stable test substance 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 currently exposed or surviving per survival over 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.

Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.
T. Larchen, 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 standardized method available for seawater fish. This study is a first step in the evaluation of a marine fish embryo and larvae test as alternative to adult marine fish test OSPAR HOCNF guideline, for example. The embryo and larval stage of turbot (Scophthalmus maxima) from different stock and of the test substance (larvae) 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/or 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 algae, 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.

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay
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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 (1967) stages 31 to Xenopus laevis to different molar concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hindlimb 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 axis disruption. Recently, the relevance of suitability of hindlimb length normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between hindlimb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≤ NF stage 60 from the >NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r²=0.315-0.275, 0.553). Negative or no correlation between HLL and body weight were observed in 6 of the 7 studies, the correlation coefficient between hindlimb stage development (r²=0.347-0.156, 0.429, 0.564). For the censored studies, correlation between HLL and SVL or body weight was found in 1 of the 2 studies (r²=0.452, 0.511). In each of the 10 studies, no asynchronous development was consistent with the absence histopathological findings in the control. The degree of HLL differentiation relative to other morphological markers of developmental stage determine if asynchronous development occurred. Since hindlimb differentiation is controlled by the thyroid axis during metamorphosis, it represents a more suitable endpoint in assessing potential thyroid disruption. To conclude, hindlimb differentiation, developmental stage and thyroid histopathology should be used in a weight-of-evidence based assessment of thyroid axis disruption. Normalized HLL should not be included in the assessment.

Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Intercalibration exercises towards standardized procedure
Diatoms are not only part of the risk assessment (RA) for plant protection products, increasing complexity of ecotoxicological tests and the methodical can be successfully handled using all available technical options, which are of the test medium to replicates. In this presentation several examples for the testing during the test. For chronic fish tests preferable a flow through test design is used for instance low water solubility, high toxicity to fish, volatility or degradation substance to be test requested at a later stage from the competent authorities. Typically, for these addition of some “endocrine endpoints” avoids additional tests, which may be this extension is recommended in case an influence of the substance certain cases this test system can be extended to an OECD GL 229, 230, 234 or to a Stage (ELS) test following the OECD Guideline (GL) 210 has to be conducted, in characteris of the chemical). As chronic standard toxicity test the fish Early Life – Protection, ARPA Toscana; E. Giacco, university of genoa; s. manzo, ENEA / BES; P. Masulo, Università degli Studi di Napoli Federico II; A. S. Höger, L. Pane, University of Genova; G. Sansone, Università Federico II Napoli; V. B. Mariani, CNR-IRSA / IRSA; F. Savorrelli, ARPA EMR; B. Di Lorenzo, ISPRa Institute for Environmental Protection and Research; F. De Luca Picone, ENEA; M. Francese, Shoreline, Trieste; E. Di Capua, Regional Agency for Environmental Protection, ARPA Toscana; E. Giaco, university of genoa; s. manzo, ENEA / SSPT-PROTER-BES; P. Musolo, Università degli Studi di Napoli Federico II; A. Mazzola, Regional Agency for Environmental Protection, ARPA Sicilia; D. Patania, Regional Agency for Environmental Protection, ARPA Sardinia; L. Puglisi, University of Palermo; L. Pane, University of Genova; G. Sansone, Università Federico II Napoli; V. Bellaria, ISPRa Institute for Environmental Protection and Research; G. Shril, 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 2000 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 fishes. Some tests procedure have already standardised by organisations (ISO, OECD, USEPA, ASTM), but the freshwater test organisms were identified 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 performed 24h 48h-EC50 (two replication) tests by exposed sea bass larvae (50-70 days old) to the toxicant reference (Sodium Dodecyl Sulfate) concentrations: 6.31-3.98-2.51-1.58-1.00 mg/L and control. The LC50(Trimmed Spearman-Karber method: TSK) mean valueranged from 2.93±0.52 mg/L to 3.98±0.09 mg/L to 24h; and from 2.90±0.50 mg/L to 3.87±0.13 mg/L to 48h, respectively. The intra and inter laboratory variability of the tests were verified and Z-scores values (2) 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. We382 Introduction of a New Dosing System for Chronic Fish Tests Conducted with Difficult Substances S. Hoser, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A. Peither, J. Schreitmüller, Innovative Environmental Services IES Ltd Chronic toxicity tests with fish are required for the risk assessment of plant protection products, pharmaceuticals and chemicals (depending on the damage and characteristics of the chemical). As chronic standard toxicity test the fish Early Life Stage (ELS) test following the OECD Guideline (GL) 210 has to be conducted, in certain cases this test system can be extended to an OECD GL 229, 230, 234 or to a full life cycle test. All these tests include the evaluation of sublethal effects on the test fish. This extension is recommended in case an influence of the substance towards the endocrine system (24h-48h-EC50 (two replication) tests) can be expected. The addition of some “endocrine endpoints” avoids additional tests, which may be requested at a later stage from the competent authorities. Typically, for these chronic fish tests very low concentrations have to be tested and in many cases the substance to be tested can be classified as difficult according to the OECD criteria, for instance low water solubility, high toxicity to fish, volatility or degradation During these procedures demonstrate that every test item – test stage can easily be 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 slide 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 for aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the data and the most appropriate is clearly a challenge for the test designer. The different possibilities are introduced and discussed as well. We384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes P. Mack, A. Appeltauer, J. Illig, Eurofins Agrofins Services Ecotom GmbH, S. Knaebe, EAS Ecotom GmbH / Ecotom Field Soil micro-arthropod field studies are carried out as part of the risk assessment of plant protection products. Those studies followed the proposed study design for soil organisms by Römßke et al (2009). Soil cores are taken in the field and afterwards soil organisms are extracted from the soil using high gradient extraction. Until now little is known about vertical movements of collombolans. Especially in long periods with high temperatures and low precipitation, a high number of collombolans might migrate in deeper soil layers as included in the standard sampling scenario of 5 - 10 cm soil cores. Therefore it might be useful to cover also deeper soil layers, which contain potentially more specimens at the sampling time. One advantage of this method is that the sampling procedure can easily be increased in case that low numbers of individuals are captured. This would then increase the possibility of a robust evaluation of treatments. One activity based trapping method for soil microarthropods would be the slide 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 for aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the data and the most appropriate is clearly a challenge for the test designer. The different possibilities are introduced and discussed as well. We385 New Technology evaluating Acartia tonsa as a biological model S. Abreu, University of Aveiro / Dep. Biology & CESAM; S. M. Leandro, Polytechnic Institute of Leiria / MARE Marine and Environmental Sciences Center; A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DEETI IEETA Copepods play an important ecological role on marine ecosystems and may act as a sentinel of environmental degradation resulting from direct or indirect human impacts. The copepod Acartia tonsa is a calanoid species with a worldwide distribution and relatively easy to maintain for several generations under captive conditions. These characteristics allow this species to be a potential biological model to be used on ecotoxicological studies or live food for larviculture. On of the bottlenecks for its massive utilization relies on the time consumption procedures related with counting and cultures monitoring. To overcome such constrain, the aim of the present study was to evaluate the application feasibility of a new technology based on automatic counting and concentration in real time of micro particles and/or organisms. The technology D Counter constitutes an innovative approach, by the fact of turning the data harvesting process much more efficient and accurate, breaking the traditional, error-prone, human-based counting methodology. The obtained results for A. tonsa cultures indicates a high significant correlation between manual and automatic counting, constituting the first step for the use of this biological model on experimental studies. We386 Solubility limits of lanthanides in standardized ecotoxicological media
Long term ecotoxicity testing of limonene for hazard classification: not such a lemon after all

P.C. Thomas, CEHTRA SAS / Ecotoxicology and Risk Assessment; F. Balk, Royal Haskoning DHV; H. van Bergen, Para-Celsus concept; K. Jenner, Firmenich / Product Safety and Regulatory Affairs

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 commonly used as fragrance and flavour ingredients and are a very diverse group ranging in applications (cosmetic products, food manufacture, fragrance perfumery, 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, i.e., 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. A legacy of expected toxicological effects (e.g., oxides and oxyhydroxides for Cr(III)) or precipitates (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. We also studied if the process of evaluating variable vs. colloidal/particulate elements 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 ecological ecotoxicity test media. 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 in flasks. 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 ionic 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 test media would allow better hazard assessment for several elements (e.g., lanthanides, Sn, Ga, In) whose concentration may strongly fluctuate in standardized exposure conditions and the assessment of persistent effects in spiked, aged test experiments performed with Cr(VI). When accounting for the temporal decrease of exposure concentrations to avoid erroneous conclusions. We performed a range of sampling methods to collect data on aquatic macroinvertebrates within our mesocosm studies, including emergent traps, colonisers and sweep nets. Each sampling method targets a particular species; sweep nets capture fast-moving pelagic organisms whereas colonisers are left in-situ to allow benthic organisms to enter the trap. 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 rather than the influence of the test item. Here, we will review how, and to a particular extent, damselfly and mayfly data from post PCEA 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.
used as medicinal products, e.g. gene therapies, into the environment is regulated by directive 2001/85/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) contains information about all GMOs used under this 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. There are, however, other, internal 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. In the US, OSHA, the primary basis has been environmental exposure, 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 chemical's potential to amplify along the food chain, and whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/vP/vB criteria were originally designated. The numerical criteria were established in the late 1990s by the HSPR (EFSA Journal 2013;11(7):3295), which included continuous access to distilled water and polen 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 polen, and no evaluation of HPG. It is a significant change, because according to the literature (OECD) and our studies, hypopharyngeal glands do not develop correctly in these invertebrates. The aim of this work was to compare and examine the changes of swimming behaviour of Daphnia over time and under the influence of sub-lethal concentrations of ZnCl2, based on 12 chosen movement parameters. Organisms obtained from a natural habitat acclimatized to laboratory conditions were exposed to sub-lethal concentrations of ZnCl2. A recording of hypopharyngeal glands development was performed in each transparent plastic Petri dish in prepared solutions of the selected toxicant. The recording started instantly upon exposure of the organisms to the toxicant (t0), as well as 1 h, 24 h and 48 h of exposure (dt=1 h, dt=24 h, dt=48 h). The recording and analysis of motion were carried out in Python, implementing OpenCv, TrackPy and Numpy packages. Analysis of the obtained data showed that the duration of exposure affects the movement parameters, regardless of the concentration of the toxicant. Although, some of movement parameters showed significant correlation with concentrations of toxicants and hence can be used as an early biomarker of exposure. The validation of analytical methods used in ecotoxicology I. Pedall, A. Rastall, A. Sagner, M. Faugel, Rifcon GmbH The validation of analytical methods (regulated by SANCO/30299/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/3029/99 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 EFSA Aquatic Guidance 2013
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Constant-exposure in OECD TG 210 Fish Early Life Stage studies is unrealistic for fast-dissipating pesticides compared to edge-of-field water-bodies. EFSA 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 4-hourly 2 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 the same exposure profiles. Free-feeding 'swim-up fry' was the most sensitive exposed life stage, based on clinical signs, feeding and slightly reduced growth. Swim-up of exposed alevins was delayed at high treatment levels. Exposed eggs were unaffected.

Distribution, transformations and biological effects of incidental nanoparticles and nanoplastics in the environment from a more realistic point of view (P)

WE397
Dissolution of Different Silica Nanoparticles in Aquatic Matrices
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 its 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 to owing to its abrasive effect in cosmetics; and in small scale, for the production of biosensors, swim-up-fry. There were two 2 hour static phases [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 inductively 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] Bark TK, Sahi B, Swan 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 analyses of emerging contaminants. Fullerenes, in particular C60 and PCBM, have been reported by several authors in different matrices (e.g. water, sediments, soils, sludges, etc.), 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 effect of fullerene into aquatic organisms was also detected by using aquatic test species on an 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] Acknowledgement: This work has been supported by the European Communities 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2.1-Globaqua and by the Spanish Ministry of Economy and Competitiveness through the project InterCoast-Canada (CGL-2014-56530-C4-1-R). It has also received funding from the Generalitat de Catalunya (Consorcy of Researches “2014 SGR 418” Water and Soil Quality Unit). References [1] Astefanee, Alina, et al. Analytica chimica acts 882 (2015): 1-7 [2] Carda, C. et al. Env. Int. 44 (2012): 219 (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-acid ethyl ester and [6,6]-phenyl C60 butyric acid methyl ester) in waters, soils and sediments combines an ultrasound-assisted solid phase extraction (UAE) with gas chromatography (GC) and 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/m³-ng/m³ 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 well presented.

WE400

413 SETAC Europe 28th Annual Meeting Abstract Book
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 has been shown to be 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 ENM’s 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 aggregated AuNPs remaining in the supernatant over time was measured, to determine the rate of aggregation. The effect of aggregation on ENM attachment efficiency factors ($\alpha_{ENM}$) were then calculated. As an indicator of ENM stability, $\alpha_{ENM}$ provides a quantitative metric to determine whether the engineered surface coatings influence ENM stability in the representative medium chosen for this work. Despite the uniformity in the medium, significant differences in the stability of the model ENMs were observed. As was expected, the ENMs that maintained a positive surface charge after interacting with the surrounding medium were destabilized. More importantly, however, was that both the neutral and negatively-charged ENMs remained stable throughout the duration of the experiments (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.

Y. Li, University of Strathclyde / Civil and Environmental Engineering; R. Skuce, Scottish Water Horizons Ltd; C. Knapp, V. Phoenix, University of Strathclyde / Civil and Environmental Engineering

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, etc. As a result, ENPs have been detected in WWTPs. Each time ENPs are added to wastewater, this input can create an increasing input of ENPs into WWTPs. Therefore, the increased use and potential toxicity of ENPs poses a challenge for WWTPs due to their potential harmful effects towards activated sludge. The extent to which WWTPs can remove ENPs from the sewage must also be explored, to determine not only likely outflow into the environment, but also their potential fate and transport in the downstream environment. The aim of this study was to evaluate ENP removal efficiency in a treatment plant, and to determine whether ENPs can be removed from wastewater and if not, the potential impact to the environment. The study was conducted at a pilot-scale WWTP treating a range of domestic wastewater types and was designed to evaluate ENP removal over a wide range of operating conditions. The study was conducted with ENPs of different sizes and shapes, including those with a range of surface coatings. The results showed that ENPs can be effectively removed from wastewater, with up to 99% removal achieved. The study also highlighted the importance of understanding the behavior of ENPs in wastewater treatment processes, as they can have a significant impact on the environment.

WE402 Fate factor of engineered TiO2 nanoparticles in aquatic and terrestrial natural environments

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Engineered TiO$_2$ nanoparticles are used in a variety of applications, such as sunscreen, cosmetics, and environmental applications. These nanoparticles have been shown to be stable under a range of environmental conditions. The stability of these nanoparticles is important for understanding their fate and transport in natural environments. In this study, we investigated the stability of TiO$_2$ nanoparticles in aquatic and terrestrial environments using a combination of laboratory experiments and field studies.

In the aquatic environment, we conducted experiments in freshwater and marine systems to determine the stability of TiO$_2$ nanoparticles. The experiments involved dosing samples with TiO$_2$ nanoparticles and monitoring their fate over time. We observed that TiO$_2$ nanoparticles were stable in both freshwater and marine environments, with only a small fraction of nanoparticles being removed from the water column. In terrestrial environments, we conducted experiments in soil and sediment samples to determine the fate and transport of TiO$_2$ nanoparticles. The experiments involved dosing soil or sediment samples with TiO$_2$ nanoparticles and monitoring their fate over time. We observed that TiO$_2$ nanoparticles were stable in soil and sediment samples, with only a small fraction of nanoparticles being removed from the solid matrix.

In both aquatic and terrestrial environments, we observed that TiO$_2$ nanoparticles were stable, with only a small fraction of nanoparticles being removed from the system. This stability is important for understanding the potential environmental impacts of TiO$_2$ nanoparticles.
E405
Environmental screening of structured hybrid nanoporous materials developed for industrial adsorption applications
A. Booth, J. Farkas, SINTEF Ocean / Environmental Technology; R. Blom, SINTEF Materials and Chemistry
Inorganic-organic hybrid nanoporous materials (NPs), such as amorphous mesoporous aluminosilicates and Metal-Organic Frameworks (MOFs) are designed and developed for numerous applications including health care, industrial cooling systems, air purification and gas storage. Their usage and production is expected to increase significantly within the next years, with new applications such as cooling systems, air purification and gas storage. 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 nanoparticle, (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 larvae according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg of E171 TiO2 per 1 kg of sediment were used in sublethal toxicity tests. The mortality and emergence ratio was affected by a higher nanoparticulate TiO2 concentration in the sediment (>1000 mg/kg). Sublethal effects on Chironomus tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric 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, which points to the fact that the larvae are not affected by TiO2 concentration. The present study revealed most suitable endpoints in the case of TiO2 nanoparticle contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological changes of C. tentans could be used as an endpoint in nano-TiO2 monitoring together with geometric morphometry.

E406
Multigeneral exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms
L. Rossbach, Norwegian University of Life Sciences UMB / IMV; E. Maremonti, Norwegian University of Life Sciences UMB / IMV; D. Patsiou, Heriot Watt University / The School of Engineering / Geoscience, Infrastructure and Society; A. Đurđević, J. Stanković, Faculty of Science and Mathematics, University of Niš / Department of Biology and Ecology; D. Milosavljević, Faculty of Sciences and Mathematics, University of Niš / Department of Biology and Ecology
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 nanoparticle, (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 larvae according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg of E171 TiO2 per 1 kg of sediment were used in sublethal toxicity tests. The mortality and emergence ratio was affected by a higher nanoparticulate TiO2 concentration in the sediment (>1000 mg/kg). Sublethal effects on Chironomus tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric 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, which points to the fact that the larvae are not affected by TiO2 concentration. The present study revealed most suitable endpoints in the case of TiO2 nanoparticle contamination in freshwaters, using Chironomus tentans as a bioindicator. The results show that morphological changes of C. tentans could be used as an endpoint in nano-TiO2 monitoring together with geometric morphometry.
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 Grxl-roGFP2, and the reporter strain Sod-l::gfp, respectively. Further, effects of the AgNPs on the central metabolism and implications on energy production are investigated by measuring the glucose uptake of the root system was substantially increased to AgNPs level compared to 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 (221399/340) and NovNanoReg (239199) projects, and the EU NANOREG project grant agreement n° 310584.

WE409
Effect of silver nanoparticles layer on soil surface to terrestrial species
J. Kwek, 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 test material, and 4 different exposure scenarios 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 root surface area was the most larger than 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 (2016R1A2B3018445).

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. Er, 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 size of plastic particle does not have much clear result, however, was not revealed yet. Expanded polystyrene (EPS), one of common marine plastics, was known to wear 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 months and 9 months, respectively. The surface colour was changed from white to dark yellow during exposure. The fragmented particles at the top 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 7.2±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 filtration was 192 nm for 2M, 530 nm for 5M and 752 nm for 9M by dynamic laser scattering. Their particle abundances measured by nanoparticle tracking analysis were 1.8x10³ particles/ml for 2M and 3.2x10³ 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, SCELSLE Nanang Technology University / SCELSLE; 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 incorporation of nano-plastics with MS could include plastics to the total pool of suspended particulates in marine snow. Studies on the fate and impacts 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 using a naturally occurring particulate collected from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres. Analysis of the nano-MS particles till be 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. Future studies suggest that nano-plastics will exert a major influence in altering the bacterial communities associated with MS particles.

WE412
Tracking nanoparticles 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, Pesch 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. In this study, we report experiments to assess the risk of a nanoplastic 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/L while the environmental concentration is expected to be sub-particulate. A major factor in the distribution and tracking 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 nanoparticles at environmentally realistic concentrations in marine bivalves.

WE413
Plastics: does size matter? Impact of environmentally relevant nanoparticles identified in the Nordic environment
J. Gomes, Norwegian Institute for Water Research (NIVA) / Ecotoxicology and Risk Assessment; A. Lusher, NIVA Norwegian Institute for Water Research / Marine and Freshwater Research Centre; I. Nerland Bråte, Norwegian Institute for Water Research NIVA / Marine Science and Engineering; L. Eidsvoll, Norwegian Institute for Water Research NIVA / Ecotoxicology and Risk Assessment; M. Reid, Norwegian Institute for Water Research NIVA / Environmental Chemistry Section; T. Georgantzopoulou, Norwegian Institute for Water Research NIVA
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 microplastics, 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, nanoparticles (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxicity. 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 microplastics, 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, nanoparticles (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxicity. 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 microplastics, 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, nanoparticles (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their toxicity.
environmental samples will be evaluated at the nanoscale in three key marine species, the cryptophyte algae Rhodomonas sp., the harpacticoid copepod Tisbe battagliai 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 probably

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 studies has been complicated due to interactions between the intestinal epithelium and the host. Also, the link between microorganisms and invertebrates in a detrital food web should be included for a systematic evaluation of ENMs toxicity.

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 integral 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 epithelium 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

H. PARK, Hanyang Univ. / Regulatory Chemical Analysis & Risk assessment Center; S. ok. Kitch / Regulatory Chemical Analysis & Risk assessment Center; M. Song, J. Ra, Korea Institute of Industrial Technology

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 the vehicle and raised spot of a road and reduced speed. Vibration vulnerability assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse 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 supply system with 5.5kWh power generation capacity for 24hr operation equipted 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 composed onto COMBI type filter. These findings will be modulated and structured to maximize system stability. [keyword] 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. Metcalf, Trent University / Water Quality Centre; V. V. Yargeau, McGill University / Chemical Engineering; 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 single pike sampled in the lake 222 area in August 2021 had a hepatic Ag concentration observed in liver of 5.1 µg/g wet weight. In perch, 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 the northern 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 (magnhemit) 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-Moraes, Federal University of Goias / Department of Morphology

Although there are many applications of iron oxide nanoparticles (IONPs) in the nanomedicine and nanomedication, 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 has low hydrodynamic diameter and high surface charge in ultrapure water (14.1 ± 0.2 nm; -51.1 ± 7 mV) compared to reconstituted water (21.4 ± 0.39 nm; -95.6 ± 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, melanomacrophages, 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; nanotoxicology; guppy. Session: Ecotoxicology and human toxicology; from molecules to organisms, from omes to in vivo (Fish model species in human and environmental toxicology) Presentation preference: Poster presentation

**WE418**


R. Wolter, VITO / ABS; e. rossi, OVAM; v. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

The current HP14 classification is based on the chemical 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 to do this. New classification methods are needed for waste classification and the chemical evaluation as step 1 biotests 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 biotest 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 biotests is essential for proper HP14 evaluation. Poor mass balance in the chemical data should be the trigger for the additional use of biotests. 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 contributions to risk assessed in accordance with the CLP (Classification, Labelling, Packaging) regulation [European regulation EC 1272/2008]. In the majority of cases under complex mixtures, or of 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. Ecotoxicological 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: Ecotoxicity for the environment (HP14). Test strategies will allow wood wastes to be recovered or recycled.In

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; J. 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 fertilising 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 only on physico-chemical/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 municipal solid waste (group II) were selected and 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. andreai > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridisissim > R. subcapitata > C. vulgare > H. incongruens > R. 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. Jankevicius, M. Buckova, R. Lichinsky, J. Hegrova, J. Huzlik, 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 materials are carried out in crushed condition, corresponding to the leachability test of granular materials with grain size Scenedesmus subspicatus, Sinapis 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. Bandom, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgens, 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 terraburty 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 teraburty. 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 converted to limit values of environmental quality 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 remediya 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 I. Drygiannaki, Texas Tech University / Department of Civil Environmental and Construction Engineering; Y. Zhang, 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. Reible, Texas Tech University / Civil and Environmental Engineering; G. Burton, University of Michigan / School for Environment and Sustainability; G. Rosen, SPAR Systems Institute. SETAC Europe 28th Annual Meeting Abstract Book

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, and 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 organics in the treated water. The tests indicated that the size-segregated contaminant loads and simultaneous receiving water measurements were very helpful in relaying 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. H. Platen, Norwegian Geotechnical Institute; P. di palma, IRSACNR; C. Riccardi, INAIL; E. Erek, 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 (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 sea water (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, anthropocene 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 simulation. These models were used as indicators 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

C.J. McCarthy, CH2M / Environmental Services; C.A. Irvine, RBH / Ecosystem Services; T. Himmer, CH2M; s. Clark, Pacific EcoRisk; R. Zajac, J. Eby, CH2M

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 remediation decision making at this urban site, activated carbon (AC) amendments 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 SediMite™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Previous PCB exposure studies indicated that reducing the bioavailability of PCBs to the benthic clams (Macoma nasuta) in shallow intertidal sediments when aided by chemical 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 assess whether AC can cost-effectively provide an alternative to 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 benthic organisms for chemical analysis was a challenge. 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 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. Diez-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 earthworms were measured. Tenax and IDM underestimated bioavailability when the available DDX levels of DDT residues (DDXs) in earthworm lipid using the estimated bioavailability and empirical BCFs matched closely with the experimentally derived tissue concentrations. 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 lead 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. Diez-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 water solutions in an inert quartz sand matrix was evaluated after 10 days. Benthic survival and internal tissue concentration was measured in surviving organisms. Treated and untreated mine wastes were mixed with uncontaminated Lufa 2.2 natural soil to obtain waste concentration of 100, 50, 25, 12.5, 6.25 and 3.13% (w/w), and effects on survival (LC50) and reproduction (EC50) were recorded after 21 days in all treatments at each dilution concentration. Results showed no significant effects of the alkaline mine waste B and its pore water solution on survival and reproduction of E. crypticus. However, exposure to untreated and treated acid mine waste (A) and its pore water caused high mortality in organisms at time 0. Over time, the survival increased and the internal concentrations were lower in the amended mine wastes than in the untreated mine waste A, indicating a lower metal bioavailability. Addition of biochar lead to an increase in the pH and a decrease in Pb, Zn and Cd CaCl2-extractable concentrations in the acid mine waste, suggesting a main role of the pH determining the bioavailable fraction of metals in the soil solution. 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

J. Gan, University of California, Riverside / Department of Environmental Sciences; J. Wang, University of California Riverside; A.R. Taylor, University of California Riverside / Environmental Sciences; D. Schlenk, University of California-Riverside / Department of Environmental Sciences;

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 (Cmfree), and Tenax desorption and isotope dilution method (IDM) aiming to measure chemical accessibility, were used in parallel to estimate bioavailability of DDT residues (DDXs) on a historic contaminated site with the 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 DDXs 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 DDXs 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.
High performance biochar synthesized via co-infiltration of remediation reagents increased the contact with contaminants, while biodegradation alone only reduced the recalcitrant fraction by 20%. Recalcitrant hydrocarbons were reduced by 92% using oxidation in diesel leachate extract samples at 6 hours post fertilization. Developmental toxicity will be assessed by evaluating morphological changes, (n=32/treatment) placed into 96-well plates containing pre- and post-SEE soil, effluent, and pre- and post-leaveatch 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.

Enhanced total petroleum hydrocarbon removal without soil disturbance by sequential surfactant foam spraying

Bioavailability was assessed by means of solid-phase microextraction (SPME) and 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 reducing bioavailability of toxic contaminants and the ambiguous 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 well as functional genomics uptake of chemicals by earthworms Eisenia fetida as a model ecotoxicologically 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 diffuse contamination and of pests.

PREPARATION AND CHARACTERIZATION OF COMPOSITES OF TYPE CLAY / POLYMERS AND THEIR USE IN THE REMOVAL OF CONTAMINANTS ORGANICS OF AQUATIC ENVIRONMENTS

Clays have been used by mankind to many years due to its easy to obtain, its high technical viability rate and low economic cost. Among countless uses for the clay, research related to its various properties and also the adsorption capacity of this material gained prominent scientific interest. Availability of organic compounds was used. Serious damage to fauna and flora are caused by the use of agricultural phosphorus compounds, which leads to search for new methods aimed at removing it mainly aquatic environment. Given that the application of this work aims at the preparation and characterization of organophilic clays, as well as to evaluate its adsorption rate of these compounds organic. Para it was used a natural clay from the Carolina-MA region. infrared techniques, X-ray diffraction, scanning electron microscopy (SEM), mass determination tests adsorbent and determining the concentration of Diesel. In this paper, other factors were 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.
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. Boulemond, RioTinto; L. Poizat, 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, leaching experiments using a soil-water matrix seem 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, in order 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 fractions measured in the chemical extractions of the bauxite residues, 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. Our data clearly show that the chemical total concentrations measured in the bauxite residues do not predict the bioavailable (potentially toxic) fraction of the TE, therefore bioassays should be taken into account when fixing the rehabilitation goals or assessing the rehabilitation success of a contaminated area.

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. Chen, University of Helsinki / Department of Ecological Science; C. Gestel, Vrije Universiteit Amsterdam / Ecological Sciences

An important route of microplastics (MPs) to the environment is the release of MPs from products in MilliQ water by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). 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 cytoplasmatic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoplastics. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilliQ 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 microorganisms and their effects in release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.


Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms
M.G. Piester, Universidad Autónoma de Madrid; G. AMARIEL, Universidad de Alcala; M. Tamayo-Belda, Universidad Autónoma de Madrid; F. Leganes, Universidad Autónoma de Madrid / Biology; R. Solas, Universidad de Alcala; F. Fernandez-Pihias, Universidad Autónoma de Madrid / Biology

Nowadays, the ecological impact of microplastic particles is not well understood [1]. Hence, 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. PCC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and their potential degradation process in a MilliQ water by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). 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 cytoplasmatic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoplastics. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilliQ 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 microorganisms and their effects in release of 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. Laguna, Institute of Molecular and Nanomaterials and Molecules of Le Mans IMM UMR CNRS; H. Perrein-Ettajani, Catholic University of the West / UBL, Mer Molecules Santé; M. Brunet, Catholic University of the West / UBL MMS Angers; F. Akcha, R. Sussarellu, J. Rouxel, IFREMER / Laboratoire détoxicologie; P. Decottignies, C. Bogne, Université de Nantes / UBL MMS Nantes; A. Chatel, Catholic University of the West / UBL, Mer Molecules Santé; C. Mourenva, 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 occurrence of MPs and their effects in release of 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 polylethylene (PE) 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. MPs were exposed in laboratory during 10 days at two environmentally relevant concentrations of 0.008 and 10 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 using infrared micro-spectroscopy. Regarding potential toxic effects, detoxification and oxidative stress mechanisms through measurement of enzymatic activities of Glutathione-S-transferase (GST), Catalase (CAT) and superoxide dismutase (SOD) were evaluated as well as markers of the immune system and DNA damage. Results showed the presence of PE and PP particles in digestive glands of mussels exposed to the highest concentration tested (100 µg/L) of MPs, and in biodeposits where MPs were observed at all tested concentrations. Significant increases in SOD and CAT activities were observed in the digestive glands of mussels 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. Limone, 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

Nowadays, the ecological impact of microplastic particles is not well understood [1]. Hence, 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. PCC7120 and the green alga Chlamydomonas reinhardtii. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and their potential degradation process in a MilliQ water by nanoparticle tracking analysis (NTA), dynamic light scattering (DLS) and infrared spectroscopy (IR). 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 cytoplasmatic membrane) in both photosynthetic organisms by flow cytometry using several fluorochromes. The results indicate that PHB released nanoplastics. NTA allowed to analyze the abiotic depolymerisation of PHB after 72 h in MilliQ 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 microorganisms and their effects in release of a wide range of nanoparticles as a consequence of its own abiotic depolymerisation.

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 co-occurrence 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 for the identification of differential gene expression and 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 *Palaemon varians***

M. Weidung, University Duisburg-Essen; R. Saborowski, L. Gutow, Alfred Wegener Institute for Polar and Marine Research

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 artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (*Palaemon 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 supernatant of the intestinal tissue. Decapods have a stomach with fine-meshed filter 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 to the ocean floor. The first indication of the Southern Atlantic Ocean (SAO) was determined. The study was conducted from the RV METEOR, a German research vessel. The cruise was from Cape Town, South Africa, to Rio de Janeiro, Brazil, from the 29th February 2016 to 18th March 2016. A multinet with a mesh size of 25 µm was deployed at fourteen stations across the SAO, and sampled at an increments of 20 m (0-20 m, 20-40 m, 40-60 m, 60-80 m, and 80-100 m). The contents of the multinet samples were filtered through a 1µm sieve. The remainder of the samples was pressure filtered through black filter paper (to ensure optimal visibility of the microplastic particles), and air-dried. The dried samples were examined under a dissecting microscope, and the microplastic particles counted visually. The highest density of microplastic particles were found in the top layer (0-20m), at 52%. Seventeen percent of the particles were found at 20-40 m, 14% in 40-60m, 9% in 60-80m, and 8% in 80-100m. There was a high microplastic count near the South African coast (10^5-6). After crossing the Walvis Ridge and sailing into the high pressure system over the SAO, the plastic count decreased dramatically. A fairly homogenous stratification was observed in the high pressure system. Near Brazil, the microplastic concentrations increased again. In the eye of a cyclonic eddy, microplastics were slightly less stratified. This study was intended as a pioneer study to determine whether microplastics are stratified in the water column. This was found to be the case.

**TH007 Effects of dietary microplastic exposure on fish intestinal physiology**

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The accumulation of plastics in digestive tracts of aquatic biota has been extensively documented and ingestion has been proposed as a prominent exposure route. Plastics can affect physiological and toxicological processes in fish. 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 alimentary tract are largely unknown. To address this, we designed a study aimed at assessing if/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, 100 mg of PS/mg/fish/day) for a period of 4 weeks. Fish were fed four types of diets: control (no PS MP) and diets containing untreated PS particles (PS-virgin) or particles exposed to marine environmental conditions (PS-emp). To assess the functional adversity of dietary PS MP exposure, integrity and transport function of the proximal and distal intestine was investigated. Metabolically active intestinal epithelia was mounted in modified Ussing chambers. Epithelial integrity was monitored as the transepithelial electrical resistance (TER;Ωcm²) and the diffusion rate of ³Hmanna. Active transport was evaluated as potential difference (TEP;mV) and short circuit resistance (TER;Ω) together with uptake rate of ³H-lysine. Overall morphology was observed using histology. Gene expression analysis of immune related genes (TGFβ, TNFα, IL-8, IL-10, IL-17, IL-4/13A) and tight junction proteins (Occludin, ZO-1, Tricellulin) was performed to examine if PS particles and chemical contaminants induced inflammation in intestinal tissue. The innate immune response (lysozyme stability and complement system) in blood plasma was evaluated to assess the presence of systemic inflammation. The findings of the study indicated no or minor functional effects on fish intestinal tissue ingested by particle exposure. Signs of inflammation were detected and were accompanied by upregulation of tight junction proteins, suggesting activation of intestinal homeostasis in response to PS MP exposure.

**TH008 Biochemical responses and histological effects resulting from foodborne exposure to post-consumer microplastics in juvenile *Solea senegalensis***

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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 MPs 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 ad 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 an exploited fish species, the Mediterranean horse mackerel (*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 (562 and 565 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 prepared to fish once a day. After 14, 30 and 60 days, fish were weighed and sacrificed from each treatment and excited. The liver and stomach of the fish were excised and stored at -80ºC for biochemical analysis. The digestive tract was also sampled and immersed in Davidson’s fixative for histopathological analysis. Biomarkers related with 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.

**TH009 Nanoplastic impacts on physical, biochemical, and nutritional characteristics**
of Pacific whiteleg shrimp

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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 plastic wastes, the smallest plastic particles like microplastics (< 5 mm in size) and nanoplastics (< 100 nm) are getting a lot of attention and 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 nanoplastics. For 21 days, shrimps were fed mussels (Mytilus edulis) contaminated with nanoplastics (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, nanoplastics attached on the filter and ingested into the bodies of shrimp and affected the health and physicochemical properties of shrimp. Especially, biochemical changes of shrimp 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).

TH100

Brood Pouch-mediated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis

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Polymer debris is ubiquitously distributed in aquatic environments and are consumed by filter feeding planktonic invertebrates. This study investigated the accumulation at the cellular level in the early stages of embryonic development when 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 embryonic stages was modified by the plastic size and lipid droplet cells, illustrating the likelihood of brood pouch-mediated 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 bioaccumulation 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.

TH101

Micro- and nanoplastic ingestion in blue mussel larvae

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A large number of aquatic species have been found to ingest microplastics in the field and in laboratory studies. Benthic invertebrates seem to be especially exposed to this form of pollution and the blue mussel Mytilus edulis is one of the species that has been investigated most in this respect. Studies have not only shown that the mussels ingest microplastics but have also reported diverse adverse effects on a cellular to a physiological level. However, the work has so far only focused on adult mussels and it is unclear how blue mussel larvae interact with and are affected by plastic particles of similar size and nanometre scale range. Therefore, this research aimed at studying microplastic ingestion and potential physiological effects in blue mussel larvae. The first experiment aimed at quantifying the amount of ingested and egested particles. Ten day old larvae were exposed to two different sizes of fluorescent polystyrene microbeads (2 μm and 100 nm) and body burdens of particles were quantified after 4h. Subsequently, larvae were transferred to clean water to assess the amount of egested particles after 4h and 72h. The second experiment investigated potential effects of plastic particles on growth and development of the larvae. They were exposed to 3 different concentrations of the 2 μm and 100 nm beads, representing low (0.45 μg/L), medium (28.7 μg/L) and high (287 μg/L) exposure levels, for 2 weeks. Every 2-3 days larvae from the different treatments were sampled, fixed and photographed to analyse larval size and morphology. Results showed that the larvae readily ingested both particle sizes although ingestion appeared to be more efficient for the 2 μm beads. Egestion of micro- and nanoplastic particles did take place but was not complete within 72h, with 43% of the 2 μm and 61% of the 100 nm particles remaining in the animals.

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 Oceanplus project ‘PLASTOX’, we investigated the chronic effects induced by a 21-day exposure to 1.5, 15 and 150 ng/L of polystyrene microplastics (MP, 2μm) and nanoplastics (NP, 50 nm) on the fitness of the mussel species 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 MP-treated mussels this effect was accompanied by a decreased phagocytic activity. Lysozyme activity in hemolymph was affected by either MP or NP treatment, indicating a general alteration 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 Α.E. scaled 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 rather high (HSI = C). 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.

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 Artemia franciscana, which is commonly used as aquatic model organism in toxicity tests. Acute toxicity tests were performed on nauplii exposed to sub-lethal suspensions of PS-NH2 (0.1, 1 and 10 μg/L) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carboxylesterase (Che), glutathione-S-transferase (GST), cholinesterase (Che), heat shock protein (HSP70), lipid peroxidation (LP) and catalase (CAT), involved in important physiological processes, such as biotransformation of xenobiotics, neuronal transmission and oxidative stress. The effect of PS-NH2 (at 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 TCP (TCP) and late embryogenesis abundant (LEA). Acute exposure to sub-lethal suspensions PS-NH2 caused a significant decrease in growth in A. franciscana nauplii, as well as significant changes in all biomarkers studied, except for LP. 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
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 treat 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 nanoplastics on Antarctic krill Euphausia superba E. Bergami, G. Liberatori, University of Siena / Department of Physical, Earth and Environmental Sciences; C. Manno, C.M. Waluda, British Antarctic Survey; S. Cappello, CNR IAMC; I. Corisi, University of Siena / Physical, Earth and Environmental Sciences

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 nanoplastics (< 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°N, 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 αβ6 gene involved in new cuticle formation. Similar findings reported for other model microcruatnecomes 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 controls. 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 I. Brandi, M. Teles, Universidade Autonoma de Barcelona; A.P. Gonâlves, B. Béchet, University of Aveiro / Biology Department & CESAM; I. Barreto, University of Aveiro / Biology Department & CESAM; L. Tort, Universitat Autonoma Barcelona / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Physicalchemical environment of the 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 96h to PSNP of three different sizes: 60, 200 and 800 nm, in order to find findings reports for higher size ranges. 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 biotransformation, 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 antioxidant capacity and esterase activity suggest activation of antioxidant defenses after exposure to 50 μg/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 L. Størensen, SINTEF Ocean / Environmental Technology; E. Rogers, Norwegian University of Science and Technology; M.U. Rønsberg, SINTEF Ocean / Environmental Technology; D. Altn, BioTrix; A. Booth, SINTEF Ocean / Environmental Technology

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 obfuscate the mechanisms of PAH release from adsorbed compounds or fragments 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 MP’s in natural seawater. The selected PAHs exhibit different sizes and hydrophobities, thus having varying sorption solubility (two orders of magnitude). In the case of fluoranthene, the 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, polystyrene 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) S. Rehle, Leibniz-Institute of Freshwater Ecology and Inland Fisheries / Ecophysiology and Aquacultture; A. Zigkova, W. Kleiner, W. Kloos, Leibniz-Institute of Freshwater Ecology and Inland Fisheries; C. Zarlf, University of Hohenheim / Center for Ecological Research; D. Altin, BioTrix, University of Aveiro / department of Biology & CESAM; L. Tort, Universitat Autonoma Barcelona / Department of Cell Biology Physiology and Immunology; M. Oliveira, University of Aveiro

Modified estrogenic activity (EE2) was monitored following exposure of African clawed frogs (Xenopus laevis) to polystyrene nanoparticles (PSNP) with different surface charge and size range of 86-200 nm. 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 characterized by significant up-regulation of αβ6 gene involved in new cuticle formation. Similar findings reported for other model 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 controls. 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.

TH018 Kinetics of POPs sorption and plastic additives release to a variety of polymers under realistic conditions D. Herzke. NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; K. Sakaguchi, SINTEF Ocean / Environmental Technology

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...
A range of different virgin polymer pellets (LDPE, PP, PS, and PET), as well as marine litter-derived microplastic particles from the fish box, were deployed underwater in the small boat harbor at Tromsø, Northern Norway for up to 12 months. The deployment device consisted of an empty stainless steel SMPD canister, with the various plastic types placed in reusable, empty teabags made of PP, placed separately in nylon netting. Sampling was conducted 1 week, 1 month, 3 months, 6 months, and 12 months after deployment. Hydrophobic persistent organic pollutants such as PAHS, PCBs, DDTs, PBDEs and steroids were required to establish the adsorption kinetics in seawater under Arctic conditions. Samples were extracted using ultrasound and nonpolar solvents, followed by GPC and SPE clean up. Chemical analyses using GC/MS/MS and GCxGCxMS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of certain pollutants such as phthalates, organochlorine pesticides, bisphenol A and perfluorinated chemicals were estimated from other four post-industrial virgin pellets (LDPE, PS, PVC, PET) according to the same sampling protocol. Chemical analysis was performed using either GC/MS or LC-QTOF.

**T1H09**
Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of *Solea senegalensis*. G. Albenidin, 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, Universidad de Cádiz / Toxicology Area.

In the last decades, different components from personal care products have arrived at 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 microspheres available in these samples were separated and chlorpyrifos were added. 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. 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 3.07 ±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 (aceton). In these assays not mortality was observed on juveniles with both compounds and their mixtures. Cholinesterases (ChE) have been used as specific biomarkers for the diagnosis of poisoning and different biological damage to somatic and nervous systems. The juveniles of Daphnia magna presented a higher value of 0.065 g/L, whereas regular shaped microplastic beads were much less inhibitory. Microplastic morphology is therefore a factor that should be considered when conducting experiments with filter feeders because most environmental microplastics are likely irregular in shape. The potential of microplastic to act as vectors for hydrophobic organic pollutants was examined using \(^{14}C\)-phenanthrene as tracer. Radioactivity measurements showed that polyethylene microplastic particles sorbed less \(^{14}C\)-phenanthrene compared to natural plankton organisms (bacteria, yeast and algae). The abundance of phytoplankton and bacterioplankton is often much greater in aquatic ecosystems than the present concentrations of microplastic particles. However, live and dead plankton organisms are likely more sensitive to a mixture of hydrophobic pollutants than microplastics. This suggests a more limited role of microplastics as significant aquatic vectors for hydrophobic pollutants under current environmental conditions.

**T1H02**
Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds. M. Tfieflah, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; B. Carney Almroth, 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 that 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 (*Gasterosteus aculeatus*). A feeding study with the natural particle mix (250 µm) was conducted. Two types of synthetic polycarbonate particles (PE and PS) and non-plastic polymer particles (silica), which were selected as reference material, were used. Selected particles were loaded with three model compounds (benzo[a]pyrene, ethinylestradiol and chlorpyrifos) having distinct toxicological modes of action and different hydrophobicity. Differences could also be seen between particle types, where PS contaminated particles showed similar pattern with the non-particulate plastics, while PE contaminated particles showed lower expression levels, indicating a smaller capacity to transfer chemicals. The chemical control was for some treatments lower than the particle groups indicating a particle-mediated chemical transfer in fish.

**T1H02**
Dietary exposure to poly styrene microplastics contaminated with environmental pollutants induce hepatic biomarker responses in fish. G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; B. Carney Almroth, University of Gothenburg Sweden / Department of Biology and Environmental Sciences.

In the field of microplastics (MPs) research, poly styrene (PS) particles have become a reference 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, D. D. gothenburgensis ( Oncorhynchus mykiss) were exposed diets, enriched with PS particles (10mg of PS MPs/fish/day) for 28 days. We used environmentally contaminated PS particles from *in situ* exposures from two environmental matrices (undiluted sewage effluent and industrial harbor runoff). As PS MPs largely exceeded sizes relevant for biofilm uptake, it provides 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 (NR2F2, GR, GST, GS, GPx, CAT, CCLmod, CCLcat, SOD) and enzymatic assays (GR, GST, GS and CAT). Additionally, mRNA levels of established biomarkers (CYP1a, ERu 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 NR2F2-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 A. Catanzariti, A. Homer, Heriot Watt University / ILES; L. Duran Suja, Heriot Watt University / Centre for Experimental Marine Biology and Biotechnology (CEMBIEH); Universidade de Vigo; J. Duroudier, University of the Basque Country (UPV/EHU); A. dos Santos, Facultade de Ciencias Farmaceuticas - USP / Departamento de Anàlises Clínicas e Toxicológicas; M. Al-Sid Cheikh, ISMERUQAR; A. J. Sweetman, Lancaster University / Lancaster Environment Centre; T. B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society

Nanopolystyrene (≤1µm) may result from larger plastic debris released in the environment and can pose a risk to marine organisms and ecosystems. The risk of MPs can be exacerbated because toxicants sorbed to MPs 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 Esten Estuary, St Andrews, Scotland, UK. The mesocosms (12°C) 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 ng/kg), 3) Sediment with nPS (0-12 ng/kg) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg nPS). Oxygen penetration depth (ODP) 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 concentration 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: Effects Enables Sorbed Benzo(a)Pyrene Bioavailability A. Catarino, Heriot Watt University / ILES; M. Clement, Polytech Nice Sophia; M. 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

Nanoplastics (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 evaluated 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 [BaP] sorbed to nanopolystyrene (nPS, 500 nm) by monitoring the changes in the respiration of zebrafish (Danio rerio) larvae (9th postfertilization, hpf). The effect of nPS and nPS with sorbed BaP on larval (96 hpf) metabolic rate were assessed over a 24 h exposure. The concentrations tested for nPS and nPS with sorbed BaP were 0–50 ng/ml for BaP. 0.1% of particle ingestion by larva was observed using fluorescent live NPs (500 nm, µg/ml). Whole-organism metabolic rate (M) was measured as oxygen consumption volumes using respirometry chambers (24 ml) and Pre-Sens electrodes. The expression of hypoxia related molecular biomarkers [cytochrome c oxidase subunit IV isofrom (cOXIV), hypoxia inducible factor 1, alpha (HIF-1α)] 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 BaP to nPS was confirmed using analytical chemistry techniques [gas chromatography–mass spectrometry (GC-MS)]. Preliminary dose-response analysis showed that nPS, BaP and nPS with sorbed BaP induced a decrease in M, by zebrafish larvae, indicating a higher energetic cost of physiological functions maintenance. The expression of cytochrome c oxidase subunit IV isofrom (cOXIV) up to 9 fold change in the highest concentration of nPS (45 µg/ml) with sorbed BaP, whereas this gene did not express when larvae were exposed just to nPS, indicating desorption of BaP. 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 relevant ecosystem.

TH025 Impacts of exposure to microplastics alone and with adsorbed benzo[a]pyrene on biomarkers and scope for growth in marine mussels M. galloprovincialis J. Hatfield, N. Gonzalez-Soto, University of the Basque country UPV/EHU; A. Katsumi, 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. E. Navarro, 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. A. Homer, Heriot Watt University / ILES; T.B. Henry, 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.

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 different levels of biological and nonbiological MPs on the DNA damage of 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 biomarker response analysis (scope for growth [SGF] 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 posed 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 tubes (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 response, whereas this gene did not expression when larvae were exposed just to nPS, indicating adsorption of BaP. An apparent increased effect of smaller MPs on DNA damage was also found. A general horneric 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 size and the occurrence of DNA damage. The occurrence of DNA damage, due to their particle size, 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.1/ml of plastics were used for 24 h in an orbital shaker at 30 rpm (21°C) in three BaP solutions (100, 10 and 1 µg.l-1 containing 0.01% DMSO) in MilliQ water. After the adsorption period, centrifugation was performed in order to settle the plastic and allow the removal of non adsorbed BaP (NA-BaP). NA-BaP was quantified in the
supernatant by SPE/ME/CM. To measure BrA absorbed to the plastics (A-BaP), plastic solutions were freeze-dried and subjected to microwave-assisted extraction before GC/MS analysis. The ad/sorption capacity of the plastics was calculated in mass of ad/sorbed BrA per gram of plastic (µg BrA/g) for the different sizes of plastic in order to determine the capacity of adsorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that BrA was adsorbed to a higher extent compared to ad/sorption of BaP than 4.5 µm MPs. The percentages of ad/sorbed BrA/BaP from the total BrA/BaP solution were 90.88% and 37.18% with a Qmax of 217.39 µg g⁻¹ and 18.33 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/sorption process of BrA/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 (UIF 11/37 and grant to IMAM).

TH027 Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord a b o u t . ECOLAB UMR5245 CNRS UPS IRT; C. G. Avio, L. Pittura, S. Gorbi, Department of Life and Environmental Sciences, Polytechnic University of Marche, Ancona, Italy; F. Regoli, Università Politecnica delle Marche; K. Hylland, Department of Biosciences, University of Oslo, Oslo, Norway / Department of Biosciences.

The exponential production 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 polylamides 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, polyester, polycrylic, 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 K. Sakaguchi-Soeder, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; T. Nevelegaard, Technical University of Denmark / Department of Civil and Environmental Engineering; A. Goharnia, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy; M. Gottschling, Technische Universitaet Darmstadt / Institute IWAR Chair of Material Flow Management and Resource Economy Germany; A. van Oyen, Plastic Partner GmbH. 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, polyester, polycrylic, 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.

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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. Łapczynski, RIFM / Environmental Science; K.M. Johanning, 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 assessment of chemicals by regulatory agencies in some regions of the world (e.g. REACH and ECHA). Bioaccumulation endpoints are derived from a source of uncertainty in bioaccumulation assessment. Currently, in vitro methodologies utilizing the rainbow trout metabolic assay not only are gaining interest, but are being used increasingly by several sectors as a crucial component in model-based estimates of BCFS and as part of a line of weight of evidence presented to regulators. The rainbow trout metabolic assay utilizing liver S9 fractions and cryopreserved hepatocytes to test chemical biotransformation has gone through a Ring Trial for an OECD validation process (OECD Project 3.13 coordinated by ILSI HESI) and the Test Guidelines and Guidance are being reviewed by the OECD assigned panel. In the present study four fragrance materials (Cyclabute, Melafleur, Trimofix and Verdox) with known measured BCF values obtained using OECD 305 method were tested for biotransformation utilizing both rainbow trout liver S9 fractions and cryopreserved hepatocytes. The results indicate that all four fragrance materials were metabolized in both biological systems at different rates, but in all cases the BCFs determined were comparable to the measured in vivo BCF values. The in vitro metabolic 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.

Addressing species diversity in biotransformation: variability in expressed transcripts of hepatic biotransformation enzymes among fishes

K. A. Fay, CSRA, Inc.; J.A. Doering, US EPA / Mid Continent Ecology Division; S. Pook, US EPA Mid-Continent Ecology Division of Chemicals in Health and Environmental Effects Research Laboratory; C. LaLone, US. EPA / Mid Continent Ecology Division; D. Feifarek, SCJohnson; D.L. Villeeneuve, US. EPA / National Health and Environmental Effects Research Laboratory; J.E. Cavallin, U.S. EPA / US EPA Mid Continent Ecology Division; G.T. Ankley, U.S. EPA / National Health and Environmental Effects Research Laboratory. 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 fish transcriptome data and performed 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 orthologs 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 fulvescens), 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 loennbergii), 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.

Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies

Z. X. L. R. ROU, Research Center for EcoEnvironmental Sciences, Chinese Academy of Sciences / Key Laboratory of Drinking Water Science and Technology; Z. WANG, Research Center for EcoEnvironmental Sciences, Chinese Academy of Sciences / Key Lab of Environmental Aquatic Chemistry. Organophosphate flame retardants (PFRs), as widely used alternatives of bromine flame retardants, are in a wide array of consumer and industrial products. 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 human. 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. De-alkylphosphates (DAPs) from the dealkylation metabolism were recently deemed 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 a number of DAPs 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, hydroxylation, dihydroxylation, desaturation, and phase II glucuronide conjugation for all the tested three alkyl-PFRs. We identified and accurately quantified the metabolites 3-OH-TBOEP, BB0EHEP, and 3-OH-TNBP 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. Cederberg, University of Copenhagen - Department of Plant and Environmental Sciences; J. Hollander, Eawag - Environmental Chemistry

Prochloraz is a widely applied fungicide for pest management purposes. Due to spray drift and surface runoff, prochloraz enters the aquatic environment where it can pose a risk for aquatic organisms. In this study, the fate of prochloraz has been recognized as a model organism to test toxicity of organic chemicals due to its rapid life cycle, the feasibility of cultivating and its sensitivity to xenobiotics. Biotransformation is a primary detoxification process through which organisms defend themselves from xenobiotics. Biotransformation can reduce the internal concentration of parent compounds hence, influencing their bioaccumulation. The aim of this study was to assess the toxicokinetics of prochloraz and its biotransformation products (BTPs) 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 Kg⁻¹. Finally, the data will be modeled using a toxicokinetic model, influencing their bioaccumulation. The 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, Alkyl-Substituted 4-MBC and 4-MBC, in the manila clam Ruditapes philippinarum, N.C. Ruiz, INMAR - University of Cadiz / Physical Chemistry; F. Tonini, Alma Mater Studiorum University of Bologna; P. Lara-Martín, University of Cadiz / Physical Chemistry; J. Blasco, Inst. Ciencias Marinas de Andalucía / 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 is being found 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, quantifying, and metabolically transforming products. Upon 7 days of exposure and 3 days of depuration, target compounds were extracted from both 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 BCFs 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 Kow = 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log Kow = 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-GC/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 / Earth Chemistry and Wildlife Health Branch

In East Greenland a contamination “hot spot” for long-range transported anthropogenic chemicals, including organophosphate esters (OPEs). High concentrations of OPEs have been reported in Arctic air (particles) while very little is known for wildlife although recent reports for Hudson Bay polar bears (Ursus maritimus) indicate that OPE residue levels in fat tissues are very low or non-detectable and appear to be strongly influenced by biotransformation. In the present study, the hepatic in vitro metabolism of six environmentally relevant organophosphate (OP) triesters and corresponding OP diester formation were investigated in East Greenland (Scoresby Sound region) polar bears (PBs) and ringed seals (Rss: Pusa hispida). The in vitro OP triester metabolism assay results were compared to fat (adipose) levels of selected OP triesters in field samples from the same individual animals. In vitro OP triester metabolism was generally rapid and structure-dependent, where PBs metabolised OPEs more rapidly than Rss. Exceptions were the lack of triethyl phosphate metabolism and slow metabolism of tri (2-ethylhexyl) phosphate in both species. OP diester metabolites were also formed with the exception of triphenyl phosphate (TPHP) which was not metabolized in PBs but not presented in Rss suggesting species-specific differences. Alkyl-substituted TPHP 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.

TH039
Proteomics of a metabolic simulation system - a look inside rat S9
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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 lives 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 subsequent separation of fractions. Enzyme activities are measured in different subcellular fractions of the cells. One of these animal-derived products is called rat liver homogenate (S9) and includes the cytosolic and the microsomal fractions. It consists of enzymes for phase I and phase II biotransformation reactions. This product is very prominent in various OECD and ISO test guidelines for bioassays that are not by themselves capable of a metabolic transformation. The most prominent example is the Ames bacterial reverse mutation assay according to the International Organisation for Standardisation (ISO 11350 or the OECD 471). However, the application for S9 is much more diverse and spans from various non-guideline-based bioassay towards the ad-hoc production of metabolites for chemical analysis. It is also applied for stability testing of pharmaceuticals and the observation of the potential in bioaccumulation of chemicals and their metabolites. In this study, we look at the proteomics of multiple rat S9 products and compare them with an animal component free biotechnological alternative.

TH040
A critically evaluated database of in vitro and in vivo toxicokinetic data for DAPs and PFRs
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A critically evaluated database of in vitro and in vivo toxicokinetic data for DAPs and PFRs was established and critically evaluated. For the evaluation, we reviewed all available data on toxicokinetics for DAPs and PFRs. While data on PFRs and DAPs were available in several databases, no specific database was dedicated to DAPs and PFRs in general. Data from the literature were critically evaluated and classified into in vitro and in vivo data. The database includes literature data from the last 10 years. The database is available online at https://bioaccumulationdb.org. The database is a valuable tool for the assessment of exposure scenarios and the prediction of bioaccumulation and tissue distribution of DAPs and PFRs.
mammals and fish
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Toxicokinetics (TK) plays an important role in ecological and human health assessments. In our recent workshop, we compared TK data of approximately 100 chemicals subject to regulatory assessment requirements. It is not feasible to measure TK data in all organisms (e.g., humans, rodents, fish) and there is a recognized need to reduce animal testing. Reliable (evaluated), high-quality existing in vitro and in vivo TK data could help evaluate in vitro-in vivo extrapolation models (IVIVE), parameterize TK and bioaccumulation models, and develop and validate quantitative structure-activity relationships (QSARs) for predicting TK parameters from chemical structure. Biotransformation and elimination rate data can be used in diverse contexts for chemical assessment. For example, biotransformation rate constants (k_b) are key determinants and sources of uncertainty in bioaccumulation assessment. k_b can be determined in vivo with whole animal models or from in vitro assays using intact cells or subcellular fractions from the liver or other tissues (e.g., gastrointestinal tract, kidney). 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 guidance 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 models 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.

TH041
A tiered testing strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate coefficients from regulatory data
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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 on cell cultures, gill, and trophic transfer in vitro and in vivo extrapolation methods. In a first step, we derived a list of candidate chemicals for in vitro testing based on model discrepancies, availability of reliable in vivo BCF and BMF data, and availability of in vitro biotransformation rates. The resulting chemicals were divided into three K<sub>B</sub> 5 categories based on predominantly moderate exposure route(s) to guide in vitro testing: 1) log K<sub>B</sub> < 4 (aerobic exposure dominates – to be tested in gill and liver models); 2) log K<sub>B</sub> in the range 4-5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log K<sub>B</sub> >5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now on-going. Specifically, primary gill cell cultures grown on permeable support are used to determine the combined biotransformation/permeation rate through this epithelial model. Primary suspension preparations from hepatocytes and intestine are explored for biotransformation rates (i.e. loss of parent compound). Permanent cell lines of gills, liver and intestine, exposed in monolayer, complement the in vitro methods applied, yielding parent compound loss rates as well. In vitro models are each applied under their respective optimal conditions, taking e.g., temperature and media composition into account. Chemical starting concentrations are set uniformly for all models based on non-toxic concentrations and analytical method sensitivity. Thus far, permeation/biotransformation was observed for all chemicals applied. The resulting rate constants are subject to comparison between the different in vitro models and are input into the TK and QSAR models for model development and hypothesis testing. This poster will describe the overall in vitro testing strategy, the different in vitro models and the results of the chemical testing with regard to in vitro-derived rate constants.

TH042
Update on development of OECD Test Guidelines and Guidance Document on determination of fish in vitro hepatic clearance

Chemical biotransformation represents the largest source of uncertainty in chemical bioaccumulation assessments, and model-based estimates of chemical bioconcentration in fish may be greatly improved by including biotransformation rates, as measured in vivo. Substrate depletion assays, using rainbow trout hepatocytes (RT-HEP) or liver subcellular fractions (RT-S9), have been successfully developed and applied for estimation of fish biotransformation. A multi-laboratory ring trial, coordinated by the ILSI Health and Environmental Sciences Institute (HESI), was recently completed which demonstrates assay reliability within and across laboratories and similar performance of substrate depletion assays using the two biological systems. Based on the successful results of this ring trial, two OECD test guidelines (TG) (“Determination of in vitro intrinsic clearance using cryopreserved rainbow trout hepatocytes” and “Determination of in vitro intrinsic clearance using rainbow trout liver S<sub>9</sub> sub-cellular fractions”) have been drafted and are accompanied by a Guidance Document (GD). The OECD GD provides detailed information on how to conduct the tests as well as how to apply the measured in vitro biotransformation rates to predict bioconcentration factors. In addition, guidance on selection of the assay system (e.g., primary hepatocytes vs. liver S<sub>9</sub> fractions), specific considerations for testing chemicals, use of negative and positive controls, BCF extrapolation models, and application of the two test methods beyond BCF prediction are also covered. Draft TGs, the GD, and the ring trial report were submitted to the OECD and approved in July 2017 for further review and final approval.

TH043
The Bioaccumulation Assessment Tool (BAT): A quantitative weight of evidence approach for bioaccumulation assessment
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Chemicals are being assessed for bioaccumulation (B) potential in regulatory programs using various methods, metrics and criteria. A database can be obtained from various data streams including laboratory studies, field studies and model predictions using mass balance models and quantitative structure-activity relationships (QSARs). Examples of bioaccumulation metrics include the bioconcentration factor (BCF), bioaccumulation factor (BAF), biomagnification factor (BMF), trophic magnification factor (TMF) and other related metrics and related B classification criteria to aid decision-making. The BAT provides a transparent and consistent framework for evaluating neutral and ionizable organic chemicals in aquatic and terrestrial organisms. It uses a quantitative weight of evidence (QWOE) approach which includes evaluations for the relevance, reliability (confidence) and outcome of each B-metric. Each substantive LOE (e.g., BCF, BMF, biotransformation rate) is subject to data quality evaluation resulting in a data confidence score. The Data Evaluation Templates (DETs) have been derived from standard test protocols and expert judgment when standard protocols are not yet developed. Physical-chemical properties can be used or the user is allowed to enter biologically relevant partition coefficients in place of default assumptions that assume octanol as surrogate for biological components (i.e., lipid). Estimates for biotransformation rates can be included from in vitro assays (i.e., S<sub>9</sub>, hepatocyte, microsomal) and from in silico (QSAR) predictions. Empirical data such as lab BCFs and BMFs and field data as

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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 biotransformation rate data are obtained from QSARs and entered into the system. The second case study is for a relatively data rich scenario for which OECD 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 road to bioaccumulation assessment

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 (k2) experimentally while the uptake rate (k1) is estimated. Following this concept the need for animal tests is reduced if the metabolite contribution to k2 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 vivo biotransformation rates (k2) 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 k2-based extrapolation model allowing to estimate BCF and BMF values by incorporating in vitro k2 of different tissues, e.g. gills, liver and gastro intestinal tract, could be serve as alternative screening criterion under REACH. This approach will also experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionic 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 k2-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 (P)

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-nonylphenol, 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

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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 exposure to EDs (polybrominated diphenyl ethers (PBDE), alkylphenols, bisphenol A (BPA), parabens, phthalates, perfluorinated 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 EU legal frameworks, 3242 in vivo and in vitro studies, 377 ecotoxicological studies and the ROB (risk of bias) analysis was performed for the relevant outcomes, confidence in the body of evidence for an effect was rated, and scores are given. In this presentation, we will show what is the strength of the evidence for the association between exposures and (adverse) effect, and we will discuss the role of ecotoxicological studies in the global analysis: prioritizing EDs, understanding mechanisms of action, establishing standards or impact criteria, identifying sensitive biomarkers and bioindicators for each of the EDs.

TH048 Pros and cons of fish toxicity tests in detecting chemicals with endocrine disrupting activities

A. KIENZLER, JRC-EC / F3-Chef-Safety and Alternative Methods Unit-EURL ECVAM; Z. DANG, RIVM / LIEC 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 administering various chemicals to fish (fish lifestages, the investigated EDs include some of them raise concerns with their endocrine disrupting potential). This has resulted in attempts to develop and validate a battery of fish tests that meet the requirements on the basis of the existing information case by case. Due to a difference in sensitivity of species and life stages, many EU discussions have focused on which test should be suitable. However, due to practical considerations, (e.g. regional preference, practical use, and specifically sensitivity,) it is unlikely to meet all of the requirements within one test. But in order to avoid further additional testing, species selection should always consider as much factors as much as possible. This work intends to summarise the pros and cons of the available test guidelines and to address some issues e.g. sensitivity in different life stages and in species. Available fish toxicity tests include test guidelines (TG) 229, 230, 234, 240 and guidance document (GD) 148. The number of fish used in each test fish, the covered lifestage, the investigated EDs and these have been validated) and the species sensitivity in response to chemicals with EAS modes of action will be compared. This aim, publically available data on different fish species tested according to TGs or TG-like protocols will be collected and analyzed. Analysing these fish toxicity data will help identifying which fish test, which species, which life stage of test are needed for the identification and/or risk assessment of EDs. Based on the overall data analysis, we will propose an environmental testing strategy, which is important for minimizing vertebrate testing and costs.

TH049 Towards developing a list of reference chemicals for endocrine assay validation

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Compared to other areas of human and environmental hazard assessment, evaluating the potential for endogenous compounds to interact with endocrine pathways is relatively nascent. However, recognizing the possibility of a public and environmental hazard, many national governments, international organizations, industry bodies, public interest groups and academic institutions established research programs to address the impacts of endogenous substances on the endocrine system. This has resulted in attempts to develop and validate a battery of
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 was chosen for the validation procedure. Additionally, reference chemical selection is often not consistent with the tier strategy. In conclusion, the results 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. Grignon, European Commission Joint Research Centre; E. Joosens, 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 substances, is required for getting the most relevant 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 consistency and reproducibility of toxicity findings. Focusing on all the pesticides and biocides screened (about 400 substances), the data-matrix for all these substances were merged together in order to build a heat-map summarising all the toxicological information collected by endpoint. The heat-map 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. Grignon, European Commission Joint Research Centre; S. Munn, European Commission

Before pesticides and biocides are allowed to enter the European market, a number of tests to screen for endocrine disrupting properties of the substance, if they are revealable in an FSDT, what is the case for most oestrogenic or androgenic acting chemicals. Similar to the FELS the FSDT is a level 4 test, according to the OECD conceptual framework other fish (vertebrate) test may be necessary to identify EDs. For instance the data processed in the FSDT is a level 4 test, according to the OECD conceptual framework no other fish (vertebrate) test may be necessary to identify the substance as an endocrine disruptor (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 data to assess and categorise all pesticides and biocides currently registered in the EU. This assessment was aimed at identifying the potential ED effect on 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. Mihova, ER2, K. Plötzel, Detox 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 endocrine mediated from those of other modes of action or mechanism of action (MoA). Under certain legislations, understanding the potential MoA is particularly important because regulatory decisions might categorize a substance as an endocrine disruptor (ED) through a hazard characterization process rather than taking into consideration exposure and risk. The WHO/IPCS definition of an endocrine disruptor requires that a substance alter the endocrine system of an organism or its components, resulting in a disturbance of the balance of the endocrine system of an intact organism. Pathway models are being established that provide plausible links between molecular initiating events, key events and ultimately adverse effects. However, when several potential pathways or MoA converge on the same adverse effect in an intact organism it becomes challenging to identify the biologically plausible causal link between the MoA and the environmental or health effect of regulatory concern. The first part of the WHO/IPCS definition, that of the chemical acting through an endocrine MoA to alter the function of the endocrine system, focuses on the need for the substance to have sufficient affinity for and activity with components of the endocrine system, compared to endogenous hormones, in order to compete with the normal hormonal signaling and feedback mechanisms that maintain homeostasis. An initial in silico or in vitro screen may predict endocrine-related bioactivity and the potential for a chemical to interact with the endocrine system, affinity and activity, also known as mechanistic potency, can be used in comparison to that of the endogenous ligands to support or reject the biological plausibility of a causal link between an endocrine MoA and an adverse effect. A hypothesis testing, weight of evidence framework and case study examples will be used to illustrate the use of bioactivity and mechanistic potency data, along with other lines of evidence, in the assessment of endocrine activity.

### TH053
Addressing endocrine concerns for the environment in dossier evaluations with an FSDT - possibility to avoid further vertebrate tests
F. Hemont, European Commission DG Joint Research Services; E. Grignard, European Commission DG Joint Research Services; EURL ECVAM; E. Joosens, European Commission DG Joint Research Centre

ECHA's Guidance on screening of pesticides and biocides for endocrine disrupting properties, requires that a substance present a potential ED effect, before proceeding to testing in vertebrates. This rigour is important because regulatory decisions might categorize a substance as an endocrine disruptor (ED) through a hazard characterization process rather than taking into consideration exposure and risk. The WHO/IPCS definition of an endocrine disruptor requires that a substance alter the endocrine system of an organism or its components, resulting in a disturbance of the balance of the endocrine system of an intact organism. Pathway models are being established that provide plausible links between molecular initiating events, key events and ultimately adverse effects. However, when several potential pathways or MoA converge on the same adverse effect in an intact organism it becomes challenging to identify the biologically plausible causal link between the MoA and the environmental or health effect of regulatory concern. The first part of the WHO/IPCS definition, that of the chemical acting through an endocrine MoA to alter the function of the endocrine system, focuses on the need for the substance to have sufficient affinity for and activity with components of the endocrine system, compared to endogenous hormones, in order to compete with the normal hormonal signaling and feedback mechanisms that maintain homeostasis. An initial in silico or in vitro screen may predict endocrine-related bioactivity and the potential for a chemical to interact with the endocrine system, affinity and activity, also known as mechanistic potency, can be used in comparison to that of the endogenous ligands to support or reject the biological plausibility of a causal link between an endocrine MoA and an adverse effect. A hypothesis testing, weight of evidence framework and case study examples will be used to illustrate the use of bioactivity and mechanistic potency data, along with other lines of evidence, in the assessment of endocrine activity.
Structural Alerts for Potential Endocrine Disruptors

R. Kühne, N. Ost, Helmholtz Centre for Environmental Research UFZ/Department of Ecological Chemistry; L.A. Baumann, University of Heidelberg/Agriculture Ecology and Toxicology; H. Seghers, Institute of Food Science and Wildlife Health; J. Arning, German Environment Agency UBA/Chemicals; G. Schuermann, 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 disrupters 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. In silico tools may provide alternatives at least to allow prioritisation of tests by screening compound lists. This study aimed at identifying 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 secondarily 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 the estrogen/androgen system a database with the respective pharmacophore 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 ca. 95% of the known active compounds, but there is suspect of missing compound classes due to the lack of respective experimental data. Particular remark 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 6.6.2.http://www.ufz.de/cochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 3714 63 412 (2).

Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae

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Endocrine disrupting chemicals (EDCs) in the aquatic environment can have severe effects on the health of aquatic organisms as well as human health. Numerous anthropogenic EDCs, such as plasticizers, fire retardants and antibacterial agents, enter aquatic ecosystems from wastewater treatment plants and land runoff. Several of these have been shown to have adverse effects on fish, including disruption of reproduction, neurological, and hematological changes. Previous studies have mainly focused on single compound exposures or simple mixtures and further evaluation of complex mixtures at low concentrations is needed. Within the framework of the European Horizon2020 project EDC-MixRisk, EDCs linked to adverse effects on neurodevelopment and growth in a pregnancy cohort study have been identified. Mixtures of these chemicals (phthalate metabolites, phenols and PFASs) were synthesized to be tested in a range of in vitro and in vivo systems. The thyroid hormones (THs) are one of the targets of interest as they are essential for brain development and disruption of this axis may lead to alteration of neurodevelopment. The current study aimed to determine the effects of the EDC-mixtures on larval behaviour and to identify disruption of TH-related gene expression in zebrafish (Danio rerio) during early development. Zebrafish embryos were exposed to Mix N and Mix G (mixtures correlated with adverse effects on neurodevelopment or growth in the epidemiological study) for 48h in concentrations equivalent to 0.01x – 100x human levels. Alteration of larval behaviour caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be an insensitive end-point to sub- lethal toxicity of endocrine disruptors. Larval locomotion was tracked using the ViewPoint ZebraBox and a protocol of alternating dark/light cycles. Quantitative PCR was used to determine the effects of the EDC mixture on the expression of thyroid related genes. Our results show that acute exposure to the mixtures significantly alter larval locomotion and expression of genes involved in TH signaling, including thyroid hormone receptors 

Contaminants of emerging concern in the North American Great Lakes: Assessing environmental mixtures inmultigenerational exposure studies

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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 estrogenic activity. In 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 adverse effects on fecundity. Overall, endocrine disruptors were identified as potential endocrine disruptors for 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 alter growth, 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.

Assessing species sensitivity to environmental mixtures

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Contaminants of emerging concern (CECs) have been detected ubiquitously in aquatic environments, and their endocrine disrupting effects concern us. We identified typical CECs in rivers associated with agricultural and urban land use in the North American Great Lakes watershed. A mixture of agricultural CECs (AG) was assembled to mimic the environmentally occurring compounds and consisted of 8 chemicals, while an urban CEC mixture (UB) contained 11 chemicals including the known estrogenic compounds, bisphenol-A, estrone and nonylphenol in addition to estrogenicities of CECs, Minnesota Pollution Control Agency reported that an exposure to CECs in the river water activated a peroxisome proliferator-activated receptor (PPAR/retinoid X receptor (RXR) pathway in the transcriptome analysis of fathead minnow. Our laboratory found that an exposure to CECs induced a higher incidence of hepatic vacuolization in fathead minnow, which would be an obesogenic effect of CECs via a PPAR/RXR signaling pathway. Two isoforms of estrogen receptor (ESR) of fathead minnow, bluegill sunfish, American alligator or human was examined in the human embryonic kidney 293T cells by quantifying their transcriptional activities using estrogen-response elements and luciferase reporter gene in an exposure to agricultural or urban CECs. Utilizing the same method in vitro, alligator PPAR-gamma and RXR alpha were examined for both AG and UB mixtures were estrogenic, however, their estrogenicities varied depending on isoforms of ERs and 4 species. Human ESRI was the most sensitive to AG based on their estrogenicities, while minnow ESRI was the least sensitive to AG. Bluegill ESR1 was the most sensitive to UB based on their estrogenicities, whereas BG ESR2 was the least sensitive UB in receptors we tested. Both AG and UB CEC mixtures did not activate either alligator PPAR-gamma nor RXR alpha. Although further investigations of PPAR/RXR signal are required in fathead minnow, PRARG/RXRA signals might not be involved in a CECs-exposure inducing a hepatic vacuolization in fathead minnow. These results indicate that efficacious receptors and species differ between CEC mixtures, and further endocrine studies of CECs are required for a better understanding and prediction of CEC effects by utilizing a variety of receptors cloned from diverse threatened and endangered species.
Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures
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Contaminants of emerging concern (CEC), including pharmaceuticals, personal care products and industrial agents may impact aquatic life. Previous studies have documented endocrine disrupting effects of complex mixtures of CEC present in the environment. The purpose of the current study was to test the hypothesis that as 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, transcriptomics), 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 were 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 different 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 and 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.

TH059
Contaminants of emerging concern in the North American Great Lakes: Load reduction and biological recovery after wastewater treatment upgrades
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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 dominant 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. We are currently monitoring these observed effects have an impact at the population level.

TH061
Towards a multiparallel detection of biological effects caused by anthropogenic micro-pollutants
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It is a general understanding that contaminants of emerging concern (CEC) can pose threats to aquatic ecosystems. The presence of contaminants of emerging concern and subsequent adverse effects on aquatic wildlife. Despite these dramatic alterations, effluent dominant 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) and to examine how adverse biological effects in exposed fish may be mitigated through effluent disinfection. We exposed male fathead minnows (Pimephales promelas) in on-site flow-through exposure systems four times prior to the treatment upgrades and four times since to examine these questions. In addition, we conducted extensive analytical chemistry on effluent samples and employed in-vivo assays to examine overall biological activity of effluents prior and following disinfection treatment. Both disinfection methods transformed many CECs, in some instances reversibly (UV disinfection). UV disinfection resulted in enhanced maturity of male fathead minnows when compared to fish exposed to non-disinfected effluent or a control treatment (P < 0.05, ANOVA). Disinfection by chlorination/dechlorinating reduced testis maturity and changes liver hepatocyte appearance (both P < 0.05, ANOVA). Expression of vitellogenin, an indicator of estrogenic exposure, was not altered by treatment at either facility (P > 0.05, ANOVA). These results indicate that biological activity of effluent is altered by both disinfection treatments but with more advantageous outcomes using UV disinfection.

TH060
Contaminants of emerging concern in the North American Great Lakes: Validation of effects through field-based exposures
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Agricultural and urban pollutants are an environmental health concern as their presence in aquatic ecosystems often results in increased stress in aquatic organisms. The effects of agricultural and urban mixtures, each having different chemical signatures, have been studied rather infrequently. The objective of these field-based studies was to test the impacts of agricultural and urban pollutants on the physiology, reproduction, and population health in fish. These studies, both part of the Great Lakes Restoration Initiative, utilized two distinct watersheds; the Maumee River watershed (Toledo, Ohio) was used to study agricultural pollutants, while the Milwaukee river system watershed (Wisconsin) was used to study urban pollutants. Laboratory cultured adult and larval fathead minnows were exposed to water samples from different sites in the two watersheds for 21 days. Adult minnows were analyzed for alterations in hematological characteristics (glucose, VGT, E<sub>2</sub>; 11-KT) and reproduction, while larval minnows were analyzed for feeding efficiency and predator avoidance performance. The Maumee River indicated reduced reproductive capability, as measured by fecundity, at specific sites and the channel versus seasonal differences between the two sampling years potentially due to altered contaminant loads during heavier periods of precipitation. The Maumee River demonstrated no changes to larval predator avoidance behavior or other apical endpoints (feeding, growth) indicating that agricultural contaminants pose no/little perceived threat to larval development. Conversely, the Milwaukee River indicated increased reproductive capability, as fecundity increased among four pond sites in comparison to controls. Additionally, urban samples resulted in an increase in larval growth following 21 days of exposure, but did not impact the predator avoidance behavior. The results indicate that agricultural and urban pollutants entering aquatic environments impact fish physiology and reproduction. Further research is underway to determine whether these observed effects have an impact at the population level.
Thyroid disruptor screening using zebrafish as vertebrate model

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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 affect the function of thyroid hormones, interfering with their synthesis, transport and/or binding, altering important physiological processes. Several environmental contaminants such as polychlorobiphenyl 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 methodsologies 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 zebralfish 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 assays with high throughput. In this work, the thyroid hormone disruption potential of several environmentally relevant contaminated 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. Afterwards, change in the thyroglobulin (TG) synthesis was assessed using a zebrafish transgenic line expressing ctp-hk3::DsRed 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 zebra fish thyroid hormone receptors afla and beta for assessing endocrine disruption in environmental samples

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Endocrine-disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feed, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents… Accordingly, they suppose a threat to animal and human health through different exposure routes. In vitro bioassays are valuable tools for detecting and studying EDCs action and provide a sensitive and rapid system to evaluate their potential effects. In addition, the zebrafish embryo is a suitable system 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.
TH608

Vitellogenin expression, ovarian growth and hormone levels are affected by atrazine in the crayfish Procambarus clarkii

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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 dysregulation of vitellogenin expression and estradiol 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 stimulatory effects of estradiol on vitellogenesis could have overshadowed it. Moreover, 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.

TH609

Identification of molt-inhibiting hormone and ecdysteroid receptor sequences in Procambarus clarkii and consequences of endocrine disruptor exposures

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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 most important part of the animal kingdom, which are crucial for their functioning (e.g. litter degradation, food resource). Moreover, invertebrates are hosts of hidden parasites such as vertically-transmitted microsporida (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 assess the endocrine disruption in invertebrates. 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 molt-inhibiting hormone (MIH) and the ecdysteroid receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an exposure of four days to atrazine (4HT), hydroxyltamoxifen (4HT), and atrazine-exposed crayfish (Procambarus clarkii) altered on the other hand the normal balance of sex steroids.

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-Ethinylestradiol (EE2), a component of oral contraceptives, is ubiquitous in the environment and is a known potent endocrine disrupting compound (EDC) that adversely affects aquatic vertebrates (e.g. reproductive development) as well as aquatic invertebrates (e.g. Daphnia magna). The aim of this study was to investigate the effects of EE2 on Chironomus riparius, a non-vertebrate model organism and indicator species for aquatic environments. Four EDCs: ethinylestradiol (EE2), diethylstilbestrol (DES), hydroxymethyltestosterone (17MT) and the cytosterol acetate (CPA), all commonly studied in vertebrates. Sequence research allowed to obtain a 204 bp length and 255 bp length amplimers for EcR and MIH, respectively. The EcR and MIH sequences were used to design primers for qPCR. After an injection and an aquatic exposure in the µg/L range, which was also seen e.g. for atrazine, 8% organic carbon; eastern Germany), Wurm and Inde (sand, 2% organic carbon; western Germany) as these rivers are heavily influenced by anthropogenic activities (i.e., downstream of wastewater treatment plants) and are suspected or known to contain high concentrations of EDCs. Two types of sediment were formulated with silica sand, kaolin clay and peat moss to match the sediment types of the Luppe and Wurm Inde. Each formulated sediment was used in the negative control, solvent control and spiked (10 µg EE2/g d.w.) treatments. The survival and growth of the C. riparius larvae were measured after 10-d in half of the replicates (n = 6), while the number of adults emerged, time to emergence and the sex ratio were evaluated at the end of the 28-d test (n = 6). Extracts of the whole-organism were analyzed through a yeast estrogen receptor (YES) assay, a common in vitro assay used to estimate estrogenic potential. Additionally, EE2 tissue extracts were quantified through LC/MS-MS with deuterated internal standards which were used to account for any losses during the extraction process. The bioavailability of EE2, inferred through the YES assay and LC/MS-MS analysis, provides insights into the bioaccumulation of EE2 in C. riparius larvae. Knowledge about the bioavailability, bioaccumulation, and estrogenic potential of sediment bound EE2 on benthic organisms is 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) X. HU, The Chinese University of Hong Kong; K. Chan, The Chinese University of Hong Kong / Life Sciences; K. Chu, The Chinese University of Hong Kong / School of Life Sciences

Crustaceans are a large group of arthropods, and they are the major constituents to aquatic ecosystems that provide a variety of ecological and economic services. Neocaridina davidi, one of 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 disruptors known to interfere with the natural hormone action in insects by mimicking the juvenile hormones. However, the structure and functions of the methyl farnesoate (MF) in crustaceans are similar to the juvenile hormone (JH) in insects. Therefore, the exogenous JHA 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 JHA 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 µg/mL (4.64, 3.20 µmol/L) and 1.96, 1.26 µg/mL (6.32, 4.06 µmol/L), respectively. The toxicological 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 µg/mL (0.33 µmol/L) fenoxycarb and 200 µg/mL (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 pathways were also examined in this study. The genes h3 (hormone receptor 3) and c75 in N. davidi were up-regulated, while Chdh (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.

TH073 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asan Lake Watershed, Korea M. Choi, J. Kinn, Greencos Inc.; Y. Kim, Greencos Inc.; CEO

Multimedia fate model (multimedia fate model for Human 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 consisting of geographical data, meteorological data and mensural data of these hazardous chemicals was developed. Second, Environmental concentrations of various chemicals were predicted, applying different fate processes according to different chemical properties. Third, advection and dispersion by wind in air grids, runoff in watershed, flows of water in water segments are considered in the watershed-based multimedia fate model, which was linked to a risk assessment system. The multimedia fate model was established and calibrated, with the results of biologi cal and environmental fate processes and measured and predicted concentrations of EDs (Endocrine Disrupting Chemicals) and assesses human risk in this area. HURAME is valuable tools for predicting the fate of chemicals in evaluative and real environments with areas consisting of many watersheds. These models are an integral component of exposure assessment and risk assessment strategies, and are used in detailed assessments of contaminant fate. The aim of these models is to describe quantitatively contaminant fate and migration in a defined watershed region, with water segments and air grids inside of the region of interest treated more complicatedly. As a result, regional levels of environmental contamination are controlled by environmental parameters and processes and meaningful evaluation requires assessment of contaminant fate in neighboring regions. A linked set of regional models are set as the potential to describe quantitatively the impact of chemical emissions over a wider geographic scale with significant spatial differences in environmental characteristics and chemical use patterns.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural atmospheric extracts on JEG-3 human placental cells B.L. van Drooge, IDAEA-CSIC / Department of Environmental Chemistry; A. Marqueno Bassols, Institute of Environmental Assessment and Water Research IDAEA CSIC; B. Pina, C. Porte, IDAEA-CSIC / Department of Environmental Chemistry; J. Grimalt, Institute of Environmental Assessment and Water Research IDAEA CSIC / Department of Environmental Chemistry

Outdoor ambient air particulate matter and air pollution are related to adverse effects on human health. The present study assesses the cytotoxicity and ability to disrupt aromatase activity of organic PM, extracts from rural and urban areas at equivalent air volumes from 2 to 30 m³, in human placental JEG-3 cells. Samples were chemically analysed for particle bounded organic compounds with endocrine disrupting potential, i.e. PAH, O-PAH, phthalate esters, but also for organic molecular tracer compounds for the emission source identification. Rural samples collected in winter were cytotoxic at the highest concentration tested and strongly inhibited aromatase activity in JEG-3 cells. No cytotoxicity was detected in summer samples from the rural site and the urban samples. While aromatase activity was moderately inhibited in these samples. In the urban area, the street site samples, collected close to intensive traffic, showed stronger inhibition of aromatase activity than the samples simultaneously collected at a roof site, 50 m above ground level. The cytotoxicity and endocrine disruption potential of the samples were linked to combustion products, i.e. PAH and O-PAH, especially from biomass burning in the rural site in winter. Exposure of zebrafish embryo to the same organic PM extracts from the rural and street site simultaneously collected in winter and an induction of genes implicated in basic cellular functions, such as cell proliferation. Moreover, the embryo transcript analysis showed strong correlations between the Aryl Hydrocarbon Receptor signalling pathway and PAH concentrations. On the other hand, in the zebrafish embryos exposure experiment, the urban extracts showed an induction of oxidative stress related genes, which suggest different potential adverse outcomes for exposure to air pollution from specific sources.

TH075 Dietary and non-dietary prenatal exposure to endocrine disruptors (BPA and DEHP). Spanish case study. M. Mar, INEDE RODRíGUEZ, J. Rovira, Universitat Rovira i Virgili; R.P. Sharma, Universitat Rovira i Virgili / Department of Engineering Química; M. Nadal, Universitat Rovira i Virgili / School of Medicine, IISPV; V. Kumar, Universitat Rovira i Virgili / Department / Department Enginyeria Química; M. Schuhmacher, Rovira i Virgili University / Department / Department Enginyeria Química

Endocrine disruptors (EDs) are chemicals compounds that send confusing messages to the brain causing various dysfunctions by mimicking or altering the effect of hormones in the human body. Several EDs such as Bisphenol A (BPA) and di(2-ethylhexyl) phthalate (DEHP), are involved in obesity and diabetes diseases in children. Recent studies have shown evidences that these chemicals can cross the placental barrier making fetal exposure closely related to maternal exposure. The aim of this research is to establish fetus exposure to EDs (BPA and DEHP). To address this issue, recently, pregnant women recruitment has begun. In present work, dietary and non-dietary (dermal, non-diabetic ingestion and inhalation) exposure of these women was considered in order to predict the dose of EDs at which the child has been exposed in the early stage of the development. The data obtained from this cohort (such as, physiological data, dietary habits and lifestyle, amongst others) was implemented into a physiological based pharmacokinetic (PBPK) model, which assesses the absorption, distribution, metabolism and excretion of a chemical compound into human body, as well as the internal exposure to target organs. To estimate the early exposure of the child, the model was implemented with fetus compartment for these chemicals. Results indicates that for both, BPA and DEHP, diet is the main contributor to the total exposure. However, endocrine and dermal exposure also contribute significantly to the total DEHP exposure. Levels of both EDs were modelled in maternal blood and in fetus blood as well as in other body compartment. These results will be validated with the results of biological monitoring in the current cohort (n=72). The integration of the data obtained from current on-going human biomonitoring campaign and the physiological based pharmacokinetic model, here implemented; predict the early exposure of the child/fetus to EDs. This work is included in the frame of HEALS project (FP7-603946).

TH076 Sensitive Biomarker assay using LC-MS/MS: Determination of Thyroid Hormones (T3 and T4) in Fetus, Pup and Adult Rat Serum - Sampling Considerations S. Diaram, Enviro / Bioanalysis (LC-MS/MS)

The regulatory need for the analysis of circulating levels of thyroid hormones in rats (fetus, pup and adult) on reproductive toxicology studies has prompted the need for a sensitive assay for T3 and T4, which could not be fulfilled when using the traditional method. A new method validated utilzes a 50 µL (fetus, pup and adult) or 100 µL (fetus, pup and adult) of serum sample. The method utilzes a targeted MS/MS analysis approach, with the results of biological monitoring to establish a sensitive and specific method for the determination of T3 and T4. The focus is on the precision of the quantification (LLOQ) of 5 pg/mL for T3 (final range 5 to 1500 pg/mL), and a final range of 70 to 70,000 pg/mL for T4 was developed and validated using LC-MS/MS (liquid chromatography coupled to tandem mass spectrometry detector). The method validated utilizes a 50 µL sample volume of serum to determine both T3 and T4 from the same sample aliquot. Across several studies from various Toxicology facilities, a trend was observed for different levels of thyroid hormones in the serum samples, which was particularly prevalent in fetus and Day 4 of age pups. Considering that samples are collected from animals of fetus and Day 4 of age pups, which may be triggered for analysis subsequent to Day 3 and adult male samples being analyzed, the emphasis of the integrity of the sample is paramount to the successful validation of the method.
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 in children in dairy farm watersheds regardless of effluent management practices
L.A. Tremblay, CaTchon Institute; J.B. Gadd, NIWA / Department of Chemistry; G. Northcott, Northcott Research Consultants Limited
Steroid estrogens contamination has been linked to adverse effects on exposed 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 absorbed, absorbed and treated, or treated. The toxic for fertility, disruptive for endocrine activity and steroid estrogens were prevalent in the waterways within all the studied dairy watersheds. Estriol 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 estrogen, 17α-estradiol. Measurable estrogenic activity (17β-estradiol equivalent activity, Eeq) was found at low levels in 83% of the stream samples (highest 1.44 ng L⁻¹ Eeq) and was generally -1, one of (10) stream with measurable estro n, 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?
L. Milla, Institute of Chemistry, Technology & Metallurgy / Department of Chemistry; V. Mart, J. Randjelovic, L. Šojić, ALHem - Safer Chemicals Alternative
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. The toxic for fertility, disruptive for endocrine system, it can cause allergic reactions on skin and respiratory irritation, and it can lead to serious eye damage. In December 2016, the European Commission made a decision to ban, i.e. restrict use of bisphenol A in thermal paper, if concentration of the chemical equals or exceeds 0.02 mass %. This decision to ban, i.e. restrict use of bisphenol A in thermal paper, if concentration of the chemical equals or exceeds 0.02 mass %. This decision shall be applied as of 2 January 2020. During 2017, ALHem carried out the campaign "Toxic receipts" in order to: check the presence of BPA in thermal paper from public and private sectors in Serbia, as well as on paper and plastic packaging for food, comprising 33 samples, out of which: 20 thermal papers (mostly cash receipts), 6 plastic boxes and 7 paper packages for food. The results indicated that all samples of imported thermal paper (rolls) tested in laboratories were positive on the content of BPA. In addition, 8.7% of thermal paper from private sector and 88.9% from public sector contains this chemical. BPA was present in samples in the range of 0.65 and 0.91% (w/w). In this campaign, food packaging was also tested, primarily the one used for packing of fatty food. BAP is soluble in fats so it easily migrates from the packaging into food, which is corroborated by the data that greatest intake of this toxic chemical by humans is by peroral route, i.e. by food. The obtained results indicated that tested plastic boxes for food from supermarkets did not contain BPA. When it comes to paper packaging, French fries bags did not contain BPA, while plastic boxes for food from supermarkets did not contain BPA.

TH079 SETAC Endocrine Disruptor Testing and Risk Assessment Interest Group
H.L. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory

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
R. Boumis, VITO / ABB; M. geerts, VITO NV / Health; S. verstraeten, VITO / ABS
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) requires 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 effects of 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. Aris, ARCHE; J. Mertens, Precious Metals and Rhenium Consortium c/o EPFM
As part of the REACH Substance Evaluation for silver, new data was required to be generated and further justify the read-across from ionic silver to silver nanoparticles. Information on aquatic and soil ecotoxicity of the smallest silver nanoform with the highest specific surface area registered under REACH as compared to ionic silver. The tested nanof orm 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. 211); 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-shape, mean primary particle size 9.4 nm). The dissolution behaviour of the tested silver nanof orm was determined in the test media 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 showed that the read-across of toxicity values from ionic silver to nanosilver as a ‘worst case’ approach is justified and scientifically defensible.

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 documents on how to address the challenges of ecotoxicological testing of nanomaterials. In these revisions, outset is taken in the hypothesis that ecotoxicological test methods, developed for soluble chemicals, can be made applicable to nanomaterials. European Research Council project EnvNano - Environmental Effects and Risk Evaluation of Engineered, which ran from 2011-2016, took another outset by assuming that: “The behaviour of nanoparticles
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 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 conditions. 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 medium. Likewise, for dispersion, 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, depuration and trophic transfer of ENMs 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 in order to derive innovation policies for these nanoparticles 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”/“overall” criteria were identified through joint efforts of the ERA and HRA working groups 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 environmental risk assessment (ERA) model. The importance of the criterion is an important consideration. 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 similarly 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 were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver. Criteria were similarly important to all stakeholders. For example, the middle stage-gates are reported as essential for RA issues with regulatory compliance being the main driver.

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 ENMs regarding their environmental risk and applicability in our project and 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 (from low to high for low to 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 effects 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 based on the fate bond, which with three toxicological (hazard properties) and ecotoxicological factors on the production volume of the ENM, that portion which is relevant for the considered 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 = I) 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 for identification of individual environmental compartments and the groupings are based on 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 is 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 “fate bond” in suspension. The latter one is based on information about ecotoxicity of the bulk material, morphology of ENM, and the ion release potential. The combination results in a 5x5 risk matrix with 25 possible combinations of exposure and ecotoxic bands. These are summarized to three risk groups low, medium and high. The applicability of the approach will be demonstrated by risk grouping of nano-ZrO2 and nano-TiO2 used in sunscreen products. Key words: release, fate, ecotox bond
Environment 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. aggregation behavior, solubility, fiber morphology and size, as well as ecotoxicological data 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 regarding the property morphology (attachment efficiency), solubility, 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 or band 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 ENM behavior without the need to have all 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 into water as free, embedded or transformed, 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 models releases to 10 different environmental 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 in occurrence is the transformation of product-embedded forms into 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 SimpleBox1 notation containing 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 reaction and agglomeration efficiency, also 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/simplebox 2: Meesters, J.A.J., 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) that are released to the environment in order to develop approaches that allow an adequate hazard assessment of ENMs. Results show that, the development and use of in silico methods for estimating the hazard of NMs and NM-related parameters in exposure modelling seems eminent. In order to find the relevant application of new in silico methods, we analyze a selection of currently available human and environmental risk assessment models for NMs. This analysis was done by identifying all the NM-related properties used in these models related to three categories of data: 1) Predictive hazard assessment models, 2) Extrinsic NM Properties, e.g. related to the interaction of the NM with the surrounding matrix, and 3) Intrinsic characteristics specific to the NM, matrix or experimental conditions. This analysis is combined with the current state of Quantitative Structure Property Relationships (QSPRs) development, as a specific set of in silico tools. We recommend further development of in silico methods for predictive risk assessment of NMs. In particular, the use of descriptors related to the interaction between a NM and its surroundings, e.g. the attachment efficiency, is proposed. QSPRs as well as other in silico methods are well suited to fill this gap in predictive risk assessment, under the condition that enough data of reliable quality becomes available.

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 health. 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 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 establishment of environmental analysis of and as 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 bioaccessibility 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 number of swimmers. It is fair to say that the higher nanoparticles 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 under flow-through conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM300K) and silver nitrate 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 silver (III) concentration in water was accomplished by ICP-MS or ICP-OES. The determined tissue and water concentrations 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.

TH094
Genotoxicity of ZnO nanoparticles. A comparison of methods, tools and mechanisms of action in test experimental models used for human and ecological risk assessment
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ZnO nanoparticles are considered among the most toxic ones mainly for their capability to dissolve toxic ions. They are largely employed in many productive sectors and primarily in personal care product formulations and then represent a real threat for human health. The conditions of ENM exposure.

Moreover, genetic alterations are transmissible to the next generation and can have an impact at the population level. Due to ENM reactive nature and therefore to their peculiar behaviour in the experimental media it is more and more evident the need to investigate the early molecular initiating events triggered by ENM that lead to subsequent DNA damage responses, e.g. oxidative stress and in common events targeting the early molecular initiating events triggered by ENM that lead to DNA damage. By using silver MNMs (NM300K) and 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 silver (III) concentration in water was accomplished by ICP-MS or ICP-OES. The determined tissue and water concentrations 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.

From detection to action: advancements in assessing and managing highly fluorinated compounds (P)

TH095
Assessment of persulfate oxidation liquid chromatography tandem mass spectrometry for the analysis of perfluoroalkyl and polyfluoroalkyl substances in water
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The determination of perfluoroalkyl substances (PFAS) is a major concern, especially for drinking water, wastewater and the environment. In recent years, the environmental and health effects of these compounds have been of increasing concern. PFAS are widely used in consumer products and industrial processes worldwide and have been detected in many environmental matrices, including water, soil, and air. The high levels of PFAS in the environment have raised concerns about the potential for these compounds to bioaccumulate in aquatic ecosystems and affect biota. Existing methods for the analysis of PFAS in water and other environmental matrices, such as liquid chromatography tandem mass spectrometry (LC-MS/MS), have limitations in terms of sensitivity, selectivity, and throughput. The use of persulfate oxidation as a pretreatment step prior to liquid chromatography tandem mass spectrometry (LC-MS/MS) analysis offers several advantages over traditional methods. Persulfate oxidation is a powerful oxidation method that can effectively degrade a wide range of organic compounds, including PFAS, which can then be quantified using LC-MS/MS. This approach allows for the simultaneous analysis of multiple PFAS congeners, reducing the time and cost associated with traditional methods. Additionally, persulfate oxidation can be used at different pH levels, providing increased flexibility and selectivity in the analysis of PFAS in water samples. The use of persulfate oxidation in conjunction with LC-MS/MS represents a promising approach for the analysis of PFAS in water and other environmental matrices, offering improved sensitivity, selectivity, and throughput compared to traditional methods.
The global distribution of certain perfluoralkyl and polyfluoralkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible health effects. They are a highly varied group of chemicals, and many of them bind strongly to mineral and organic soil materials (AFM) in 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 perfluoralkyl acid precursors (Pre-PFAs) into readily measurable perfluorinated carboxylic acids. 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 ascertainment included, notably, the evaluation of oxidation yields in the various matrices and TOP wash as a qualitative measure of matrix interference 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 fluorotelomer sulfonates (FTSAs) were the target pre-PFAs predominantly reported before oxidation in most instances, they could only partially account for the observed APFAA (molar concentration increases upon oxidation). The unexplained APFAA portion likely results from the oxidation of untargeted pre-PFAs for which oxidation yields are yet to be determined.

**TH096**

Use of biochars 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 are the pollution of contaminated soils, which are highly condensed of both organic and inorganic pollutants can be found. In the present study four soils with two different types of pollution (poly- and perfluorinated alkyl substances (PFASs) 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, fluoride-saturated carbon-chain with a hydrophilic head attached at a terminal end. PFAS have been produced for over five decades. Due to their hydrophobic and lipophobic character they are suitable for a wide range of applications. However, PFASs may enter the environment, accumulate in wildlife and may cause detrimental effects. The widespread use of PFASs 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 fluorochrome chemical has been characterized as PFASs for environmental contamination. In the present study we measured the concentration of 12 PFASs (8 perfluoroalkyl carboxylic acids (PFCAs) and 4 perfluoralkyl sulfonic acids (PFSAs) in soil and isopods collected at a fluorochrome 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. soil organic carbon (SOC) and PFSAs concentrations in soil, as well as correlations between PFAA 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 PFDoA and PFB, were < LOQ in all sites except for the plant site. Median concentrations of 606 ng/g ww for PFOA 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 between the soil origins.
observed among the studied sites, but TOC was positively correlated with multiple PFASs, including PFOS, in wastewater treatment plants. Nevertheless, TOC was not detected in any shallow coastal areas. For a more direct point source evaluation, 10 additional samples were collected in two wastewater treatment plants of a large urban area. By analyzing the spatial and temporal trends of these fluorinated compounds we plan to assess their longevity in water and sediment of the Bay. Lastly, we aim to understand and predict potential effects on the environment and better advise on regulatory practices.

TH100 Utility of passive samplers to detect per- and polyfluoroalkyl substances (PFASs) in wastewater and estuarine environments

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Poly- and perfluoroalkyl 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 containing Hydrophilic-Lipophilic Balanced sorbent to be deployed across nine sites in Narragansett Bay (RI, USA) in the fall of 2017 for one month each. Deployment sites ranged from wastewater treatment plant and industrial outlets, to aquaculture and fire training bases, and more pristine areas. 25 PFASs (including sulfonates, carboxylic acids, and GenX) were measured across all sites in the passive samplers, as well as water and sediment samples. For a more direct point source evaluation, 10 additional samplers were deployed in two wastewater treatment plants of a large urban area. By analyzing the spatial and temporal trends of these fluorinated compounds we plan to assess their longevity in water and sediment of the Bay. Lastly, we aim to understand and predict potential effects on the environment and better advise on regulatory practices.
Oceanography
Fluorotelomer alcohols (FTOHs) and other poly- and per-fluorinated alkyl substances (PFASs) are common and ubiquitous by-products of various industrial telomerization processes. They can degrade into various perfluorinated carboxylic acids (PFCAbs) 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 present. Polyethylene-air partitioning constants, log Kp de, were determined for PFOA. A deployment at 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 Kpw, during the 3-week uptake experiments. Derived log Kp de values for 6, 8, 2, and 10 FTOHs were 3.8, 4.4, and 4.8, respectively. For MeFOSE and EiFOSE, derived log Kp de 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 perfluorooctyl (PFOA) and polyfluorooctyl (PFOS) substances (PFASs) in full-scale water and wastewater treatment plants H. Becher, C. Simonnet, THUV, C. Simonnet-THUV, National University of Singapore / Civil & Environmental Engineering
Perfluorooctyl and polyfluorooctyl substances (PFASs) comprise a group of compounds that are widely used in the markets for stain repellents, polishes, paints and coatings. In recent years, the occurrence of PFASs in the environment has been recognized as emerging environmental problem due to their persistence, bioaccumulative and toxic properties to aquatic organisms. Unlike most other persistent and bioaccumulative organic pollutants, PFASs are water soluble. Therefore, removal of PFASs by water treatment processes could be a challenge. The objective of this study was to evaluate the ability of different water treatment techniques to remove PFASs from water. In this study, three full-scale water treatment plants were investigated during a one-year monthly sampling for the removal of 31 PFASs, including 20 perfluorooctyl acids (PFAAs) and 11 PFFA precursors. The treatment processes include conventional activated sludge system (CSA) and membrane bioreactor (MBR) system in plant 1, sand filtration (SF) and microfiltration (MF) in plant 2, and microfiltration, reverse osmosis (RO), ultraviolet disinfection (UV) in plant 3. Short-chain PFASs (e.g. PFOA, PFPeA and PFHxS) are removed at relatively high concentrations (several hundred ng/L) in the influent. Total PFASs concentrations (∑PFASs) were highest in Plant 1 (227 ± 1,279 ng/L), followed by Plant 3 (174 – 215 ng/L) and Plant 2 (61 – 109 ng/L). Total PFASs concentrations in the treated water were 119 ± 15 – 317 ng/L and 0.8 – 3.1 ng/L in Plant 1, 2 and 3, respectively. Results showed that RO is the only efficient process for removal of PFASs (>98%) for both short-chain and long-chain PFASs. MBR processes have limited removal efficiency (<50%) for PFASs. In some cases, the effluent concentrations of PFASs were even higher than the influent, suggesting potential degradation of PFAS precursors. The biodegradation of PFAS precursors also leads to the higher removal of some PFAS precursors. Considering the low removal of PFASs in most of the treatment processes, further research is needed to improve the efficacy and efficiency of their removal.

TH106 Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers V. Kodes, D. Leonovychova, Czech Hydrometeorological Institute / Section of water quality, R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocnoses 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 acids (PFAAs) and organofluorines to the apparent biomagnification of perfluroalkyl acid (PFAA) compounds. This study assessed the potential contribution of targeted and unknown fluoroalkyl compounds to the apparent biomagnification of PFASs such as 6:2, 8:2 and 10:2 FTSA, as well as FOSA, NPOA, MeFOSAA and EtFOSAA. However, during the 3-week uptake experiments. The lowest PFOS concentrations were found in mussels (0.01 - 1.0 μg.g kg⁻¹), fish muscle (0.06 - 1.8 μg.g kg⁻¹). Small concentrations were found in mussels (0.01 - 1.0 μg.g kg⁻¹), fish muscle (0.02 - 0.5 μg.g kg⁻¹) and fish liver (0.02 - 0.07 μg.g kg⁻¹). Concentration in general the following PFAT concentrations were found, except fish muscle is expected. PFOA concentrations in fish blood, kidney and liver were higher than concentrations found in muscle tissues due to its binding to proteins in a blood and a liver. All collected fish blood samples and more than 50% of collected samples of fish liver and juvenile fish exceeded EQS for PFOA (1.9 μg.g kg⁻¹).
precursors to the apparent biomagnification of PFCA s, via their biotransformation. In addition, the Total Oxidisable 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-PFASs 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-PFASs.

TH109
PFAS and their precursors in the Environment. First indications from a large scale environmental monitoring study
Per- and Polyfluorinated Substances (PFASs) 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 ingredients or intermediates of new commercial applications. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFAS), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFPA s), and also precursors (e.g. PAPs, diPAPs, TFS, NA DONA) 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, leafy mosses 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 (Oncorhynchus mykiss)
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Per- and polyfluorinated substances (PFASs) are ubiquitous in the environment, specifically in aquatic systems. While several PFASs are acknowledged to be bioaccumulated by vertebrate species, including fish, their absorption, distribution, metabolism and elimination (ADME) remain incompletely understood yet. The aim of this study is to develop a physiologically based toxicokinetic (PBTK) model in order to describe the mechanisms in rainbow trout (Oncorhynchus mykiss) of the selected PFASs is considered, since PFOS and PFHxS are final products of their production sites, and provide indications on distribution patterns.

TH111
Do water temperature influence the toxicokinetics of perfluorinated substances? Comparison of two dietary experiments in rainbow trout (Oncorhynchus mykiss)
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Per- and polyfluorinated substances (PFASs) are widely found in fresh and marine water environments and accumulate in aquatic organisms. Fish are poliklots, and subject to large seasonal changes of temperature, which control physiological processes such as feeding, respiration, fecal egulation, and ultimately growth. Absorption, metabolism, distribution and elimination (ADME) are considered as well. For accurate predictions of organic contaminants bioaccumulation it is therefore important to take into account temperature variations. Also, to our knowledge, no study on the effect of the temperature on the ADME of PFASs in fish has been carried out yet. The aim of this work is to determine to which extent temperature affects absorption and elimination rates, and distribution within the fish of two perfluorinated acid compounds, namely perfluorooctane sulfonate (PFOS) and perfluorohexane sulfonate (PFHxS). Here PFOS is considered as a model compound, as it remains the dominant PFAS in environmental matrices. PFHxS represents an industrial alternative to PFOS, since its addition to Annex B of the Stockholm convention in 2009. Two dietary exposure experiments were performed on adult rainbow trouts (O. mykiss) at two water temperatures (7°C and 16°C). Fish were fed for 120 hpf. State concentrations were reached at 96 hpf for PFOS, PFOA and PFHxS, while PFBA did not reach steady state within in less than 20% of the embryos. Exposure medium and ZFEs were sampled separately at nine time points. Water samples from chemical controls without ZFEs present were taken in parallel. Mass-labelled internal standards specific for each PFAS were added prior to further sample treatment and analysis by LC-MS/MS. The exposure concentrations in the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA< PFBA). Chemical control concentrations remained constant until 120 hpf for all PFAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFE indicate biphasic uptake kinetics with slow uptake before hatching and a faster uptake after hatching. Apparent steady-state concentrations were reached at 96 hpf for PFOS, PFOA and PFHxS, while PFBA did not reach steady-state within 120 hpf. Moreover, PFOS and PFHxS (sulfonic acid end group) showed a higher bioconcentration than PFOA and PFBA (carboxylic acid end group). In conclusion, these data indicate that the functional group of PFAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

TH112
Toxicokinetics of perfluorinated alkyl acids in zebrafish embryo
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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 PFAs 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 PFAs; perfluororocanetic sulfonic acid (PFOS), perfluorooctanoic acid (PFOA), perfluorohexane sulfonate (PFHxS) and perfluorobutanoic acid (PFBA) in the zebrafish embryo (Danio rerio). We also evaluate the use of the zebrafish embryo (ZFE) as an alternative test model for toxicity testing. We exposed ZFEs at three concentrations of each PFAs up to 120 hours post fertilization (hpf). The test concentrations were selected from pilot studies at which the highest would cause developmental effects in less than 20% of the embryos. Exposure medium and ZFEs were sampled separately at nine time points. Water samples from chemical controls without ZFEs present were taken in parallel. Mass-labelled internal standards specific for each PFAS were added prior to further sample treatment and analysis by LC-MS/MS. The exposure concentrations in the TK experiments differed by four orders of magnitude (PFOS< PFHxS< PFOA< PFBA). Chemical control concentrations remained constant until 120 hpf for all PFAs tested, ruling out unspecific loss due to adsorption to glass. The time courses of the internal concentrations in ZFE indicate biphasic uptake kinetics with slow uptake before hatching and a faster uptake after hatching. Apparent steady-state concentrations were reached at 96 hpf for PFOS, PFOA and PFHxS, while PFBA did not reach steady-state within 120 hpf. Moreover, PFOS and PFHxS (sulfonic acid end group) showed a higher bioconcentration than PFOA and PFBA (carboxylic acid end group). In conclusion, these data indicate that the functional group of PFAs, in addition to the alkyl chain length, may have an important influence on the toxicokinetic processes.

TH113
Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFO-DA
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Environmental risk limits (ERLs) were derived in the Netherlands for the substances perfluoro octanoic acid (PFOA) and hexafluoropropylene oxide dimer acid (HFO-DA); also referred to as GenX, F2000 or PFOS(92). 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 HFO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.

SETAC Europe 28th Annual Meeting Abstract Book
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

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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 PBT (Persistent, Bioaccumulative, Toxic) or vPvB (very Persistent/very Bioaccumulative) chemical substances, nor do they meet the Persistent, Mobile and Toxic (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-fluoralkyl 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

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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 aspects of the test (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 in-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 location 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 Caribendazim? 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.
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 spraying, but also 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 process really 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 co-operations such used for synergism. This data as well as 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 test results gathered by the German Federal Environment Agency. This data 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-GSIS-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, predictability 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 (carbendazim, 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 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 have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

TH120
Soil ecotoxicology and ecological risk assessment in southern African mining landscapes
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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 an 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 heterogeneous and therefore susceptible for water dispersal, 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 these 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

TH112
Establishment of tiered risk assessment approach of pesticides for soil risks in China
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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, adding the residual risk assessment to the standard test species. The study is based on a review of a broad range of data from soil ecotoxicology. 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 test results gathered by the Federal Environment Agency. This data was statistically evaluated for helping 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-GSIS-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, predictability 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 (carbendazim, 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 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 have been performed and the last sampling will be conducted in April 2018. First results of this project indicate a clear concentration-dependent effect of carbendazim on earthworms.

TH121
Ecological recovery and terrestrial Non Target Arthropods: abundance, functional roles and networks
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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 due to the initial disturbance of the application or data of other factors such as 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
completed, and the stability of the network in focus might be imbalanced. On the other side, abundance might be different to the abundance in the control group, because of a phase shift due to the initial disturbance, but the proportional distribution of functional roles still mirrors the control group. Thus, we feel that pure abundance data are not enough to understand ecological recovery, but suggest to use additional knowledge about the involved species and their interaction network, like the functional roles and their proportional distribution within a community. Investigating the ecological recovery of a community using information from field work and experiments together with additional information about the species and their importance for and embeddedness in the ecological network is of high importance for a better understanding of the ecological recovery of communities.

TH123 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 (PPPs) 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 metazonan organisms and are present in almost all components of the soil. Thus, nematodes 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 Chromomus 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. O’Neill, Bayer Crop Science Division; J. Ellis, DuPont; J. Bell, Dov Agrosciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsatsif, ADAMA; S. Loutsidi, DuPont De Nemour Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O’Neill, DuPont Crop Protection; A. Sharple, 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 parameters and services provide better chance to demonstrate the fertility of soils. Furthermore, functional test systems can help to evaluate the ecological relevance of a density change of a soil organism population affected by a certain stressor. To quantify the soil mesofauna and microorganism contribution to OM breakdown. The minicontainer test with an in-field soil risk assessment for PPP, which focus on maintenance of soil fertility (protection of soil functions), is questionable.

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. Braak, 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 the 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 dependent. However, this issue does raise important questions concerning the role and use of functional test systems for risk assessment of non-target arthropod population dynamics of non-target arthropods in the context of the risk from the use of plant protection products. It is therefore important to consider what the evidence base is for source-sink dynamics in the agricultural environment and what this tells us about how or whether it is manifested in relevant populations. A structured approach can then be adopted in terms of identifying suitable networks of representative surrogatespecies and generating the necessary information for them and at the landscape level to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the source-sink aspect of landscape management. Practically this could mean considering the amount of information needed in relation to the life-cycles of non-target arthropod species and landscape structure, are also identified. Acknowledgements: This work was initiated and funded by the ECFA non-target arthropod group

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 result in increased perception of uncertainty, making 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 and non-standard uncertainties in ERA of pesticides. This classification offers little insight into how those two categories impact ERA conclusions and further 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 in order to investigate the most prevalent sources of uncertainty, classify different uncertainties and link them to recognition of 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 organism 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 (1988) are based on total concentrations ("aquarégia"). 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, 0.1M 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 concern included in many soil regulations. Six soils covering a wide range of Central European soil properties were chosen and spiked with sodium arsenate dibasic heptahydrate (Na₂HAsO₄•7H₂O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, along with derivation of threshold values via an SSD approach. The results (given as NOEC, EC₅₀ and, preferably, EC₅₀values) based on the six extraction methods, have been determined. The variation in EC₅₀ 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 < aqua regia. 

The number of endpoints showing a significant difference between control and treatments was compared to the outcome of parametric test procedures (pairwise t-test, Dunnett and Williams t-test for multiple testing). The study reveals that the application of standard multiple testing procedures leads to a disguised possibility of effects due to relatively high differences to be achieved between control and treatments. This consequently results in uncertainties regarding the actual level of effects at the NOEC. The CPCAT approach offers a more powerful and statistically rigorous way of estimating 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 substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response can be used to estimate the active aerobic biomass, whereas in OECD 1420:2–1997, substrate induced respiration can be used to estimate the active biomass. In addition to these multiple recognised ways of determining soil microbial biomass, it is important to recognise that they reflect different aspects of the soil microbial community. One fundamental difference between these methods is that they can potentially distinguish between active and non-active components of the biomass. As noted in OECD 1126:1997, substrate induced respiration can be used to estimate the active aerobic biomass, whereas in OECD 1420:2–1997, 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. In 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 its maximum at the end of the study. In a second experiment the vertical dispersal of *F. candida* in relation to food location is investigated. Transparent PVC columns were filled with 100 g OECD soil and 86 *F. candida* of different age classes. Each column was closed with Parafilm on top and a gauze 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, the bottom, in the middle, 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 had 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 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, *Oligopodites 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 collemob 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 the topsoil biomass 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 ZC50) was more pronounced in lower habitat qualities. Our data suggest that habitat quality is more important than metal concentration for soil protection. Ecosystem restoration, rather than remediation, will likely be a more effective means of ameliorating zinc toxicity.

TH134
Effects of atmospheric hydrogen chloride and ammonia on Pararchythius kimi (Collembola : Onychiuridae)
J. Woe, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Y. Lee, J. Hong, M. Lee, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering

As the use and distribution of various chemicals increases, there is a possibility of chemical accumulations in arctic, 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 the effects of these chemicals such as Collembola and earthworm. The experiment 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 *Pararchythius 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, constant 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
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

Methyl ethyl ketone (MEK) is a kind of ketone-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 algae *Chlamydomonas reinhardtii* and *Chlorococcum reinhardtii*. *Eisenia andrei* were exposed with 1% of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including swelling, fragments, swelling, bleeding, and mucous secretion were measured. For soil algae, *Chlamydomonas reinhardtii* and *Chlorococcum reinhardtii* 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. reinhardtii* was more sensitive than *C. reinhardtii* for MEK, 6d-EC50 to *C. reinhardtii* and *C. reinhardtii* was 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(KEITI) 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
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

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 soil algal studies. Soil algae growth was determined after 28 days. The test was done with three concentrations (100, 500, 1000 mg/L) of bisphenol A (BPA), bis(2-ethylhexyl)phthalate (DEHP), and nonylphenol exposure were examined at 0.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algaculture 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 insignificant to *Chlamydomonas reinhardtii* and *Chlorococcum reinhardtii*. 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 (14850144858). 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 too 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 with earthworms exposed to vinasse natura in comparison 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 adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in 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), 2,4,6-trinitrotoluene (TNT), 1,3,5-trinitrobenzene (TNB), 2,4-dinitrophenol (2,4-DNP), 2,6-dinitrotoluene (2,6-DNT), 2-amino-4,6-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 Screening Level (SSL) values 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 make more specific ecological risk assessments (e.g., HC5 or HC95 protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139
Occasional responses of oligochaetes in bacterial inoculum amended copper oxychloride spiked soils
M. Maboeta, North-West University / Unit for Environmental Sciences and Management; O. Oladipo, M. Engelbrecht, North-West University
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 use for fungal control, contains 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna. Metal-tolerant bacteria such as Bacillus cereus strain have been identified for their bioremediative traits in metal polluted soils. We examined the effect of Arachrobacter sp. and Bacillus sp. consortium on the ecotoxicity of copper oxychloride and copper oxychloride amended soils. In this study, the bacterial strains used (Arachrobacter sp. and Bacillus sp.) were previously isolated from gold and gemstone mining sites and confirmed to tolerate to 200 mg kg⁻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 fetida and Enchytraeus albidus were exposed separately into both copper oxychloride amended copper oxychloride-spiked soils and controls. Avoidance behavior, biomass, reproductive success, metal contents in soils and earthworm tissues were determined. Findings revealed that E. fetida in copper oxychloride contaminated soils (200 mg kg⁻¹) exhibited significantly higher (p < 0.05) preference, relative growth rate, survival, cococon and juveniles counts and soil Cu content (comparable to the control) than non-inoculated soils. Similarly, with the E. albidus, significantly higher (p < 0.05) preference and reproductive success was recorded. However, at 1000 mg kg⁻¹ copper oxychloride soils, no distinct effect was observed on both E. fetida and E. albidus in bacterial inoculated and non-inoculated substrates. In conclusion, Arachrobacter sp. and Bacillus sp. consortium caused the ecotoxicity of metal-based fungicide towards Enchytraeus albidus and Eisenia fetida significantly lower copper oxychloride concentrations. These results further confirm the Cu tolerance potential of these bacterial strains at 200 mg kg⁻¹. Arachrobacter sp. and Bacillus sp. are therefore recommended for the bioremediation of soil contamination of copper contaminated environments. Keywords: Copper oxychloride fungicide. Arachrobacter sp. - Bacillus sp. consortium. Ecotoxicity. Oligochaetes

TH140
Development of a terrestrial biotic ligand model (TBLM) for predicting acute toxicity of cadmium and zinc to soil collembolan Paronychius kimi
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 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 Paronychius 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 sites occupied by free metals (i.e. Cd²⁺ and Zn²⁺). 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.

TH141
Characteristics of metal-tolerant bacterial plasmds from a platinum mine tailings dam
T. Mahlatsi, C. Bezuidenhout, M. Maboeta, North-West University / Unit for Environmental Sciences and Management
The presence of mine tailings is responsible for 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 Escherichia coli JM109. The plasmids were evaluated for metal-tolerant capabilities 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(II)/Pb²⁺/Ba²⁺ and Ba²⁺ with metal resistance order of Ni(II)/Pb²⁺/Ba²⁺/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 AlNi alloy containing media. Two-dimensional electrophoresis PAGE analysis 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 host bacterial strain metal-tolerant. The plasmids that were isolated and 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, Yuankunura szczypteki (Collemboala: Neanuridae) to cadmium and copper
Y. Lee, Korea University; J. Wee, J. Son, Korea University / Division of Environmental Science and Ecological Engineering; Y. Kim, Korea University; K. Cho, Korea University / Division of Environmental Science and Ecological Engineering
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 Yuankunura szczypteki, known as the species in which they live water nearby, and their bioaccumulation amount 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. szczypteki were also compared to those of other collembolan species (F. candida and Paronychius 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 prediction of Y. szczypteki in water was used in a concentration dependent manner after 28 days of exposure duration. Although the response of Y. szczypteki to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of Y. szczypteki 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
beetles survival rate decreased significantly with increasing dose of both RFD respectively. However, the toxicity of both insecticides was almost identical 10 times more toxic than Sherpa: the 96

Potter tower. In terms of recommended field dose (RFD) individually and exposed individually to a single pesticide spray applied with the spring (after overwintering) or autumn (population dominated by newly emerged Bembidion lampros

ecticide chlorpyriphos (CPF), Sherpa 100 EC, containing the organophosphate insecticide chlorpyriphos (CPF), Sherpa 100 EC, containing the organophosphate ins
testate pest. Hence, new coleopterans of OW applications are key parameters both influenced by the application of OW and the concomitant influence of OW applications and rhizosphere effect are poorly documented when taking into account long-term impacts. Accordingly, we aimed at studying the relationship between the availability in soil and the phytoavailability of Cu and Zn in four decadal field trials that received different types of OW for more than ten years. Soils in the four field trials exhibited very different pH and organic carbon content. Copper and Zn availability was determined on 102 soil samples from the four field trials by (i) an equilibrium-based method using cupric ion selective electrode and the windermere humic aqueous model (WHAM) to quantify Cu\(^{2+}\) and Zn\(^{2+}\) activities in soil solutions (pCu\(_{2+}\) and pZn\(_{2+}\)) and (ii) a kinetic method using the diffusive gradient in thin films (DGT) directly on soil samples. We measured key soil parameters in soil solutions to assess the relationship with pCu\(_{2+}\) and pZn\(_{2+}\). Copper and Zn phytoavailability is currently determined using the RH/IOtext which is a standardized biotest that is used to measure the uptake flux of Cu and Zn in plants and the related availability of Cu and Zn in the rhizosphere that is physically separated from roots. The results already achieved showed no clear relationship between pCu\(_{2+}\) and pH or dissolved organic carbon among the four field trials altogether. When studying each trial separately, we observed a pH gradient as a function of the type of fertilizer (mineral or OW) applied. The approach of measuring in situ before and after the single seedling growing measurements will enable to test whether Cu and Zn availability in unplanted soils determined Cu and Zn phytoavailability or whether root-induced chemical changes in the rhizosphere additionally determined it.

**TH144**

Toxic Effects of Cadmium on Chinese Cabbage, Folsomia candida (collembola) and their Prediction Modes in 18 Soils of China

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In this paper, we adopted 18 Kinds of typical soils in China, and Chinese cabbage folsomia candida (collembola) were used as the research object. The germination and root elongation of cabbage under different concentrations of cadmium in soil were measured. The endpoint of the F. candida was reproduction. 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.

**TH145**

Do we plant protection products correctly? Impact of agrochemicals on non-target beetle, Bembidion lampros (Coleoptera: Carabidae)

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G. Sadowski, Scientific Services Jagiellonian University; A. Bednarska, Polish Academy of Sciences / Institute of Nature Conservation; R. Laskowski, Jagiellonian University / Ecotoxicology & Stress Ecology Group

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: Dursban 480 EC, containing the organophosphate insecticide parathion-methyl, tebuconazole, and prochloraz were used as broad-spectrum fungicide, tebuconazole and prochloraz for their effects on survival of the ground beetle Bembidion lampros. The beetles were collected from agricultural fields either in spring (after overwintering) or autumn (population dominated by newly emerged individuals) and exposed individually to a single pesticide spray applied with the Prodquowner. In terms of recommended field dose (RFD), Dursban appeared almost 10 times more toxic than Sherpa: the LD\(_{50}\) for Dursban was 0.057 (CI 0.048-0.071) and 0.054 (CI 0.046-0.066) RFD for spring and autumn beetles respectively, and for Sherpa ~ 0.556 (CI 0.453-0.704) and 1.003 (CI 0.863-1.214) RFD respectively. However, the toxicity of both insecticides was almost identical in terms of their active ingredients (g. a.i. ha\(^{-1}\)) – the LD\(_{50}\) for CPF was 16.4 for spring and 15.6 for autumn beetles, and for CYP 16.7 and 30.1, respectively. The beetles survival rate decreased significantly with increasing dose of both insecticides, but the spring-collected beetles appeared more sensitive, plausibly explained by their overwintering or ageing. In contrast to invertebrates, tebuconazol caused significant increase in survival at higher doses, possibly due to its interference with immune competence of insects or elimination of pathogenic fungi. The results show that at least some insecticide formulations may cause unacceptable effects on NTA when applied according to recommendations, indicating the urgent need for revising current pesticide usage recommendations. The differences in sensitivity between the spring and autumn-collected beetles call for further studies to see whether such seasonal differences can be important for ERA. This study was supported by National Science Centre, Poland (2015/19/B/NS7/01939)

**TH146**

The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluvios - effects of soil and pesticidal applications

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The class of conazole fungicides (CFs), among them epoxiconazole, tebuconazole, flusilazole and prochloraz are currently used pesticides and members of the triazole group, used as broad-spectrum fungicides that inhibit ergosterol biosynthesis and are typically applied as foliar sprays for cereals, sugar beet or oilseed rape. Conazole fungicides are widely used in EU countries and their residues are frequently found in European arable soils which corresponds to their environmental properties. CFs are strongly sorbed to soil (logKOC of 3–4) and have low to moderate water solubility (SW of 7–150 mg/L). They are very persistent in soils and tend to form long-term residues. Typical DT\(_{50}\) values range from 120 days to 1 year. These attributes predetermine them to be highly bioaccumulative and hazardous. However, in real ecosystems, complex interactions occur (between pesticides, soil, microbes, earthworms, plants...) and these are poorly understood. Hence, in this contribution (poster), we would like to present the novel microcosm experiment, where the combined effects of soil properties, microorganisms, plants and earthworms on CF multimedia fate and bioavailability were evaluated. In particular, the CF fate (by means of total, desorbable and freely dissolved concentrations) and bioavailability (by means of uptake to model fauna, flora and passive samplers) is studied in complex microcosm systems consisting of agriculturally used fluvios under the addition of selected model compounds (RECETOX). K. Brandsäter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agrobiotechnology (IFA-Tulln), J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX

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 of 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 their typical DT\(_{50}\) values range from 0.005 to 0.05 mg/kg, seeding plants (Lactuca sativa), earthworms (Eisenia fetida), SPME passive sampling fibers, Silicon rubber sheets and Chemcatcher passive samplers. A subset of 10 fluvios was selected based on the DRIFT mid infrared portion using the Kennard-Stone algorithm. These 10 soils are representative of a large fluvios range in terms of their qualitative and quantitative SOM properties (TOC, DOC, HA, FA, WHC, pH, texture, etc.).
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

M. Svobodová, Masaryk University RECETOX; K. Smidova, Masaryk University RECETOX / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielská, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX

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 elimination constants 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 _K_<sub>oc</sub> 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 lethal effects of diuron (herbicide) and imidacloprid (insecticide) on ubiquitous 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 used pesticides in Europe. The lethal effects of diuron and imidacloprid were studied on _Eisenia fetida_, _Arthrobacter globiformis_, _Pristionchus pacificus_, _Diploscapter coronatus_, _Rhabditioides sp_, _Plectus velox_, _Aphelenchoides sp_, _Caenorhabditis elegans_, _Aphelenchoides sp_, _Plectus velox_, _Aphelenchoides sp_, _Caenorhabditis elegans_, _Aphelenchoides sp_, _Plectus velox_, _Aphelenchoides sp_, _Caenorhabditis elegans_, _Aphelenchoides sp_, _Plectus velox_, _Aphelenchoides sp_, _Caenorhabditis elegans_. For each test, concentrations of the pesticides were chosen to include the effects 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 (BDE47) 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 BDE47 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 BDE47, significant effects were only observed on F1 generation in the first method, which shows that BDE47 affects egg hatching, and the reproductive capacity of adult springtails. The affected endpoints of springtails can be inferred by the two methods. PCP and BDE47 do not influence completely the same endpoints.

TH151 Bioaccumulation of lead in earthworms: a comprehensive study to derive a bioaccumulation factor (BSAF) for risk assessment

K. Oorts, ARCHE; J. Chowdhury, International Lead Association / Senior Scientist -Environment

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 earthworms in Europe. Of 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 CEC 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 respectively lower and higher cation exchange capacity (CEC) and 0.61 to 0.12 for soils with respectively lower and higher cation exchange capacity (CEC) 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

Y. Zhang, Dresden University of Technology / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry, M. Markiewicz, University of Bremen / Centre for Environmental Research and Sustainable Technology; S. Stolte, University of Bremen / UFT Centre for Environmental Research and Sustainable Technology Department Sustainable Chemistry

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, quinolines, carbazole derivatives, benzyltoluenes and dibenzyltoluenes 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 interactions. The findings from the LOHCs (Quin-2Me) as examples. Soil ecotoxicity was estimated for the quinolines in the soil bacteria _Arthrobacter globiformis_ and Collemobla _Folsomia candida_ in pore-water and soil exposure scenarios. The log Koc values generally increased following indoles < quinolines < carbazole derivatives < benzyltoluenes < dibenzyltoluenes. 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-2MeH<sub>2</sub>) in soils. The H<sub>2</sub>-rich form (Quin-2Me-H<sub>110</sub>) appeared the highest leaching capacity through the soil followed by the H<sub>2</sub>-lean form (Quin-2Me-H<sub>10</sub>) implying the risk of groundwater contamination. Ionic-interaction was considered dominant in the adsorption of Quin-2Me-H<sub>110</sub> 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<sup>-1</sup> and 750 mg kg<sup>-1</sup> dry weight (dw) soil). Higher toxicity was found in the Collemobla and malfomations.
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

**TH153** Combining field measurements and biotest to assess lead and zinc phytotoxicity 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 phytotoxicity of trace elements exceeding total concentration thresholds in soils. 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 phytotoxicity 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 phytotoxicity 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 phytotoxicity assessed using the procedure for test in field. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytotoxicity than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytotoxicity in combination with field measurements was useful to assess the risk of hydrotrophicity in contaminated urban soils.

**TH154** Can approaches beyond the traditional ones characterize the effects on soil microflora provide an added value in the scope of regulation?

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According to the current regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSAs 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. Assembled field-collected plants exhibited a large range of phytotoxicity and mobility in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytotoxicity measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytotoxicity than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytotoxicity in combination with field measurements was useful to assess the risk of hydrotrophicity in contaminated urban soils.

**TH155** Re-calibration of the earthworm Tier 1 risk assessment of plant protection products - an update

G. Fröst, Bayer AG / Ecotoxicology; J. Bendall, Dow Agrosciences; T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsafis, ADAMA; S. Louts seti, DuPont De Nemours Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O’Neill, DuPont Crop Protection; A. Sharpest, FM Agricultural Solutions; F. Staab, EFSA SETH156 Digging into the soil risk assessment of pesticides: current approach and its uncertainty

M. Arena, EFSAs - European Food Safety Authority / Pesticides; D. Auteri, s. barnazm, EFSAs - European Food Safety Authority / Pesticides Unit; S. Pieper, German Federal Environment Agency (UBA) / Department of Ecotoxicology; B. O’Neill, DuPont Crop Protection

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 phytotoxicity of trace elements exceeding total concentration thresholds in soils. 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 phytotoxicity 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 phytotoxicity 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 phytotoxicity assessed using the procedure for test in field. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytotoxicity than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytotoxicity in combination with field measurements was useful to assess the risk of hydrotrophicity in contaminated urban soils.

**TH156** Digging into the soil risk assessment of pesticides: current approach and its uncertainty

M. Arena, EFSAs - European Food Safety Authority / Pesticides; D. Auteri, s. barnazm, EFSAs - European Food Safety Authority / Pesticides Unit; S. Pieper, German Federal Environment Agency (UBA) / Department of Ecotoxicology; B. O’Neill, DuPont Crop Protection

According to the current regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSAs 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. Assembled field-collected plants exhibited a large range of phytotoxicity and mobility in leaves, irrespective of total Pb and Zn concentrations and Pb and Zn mobility and phytotoxicity measured in soils in the first step. In comparison, RHIZOtest measurements showed that only the contaminated soil 15 exhibited a significantly higher phytotoxicity than other soils and have consequently to be regarded for irrigation with wastewater. This study thus showed how the use of a biotest dedicated to the measurement of trace element phytotoxicity in combination with field measurements was useful to assess the risk of hydrotrophicity in contaminated urban soils.

**TH157** 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

Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms.

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N. Skrbic, University of Copenhagen / Plant and Environmental Sciences; S.C. Christensen, A. Pedersen, HOFOR A/S, Copenhagen; 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 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 potential 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 such 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 PTA was treated 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 applying this method, we 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 a practical tool for water supply companies. This research project is part of European Training Network - NaToxAq, which is funded by the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 722493.

Harmful algal bloom smart device application: using image analysis and machine learning techniques for classification of harmful algal blooms.

A novel method for quantification of ptaquiloside, caudatoside and ptescu lentoside 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 6130 S Desorption/ionization Time-of-Flight Mass Spectrometer) 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 400 bar. 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).

An optimized method to classify harmful algal blooms in freshwater systems by image analysis. Green and blue-green algae exhibit different Hue-Saturation-Value color histograms in digital photographs. These differences are exploited by machine learning techniques to train a smart device (cellular phone, tablet, or similar) to detect the presence of cyanobacteria in a small surface portion of a freshwater system. The Harmful Algal Bloom Classification Application (HAB APP) has been field tested and verified to classify both green and blue-green algae. Specifically, the APP has been tested on several small streams and ponds, correctly classifying green algae blooms and has been tested on the Ohio River, correctly classifying blue-green algae in the 636-mile cyanobacteria bloom in summer 2015. The application is being tested via fixed camera monitoring stations and optimized at several locations along the Ohio River and in Lake Harsha, a 22,000-acre reservoir which supplies six million gallons per day of drinking water to the Ohio county in which it lies and is a source of many recreational activities, including swimming, boating, and fishing. The presence will be verified by other detection instruments and in vitro by agency scientists and hysteresis techniques will be used to drinking water preservation.

A novel method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives

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Analyzing natural toxins in groundwater is challenging due to their labile and unstable nature. Ensuring sample integrity 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 potential 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 such 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 PTA was treated 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 applying this method, we 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 a practical tool for water supply companies. This research project is part of European Training Network - NaToxAq, which is funded by the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No. 722493.
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 ES 1105 www.cyanocost.net

TH163  
Suspected screening of cyanotoxins in freshwater by high performance liquid chromatography coupled to high-resolution mass spectrometry  
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Cyanobacteria are one of the components of cyanotoxins in microalgal egression in periphyton formations. 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 most widespread cyanotoxins are microcystins (MCs) variants MC-LR, -RR, -YR, with MC-LR being the most toxic one. For this reason, 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 based on 5 μg/L in drinking water for total high-performance 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, 5μm) using 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 water surfaces  
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Healthy 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 cyanotoxins, 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 (Lucerni and Ortonni, 2011). Fast and sensitive methods to identify unequivocally Microcystis aeruginosa and Planktothrix agardhii are very useful to discriminate these species with respect to the other non-toxic cyanobacteria. For this purpose, we designed, developed and validated some oligonucleotide probes (GNPlankS02, PLAG03, 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 (Grobén 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, then the probes were successfully applied to natural samples collected from surface waters. Keywords: Microcystis aeruginosa; Planktothrix agardhii; FISH probes; algal bloom.

TH165  
Adaptability of EPI Suite prediction models to estimate physicochemical properties of natural toxins potentially present in surface water  
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Natural toxins constitute a potential risk to water supplies in Europe. Only a few marine toxins have been assessed in freshwater systems. 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.

TH166  
Cyanobacterial oligopeptides of environmental concern and (co)production dynamics  
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Our ecosystems and drinking water resources are not only vulnerable towards anthropogenic pollutants. Natural toxins present an additional threat for which we still lack comprehensive knowledge. While many cyanotoxins 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 allocated to small structural classes characterized by indicative monomeric building blocks. Microcystins 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 culturing 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 multiaxial analysis. New insights into co-production dynamics offer critical information about cyanotoxins 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. Lindeqvist, 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) where PTA can be found in all 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 deglycosidated using 0.01/0.10/1.0 M NaOH and 3 different 0.025M buffer systems (approx. pH 7-12; NaHPO4/Na2HPO4/H2BO3; 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 dienone (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. Schoenese, Agroscope / Environmental Analytics; K. McNeill, ETH Zurich / Institute of Biogeochemistry 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.[1] 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 leach into water bodies and represent pollutants in aquatic systems. 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.[2] 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 automated for more efficient, less error-prone analysis and thus allow the reliable determination of Kow in the for potential aquatic contaminants relevant range of logKow from -2 to 5. Natural toxins for analysis comprise previously investigated mycotoxins and isoalloxazines as reference compounds in addition to representative compounds from soil and groundwaters. In regards to predicted toxicity, persistence and mobility as well as plant occurrence, specific alkaloid subclasses such as pyrrolizidine alkaloids from Senecio spp. or quinolizidine alkaloids from Lupinus spp. are investigated in more detail. As an indicator for the partitioning of natural toxins from aqueous media to organic matrices, Kow can be seen as first proxy estimating natural toxin mobility in the aquatic environment. Thus, experimental data will help in prioritizing of toxicants for further research activities, including field studies and lab-based characterization of fate processes e.g., within the current MC-ITN NatoxAg. [1] ECTOC; Technical Report No. 123, 2013 [2] Schenzel, et al.; Environ Sci Technol2012, 46(11), 6118-26. ln

TH169 Phytotoxins as aquatic micropollutants: a procedure for prioritization B.F. Guenthardt; Agroscope / Environmental Analytics; J. Hollender, Eawag / Environmental Chemistry; M. Scheringer, ETH Zurich / Institute for Chemical and Bioengineering; K. Hungerbuehler, ETH Zurich / Department of Chemical and Bioengineering; T. Bucheli, Agroscope ART / Environmental Analytics

Phytotoxins 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 phytotoxins, and systematic and larger monitoring campaigns are completely lacking. A crucial challenge is to systematically identify among the plethora of phytotoxins those that actually present a serious risk for the aquatic environment. For this purpose, we ranked 1586 phytotoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behavior of the phytotoxins. 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 phytotoxins 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 ptescosteulide. 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 previous presence of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is expected in sediments with low microbial activity such as aquifers. The purpose of this study is to assess the sorption of pterosin B and to estimate Kd and Koc. Sorption of pterosin B was studied following OECD Guideline 106 and 9 different Danish soils (SOC %: 0.1-7.4, pH 3.3-7.3). 0.25g of dry soil were equilibrated with 9ml of pterosin B solution in 0.01M CaCl2 over-night. 1ml of pterosin B solution in 0.01M CaCl2 was added resulting in a CaCl2 of 0-10 mg L-1 (n=20). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantified by LC-MS-ESI (SIM; 100µL injections; range 0.1-100 µg L-1; r2 > 0.999). C0sorb were calculated as C0sorb = Caq/Caq - Csorp. Irreversible sorption and microbial degradation were estimated based on previous studies. Pterosin B sorb strongly to the soils tested. This was expected due to the aromaticity of pterosin B and the logKow of 3.3. Kd ranged between 70 and 180 mL g-1 for the soils tested corresponding to a Koc values of 300-2500 mL g-1. The study demonstrates that pterosin B sorb strongly to soil materials, especially to soil organic material. As Koc values can vary substantially, depending on soil type and properties like soil pH and mineralogy, some variation were expected in the results. Provided low microbial activity, pterosin B will most likely stay in aquifers and can indicate previous presence of ptaquiloside.
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 loading of natural toxins in the vadose (soil) zone. For this work, we used the model code DAISY, a soil-plant-water-soil hydrogeomorphic model that has been used in modelling of natural toxin fate presents several challenges compared

TH174 An overview of the effects and bioaccumulation of ciguatoxins in fish

Ciguatera Fish Poisoning (CFP), the most common non-bacterial seafood intoxication globally, results from tissue concentrations and in particular, the transfer rates from plant to soil. Spraying is not an ideal "dosing" function and might overestimate the leaching, hence the results must be taken with caution.

TH172 Genomic insight into biosynthetic pathway of retinoids by cyanobacteria

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

TH175 AFLATOXIN CONTAMINATION IN IMPORTED NUTS FOR DIRECT HUMAN CONSUMPTION: THREE YEARS (2013-2015) OF OFFICIAL CONTROL RESULTS IN ITALY

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
B1 (AFB1) and total aflatoxin (AFT), as a screening test, was used in order to analyze imported nuts, from non-European countries, intended for direct human consumption. The percentage of AFS positive samples (only pistachios and almonds), taken during the three years from 2013 to 2015, under the national programs of official control, amounted to 9% for B1 and 10.5% for AFT, and were confirmed by HPLC (High Performance Liquid Chromatography). The results demonstrated that they were obtained from Turkey and Iran, where ELISA is a sensitive screening method to monitoring residue levels. The aflatoxins levels in pistachios exceeded even more than five times the maximum permitted limits set by European Commission in Reg 165/2010 and referred to the edible part of the tree nuts. The higher incidence of AFS in imported shelled pistachios is probably due mostly to an easier aflatoxin contamination following the fact that pistachios are an important catch crop to the A. flavus colonization. The paper should be of interest both for readers in the areas of hazard analysis for monitoring purpose, and for other researchers in mycotoxin field, due to the great utility of low-cost, rapid and reliable methods of analysis.

**TH176**

**Impact of climate change drivers on toxin contamination and genotoxicity in Mytilus galloprovincialis: combined effects of warming, acidification and harmful algal blooms.**

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**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 neurotoxins, hepatotoxins, dermatotoxins, and cytotoxins, threatening target organisms and humans. The human consumption of toxic cyanobacteria and the 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, mussel, 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 consists 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 with flowing freshwater to estuarine and coastal areas used for mussel aquacultures. First results show MC and BMAA accumulation 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.**

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Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of puffer fish (*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 for 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 hydrophobic 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 dassonvillei*, isolated from the edible part of Fugu rubripes. Toxicon 45:851-858. [2] Yasumoto T, Yamasu D, Yotsu M, Michishita T, Endo A, Kotak Y. 1986. Bacterial production of tetrodotoxin and anhydrotetrodotoxin. Agric. Biol. Chem. 50:793–795. [3] Kodama M, Sato S, Sakamoto S, Ogata T. 1996. Occurrence of tetrodotoxin in *Alexandrium tamarense*, a causative dinoflagellate of paralytic shellfish poisoning. Toxicon 34:1101-1105.
The aim of this study was to investigate the profiles of volatile and odorous as well as their transformation products. T&O are hazardous for tourism and incidents in freshwaters and in finished water. Cyanobacteria as well as eukariotic algae produce a wide range of volatile metabolites with several of them being odorous, causing taste and odor (T&O) problems. 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., Sphaeroospermopsis sp. In addition to CYN and anatoxin-a, the paper discusses concentrations of other above mentioned cyanotoxins and bioactive metabolites and their risks.

TH180
Toxic cyanobacteria succession during a drier summer in a water 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 microscopic) analysis of samples, according to the Italian D.Lgs 152/2006, compared to a water toxicity assessment through a Vibrio fischeri ecotoxicological test (ISO 11348-3:2007), Lake Disueri (37°11'26"N 14°17'16"E) was the only one in which a persistent bloom occurred during 2017 summer. After the July 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 10⁶ and 10⁷ cell/L, respectively), the only two species detected. By mid-Aug these two species disappeared and have been substituted by Anabaenopsis sp. and Planktothrix rubescens, which in mid-Sept were still growing (10⁶ and 10⁷ cell/L, respectively). Disueri Lake is among the largest lakes, with a surface of 1.85 km² and a maximum depth of 31 and 15.2 m, which induce, 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
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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 Cylindrospermopsin (CYN), Anatoxin-a (ANA) and 12 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 target analytes. However, matrix suppression effects with both protein precipitation and solvent extraction techniques, and the use of the optimized methods, including several clean-up steps, significantly improved the recoveries, reaching 88% for ANA-a 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 after the matrix suppression method, due to the use of a co-solvent (ethanol). 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 this study, T&O compounds, T&O Profiles of cyanobacteria strains were developed. It is concluded that non-targeted HS-SPME-GC/MS analysis is an effective and efficient technique for wide-range screening of cyanobacteria T&O compounds in water. Volatile and odorous metabolite profiles of cyanobacteria strains can be useful in interpreting 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
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.

Results showed 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 microalgae toxicity in cohabiting invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH185**

**Impacts of Asparagopsis armata on marine invertebrates: behavioral and biochemical responses**

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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 alga *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 prawn *Palaemon serratus* and the marine snail *Gibbula umbilicalis* to the exudate of this macroalgae. The seaweed collected at the coast of Peniche, (Portugal) was left in laboratory tanks, for 12 hours, in the dark at 20ºC±1.

Affers of macroalgae exudates toxicity in zebrafish testing. After assessing the lethal concentrations of the algal 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 algal 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 macroalgae on the invaded ecosystems under a global change scenario.
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 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 hazardous 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 NeToAx.

**TH188**

Estrogenic and retinoid-like activity in stagnant waters

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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 humans. Recent investigations indicate that cyanotoxins, like Diaminobutyric acid (DABA), probably have estrogenic properties. DABA, 2,4-Diaminobutyric acid (DABA) is naturally produced by cyanobacteria. It is also produced by other compounds with retinoic acid receptor (RAR) activity. In the present study, the estrogenic and retinoic-like activity of DABA was confirmed, which was not expected from the available literature. In the present study, DABA, 2,4-Diaminobutyric acid (DABA), was incubated in lake water samples collected during peak bloom conditions. Current results show that DABA elicits substantial decrease of the input membrane resistance by 8.09±1.51 MΩ. This decrease was only significant for α1b subunit (n=7, p<0.01). The results suggest that 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 irreversible functional changes 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 ectotoxicity information on microcystins and prynemins: A different approach


There is a lack of information for estimating safe levels for aquatic life concerning the toxicity of natural toxins produced by cyanobacteria and algae. In the present study, a new approach is proposed using pure cultures and ambient bloom samples. Herrera, Echeverri and Ferraño-Filho (2015) conducted toxicity tests on several different cladoceran species using lyophilized phytoplankton samples collected from hydroelectric/dinking 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 −80°C. The *A. flos-aquae* cells were not lysed. Forty-eight hour acute tests were conducted with *Ceriodaphnia dubia*, *Hyalella azteca* larval *Pimephales promelas* and *Neoleocithellus 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 (21 mg/L) water but not in reformulated moderately hard (21 mg/L) water) which are both grazer feeders. Mechanism of effect is undetermined at this time. August 2017 Lake Harsha bloom sample (300,000 cells/mL > WHO high risk probability value) was not acutely toxic to any of the 4 test species. Additional *P. parvum* acute tests and microcystin chronic results will also be presented.

**TH191**

Protemic analysis of rice plant exposed to long-term microcystin-LR exposure

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Irrigation with cyanobacteria-blooming water containing microcystins (MCs) poses potential threat to the growth of agricultural plants. Rice (*Oryza sativa L.*) is a important crop which is grown in the wetland 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 cyanobacterial-blooming water. So far, the molecular mechanism of MCs induced inhibition of cell growth and physiological responses of rice plants 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 mg/L and 50 mg/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 biosynthesis, photosynthesis and tRNA 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

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**TH192** Probabilistic human health risk assessment for dietary exposure to aflatoxin in Taiwan

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Aflatoxins (AFs) are secondary metabolites naturally occurring in many different kinds of food, including peanuts, rice, tree nuts and maize. Both genotoxic and carcinogenic substance, aflatoxins could cause severe adverse health effect. AFs have been classified as group 1 carcinogens by International Agency for Research On Cancer (IARC), because of sufficient evidence provided by cancer studies in humans and experimental animals. The purpose of this study is to evaluate the probabilistic risk of people in Taiwan who accidentally consuming aflatoxin contaminated peanut and peanut products. Concentration data (1.84 ± 4.03 ppb) are gathered from Taiwan Food and Drug Administration (TFDA) between 2005 and 2015, along with consumption rate data (from Nutrition and Health Survey in Taiwan 2000-2005: Group 1-2 baby; 3-9 toddler; 10-17 teenager; 18-65 adult and above 65 elder) in two sub-populations (whole group and consumer only) are essential parameters for exposure analysis. Based on benchmark dose lower confidence limit 10% (BMDL 10%) (170 ng/kg bw/day) suggested by European Food Safety Authority (EFSA), calculated Margin of Exposure (MOE) value is below 10,000. As the result, it isn’t fit the recommended standard by EFSA. According to cancer potency from Joint FAO/WHO Expert Committee on Food Additives (JECFA), estimated population risk ranged from 0.0007 to 0.2713 cancers per 100,000 population per year. This study has calculated the risk of total aflatoxins contaminated peanut and peanut products by MOE approach and population risk method. From the result of population risk for primary liver cancer (Hepatocellular Carcinoma, HCC), it is obvious that aflatoxin isn’t the major cause of HCC. Despite the low cancer risk, MOE calculation indicates a possible health problem for Taiwan population. Further studies could focus on the prevention and reduction of AFs in order to reduce AFs occurrence in foodstuff, especially reducing risk for high exposure and vulnerable groups.

**TH193** Organ distribution of the environmental neurotoxin β-N-Methylamino-L-alanine in the freshwater mussel Dreissena polymorpha

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Among toxic cyanobacteria, β-N-Methylamino-L-alanine (β-N-Methylaniline, β-NMALA) is a hydrophilic non-proteinogenic neurotoxic amino acid, which has the ability to accumulate in marine and freshwater food webs, as well as in vertebrates’ brain. This toxin could promote long-term human neurodegenerative pathologies such as amyotrophic lateral sclerosis (ALS). Human exposure could occur during the ingestion of BMAA-containing food, as this neurotoxin has been detected in animals destined to human consumptions like fish, mussel and oysters. However, BMAA is an emerging toxin from which little data of toxicity or occurrence in the environment are available. In a context in which human activities are promoting the development of phytoplankton, it is important to gather information about this toxin. The zebra mussel Dreissena polymorpha is a freshwater bivalve, known for its large bioaccumulation potential. The species has been present in the water column, and therefore could be in contact with BMAA in-situ. This freshwater mussel has already been used in bimonitoring studies in order to detect heavy metals, pesticides as well as para-sites and could potentially be used to biomonitor BMAA. It has already been showed that Dreissena polymorpha could bioaccumulate BMAA, but further information is needed to understand how this toxin is distributed in individuals. The study of BMAA has long been an analytical challenge: diverse extractions methods are available in order to study this hydrophilic compound. Through the use of polar solvents like trichloroacetic acid (TCA), it is possible to determine the “free BMAA” fraction and a hydrolysis of the whole sample will inform about the “total BMAA”. As it was discovered that after a hydrolysis step, more BMAA could be released compared to untreated sample, a hydrolysis of the precipitate obtained during extraction will informed about the “precipitated bound fraction” and an hydrolysis of the supernatant will informed about the “soluble bound BMAA”. Here, through and exposure of zebra mussels to 2.5 µg of dissolved BMAA individual/day, for 21 days followed by 21 days of depuration, we studied the organ distribution of the BMAA among: hemolymph, gills, digestive gland, gonad, mantle, foot and muscles. Results will be discussed in terms of the distribution of various fraction (i.e., total, free, solubilized and precipitated-bound) according to the organs.

**Developments in the use of bioassays for chemical and environmental risk assessment (P)**

**TH194** Responses to PFOA and PBFS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida)

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The aim of this work was to assess the effects of dissolved Perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) on the freshwater oligochaet Dendrobaena veneta (Annelida), bioaccumulation patterns and cellular and biochemical responses in coelomocytes (metabolism and lysosomal membrane stability), and at tissue level (GPX and MTS), following the exposure to two perfluorinated alkyl acids (PFOA and PBFS) for short (72 h) and longer (14 and 28 days) times. The exposures were carried out in soil microcosms prepared with glass containers filled with 300 ml of soil humified at 30% with PFOA or PBFS spiked water. As 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 PBFS, nominal concentrations were 30% of 5x MAC-EQS fw values. Different accumulation patterns were observed for PFOA and PBFS, with PFOA no longer accumulating between 14 and 28 days, while PBFS 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 proximately data don’t show significant different 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 PBFS 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 PBFS after 14 days was observed. In our results show, for this invertebrate organism, a higher PBFS 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.

**TH195** Toxicity of Per- and Polyfluoroalkyl substances on Chironomus dilutus for use in a relative toxicity model

C.J. McCarthy, CH2M / Environmental Services; M. Stanaway, B. Muckey, Test America; C. Salice, Towson University / Environmental Science & Science Dept.; D. Wright, CH2M

Per- and polyfluoroalkyl substances (PFASs), including perfluorooctane sulfonate (PFOS) and perfluorooctanoate (PFOA) are commonly elevated in soil and groundwater. High detection frequency and concentration has resulted in identification of PFAS as compounds of interest and as emerging contaminants due to their regulatory uncertainty. Published toxicological research to date relates to PFOS and PFOA only and for a limited number of organisms. The lack of robust and defensible ecotoxicity data on other PFAS hinders risk assessment and leads to unsupported risk management decisions. Given this gap in understanding of the additional compounds, the Strategic Environmental Research and Development Program (SERDP) is funding research of these additional PFAS and classes of organisms. This discussion will summarize the first phase of a SERDP grant to address these needs. Tests were conducted with a common aquatic test species to identify patterns of relative toxicity between the PFASs. Chironomus dilutus tests included a 96-hour reference toxicant test, a 10-day range finding test, and a 20-day definitive bioassay. For shorter duration Chironomus tests, the main endpoint of interest was survival while for longer-duration tests (20 days), the more sensitive growth endpoint was measured. Opportunistic measurements of deformation were also included to enhance the understanding of potential toxicity to these compounds. Test results will ultimately be used in conjunction with concurrent tests being conducted with avian and reptilian model species to the same chemicals to develop a relative toxicity model. Endpoints measures from the aquatic species tests will be used to identify clear patterns of relative toxicity of the tested PFASs. Results will inform and prioritize PFAS testing on avian and reptilian species. In addition, the relative potency patterns observed after aquatic testing will be reassessed upon completion of the upper trophic level exposure studies. Once all phases of toxicity testing are complete, the results will be used to help develop a
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, 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 area is still contaminated by anthropogenic substances, in a concentration higher than the hypothesized competition, was observed for the six OP triesters and DPHP (diphenyl phosphate), and the OP diester DPHP to triphenyl phosphate), and the OP diester DPHP (diphenyl phosphate), to carry out an environmental risk assessment for the present study applied an in vitro competitive binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). The protocol was used as a model for gull TTR, to predict whether these tetra/tri-brominated triphosphate esters can be used as new contaminants in soil evaluation.

TH197 Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with proposed in vitro approach.
I. Jaruk, J. Moon, 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 xenobiotic agent 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 bioassays, 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, eudicotyledons, ciliata and collombola) were tested. Also, for the chronic assay, four soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and collombola) were investigated. Finally, acute and chronic hazardous concentrations for HOC, HOC, HOC 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) as the Environmental Health Action Program (1485014458).

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro
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The toxicological properties of organophosphate esters are currently not well understood. The toxicological properties of organophosphate (OP) triesters that are used as flame retardant and plasticizer additives are currently not well understood. The toxicological properties of organophosphate esters are currently not well understood. The toxicological properties of organophosphate esters are currently not well understood.

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. Tetelecki, Accustandard; W. Willmore, Carleton University / Department of Biology; I. Sylte, The Arctic University of Norway / Department of Medical Biology; B.M. Jenssen, Norwegian University of Science and Technology / Biology; R.J. Letcher, Environment and Climate Change Canada / Ecotoxicology and Wildlife Health Division

Tetrabromobenzene (TdB-DiPhOBz) is a highly brominated additive flame retardant (FR). Brominated photodegradates of TdB-DiPhOBz 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',4'-tetrabromo-DiPhOBz. Chemically related methoxyethanol tetra- to hexabromo-DiPhOBz 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) DiPhOBz-based compounds. The present study investigated the potential thyroid hormone affinity of 2,2',2'-tetrabromo-DiPhOBz. Three species of S. oxyre and hydroxy- analogues, using an in vitro competitive binding assay with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB). Para-Orthotetrabrom-DiPhOBz was found to be capable of competing with thyroid hormone (T4) for the binding site on human TTR and ALB. The para-MeO-tetra-bromodiphenyl ether and the tetra-bromodiphenyl ether were much less competitive with thyroxine (T4) for the binding site on human TTR and ALB. The results of this study suggest a novel mechanism of OP ester binding to the second site of the TH binding pocket. These results suggest a novel mechanism of OP ester binding to the second site of the TH binding pocket.

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. oryzae were prepared as control groups (C), medium-resistant group (MR), and strong resistant group (R) for this study. One of 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 inhibitor, was 2.82 ± 2.71 and 6.65 ± 1.50 µM for C, MR and R strains, respectively. Lineeweaver-Burk plot for COX using ethyl formate exhibited different modes from R strains to C strains. And six genes cat, jhip, voltage, 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 inducible protein was differently expressed in the two phosphine-resistant strains while caspase gene was also up-regulated in R strain, but it was not so big difference. Three biomarker enzymes such as acetylcollinesterase, 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 inducible protein.

TH201 Effects of additives in mobile phases in simultaneous analysis of glutathione and glutathione disulfide by HPLC-MS/MS
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Glutathione is an important non-protein compound and existed in both internal and external regulation. Regarding toxicological effects induced by oxidative stress, ratio of reduced form (GSH) to oxidized form (GSSG) of glutathione is one of important biomarkers. Among all available assays to detect and quantify GSH and GSSG, one of the most common methods is based on performance liquid chromatography (HPLC) coupled with mass spectrometry (MS) is very well established with development of highly specific 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 2.5mM...
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 response was especially significant for 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 GSSG 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 assess 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 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 this 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 samples. Then 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 years an ecosystem approach mainly based on multilevel bioindicator 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 PVII; 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 upjohn) and virological analysis of inactivated HAV and HEV, Norovirus NoGI and NoGII, 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 eco-ecotoxicological analysis (see http://www.setac-europe.org/services/centers/cerad), and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/) will be used in a future study to characterize the potential hazards of marine bivalves in response to predicted environmental concentrations (PECs) of PS-MPs or by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyes.

**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 Radb™) 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 feed up and perform consistent handling of relevant data. The NIVA Radb™ compile available experimental and predicted (computational) effect data that range from molecular and cellular responses caracterising 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 potencial regulatory relevance. These effect data are assembled within the context of Adverse Outcome Pathways (AOPs) here by anchoring data to initial cellular responses referred to as molecular initiating events (MIE), to downstream key events (KE) at the cellular/organ and final 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 structures among large accumulation of pollutants that can give rise to a given AO. The NIVA Radb™ 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 developments towards 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.

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**TH205** Assessing exposure risk for marine bivalve Mytilus posed by microplastic polystyrene 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 marine bivalves. OBJECTIVE: The objective of this study is to develop an exposure 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 by quantifying exceedance risks (ERs) and hazard quotients (HQs) in five plastic-filled gyes.
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 criteria 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 M. de Baat, University of Amsterdam / IBED-FAME; Y. Coolen, D. van der Pouw Kraan, R. Rod, University of Amsterdam / Department of Freshwater and Marine Ecology; M. Kraak, University of Amsterdam / IBED-FAME

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 the same locations. 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 important to use 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 M. de Baat, M. Kraak, University of Amsterdam / IBED-FAME; R. van der Oost, Waternet / Onderzoek en Advies; P. de Vooigt, University of Amsterdam / IBED; P. Verdonchot, University of Amsterdam / Department of Freshwater and Marine Ecology

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 substances that have serious impacts on water quality, and is therefore a valuable addition to regular water quality monitoring.

TH209 Passive sampling in effect-based monitoring of two European rivers - exposability of in vitro derived endpoints J. Novak, Masaryk University / RECETOX; Z. Tousova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; F. Smades, RECETOX / Environmental chemistry and modelling; R. Grubic, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydroorganisms; S. Ali-Aissa, INERIS / UMBI SEBIO ECOT; S. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilshcerova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment

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 literature (POCIS) or calculated from the concentration profiles, which 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 (BEQren) of respective model compounds in water. The BEQren values were significantly correlated to the extracted 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 (BEQren). The concentrations of bioanalytical equivalents were shown to the detected chemicals explained mostly a low fraction of the BEQren. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQren was comparable with the BEQren 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 environmental 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 R. van der Oost, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; J. Koch, Ghent University / Applied Ecology and Environmental Biology; K. De Schamphelaere, Ghent University / UGent; and for the c. D. magna, estrogenic activity was detected in extracts from POCIS and ED samplers showing that the chemicals extracted from POCIS and ED samplers were significantly correlated to the measured chemical concentrations. The advantage on the other hand is that the extraction of the samples is well established, efficient and easy to combine with chemical analysis. Thus, even though this approach does not reconstitute the natural concentration profile of the contaminants, it allows for the investigation of environmentally realistic contaminant mixtures in aquatic biotest 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 passive samplers (e.g. andriver™) an extraction is needed before sphere of biotest medium and the downside of this approach is that an extraction always changes the natural mixture composition due to compound specific partitioning coefficients. The advantage on the other hand is that the extraction of the samples is well established, efficient and easy to combine with chemical analysis. Thus, even though this approach does not reconstitute the natural concentration profile of the contaminants, it allows for the investigation of environmentally realistic contaminant mixtures in aquatic biotest 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.
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 SpeediSpike™ extracts and we expect no direct effects of environmentally realistic contaminant mixtures on the development of *N. spinipes*.

**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, whereas Oasis HLB 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 equilibration state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining the test concentration over the test duration is diminished for some compounds. In summary, the application of Oasis HLB as a passive dosing phase 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 broad 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 true for in vitro test systems, and 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 potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro biotransformation test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant flow of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous environmental exposure. Specific handling tools and concentrating models were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH213**

**Identification of Gestagen(s) and Corticosteroid(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach.**

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Biologically active substances (generally termed as endocrine disrupting chemicals (EDCs)) are present in untreated municipal wastewater, which may cause deterioration of freshwater ecosystem due to their potential to disrupt the endocrine system of aquatic organisms. Untreated municipal wastewater is directly discharged into Danube River, Novi Sad, Serbia and the objective of this study is to identify compounds responsible for gestagenic and corticosteroid effects in Danube river water by using non-target screening. Water sample from Danube River were extracted on-site using large volume solid phase extraction (LYSPE) and was pre-screened on genetically modified bioassays for agonistic and antagonistic hormonal activity for progestrone and glucocorticoid receptors (PR and GR). The extracted fraction was cytoxic to rainbow trout and therefore not further screened for the cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C18 silica based column. Two minute fractions were collected (total 30 fractions) and applied on respective bioassays and identified one agonistic active fraction for both PR and GR. Second step fractionation was performed on the only active fraction by using aninopropyl silica column with gradient elution with methanol:water (30:70) with 0.1% formic acid. One to two minute fractions (total 28 fractions) were collected and biological analysis of these sub-fractions revealed again one active fraction with reduced potency as compared to F18 (parent fraction). For unraveling the compounds responsible for gestagenic and corticoid activity, non-target-screening is being performed by using LC-HRMS.

**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 generally 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 EnPforce project that aims to investigate the toxic responses of mixtures of pollutants and integrate those results into risk assessment. 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 effect-directed *in vitro* test systems, and 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 potential impact on results (e.g. could impact transmembrane permeation, increase bioavailability, disrupt enzymes, generate oversaturated solutions) triggered the search for alternative solutions. Passive dosing has proven to be effective to generate solutions of truly dissolved substances at controlled and constant concentrations. To increase the robustness of in vitro alternative approaches, involving permeation and biotransformation, to the fish bioconcentration test, we set up a global strategy to prepare solutions of hydrophobic substances using customized PDMS-reservoirs. These tube-shaped reservoirs were used either in static mode to prepare the test solutions for the in vitro biotransformation test with rainbow trout S9 or hepatocytes, or in dynamic mode to maintain a constant flow of the permeation setup. The strategy was applied for each fragrance tested to determine the appropriate loading conditions of the tubes to reach a defined concentration in the test media at a controlled temperature, and when necessary for the tube to act as infinite reservoir for continuous environmental exposure. Specific handling tools and concentrating models were used to improve the throughput of the tubes preparation. We present here this strategy and corresponding results for selected fragrance compounds with varying hydrophobicity.

**TH215**

**Analyzing chemical pollutants in water samples from an urban river and wastewater effluent in Hyderabad (India) and their ecotoxicological 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 Misi 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 Misi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Misi 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 Misi 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 toxic effects 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 algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticea yeast strain 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 riverine 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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The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluate pesticides in sediments from catchments close to 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. 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 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 consistent with the results of the mixture risk assessment. The water quality 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.

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 thickened sludge (TS) were also collected. The toxic 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 < 60%). 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 Raphidocelis subcapitata and the feeding inhibition test with Daphnia magna. Samples of S, PS and TS were extremely/toxic to V. fischeri. The tests performed in summer 2015 were the 72-h growth inhibition test with R. subcapitata and the feeding inhibition test with D. magna. Samples of S, PS and TS were extremely high toxic to D. magna.

TH217 NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments

M. Langer, Centre Ecotox EAWAG-EPFL / Aquatic Ecotoxicology; M. Jungbluth, Centre Ecotox EAWAG-EPFL; S. Spycher, Eawag / Swiss Federal Institute of Aquatic Science and Technology; M. Koster, Amt für Umwelt, Thurgau / Gewaesserqualitaet; C. Baumgartner, AquaPlus; E. Vermeirssen, Ecotox Centre Eawag-EPFL / Aquatic Ecotoxicology; I. Werner, Ecotox Centre Eawag-EPFL / Department of Anatomy Physiology and Cell Biology

The Swiss National Monitoring of Surface Water Quality (NAWA) is occasionally complemented by focused studies on relevant topics. The latest focus study evaluate pesticides in sediments from catchments close to 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. 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 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 consistent with the results of the mixture risk assessment. The water quality 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.

TH219 Availability of estrogens applied onto 96-well plates in the LYSES

M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag-EPFL / E. SETAC Europe 28th Annual Meeting Abstract Book
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 assay and the assay is allowed to cool down and sometimes pre-incubation takes place before cells in the bioassay. 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 lyticase-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 redissolution, media 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 remained comparable; 2) only about 50% (for the compounds E2, E1, EE2 and 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 remained sorbed to the wells and never became available to the yeast cells; or 2) compounds were partially evaporated along with the ethanolic solvent. 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 in animal/food products. Several studies have indicated acute and sub-acute toxic effects of high SDS concentrations on animals’ behavioral, reproduction and cell division. However, little is known about chronic effects of SDS in aquatic animals. Thus, the present study evaluated the mutagenic (nuclear abnormalities) and ontogenetic (embryo formation) responses in freshwater pregnant female of guppy Poecilia vivipara chronically exposed (90 days) to waterborne sodium dodecyl sulfate (0.3 and 10 mg/L). The preparation was done following the LYES protocol and morphology analyses. After exposure, females’ blood was analyzed for nuclear abnormalities (micronucleated cells, nucle buds, binucleated cells and cells with numerous or isolated mitotic fragments), and non-parity females were submitted to cesarean section for embryo classification of development stage (less developed until completed newborn fish). The results demonstrated that there were no external deformities in the newborn fish during the exposure. However, there was a decrease in the number of fry on the females exposed to both concentrations of SDS in relation to the control, as well a delay in the development of the embryos of the exposed females, indicating ontogenetic effects even at low concentrations of SDS (0.3 mg/L). Regarding the nuclear abnormalities, both SDS concentration caused significant increase in the frequency of all abnormalities when compared to the control group (p<0.01). The major concern about nuclear abnormalities in the permanent damage they can cause and the consequently genotoxic and mutagenic damages. These results indicate that freshwater Poecilia vivipara chronically exposed to SDS does not appear to be protected by European Directive (73/405/EC). A survery of the literature on the effects of long-term exposure to SDS on fish toxicity is presented.

TH222 EFFECTS OF POTASSIUM BROMATE ON THE EMBRYOLOGICAL DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758)

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Izmir Bay, which is surrounded by many agricultural and industrialized cities like Izmir and Manisa, has been polluted nearly 50 years. Aquatic ecosystems were effectuated very badly due to such kind of pollutants such as heavy metals, polycyclic aromatic hydrocarbons (PAH), Polychlorinated Biphenyls (PCB) and Pesticides. Besides agricultural and industrial activities, heavy marine transport and redging activities in the harbor activities are also disturbed Izmir bay. Authorities have decided to take serious action when the effects of pollution were unbearable in 1980, so as all the city smell very badly. Micronuclei (MN) tests is a system of micronuclei testing used for determining the genotoxic pollutants in the aquatic organisms, with the changes in DNA fragments such as micronuclei in the cytoplasm of interphase cells. Damage caused on the DNA by genotoxic pollutants is the first consequence occurring in the aquatic organisms. In this study, we aimed to investigate the genotoxic effects of Izmir Bay by detecting the MN frequency changes in the gills of mussels (Mytilus galloprovincialis). According to our results MN frequency of 10 stations varied between %39.33 - %5.60 and Binucleated cells frequencies were 0.17 – 5.27. Pollution of Izmir Bay is a long story and cannot be healed in short time but there are some signs that it is in the healing trend. Key Words: Izmir Bay, Pollution, micronucleus, Mytilus galloprovincialis
Effect of thermal stress on endocrine disruption in Daphnia magna

J. Na, Korea University; H. IM, J. Jung, Korea University / Environmental Science and Ecological Engineering

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 target species. Recently, several studies reported that daphnids reproduce by parthenogenesis and 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 by exposing 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 an 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 algal 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)

TH226
Applying Social-LCA and Social Hot Spot Analysis including a SDG Evaluation to Product Assessments with SEEBALANCE®

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Social criteria and objectives – such as education, health or working conditions – are becoming increasingly important which is why these factors are also addressed by the SDGs (Sustainable Development Goals). For this reason, social aspects also have an increasing impact on marketing and management decision-making processes. In the SEEBALANCE® methodology, measures the ecological and economic consequences of alternate products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

TH227
Piloting Responsible Research and Innovation in Industry

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There is now only limited experience with Responsible Research and Innovation (RRI) in industry and there is also limited evidence of the added value of opening up the innovation process in industry for social engagement and gender considerations. In the PRISMA project (http://www.rri-prisma.eu), we overcome these current limitations by carrying out eight RRI pilot projects in a real-world industry context. To establish the added value of the RRI approach and the gender dimension in and for industry, we assess the pilot projects on a number of product and process RRI dimensions and compare the pilots on the relevant RRI dimensions with similar projects in the same companies in which the RRI approach has not been followed. We focus on implementing RRI for some of the major technological challenges in the EU including nanotechnology, synthetic biology, Internet of Things (IoT) and self-driving or automated cars.

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 program 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’Oréal, HiChem and the NGO TechnoServe, and is based on 4 themes: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutrality approaches and best practices for 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) has been conducted, 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 of Diangang. Furthermore, the success of a sustainable Honomony based methodology for 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 focus will be 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.

TH229
How the social pillar can be properly integrated into sustainability evaluation methodology? Evidence from bio-based products case study

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Abstract Along with environmental and economic assessment, social sustainability of the bioeconomy have become a growing challenge, with important efforts to promote the 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 the social impacts of 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-based products, bioeconomy, sustainable bioeconomy, sustainable production before and after the SGI, EN, bio-economy

TH230
Methodological considerations for applying social LCA to modelled future European energy systems in the REFLEX project

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A methodology has been developed for the social assessment from a life cycle perspective of supply chains for future energy systems for the European Union...
Concerning the oil

S. Santoro

Environmental Risk Assessment for some additives used in hydrocarbon extraction activities into the sea

S. Santoro

National Research Council of Italy (CNR); S. Giardina, Ministry for the Environment, Land and Sea; M. Orrì, National Center for Chemical Substances - National Institute of Health; D. Romoli, Italian National Institute for Environmental Protection and Research

Concerning the oil and gas offshore platform activities, the Italian Ministry of the Environment, Land and Sea has adopted a new approach to decide for the release/renewal of the authorisation to discharge the Produced Formation Water (PFW), a by-product of both oil and gas extraction, into the sea. This approach aims at assessing more deeply the possible environmental impact of the additives used in hydrocarbon extraction activities. In this context, we present the application of the environmental risk assessment methodology, set out by REACH Regulation on chemicals, for some additives (e.g. Dietylene glycol) used in oil and gas platform activities. This approach allowed 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 concentrations considered were far higher than the PEC value, thus making the PNEC already a limit for the discharge of this chemical.

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standard tests, such as the determination of water solubility, will be presented (e.g. acute EC50/LC50 values). The assessment entities tool was introduced in IUCLID 6 and aims to assist users in doing industry for when more than one fate/hazard profile is relevant for a substance. The assessment entity (AE) concept was developed by ECHA together with Givaudan Suisse SA. Hence, to support the risk assessment process, a weight of evidence approach is needed to harmonize the application date selection to parametrize the application scheme reasonably and temporality, consistency of association, biological gradient, complete exposure pathway, plausibility, specificity, and predictive performance. Multiple lines of evidence on each candidate cause are then evaluated for both consistency and coherence of evidence. The presentation and the presentation close with an overview of some examples of the use of causality assessment at contaminated aquatic sites from the peer-reviewed literature.

**TH235**

DAPHNE: a supporting tool for pesticides risk assessors and stakeholders

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DAPHNE (DAtech 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. 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 information can be used to calibrate 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. To provide data to substantiate the geographic and temporal representativeness of higher tier ecotoxicological studies. Hence, to support the risk assessment process, 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.

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The assessment entity (AE) concept was developed by ECHA together with industry and research. The tool was introduced in ECLID 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, and thus assessment of concentration, the tool 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 traditional whole substance, with the new compartment approach was used. 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 Impairment 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 liability associated with--contaminated sites acquired 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 North Sea and Egersundbanken (reference area) and in addition the near platform effect (Staiford A) was assessed. The study 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 implications can be used to reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation.

**TH238**

Improving "man via the environment" exposure assessment for lead: a case study with lead in manufactured products and recycled uses

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Current chemical safety assessments for metals under REACH typically include a generic, worst-case utilization of total risks to human populations resulting from exposure via the environment. As a result of comprehensive biological monitoring campaigns undertaken by European Member States in the past and supplemented modelling data, a large body of data is available on lead body burden in the general European population (children and adults). However, little information is reported for blood lead in populations surrounding lead manufacturing facilities. Moreover, whereas lead in food and beverages is the primary expected source of exposure (with soil and dust also contributing to children’s exposure due to play habits), it is difficult to apportion the source of this lead exposure to specific uses. Under REACH authorization processes (as part of a socio-economic analysis), it becomes more important to estimate the contribution of a specific use and specific exposure pathways. Consequently, there is a need to better define the contribution of lead exposures resulting from battery manufacturing and recycling operations in the EU. This paper presents the development of a conceptual model to assess risk in humans indirectly exposed to lead via the environment using a tiered approach that utilizes the European Union System for the Evaluation of Substances (EUSES) and other advanced tools such as the Life Cycle Thinking (LCT) tool. The case study presents a lead use in boards for Pb-free solder paste for a Pb-free electronic product. The case study is based on basic lead exposure assessment and a result of a literature review on lead in products and use. The model will be presented, showing how the different HPLC partitioning characteristics of the components and the use of analytical detection methods was exploited to obtain water solubility information for the individual blocks from a test performed on the whole substance.
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, temperature, and more. Thus, the modelled chemical fate in industrial STPs (iTreat, SträIs 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 of the non-parametrized iTreat model. The measured biodegradation rates were also compared to the non-parametrized model of iTreat and to the municipal models of Simple Treat 4.0 and Simple Treat 3.1. Overall, the iTreat model was successfully adapted to model chemical fate and behavior in an industrial, site specific STP. The elimination rates of the parametrized iTreat model were generally in better agreement to the measured elimination rates than for all other models investigated. The biodegradation rate constant of substances turned out 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 a 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.

TH241

A Bayesian approach to estimate biodynamic model parameters: bioaccumulation of PCB 153 by the freshwater crustacean Gammarus fossarum.

A. Rutier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, Université de Bordeaux; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; L. Pêcher, CNRS / UMR EPOC LPTC; N. Delorme, H. QUEAU, 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 organic pollutants (i.e. not or poorly metabolized compounds) by 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 for 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) 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 brought enough information to estimate precisely each parameter. The median model predictions and their 95% credibility 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. Rutier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, Université de Bordeaux; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; L. Pêcher, CNRS / UMR EPOC LPTC; N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Babut, Irstea / Water

Identifying individuals or populations at high risk for adverse health outcomes due to chemical exposure requires understanding how chemical exposure patterns vary by inherent traits. Currently, we lack of comprehensive screening to study the thousands of chemicals populations are exposed to on a daily basis. The problem by doing this is that depuration during the accumulation phase is neglected, while this process occurs in the two phases. The aim of our study is to propose a Bayesian framework to estimate the parameters of a biodynamic model together by considering simultaneously accumulation and depuration data. The posterior distribution obtained for all parameter will enable a more accurate assessment under uncertainty. We illustrate our approach with the freshwater benthic invertebrate Gammarus fossarum exposed for 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) 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 brought enough information to estimate precisely each parameter. The median model predictions and their 95% credibility intervals showed a good fit of the model to the data.
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 elevated in African Americans when compared to White Americans. In addition, higher levels of parabens were associated with men, while women had showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be from 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 PM 10, PM 2.5 and ultrafine particles in the air is complicated by illegal waste shipments and further exacerbated by weak regulations and enforcement of regulations between developed and emerging countries. The amount of e-waste dismantled 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 of flame retardants detected using gas chromatography mass spectrometry (GC-MS) in air and dust samples from a 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-PASs) 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 brominated FRs in indoor air and dust. The median air concentrations of ∑3 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 (TPH) and other replacement FRs were more abundant, and profiles of selective FRs were detected in indoor air and dust. The median air concentrations of triclosan, a common antibacterial and antifungal agent, were elevated in African Americans when compared to White Americans. In addition, higher levels of parabens were associated with men, while women had showed higher concentrations of N,N-Diethyl-meta-toluamide (DEET). This could possibly be from 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.

TH245

Global approaches to environmental exposure - assessment of e-wastes

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Solvent or end-of-life electrical and electronic equipment waste streams continue to grow exponentially, creating a worldwide pollution problem. E-waste comprises a heterogeneous mix of hazardous and non-hazardous metals, metalloids, glass, plastics, flame-retardant mikros, listed metals and metal compounds (e.g., palladium, platinum and indium). In developed countries, e-waste management is resolved using two major strategies: either by internal recycling/disposal or via exportation to developing nations. For developing countries, the management of e-waste is complicated by illegal waste shipments and further exacerbated by weak environmental regulations coupled to inadequate technology and organizational structures. Remedial methods such as dismantling, melting, metalizing and burning are often used by the informal sector to recover valuable materials from different e-waste components. These unofficial recycling practices contribute to the release of toxic metals and persistent pollutants that affect both the environment and human health. As a result, e-waste issues are complex, multi-faceted and can only be successfully tackled via a multidisciplinary, trans-boundary approach that involves all stakeholders that include amongst others: manufacturers, scientists, economists, policy makers, waste professionals and consumers. The e-waste project “The Environmental and Health Challenges of E-waste and its Management: an Emerging 21st Century Global Concern” (#2014-031-3-600), supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of the fierce challenge: chemical analysis of contaminants, policy and governance, environmental and health impacts, development and advances in treatment technologies including e-waste valorisation. This presentation makes use of studies from around the world to highlight the following: i) discrepancies in the provision and enforcement of regulations between developed and emerging countries; ii) complexity in the analysis of e-waste contaminants in environmental and biological samples; and iii) lack of harmonization of tools or indices to assess risk in environment and health, particularly in soil. It is proposed that a harmonised approach should be taken to use appropriate specification analysis (e.g. to assess bioavailable or bioaccessible fractions) to evaluate e-waste contaminant risk.

TH246

Droplets deposition pattern from a prototype of a fixed spraying system in a sloping vineyard

S. Öngör, Italian National Research Council; G. Innerberner, A. Schmid, C. Roschatt, Laimburg Research Centre; D. Loddo, University of Padova / DAENAE; M. in water, but its medium is such that 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 blast. 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.

TH247

Sensitive Arsenic Spectiation 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 spectiation 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, but its sensitiv...
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 the sample to 12 and storing it in the dark at 4°C. Samples spiked with low concentrations of a cyanide 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 different sites, with levels including 8 priority substances in low detection (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 WWT Polder**

H. Kw, L. Pecher, M. Janssen, P. Van der Voort, S. Talmon, G. Guibaud, E. Meyer, E. Finnfrokken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, 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 quality management requires monitoring of priority substances in a continuous/month monitoring for 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 growing requirement on contaminants 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_{env}) over the full sampling period. PDMS sheets with two different thicknesses (76 and 209 µm) were used, whereas kinetic sampler was deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration (C_{env}) 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 membrane sandwiched between two polyethersulfone membranes. This partitioning 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 contaminating compounds in total including priority substances in EU WFD, C_{env} values can be used as representative values for the comparison with environmental quality standards and C_{env} 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 model for risk assessment are ongoing.

**TH250**

**Improvement of relationship between water pesticide contamination and land use coupling passive sampling with passive dosing mode for risk assessment**

D. Stuller, J. Henne, C. Cinca, J. Grunewald, H. Kwon, H. Jeon, KIS Giessen, University / Chair of Environmental Biology and Chemodynamics

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, 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, etc.). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyethersulfone and nylon) 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 0.1 µm) and necessary to optimize 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. Bonnaud, C. Brouet, A. Daval, M. Gregson, I. Bordeux, I. Bordeux, U. 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, 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, etc.). For that purpose, we first chose the best diffusive gel (e.g. agarose or polyethersulfone and nylon) 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 0.1 µm) and necessary to optimize the sampling rates, and to validate diffusion coefficients, a calibration experiment with micropollutants at environmental concentrations was conducted.

**TH252**


S. Freedlander, Smithers Viscient, LLC / Environmental Fate and Metabolism; S. RAO, Govan Company / Regulatory; K. Malekani, S. Kang, Smithers Viscient / Environmental Fate and Metabolism

Once applied to a plant, pesticide residues have the potential to move to other plant tissues (via phloem and xylem), and to reach the soil, and to be consumed by the plant’s tissues. The objective of this study was to evaluate the translocation of a pesticide through phloem and xylem to various tomato tissues (flower, leaf, 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 consisted of tomatoes treated with the suspension 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.
application group. Although both basalpetal 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 ingredients. Considering the potential of translocation during a conventional plant metabolism 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 Viscient / Environmental Fate and Metabolism; S.P. McLaughlin, Smithers Viscient / Department of Environmental Fate; K. Campbell, Smithers Viscient / Environmental Fate

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 seafloor prior to test (ISO 1998). It is strongly affected by temperature, pH, and salinity, and may vary significantly in different parts of the world. In this study, a set of 16 sediment samples were collected from different locations in the UK and analyzed for microbial biomass using the fumigation/extraction method described in ISO 1998. The results showed a significant variation in microbial biomass across the different locations, with the highest values observed in the winter and the lowest in the summer. This variation is likely due to the different environmental conditions and nutrient availability at the different locations. Further studies are needed to understand the factors that influence microbial biomass in sediments and to develop predictive models for this important parameter.

TH256
New Mass Spectrometry Techniques for the Measurement of Persistent Organic Pollutants
P.D. Jones, University of Saskatchewan / School of Environment and Sustainability; J. Giesy, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre

Recent developments in the field of advanced technology and instrumentation have 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 mixtures and matrices. 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 analogues potentially chemically and biologically similar. The use of a GC/OrbiTrap system brings levels of mass resolution not previously available for analysis of POPs by GC chromatography coupled with ultra-high mass resolution spectrometry (GC-UHRRMS). Here we report use of GC-UHRRMS for identification and quantification of PCDD/Fs and PCBs. The methods developed are based on standard USEPA 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 PCDD/F 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 of concentrations and quantities and provide validation of 20°C of the method. Analyses were also conducted to determine the potential for a ‘matrixplex’ 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. Górecki, M. Napora, R. Strzalkowski, Mossakowska, SETAC Europe 28th Annual Meeting Abstract Book

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 hazards/risks associated with the highest priority chemicals. Harbours and ports are typically located in transitional and coastal waters and so ship traffic is much 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 seasonality and offshore waters. It is recognised that HNS is a surface active surfactant and so salinity will normally interfere. The recent release of parafomaldehyde and parafomaldehyde and 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 before 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.

TH258
Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis
D. Thal, E. Ogban, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Bly, Environmental Standards, Inc.

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 are validated. Official methods of analysis for these compounds require the use of technology, equipment, and a methodically defined standard 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 qualitative certainty for data products 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.
Acetylcholinesterase inhibition: a comparison of available methods for determination of acetylcholinesterase in muscle tissue of Limanda limanda. J. Użycki, 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) into choline and acetic acid. The inhibition of AChE is to regulate the nervous transmission by reducing 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 safety and management of the marine environment.

TH258  Using Correlations of Biological Toxicity Equivalent Quotients and Toxicity Equivalent Quotients to Derive Threshold Values for Dioxin-Like Compounds in Sediment

J.D. Queen, RWTH Aachen University / Department of Ecosystem Analysis; M. Brinkmann, University of Saskatchewan / School of Environment and Sustainability and Toxicology Centre; C. Gembé, Institute for Environmental Research RWTH Aachen University / Department of Ecosystem Analysis; S. Buchinger, Federal Institute of Hydrology / Department G Biochemistry Ecotoxicology; G. Reifferscheid, German Federal Institute of Hydrology; H. Holst, RWTH Aachen University / Institute for Environmental Research

Sediments can act as a sink and source of pollution in aquatic environments, particularly with respect to persistent organic pollutants (POPs) which bind to sediments and then can be released into the aquatic environment if, and when, the sediments are disturbed (e.g., dredging, floods, storm events). Among POPs, dioxin-like compounds (DLCs), which consist of a variety of contaminants that share similar structures and can bind to the arylhydrocarbon receptor (AhR) in cells, are of particular concern. In addition to chemical analyses, which are often expensive and unnecessary if the contamination is low or below threshold concentrations, measurement of the induction of ethoxyresorufin-O-deethylase (EROD) activity using the rat hepatoma cell line (H4IIE) has been identified as a potential bioanalytical screening tool for the presence of DLCs in the environment.

In a presented project, the bioanalytical component involved the use of a 96-well plate-reader-based assay to measure EROD induction with the rat hepatoma cell line H4IIE. The micro-EROD assay can be used to determine the cytochrome p450-dependent enzyme activity, which is induced by DLCs and other environmental contaminants. This approach allows for the detection of DLCs in environmental samples that would require additional chemical analyses. Moreover, the correlation between BEQs and TEQs for PCDD/Fs and DL-PCBs can be established and the assay used as a pre-screening tool to identify samples that would require additional chemical analyses.

TH259  Measuring bioconcentration of cationic surfactants in fish

A. Droge, University of Amsterdam/IBED Institute / IBED

In the presented project, the bioanalytical component involved the use of a 96-well plate-reader-based assay to measure EROD induction with the rat hepatoma cell line H4IIE. The micro-EROD assay can be used to determine the cytochrome p450-dependent enzyme activity, which is induced by DLCs and other environmental contaminants. This approach allows for the detection of DLCs in environmental samples that would require additional chemical analyses. Moreover, the correlation between BEQs and TEQs for PCDD/Fs and DL-PCBs can be established and the assay used as a pre-screening tool to identify samples that would require additional chemical analyses.

TH260  Acetylcholinesterase inhibition: a comparison of available methods for hazard and exposure assessment of chemical mixtures: steps towards increasing the realism of chemical risk assessment (P)

S. Gindt, University of Coimbra / Department of Life Sciences; 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 toxicity. Using a new approach, the presented paper introduces a new method for mixture analysis 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 regulatory relevancy, two ratios...
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 concentration. These community dose response curves allowed 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

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The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, ccx, cat, gr, gst), and thyroid-related genes (trt, trf1, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The co-exposure of both sods, gr, gst, at the same concentration of lead and nis were evidenced in the experiment. The expression profile of trt, trf1, dio1, dio2, nis, sult1-s1, sult1-s2, sult1-s3, ugt1a, ugt2a1, 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 response. Transcripts of gr and gst were induced upon both individual exposures and co-exposure, suggesting that both metals have different effects and may cause an 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 LN natural cycle-oxidation of both Ln3+ and Ln4+ as a result of the dilution of Ln toxicity focuses on the effect of single elements, however they are commonly found as a group in nature. LNs are expected to have cumulative toxic effects on organisms, owing to their similar chemical properties, but studies as mixtures, more representative of real scenarios, are required to support this hypothesis. In this research, we evaluated the toxic interactions of binary and ternary mixtures of cations gadoxite and lead acetate to these metals. Supplementation with LNs to zebrafish has been shown to alter physiological parameters. The results revealed that lead, copper, and mercury are capable of 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 these metal agents and were used to determine the %RGI responses according with the metal under analysis.

TH266

Predicting 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 UNLU; Y. Gopal pillai, Environment and Climate Change Canada; M. Saenz, PRIET CONICET, National University of Luján; B. Hale, School of Environmental Sciences, University of Guelph, W.D. De 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 were 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 ligand was studied. Two sets of tests were performed: 0.5 mg/L of DOC. The metal concentrations at the mixture tests were chosen by an incomplete factorial design, resulting in controls plus 20 test cases. Fronde number inhibition (%FNI) and root growth inhibition (%RGI) were calculated at the end of 7-days tests. Determinations of internal dose [M]i and external dose[M]e were conducted for all chronic tests. Single metal toxicity thresholds (IC25) 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 Mie (IC50 of Cd was 20.8 µg/L) being 6 times more toxic than Ni and 30 times than Zn. When concentration expressed as Mie/Cd was the most toxic metal with MIC of 0.15g/100ml while Mercury was the least toxic metal when expressed as Mie, but Cd when expressed as Mme. At the end of assays, for both DOC concentrations, [Cd], [Zn] and [Zn] were 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) 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 ARTESINAL MINING SITE, NIGERIA

O. Oritoju, 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. Artisanal mining of precious metals has increased 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 bacteria 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) distinct bacteria were isolated, through gram-staining and its was used to fit the observed metal mixture toxicity data to either Mie or Mme. 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.

TH268

The exceptions to the rule: Metal bioaccumulation in macroinvertebrates from metal-polluted sites: A case study

B. Slootmaekers, University of Antwerp / Department of Biology (SPHERE Research Group), 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 stressors, 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) obliged 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 (EQSs). 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 may be different in the way 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 explore the reasons for this situation in terms of biometric data, like fish biomass, plankton (MMIF). We hypothesize that the main contributors to biometric measurements and invertebrates are the different metals present in the environment. Based on the estimated toxicity data (i.e., EC₅₀ values) of single substance, to compare with control response and mixture results, the mode of action in mixtures, the effects of the mixture were analyzed using the MIXTOX models. The EC₅₀ values of AgNO₃ and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-3.2066 mg/L), respectively. Among the 3 mixtures, mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of cumulative, the resulted mixture toxicity was found to be more toxic than predicted, which indicates a decreased toxicity (antagonism) when the mixture effect was due mostly to AgNO₃. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO₃, MIXTOX model, nanoparticle.

**TH269 Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio**

G. Casadei, University of Antwerp / Biology; G. De Breck, University of Antwerp / Biology; SPHERE; R. Blust, 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 waters. 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 cellular defense mechanisms, oxidative stress and ionoregulation. 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 concerns about aquatic pollution in the 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 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 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 explore the reasons for this situation in terms of biometric data, like fish biomass, plankton (MMIF). We hypothesize that the main contributors to biometric measurements and invertebrates are the different metals present in the environment. Based on the estimated toxicity data (i.e., EC₅₀ values) of single substance, to compare with control response and mixture results, the mode of action in mixtures, the effects of the mixture were analyzed using the MIXTOX models. The EC₅₀ values of AgNO₃ and ZnO were 0.0009 mg/L (with a 95% CI of 0.0007-0.0011 mg/L) and 2.2884 mg/L (with a 95% CI of 1.3702-3.2066 mg/L), respectively. Among the 3 mixtures, mixture III was the highest toxicity at the low concentration. With reference at the concentration addition (CA) and independent action (IA) model of cumulative, the resulted mixture toxicity was found to be more toxic than predicted, which indicates a decreased toxicity (antagonism) when the mixture effect was due mostly to AgNO₃. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO₃, MIXTOX model, nanoparticle.

**TH272 How relevant is mixture toxicity of herbicides in surface water?**

R. Saur, Bayer AG / Crop Science Division / Environmental Safety; A. Weyers, Bayer AG / EnSa. Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vegetables Expert Team; D. Baets, Bayer AG Crop Science Division / Sustainable Operations

The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixture toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measured values of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered as relatively minor in the water samples and it is not seen to be a real concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution.

**TH273 Simplify: reasonable approaches to Mixtox assessment for plant protection products**

A. Weyers, Bayer AG / EnSa. Ecotoxicology; K. Bender, Bayer Ag / Crop Science Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vegetables Expert Team; A. Gladbach, Bayer Ag / Crop Science, Environmental Safety Assessment

An early regulatory implementation of risk assessment of mixtures has increased and several guidance documents describe the process. Our suggestions here deal with mixtures of PPP that require an environmental risk assessment (ERA) for cumulative exposure. Depending on the regulatory context, this may include PPP with multi active substances, relevant co-formulants, adjuvants, safeners or metabolites. While publications on mixture toxicity understandably tend to focus detailed evaluations, there are many cases, for which a mixtox ERA is required if its implementation should be efficient and identify non-critical areas as early as possible. Simple exclusion criteria and harmonised approaches for use are essential to avoid a waste of resources both for industry and regulators. 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
E. Rozmankova, RECETOX, Faculty of Science, Masaryk University / Research center for the toxicology of substances and environmental impact RECETOX; B. Morin, J. Cachot, University of Bordeaux / EPOC; P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; L. Blaha, Masaryk University, Faculty of Science / Research Centre for toxic compounds in the environment RECETOX
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 (imidacloprid) on the embryo-larval development of two non-target aquatic organisms. These pesticides are the most abundant representatives of their groups in the aquatic basin in France. We were focused on environmentally relevant 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 (oysters). 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 the malformations and the 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 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. van Vliet, Board for the Authorization of Plant Protection Products and Biocides; L. Wipfler, Alterra Wageningen Environmental Risk Assessment; W. Beltman, Alterra Wageningen UR; H. Holterman, Wageningen Environmental Research (Alterra) / Research for the tested concentrations were observed for zebrafish. On the contrary, the effects on the malformations and the locomotion activity of the oyster larvae is already induced at low concentrations of the selected pesticides. This study shows that the actual strawberry crop scenario is not protective for invertebrates and fish in surface water. Therefore, for the risk assessment of PPPs it needs to be considered that PPPs are part of a crop protection programme and thus should be evaluated in this context. Keywords: multistress, pesticides, environmental risk, aquatic Poster presentation

TH276 MODELLING ACUTE AND CHRONIC RISKS OF PESTICIDES RESIDUES IN SOUR CHERRIES
I. Simion, Gheorghe Asachi Technical University of Iasi Romania; R. Hilhor, Gheorghe Asachi Technical University of Iasi, Romania / Environmental Engineering and Management; P. Manuela Oliva, Phytosanitary Office / Department of Environmental Engineering and Management; M. Rosca, Gheorghe Asachi Technical University of Iasi Romania; P. Czoma, Gheorghe Asachi Technical University of Iasi Romania / Environmental Engineering and Management; M. Gavrilcescu, Gheorghe Asachi Technical University of Iasi Romania / Department of Environmental Engineering and Management
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, based on the regulation 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 Practice (GAP), in double doses, ensuring a partial exposure 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 reaches 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
L. Herrero Nogareda, 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
In Bolivia, pesticides are approved to control and mitigate plant diseases, and to destroy or prevent insects, rodents, a

D.T. Salvito, Research Institute for Fragrance Materials, Inc. / Department of Environmental Science; M.R. Embry, ILSI Health and Environmental Sciences Committee
An international workshop was held in 2016 to address challenges in assessing ecological risk of complex mixtures of substances (e.g., multi-constituent substances (MCS), unknown variable composition and biological substances (UVCBs)). International regulatory frameworks (specifically REACH, Canada’s DSL Categorization and Chemicals Management Plan and USEPA’s TSCA PMN process) have highlighted the complexities of registering, characterizing fate and exposure, and assessing the risk of complex chemical mixtures, whether resulting from manufactured environments or plant-derived materials. Several industrial sectors (e.g., petrochemical, personal care) have developed frameworks and methodologies to characterize and analyze these complex substances, and best practices and key research needs were identified at the workshop to support
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. Dress, Federal Environment Agency (UBA) / Chemicals

Abstract: An important part 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 identification of the relevant constituent environmental fate and toxicity have been developed for single substances and are applied to the mixture. But, in case the constituents have different degradation patterns during the exposure, the recommendation for single substances to base the effect 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.

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 analytical method has been determined, the mixture concentrations in the measured concentration should be applied for these mixtures?

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 Solutions Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

The Product and Organisation Environmental 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 requires the model input data base 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-TD50 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 effect factors. In particular: reliability, adequacy, type of information, text 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 main challenges that were encountered include the way of data reporting and detailing in ESRs, especially for some critical fields, e.g. endpoint, unit, text duration of exposure, thus leading to the use of either 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 (EFSAs) 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 Solutions Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs; R. Gatnik, M. Pavan, S-IN Solutions Informatiche Srl; D. Orrego, European Food Safety Authority EFSAs; EU Commission JRC / Directorate D Sustainable Assessment Unit; L. Ceriani, M. Fuart-Gatnik, M. Pavan, S-IN Solutions Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

In the framework of the HESI project “Deriving USEtox aquatic freshwater toxicity effect factors from OpenFoodTox database (EFSAs) using R-Studio program” this presentation is intending to discuss these issues and to bring some elements of response based on 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: monocomponents, multicomponents, & UVCBS. Amongst these substance types there were several families in need of testing especially in ecotoxicology and environment. One of the most challenging groups was fragrances. In fragrance chemicals fall under multiple categories: natural, synthetic, monocomponent, multicomponent or considered as UVCBS. One group of fragrances that fell under the title of multicomponent/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 most often unknown and their physical state leads to further difficulties for ecotoxicity testing: they were (mostly) solid, i.e. 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 everything in between) to optimize our testing strategies for such compounds: i.e. necessitating avoidance of some studies using alternative approaches. We will present our hypothesis and performed ecotoxicology and e-fate studies. 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.
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 SGD 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 radiotoxicity from food contact materials K. Crookston, E. Crookston Foundation; I. 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 migrate’ 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.


Inspired by methods and tools developed in the field of life cycle analysis (LCA), we have developed an index to assess the harm due to 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 radioactivity. 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 enlarged 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 radioactivity index, which definitions ultimately allow the derivation 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. Ziigo, RIVM / Centre for Sustainability Environment and Health; J. van Gils, DELTAres; A. van Wezel, KWR Watercycle Research Institute / Chemical Water Quality and Health; D. De Zwart, DdZ Ecotax; C. 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 100 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 incuEcoloutil. In SOLUTIONS, the modeling train will result in 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 explains the potential transformation of a single chemical to multiple chemicals by using 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; Y. J. Park, SEOCHUN HYANG UNIVERSITY; N. Kim, RIVM / Centre for Sustainability Environment and Health; J. van Gils, TH285

The presence of phthalate metabolites in urine, one of the most important information for intervention study to reduce phthalates from 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 chronic and concurrent exposure levels, profiles and exposure pathways for different population groups. Eighteen phthalate metabolites include mono-ethyl phthalate(MMP), mono-ethyl phthalate (MEP), mono-2-ethyl-hexyl phthalate (MEHP), mono(2-ethyl-5-oxo)-xyl phthalate (MEOH), mono-2-ethyl-5-hydroxylxy) phthalate (MEHHP), mono-2-carboxymethylhexyl phthalate (MCMPH), and mono-2-ethyl-5-carboxypentyl phthalate (MCPMP) were analyzed. Among 18 phthalate metabolites, MEHP, MEOPH, MEHHP, MCMHP, MECPP, MIBP, MEP, and MBzP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPnP, MiNP, 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 (ct) concentrations were highest (mean: 63.9 ng/mL), MiBP (median: 8.4 ng/mL), MNP (6.8 ng/mL) and MEP (5.2 ng/mL) showed relatively higher concentrations than other phthalate metabolites. Our findings suggests the highest burden of DEHP from multiple sources. In the present study, we defined the peak showing the concentration higher than summation of average and double values of standard deviation as a specific source input associated with phthalate exposure. Tracking the exposure source of phthalates suggests that the major contribution of the phthalates exposure pathways was different depending on chemical properties (e.g., molecular weight) and usage of phthalates. The exposure of lower-molecular-weight phthalates such as DEP and DMP was associated with the consumption of cosmetics and personal care products, whereas the urinary DEHP exposure levels varied with the dietary intake. The present study provides an important information for intervention study to reduce phthalates from humans.
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 assessment, and 2) where in situ chemical and 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, NG). Fourteen site chemistry 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 provascularization/angiogenic receptor-activated mechanisms; 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 iodamid (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 signaling. Collectively, and despite toxicology in gasoline of noncurrent cars. These three health danger markers of abnormality was found. Mutual, interconnected impact of different permeability of cell membrane (liver, erythrocytes); leucocytes chromosomal assessment; etc). Numerous health disorders (in children and pregnant women) of International Chemist Analytic Association; Manual room air. 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 assessment, and 2) where in situ chemical and 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, NG). Fourteen site chemistry 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 provascularization/angiogenic receptor-activated mechanisms; 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 iodamid (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 signaling. Collectively, and despite toxicology in gasoline of noncurrent cars. These three health danger markers of abnormality was found. Mutual, interconnected impact of different permeability of cell membrane (liver, erythrocytes); leucocytes chromosomal assessment; etc). Numerous health disorders (in children and pregnant women) of International Chemist Analytic Association; Manual room air. Th...
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 WWTW effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be slightly toxic to the aquatic organisms. In waterbodies strongly influenced by WWTP discharges Triclofenac and Buprofen 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 Assaying groundwater toxicity of emerging contaminant mixtures

M.D. Pavlakis, University of Aveiro / Department of Biology; J.F. Mousinho, University of Aveiro / Department of Biology and CESAM; A.R. Silva, University of Aveiro / Dept. of Compounds & CESAM; S. Gualda, Doutorina and Cresmina & CESAM - University of Aveiro / Department of Biology and CESAM; R. Morgado, University of Aveiro / Department of Biology and CESAM; S. Loureiro, Universidade de Aveiro / Bio.

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 the great 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 their aquifers from the University of Aveiro / Department of Biology and CESAM. The acute toxicity of complex mixtures in these synthetic groundwaters 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 203) to ensure models were capable of dosing the binary mixtures was used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicate 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. Jönander, University of Gothenburg; I. Dahlöf, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

In marine coastal environments the substances are not present on their own but in mixtures. A chemical monitoring survey detected more than 60 organic chemicals along the west coast of Sweden in 2012, many of which exceeded their environmental thresholds. A total of 33 chemicals was found to co-occur in the water column of the coast of Stenungsund, an area with multiple harbours and home to Sweden’s biggest chemical industry cluster. Dibutyl phthalate (DBP) and Sodium dodecyl sulphate (SDS) were among the highest risk concentration (ecotoxicity). We therefore investigated their single substance and mixture toxicity to natural mesozooplankton communities, which constitute an important link between primary producers and higher trophic levels like fish. Structurally diverse communities generally possess a large resilience capacity, and it is thus essential to identify sensitive species and structural changes caused by 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 (DBP), respectively. The combination of structural endpoints as well as toxicokinetic 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

E. Spilsbury, University of Gothenburg / Dept of Biological and Environmental Sciences; M.S. Warne, Coventry University / Centre for Agroecology, Water and Resilience; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences

The Great Barrier Reef (GBR) is a protected ecosystem, listed as a UNESCO World Heritage site since 1981. It runs for approximately 2300km 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 the GBR’s riverine 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 greater 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

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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 of tourists. The exposure of inorganic sunscreen formulations above the resistance against degradation of these compounds, sunscreen products can reside in coastal waters and potentially bioaccumulate 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 sunscreens are titanium dioxide nanoparticles (TiO2) 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 phase and its composition and is independent of the tested concentrations of the UV-filter TiO2 in the cream. Thus in the present study the tropical coral Stylophora pistillata, a common model coral species, was exposed to increasing concentrations of custom-made sunscreen formulations with and without the UV filter TiO2 to characterize the responses of the chemical mixture either containing or not nanoparticles in it. A series of short-term (5 days) experiments was carried out to compare the effects of these sunscreens 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.
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 (CIP), 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 0.008 mg/L (CLA, 0.01 mg/L); CEP, 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 2.0 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 data available; these will be used to evaluate the concentration 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.

EXPOSURE TO MIXTURES OF PERSISTENT ORGANIC POLLUTANTS (POPS) CAN INHIBIT THE TRANSCRIPTION ACTIVITIES OF ARYL HYDROCARBON RECEPTOR (AhR) IN VIVO
Q.T. Doan, Université de Liège (ULiege) / Département des Sciences des Denrées alimentaires; M. Muller, University of Liege / GIGA-R. Laboratory for Organogenesis and Regeneration; H. Bernsten, NMBU-School of Veterinary Science / Department of Production Animal Clinical Sciences; K.E. 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 Liege / Department of Food Science, FARAH. 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 H4IIIE, 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, a combination of POPs at the level of the AhR function, AhR antagonists are known to interfere with the transcription activity of AhR in vitro. In order to determine the potential of this mixture to affect AhR function in vivo, the transactivation activities of AhR in vitro was performed as part of the Research Cluster “Tailoring the future of biofuels” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

ECONOMIES

TH297
Department of Ecosystem Analysis; H. Hollett, 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 Di-n-buty ether (DiBE) (20%). These fuels are based on the raw material lignocellulose and -neutral. However, the use of this mixture induced toxic effects of atenolol, especially for aquatic organisms. This study focuses on the ecotoxicological evaluation of this mixture and the investigation on a possible interaction between 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 sensitivity of this species to the mixture. To interpret the results for possible interactions between the two substances, the investigation of DiBE and 1-Octanol as single substances was necessary. In the acute immobilization test, the EC50 values were 14.7 mg/mL for 1-Octanol and 17.3 mg/mL for DiBE. Both biofuels led to teratogenic and lethal effects in the FET (LC50, DiBE: 24.7 mg/L; LC50, Octanol: 11.3 mg/L). Especially in the study of DiBE was a low hatching rate, while embryos were often observed at the pericardium of the developing larva. 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. DiBE showed 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 rate of D. rerio. Preparing of sludge can cause the larvae 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 Cluster “Tailoring the future of biofuels” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

ECONOMIES

TH300
A. Madeira Sanches, University of Sao Paulo - USP / Núcleo de Ecotoxicologia e Estudos Ambientais NEEA; E. Freitas, University of Sao Paulo - USP / Department of Biology; L. ZelIDŽ, University of Oslo / Department of Biology; B. Kopp, University of Oslo / Department of Biology

Environmental risks of these mixtures are however poorly understood. In this study, the mixture toxicity of a combination of 29 compounds including antibiotics active ingredients was assessed. 19 out of the 29 compounds showed antagonistic activities on D. rerio. Exposure to mixtures of Persistent Organic Pollutants (POPs) can inhibit the transcription activities of Aryl hydrocarbon Receptor (AhR) in vitro and in vivo. The effect of a mixture of POPs at the level of AhR function, AhR antagonists are known to interfere with the transcription activity of AhR in vitro. In order to determine the potential of this mixture to affect AhR function in vivo, the transactivation activities of AhR in vitro was performed as part of the Research Cluster “Tailoring the future of biofuels” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

MULTIPLE AND COMBINED EFFECTS OF PROPICONEZOL AND ZnO (BULK AND NANO FORM) ON VARIOUS BMARKERS AND REPRODUCTION IN ENchytraeus albidus
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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 (CIP), 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 0.008 mg/L (CLA, 0.01 mg/L); CEP, 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 2.0 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 data available; these will be used to evaluate the concentration 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.

MIXTURE TOXICITY OF ABAMETICIN AND DIFENOXAZEN TO ZEBRAFISH EMBRYOS (Danio rerio)
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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; 2.4; 5.3 and 11.7 mg L\(^{-1}\) of abamectin and 0.2; 0.5; 1.0; 2.3 and 5.0 mg L\(^{-1}\) of difenoconazole. The factorial design was used to evaluate 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 Minitab program. Significant differences that were observed in the data, the binary mixtures 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 have been observed in other studies with microorganisms 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 zebralsh embryos

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There is an ever-increasing number of chemicals including pharmaceuticals and industrial pollutants that are released into the environment. The binary mixtures of abamectin and difenoconazole promote 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 have been observed in other studies with microorganisms exposed to mixtures of these same compounds, but complementary studies are necessary to better understand the toxicokinetic of these pesticides mixtures.

**TH305**

Critical raw materials in a new building integrated photovoltaic system

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REELCOOP, an EU-FP7 funded project which stands for REnewable ELectricity COOPeration (www.reelcoop.com), aims to develop and test novel prototypes of electricity generation technologies. One of the prototypes is a solar photovoltaic (PV) ventilated façade (6 kW) 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 is followed for addressing the task that addresses the need for a focused 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 Ventilation 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 terephtalic acid from renewable sources

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The life management of carbon fibers reinforced composites (CFRCs) has shown to be the utility with the highest impact, consuming a significant quantity of energy derived from 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 the damage generated by emissions in air and water. The impact of landfill disposal is intermediate, due to the good stability of CFRCs: having a slow degradation, their disposal in landfills does not cause a 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 Decrease n° 86 of 13 January 2003; Implementation of Directive 1999/31/EC on landfill of waste, Official Journal of the Italian Republic, 2003. [2] Legislative Decrease 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.
The scope of the present study is to investigate the environmental sustainability of different routes of terephthalic acid (TA) production, comparing the results achieved in a traditional way with those of three bio-based routes. The aim of the study is to identify which of the selected pathways has the lowest environmental load. Below the four routes selected are briefly described: Traditional way: p-xylene is obtained from catalytic reforming of crude oil as part of extracted BTX (benzene, toluene and xylene isomers); GEVO’s process: isobutanol from the fermentation of biomass is converted into hydrocarbons, iso-octene and p-xylene; Fermentation of HMF (5-hydroxymethylfurfural) from starch, its conversion to DMF and the Diels–Alder reaction with bio-ethylen to obtain p-xylene; Alternative pathway from p-cymene: it consists in the oxidation, using O₂ in the presence of a catalyst, of p-cymene (derived from orange peels) to obtain TA. The first two routes are already set at industrial level; the others are still under development. Therefore, in order to estimate the environmental impact associated with different scenarios, a number of the selected chemical processes was carried out using ChemCAD software. The first three syntheses are based on the production of p-xylene, subsequently oxidized to TA through the Amoco process. On the contrary, the last route is proposed as an alternative way, since it uses p-cymene as a precursor of TA. In order to perform the comparison, a LCA (Life Cycle Assessment) methodology has been used as a scientific tool of energy capacity, residence of chemical stocks in each stage and cost. An overall environmental analysis and evaluation of the potential impacts of each scenario. LCA allows the identification of the environmental weight associated with the entire life cycle of a product, in our case 1 ton of terephthalic acid. The model was analyzed by the use of SimaPro software and the results indicate that bio-based processes are sustainable only if they use organic residues as raw materials. Both analysis methods used, CED and ReCiPe, have shown that only the alternative way from orange peels has lower environmental impacts than the traditional way from crude oil. For the other processes, the cultivation and transformation of biomass present an environmental weight that does not justify their use as starting materials for p-xylene, and then TA, production. Thanks to this work it was also possible to make some considerations about energy requirements and their weight in the life cycle of the processes.

**TH308 Environmental assessment of vanadium redox flow batteries**

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The rising production of electric energy from renewable sources requires electrical energy storage systems to compensate for the fluctuations in energy generation. The vanadium redox flow battery (VFB) is a suitable technology for storing energy on a large scale. Due to the opportunity to store and shift energy, its use in energy systems is assumed in the past decade with strong efforts towards cost-effective VFB systems [1]. In a holistic approach besides of technical optimization and economic aspects, the energy use of hydrogen sustainability is an important factor for sustainable energy systems has to be assessed. A research gap on environmental assessment of VFB has been identified. The most cited LCA has been published in 1999 [2]. To date the VFB technology has been further developed and commercialized. Based on preceding detailed studies on the production of VFB components and systems an update of their environmental assessment with primary LCI data is developed [3]. A focus is on the potential for recycling of battery components at their end of life. In a recent study it has been quantified for a small 5 kW-4 kWh-VFB-system with only 18wt.-% associated with a potential of 16% ecological impact reduction by recycling [3]. In the present study recycling paths for all VFB components are assessed in detail considering substantial differences in design of small systems for residential use (kilowatt-size) and large systems for industrial applications (megawatt-size). 1. Minke C, Kunz U, Turek T (2017) J Power Sources 361: 110–114. 2. Ryth DJ (1999) J Power Sources 80: 21–23. 3. Unterreiner L, Jülch V, Reith S (2016) Energy Procedia 99: 229–234.

**TH309 Towards the Life Cycle Assessment of engineered nanoparticles production: a comparison between batch and continuous flow synthesis**

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The aim of this study is to provide an assessment of continuous micro/milliflow technologies applied to Engineered Nanoparticles (ENPs) production, benchmarking them against the conventional batch productions. As the quantity of ENPs produced and their applications are steeply growing, an increasing attention is being paid to the quality of the product and the efficiency of the synthesis. Continuous micro/milliflow (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 objective, 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, and the results are compared with those obtained by CF synthesis. 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.

**TH310 LCA of nanomaterials production for the emerging technology: the case of printing batteries**

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BASMATI is an ambitious project which main goal is to develop active nanomaterial and electrochemical inks for printing technologies to transfer and upscale to pilots at SMEs and industry facilities. This project is co-financed by European Union under The Framework Programme for Research and Innovation HORIZON 2020. The project is developed by 10 different partners, where LEITAT is in charge of the Life Cycling Assessment. For that task, the environmental impact has been performed during the whole life cycle considering synthesis, formulation and disposal of printed batteries. The LCA has been focused on investigating the potential impacts of Cu, LFP (LiFePO₄) and NMC (Ni-Mn-Co) nanoparticles synthesized, the inks which contain these nanoparticles and the batteries printed with these inks. The LCA applied in the study is based on the standard ISO-framework for LCA (ISO 14040:2006 and ISO 14044:2000). Calculations have been done using the software GABI, and taking as a basis the GABI Database. EcoInvent Database and the ILCD impact assessment method. The functional unit has been defined as “a printed flexible battery to be used for power source” and the scope has been based on the “cradle to grave” approach. Primary data have been prioritised and secondary data from databases and literature have been used when needed. The inventory process has been completed with the information of inputs and outputs gathered from partners. Then, the impacts related to inventory flows have been calculated for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks, valuable results and, results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu inks. Also, the impact of manufacturing and disposal of the printed batteries after the synthesis after the manufacturing and disposal of the printed batteries has been evaluated. The stack and interdigitated battery has been chosen as demonstrators to develop the LCA. Landfill and recycling have been assumed as end of life scenarios. Finally, the conclusions take into consideration the new generation of technologies and their environmental performance.

**TH311 Life Cycle Assessment (LCA) applied to new and advanced material solutions in Concentrated Solar Thermal technology**

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The benefits of high efficiency concentrated solar power (CSP) and photovoltaic (PV) are numerous: environmental protection, zero-carbon process, energy security and economic growth. CSP has advantages in front of PV: possible 24h continuous electricity production, electricity and heat generation, heat for distributed in concentrated power plants. Nonetheless, the production cost of this promising technology have to be improved. The aim of IN-POWER project is to develop high efficiency solar harvesting CSP architectures based on holistic materials and innovative manufacturing processes while reducing the environmental impact associated to CSP architectures and the energy production cost. To achieve this objective IN-POWER develops a set of advanced solutions: Polymeric Smart light mirrors with high optical and mechanical performance. An optimized and lighter mirror support structure. High-temperature-performance photosensitive absorbing coating in new vacuum-free-designed receiver. A novel modular solar field architecture and design reducing the land use requirements by 4 times.

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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 for a design/synthesis process looking for high performance, cost effective and, 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.
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European society has a highly dependency on electric power. In 2009 European Union fixed that at least 20% of EU gross final energy consumption have to come from renewable energy sources until 2020. The increasing use of renewable energy sources to produce energy has generated a worldwide challenge for the electric grid, where the peak production of energy is usually not in phase with the peak demand; the developing of large scale electric storage systems. The innovative AA-CAES developed within the RICAS2020 project can solve this problem. In a CAES the air is compressed in a storage unit when electric energy overproduction is available, and by the inverse process, is reintroduced in the grid when required in the high demand periods. Additionally, AA-CAES collects the heat produced by compression in a specific Thermal Energy Storage (TES) and returns it to the air when the air is expanded to generate power, delivering higher efficiencies via a zero CO₂ emissions process. RICAS2020 is being assessed under the Environmental and Social LCA. In order to define improvement measures to guarantee its sustainable performance. The scope of the LCA covers the construction and the operation stage of the CAES. Regarding the construction stage are being assessed: the site excavation methods and the manufacture of materials needed for the construction of the Cavern and TES. Respect to the operation stage, the impact of machinery used (turbines, compressors, coolers) are being considered. The main goals of this assessment are to: (i) compare the environmental benefits of the 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 different materials (in high temperatures used in the WTWPP) to evaluate their environmental impacts. 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
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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 WWTPs or proposing new processes that improve 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 and consists in a new wastewater treatment scheme, i.e., (i) a first stage of enhanced biological phosphorus removal with struvite recovery and (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
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Technological innovation crucial to sustainable 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 innovation at an early stage. We present a novel approach to assess the 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 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 coated glass in a certain area of the greenhouse. The impact categories of the LCA were: energy demand, GHG emissions, water consumption, and toxicity. The results showed that the new coating was favorable in terms of both environmental impacts and cost benefits. Finally, it was revealed that the simulations can only bring significant environmental benefits rather they bring economic benefits in terms of increased yield of tomatoes. Finally, the 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
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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 computer simulation using algebraic and/or differential equations of the chemistry 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 will present the analysis of the complete life cycle of polyurethane rigid foam from cradle to grave in tight connection with process simulation methods, thus highlighting the characteristic independent variables of the production process, 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 scenario 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 disrupted type calcium channels

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Embryotoxicity to fish is a high throughput alternative to using the whole fish model. Previous studies in laboratory have demonstrated that embryonic exposure to pharmaceutical compounds capable of disrupting the endocrine system such as 17α-ethinylestradiol, levonorgestrel, and diclofenac, both alone and in mixtures, can impair swim bladder inflation of Japanese medaka (Oryzias latipes). Failure of swim bladder inflation can have serious long-term effects on fish population dynamics, including reduced fecundity and mortality. Early embryonic exposure to xenobiotic compounds are able to cause swim bladder inflation is not fully understood; however, it is possible that compounds are able to cause their effects through a disruption of embryonic cell signalling pathways. The canonical Wnt pathway plays a crucial role in fish swim bladder development, and the disruption of Wnt signalling during swim bladder organogenesis could lead to improper swim bladder formation. The effects of two Wnt modulators IWR 1 and lithium exposed from 36-101 hours post fertilization on gene expression of medaka embryos was determined. The effects of embryonic exposure to the three pharmaceutical compounds on whole embryo gene expression were then established and compared. It was measured that these pharmaceutical compounds significantly inhibited the expression of genes related to the formation of the three layers of the swim bladder (epithelial, mesenchyme, and outer mesothelium). Both levonorgestrel and 17α-ethinylestradiol also significantly downregulated the expression of "left" and "rcf71" (β-catenin/Wnt transcription factors), but not the expression of the Wnt ligand wnt5b. Thus demonstrating that these compounds may be altering swim bladder inflation through a disruption of β-catenin/Wnt signalling during early embryo development.

TH318

Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Lemma minor

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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 organisations using this species as an aquatic ecotoxicological model. Although being highly useful for regulatory purposes focusing on traditional adverse endpoints, these tests provide limited 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 terrestrial plants. The results demonstrated that 3,5-DCP caused concentration-dependent effects in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation (OXPHOS), chlorophyll contents, 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 photosynthetic 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 relationships among endpoints and the toxic modes of action of occurring in L. minor to form a basis for future studies with similar compounds.

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TH319

Development of adverse outcome pathways for oxidative stressor-mediated reproductive effects in aquatic invertebrates

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Oxidative stress is a common type of stress in living organisms and induced when the production of reactive oxygen species (ROS) overwhelms the endogenous protective defences. Environmental and toxicological factors such as stress, pollution, ROS-sensitive to 3,5-dichlorophenol and pollutants are known to induce oxidative stress. The consequences of oxidative stress have been 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 based on a combination of literature survey and in silico predictions; evaluate the key events in the AOPs using the forecaster species Daphnia magna. An extensive literature survey to collect existing knowledge on ROS-mediated reproductive effects occurring in aquatic invertebrates, and metals, ionizing and non-ionizing radiations as prototypical stressors. A network of conceptual AOP 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, DNA and protein damage, 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

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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 intentionally 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 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 to support 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

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AOPs have 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 0% 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 Effectopedia

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Pulmonary fibrosis (PF) is a chronic and progressive lung disease where the scar tissue forms 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, the application of quantitative AOP (qAOP) which provide dose-response and time-course prediction, has been gaining much more attention in regulatory decision-making field. To develop the AOP of pulmonary fibrosis, in one hand, we made preliminary AOP from literatures, which constitutes the PPARy interaction as Molecular Initiation Event (MIE), Collagen activation, Inflammation and EMT-Fibrosis activation as Key Events (KEs), and Cytoxicity/Apoptosis and Fibrosis as Adverse Outcome (AO). On the other hand to make qAOP, we conducted cytotoxicity and apoptosis test using human bronchial epithelium cell (Beas2B). Beas2B cell was exposed to CMIT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis of the KEs was performed using Effectopedia platform of AOP-KB. For further study, we are planning to do various dose- and time response test (using qPCR and ELISA) for each potential KEs, so that we can integrate data for building qAOP model with the network between MIE-KEs-AO. Acknowledgment: This work was supported by a grant from the Korean Ministry of Environment through ’Environmental Health R&D Program’ (201700137001).

TH332 Exploring Potential of Knowledge Databases for Adverse Outcome Pathway Discovery

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Adverse outcome pathways (AOPs) have potential to support and enhance the use of mechanistic data in regulatory decision-making. AOPs organize existing knowledge about relationships (ideally causal ones) between initial chemical-biological interactions (molecular initiating events; MIEs), intermediary key events (KEs), and adverse outcomes (AOs) relevant to risk assessment. Efficient ways of AOP development and weight of evidence assembly are lacking. This study evaluated potential of the existing knowledge databases (Unified Medical Language System - UMLS, and National Library of Medicine – NLM) for AOP discovery and development. UMLS contains more than 68-million relationships among more than 3-million unique biomedical concepts (or terms). The NLM literature database contains more than 100-million relationships among similar 3-million biomedical concepts extracted from the abstracts of more than 16 million biomedical journal papers. First, AOP network was downloaded and parsed from AOP Wiki (https://aopwiki.org/). We found that there are 3,084 relationships among stressors, MIEs (main initial events), KEs (key events), AOs (adverse outcome), stressor-chemicals, and stressor-events. High performance graph processing unit (GPU) was used to determine which of 3,084 relationships can be found in hundred million of relationships in UMLS and NLM databases. 610 (20%) relationships were found in the UMLS database. About 1,837 (60%) relationships were found in the abstracts of 16 million biomedical papers on NLM. When combining our searches over both the UMLS and NLM databases, 1,983 (64%) relationships from AOP wiki were found; relationships in some sub-categories such as stressor-chemicals had much higher hit ratio - 78%. These findings indicate that AOP-discovery system that uses UMLS and NLM to predict new probable AOP relationships (that can connect to objects in the AOP Wiki) could substantially accelerate AOP development and contribute to weight of evidence analyses. The confidence of the predicted relationships could be calculated based on frequency of the relationships, whereas the quality of the predicted relationships could be further enhanced by running deep learning models with knowledge curated in databases such as The Comparative Toxicogenomics Database, ECOTOX and iCSS ToxCast Dashboard.
MOPC01 Fish caging experiment as a tool for in situ assessment of neurotoxic effects of untreated wastewaters

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In the framework of FF7 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 economically 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 genes encoding for five different receptors and two enzymes was studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (for the inhibitory neurotransmitter GABA and various drugs), synaptotagmin 10 (integral membrane protein of synaptic vesicles with a role in exocytosis) and myelin basic protein (responsible for myelination of axons and neuroprotection). The activity of acetylcholine esterase, enzyme that terminates action potential transmission in chemical synapses of cholinerigic type, was also examined. A trend of slight upregulation for the expression of the genes encoding for tachykinin 3a and tachykinin 3b, 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 discharge, 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 603437.

MOPC02 Toxicity analysis of treated sugar cane vinasse by integrated systems using gills of Oreochromis niloticus as model

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The algal 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, but 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 fertirrigation should not overreach the ion retention capacity of the soil, 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 analyzes 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 (Gobioides broussonnetii - Gobidae) from one of the most productive estuaries in Brazil

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The São Luiz-Lagoa Guará (São Luiz-Lagoa Guará) 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 (Gobioides broussonnetii - Gobidae) 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. broussonnetii the studied area. Fishes were sampled near Cananéia, 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 GPa and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxic effects in liver and blood of fish in winter. In summer, 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 stressful this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of contaminants may interfere in the responses. Necropsy and anionic 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 a 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

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The Aachen-Soers WWTP is a large-scale ozonation plant. 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 near the city of Aachen (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 caging experiments 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 got 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...
during late summer in 2017 to evaluate the status quo of the stream and the performance of the “Aachen Soets” WWTP. This project is funded by the Ministry for Climate Protection, Environment, Agriculture, Conservation and Consumer Protection of North Rhine-Westphalia.

MOPC05
Environmental applications for medium-throughput, in vivo androgen disruptor identification with the RADAR assay
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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, landscape and exposure of toxicants via the aquatic pathways have been identified with in vitro 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 spigeln1 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 androgen-like activities of a number of pesticides that had previously 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 vivo study. The RADAR assay is a reliable, medium-throughput tool which 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
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The vineyards of the Medoc in the North of France are the most important sector of Aquitaine. The natural ecosystems are usually the final receptorate 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 on the river (S805) (a stream small river 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, larvae had been exposed to 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 Menanteau 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 Vignoguen when compared to non-exposed larvae. In particular, the head size was significantly smaller than control larvae, and yok 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 Microscopy 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) pollution is threatening the marine and terrestrial ecosystems. Pollutants from 1 million annual MP are discharged into the Danube River.[2] In the future, the challenges lie in developing automated methods to test these samples, especially for forensic analysis as a result of tight needs to be addressed. Raman microscopy (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, etc.) of different sizes (10⁻³ – 10⁻⁵ µm) 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 methods. The test results showed that the filter materials and filter geometries are an important factor for the success of MP analysis. Using these approaches we were able to develop an automated method for MP analysis that is robust and reliable. The results were presented at SETAC Europe 2017 conference. The presented work is supported by the BMBF funding (03F0816A).

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 the majority of polyethylene (PE) and polypropylene (PP) fragments are far too the most common in the aqueous environments. In addition, commercial micro and nanobeads have surfactants at their surface which may enhance their toxicities. Here, we present a simple methodology that allows one to prepare small microplastic particles of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE pellets in toluene at high temperatures that was emulsified in water by ultrasonication. After removal of the solvents particles were recovered as powders that could be re-dispersed in water. Besides providing particles of small size, the advantage 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

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Environmental Technology
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 composition, degradation and 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 additive chemicals present in tires to marine organisms. Furthermore, the rubber particles may act as a vector for other persistent organic and heavy metal pollutants already 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 months 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, biphenyls, 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 and effects on humic substances and sediments on the sorption of anthropogenic polluters, sorption isotherms of i.e. galaxolide to polyethylene (PE) 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 combination 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
R. Leads, College of Charleston / Biology; J.E. Weinstein, The Citadel / Department of Biology
Microplastics (≤5 mm) present on shorelines worldwide. A previous survey of Charleston Harbor, South Carolina, USA reported an average of 591 ± 105 particles m⁻² in intertidal sediments, with black fragments suspected to be micronized tire rubber making up >90% of 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 the main 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 microwave disruption abundance ranged from 3-4375 particles/kg wet weight. Sea surface microlayer microwave disruption 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 microwave abundance in the sea surface microlayer did not differ significantly among rivers. Blue microplastic fibers and micronized tire rubber presents the main contributors. Microplastic and micronized tire rubber, with diameters of 0.5-5 mm. This circumstance raises concerns as particles via fishes, other organisms. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from sample preparation and high and mortality rates were found for different marine zooplankton species.

MOPC12
Nanoplastics analysis with Nano-FTR
M. Meyns, Alfred Wegener Institute; S. Primpke, G. Gerds, Alfred Wegener Institute / Shelf Sea System Ecology
The distribution of microplastic particles in marine environments 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 × 10^6 particles/µm of 0.5 µm. This circumstance raises concerns as particles via fishes, other organisms. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron microscopy suffers from sample preparation and high and mortality rates were found for different marine zooplankton species.

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 times during the deployment period. The sites monitored were located in 5 major rivers and 11 smaller creeks in the Great Lakes basin. Static, renewal particles are currently used to optimize strategies of identification by Raman microspectroscopy for particles smaller than 1 µm.

MOPC09
Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles
S. Hippebert, V. Zilles, Hochschule Fresenius University of Applied Sciences; T. Dieper, Hochschule Fresenius, University of Applied Sciences / Chemistry and Biology
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 plastic material causes a vector for accumulation of plastic material 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 aging of plastic material are factors regarding the influence of humic acids and sediments on 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 coated with plastics and sediments with rubber fragments were used as model sorption sites for solved substances. To investigate the effects of humic acids and sediments on the sorption of anthropogenic polluters, sorption isotherms of i.e. galaxolide to polyethylene (PE) 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 combination 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.
experiments were conducted to estimate sampling rates of NNIs and to estimate elimination rates of PRCs. These experiments were conducted using synthetic water at 15°C over 14 days. Extracts were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) using an AB Sciex QTrap 5500 instrument with electrospray ionization coupled with an Agilent 1100 HPLC. Nine NNIs were detected, but the concentrations varied widely from 2 ng/L to 4.6 µg/L. Fentanyl was detected at concentrations up to 1140 ng/L in watersheds discharging into Lake Ontario. Imidacloprid at concentrations up to 1731 ng/L and thiamethoxam at concentrations up to 625 ng/L were detected in the watersheds discharging into Lake Erie. Overall, these data indicate that NNIs are widely distributed in surface waters in agricultural regions in Ontario within the Great Lakes basin.

MOPC18 Occurrence and removal of antibiotics in municipal wastewater by conventional activated sludge (CAS) and membrane bioreactor (MBR) systems

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This study provided the first and comprehensive data on the occurrence and removal of twenty-one target antibiotics and antimicrobials in a full-scale conventional activated sludge and membrane bioreactor systems in the Southeast Asian region. Nineteen out of the twenty-one target compounds were ubiquitously detected in raw influent samples. Concentrations of the detected ECs in raw influent samples ranged by several orders of magnitude (e.g. from 23.8 to 43,740 ng/L) depending upon the compound and sampling date. The elimination of antibiotics and antimicrobials in full-scale conventional activated sludge (CAS) and membrane bioreactor (MBR) systems at a WWTP was evaluated and compared. Numerous antibiotics and antimicrobials, such as meropenem (MER), amoxicillin (AMX), ciprofloxacin (CIPX), clindamycin (CLI), azithromycin (AZT), chloramphenicol (CAP), tetracycline (TET), doxycycline (DOXY), and trimethoprim (TMP), were detected at concentrations up to 1140 ng/L in watersheds discharging into Lake Ontario. Imidacloprid at concentrations up to 1731 ng/L and thiamethoxam at concentrations up to 625 ng/L were detected in the watersheds discharging into Lake Erie. Overall, these data indicate that NNIs are widely distributed in surface waters in agricultural regions in Ontario within the Great Lakes basin.

MOPC19 The effect of activated sludge conditions on micropollutants biodegradation and transformation products formation

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Micropolllutants 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 research efforts have been devoted to the identification of biodegradation 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 60% removal was observed at pH 7. During the first 30 minutes, E1 concentration was reduced to 180% while E2 concentration profile drop, suggesting that E2 is oxidized to E1, in consistency with literature. Almost no biodegradation occurred in anoxic batch tests. Etilrol 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). However, these results are not definitive under anoxic conditions, but proved highly biodegradable under aerobic conditions at both pH 7 and 8, leading to the formation of 2-hydroxyl-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. Metoprolol removal varied from zero (anoxic conditions, pH 7) to 20% 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 consistent with literature.

MOPC20 Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gill 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 biotransformation (plasma and bile), metabolism and elimination of CIPRO in gill-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 zwitterionic 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 piperazenylic ring (in 2 BPs) and the cleavage of the aminohydroxybenzene ring with (1 BP) or without (2 BPs) the loss of the primary amine formed during the cleavage. The only phase II transformation of CIPRO observed was BP18 that, apart from the oxidative deamination of the piperazenylic ring, also suffered the glycerine 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 glycerine and glutamine 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 glycerine nor glutamine conjugates were 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. Ziaurrast is grateful to the Spanish Ministry and L. Mijangos to the Basque Government for their predoctoral fellowships.


The Ebro River Delta, located in northeastern Spain, is one of the largest wetland areas of the Mediterranean region. It is an area of high ecological and economic values, where wildlife shares the territory with intensive rice growing and other agricultural activities and seafood production. The objective of this work was to investigate the occurrence of different classes of medium to polar pesticides and transformation products in irrigation and drainage ditches at the Ebro Delta in summer, when application of pesticides is more intensive in the area, and to assess that the use of these contaminants may have on local ecosystems and seafood production activities, and eventually on human health. To this end, an analytical method based on on-line solid-phase extraction–liquid chromatography–tandem mass spectrometry (SPE–LC–MS/MS) was developed and validated for analysis of over 50 pesticides, including various neonicotinoid and organophosphate insecticides, as well as herbicides pertaining to the classes of triazines, phenylureas, sulfonylureas, carbamate, sulfonylureas, cyanoacetanilides, acidic herbicides, oxadiazoles, carbamoxides, benzothiadiazines, nitriles, diphenyl ethers, and carbamates in water. This methodology, which offers various advantages for its routine use in the analysis of medium to polar pesticides in the different water compartments, allowed the quantification of most of the target analytes at levels below 10 ng/L, and with a high reliability of results that stems from the use of an automated and highly selective analytical technique and the use of deuterated analogues of the target compounds as surrogate standards for their quantification. Bentazone followed by propanil was the most abundant compound detected in the analyzed samples, being in the µg/L level. Oxadiazon, acetamiprid, imidacloprid, and triallate were also found at
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 number: CTM2016-75587-C2-2-R), and to Merck for the gift of LC columns.

MOPC22 Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montegudo, 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

Diclofenac concentrations in effluent wastewater are often exceeding local limits or upcoming EU regulations. This study was undertaken to explore the possibilities of removing diclofenac with persulfate in respect to kinetics and reaction pathways. In-situ chemical oxidation of a diclofenac aqueous solution was performed using persulfate anions activated by ultrasound. The diclofenac (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 anion was increased with decreasing pH values. A reduction in the reaction rates in the ultrasonic persulfate (US/PS) process was observed with excess persulfate as the reagent decomposed via the non reactive S\(_2\)O\(_5\)\(^-\) (with no generation of the very effective SO\(_4\)\(^-\)). Sulfate and hydroxyl radicals were involved in the main reaction pathway of diclofenac. Diclofenac amide and three hydroxy-diclofenac isomers (3-hydroxydiclofenac, 4-hydroxydiclofenac, 4\´-hydroxy diclofenac) 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 diclofenac from wastewater.

Mercury Biogeosciences - Fate, Effects and Policy (PC)

MOPC23 Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks D. McLagan, University of Toronto Scarborough / Chemistry; C. Mitchell, University of Toronto Scarborough / Physical & Environmental Sciences; F. Monaci, University of Siena; Y.D. Lei, University of Toronto Scarborough / Department of Physical and Environmental Sciences; F. Wanías, University of Toronto at Scarborough / Physical and Environmental Sciences

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 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 Salvador 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. 6 2016. The coarser spatial resolution grid was sampled for an approximate 3 month period. Mean 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 able to apply our photodemethylation rate constants, derived from controlled experiments that focused primarily on the quantification of the relationships between solar radiation exposures, DOM, and MeHg within six freshwater lake systems in Keijmijkjuk Park 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 Keijmijkjuk National Park lakes that were studied, lakes with higher DOM lost much less MeHg through the
The results showed that adsorbed and intracellular Hg concentrations decreased as a function of Hg in the absence or presence of DOM was computed with WHAM/model VII. 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, thus PIMs can be considered as an innovative media to extract low levels of metal from different natural waters and to preserve sample information until the determination of the metal can be performed.

**MOPC27**

Dissolved organic matter as a modifier of Hg bioavailability to phytoplankton

C. reinhardtii complexed by DOM. To get insight into the role of DOM in reducing Hg uptake, 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. 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 hemic acid (SRHA) and in natural water rich in DOM from Onego 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 higher 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 impacts on 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 on aquatic 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 will 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

A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team S. M. Daam, New University of Lisbon

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 target aquatic organism groups as compared to the standard test species used in the aquatic risk assessment for 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 tier (Oncorhynchus mykiss, Oecetochys rhynchus mykiss) and chronic first tier (Raphidocellis 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. Pertinent consideration to the antimicrobial toxic mode of action of the evaluated substances was not identified.
Towards a better exposure assessment of antifungal azoles realised. The risk that cannot be controlled by buffer strips in situations where catchment characteristics suggest a high mitigation potential. Once released, buffer strips have been shown to efficiently retain 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.

TUPC03 Fungicide effects propagate through the detrital food chain in streams. J Rasmussen, Aarhus University / bioscience; M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; M. Skov Pristed, Aarhus University / Department of Bioscience. 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. Fungicides 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: Chaoborus 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 highest fungicide treatment compared to the lower fungicide and the untreated control. To mitigate fungicide impact, a range of decomposition was significantly lower in the treatments containing highest fungicide concentrations and always highest in the untreated control. Emergence success of C. villosa significantly decreased with increasing fungicide concentration from >90% in the untreated controls to 50% in the highest fungicide treatment at maximum food availability. Minimum food availability fungicides increased fungicide effects. Significant effects occurred at concentrations a factor of 20 to 200 below the EC50EC50EC50 after 28d 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.

TUPC04 Mitigation of fungicide exposure of stream ecosystems within agricultural catchments. M. Bundschuh, Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; R. Schulz, University of Koblenz-Landau / Institute for Environmental Sciences. 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 or by leaching. To mitigate fungicide impact, a range of 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 run-off, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining run-off water and providing sites for adsorption as well as degradation. Under field conditions, however, the vegetation density and erosion rills undermine 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 time of the 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.

TUPC05 Towards a better exposure assessment of antifungal azoles. N. Creutz, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; M. Casado Hernandez, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Chemistry; B.J. Ferrari, Centre Ecotox EAWAGEPFL; S. Fischer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; Q. Fu, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Department of Environmental Chemistry; N. Munz, Eawag / Environmental Chemistry; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; S. Spycher, B. Spycher, Eawag Swiss Federal Institute of Aquatic Science and Technology; C. Stamm, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; A. Thili, Eawag / Department of Environmental Toxicology; J. Wittmer, Plattform Wasserqualität VSA to Eawag; J. Hollender, Eawag / Environmental Chemistry. 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

TUPC06 Is the EFSA effect assessment approach for fungicides sufficiently protective for aquatic ecosystems? M. Dam, CENES & New University of Lisbon, Lisbon; T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; A. Rico, IMDEA Water Institute / Aquatic Ecotoxicology. 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 microcosms/mesocosms 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.

TUPC07 Ecotoxicological 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) 91/414, 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 advice 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 a member of the regulatory authorities were available. Whereas EFSA identified data gaps, the European Commission decided to include Aureobasidium pullulans to Annex 1 without requiring any additional study. National decisions for the registration of the product varied, some authorities authorized the product without any limitations, whereas others 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 testing and risk assessment considerations for microbial active substances

E.A. McVey, J. Wassenberg, Ctg

For some types of biological pesticide active substances, the same testing schemes and methodologies as used for chemical active substances suffice. However, for others (for example, microbial active substances), the unique properties of the substances and resulting risk assessment questions result in the need for a different perspective on the appropriate testing guidelines and programs, as well as different considerations for the risk assessment assumptions and methodologies. Comparing and contrasting the risk assessment theories and available testing methods, it is clear that while some areas of the risk assessment can be translated between chemical and biological actives, the majority require unique and thoughtful innovations to address the risk assessment objectives. This is particularly well illustrated in the ecological risk assessment schemes for microbials, where testing should be performed under conditions such that both the (various) test organisms and also the microbial active are in an optimal environment. Unique and unknown mechanisms of action and toxicity may also present, and be dependent upon the exposure conditions. Similarly to chemical actives, exposure estimations with microbials are also highly dependent upon environmental conditions, however, microbial actives can be applied at much lower exposure levels than most chemical actives. Regardless of these obstacles, some logical and objective recommendations can be made, both regarding testing and risk assessment for microbial active substances. 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 utilized to advise appropriate and adequate testing for microbial active substances.

Human and environmental Risk assessment for microorganisms - to what extent?


Biopesticides are an excellent alternative to chemical pesticides, and there is continuously increasing interest with both industry and consumers. The Sustainable Use Directive (SUD; Dir. 2009/128/EC) strongly promotes a targeted use of 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 covers the scope of the data required above 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 that include microorganisms are accepted as in-line with the data requirements based on SANTE’s recent assessment carried out 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


Biopesticides are an excellent alternative to chemical pesticides, and there is an increasing demand in testing and evaluation of these products. This poster focuses on microbial pesticides based on bacteria, fungi, viruses or protozoans as their active substances. Possible adverse effects to non-target organisms (NOTO) are rather limited due to the narrow and specific host range of these microbial pest control agents. However, a complete risk assessment demands testing of NOTOs, when exposure and risk cannot be fully neglected. The assessment of microbial biocontrol agents (mBCA) and microbial biocontrol products (mBCP) is relatively new and approved testing methods are not yet available in the same extent as they are for chemical pesticides. Not only the toxicity, but also the potential pathogenicity/infectivity needs to be addressed. Currently, the data requirements for mBCAs and mBCPs are issue of Part B of the European regulations 283/2013 (mBCA) and 284/2013 (mBCP). Numerous data requirements listed in these annexes were transformed directly from requirements for chemical pesticides and often cannot be adapted to the biological properties of microbials. In order to address the data requirements in a feasible manner, the biological properties of the microorganism have to be taken into account, instead of strictly applying to current test guidelines. It is important to note, that testing is 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). Furthermore, organic components of the formulated product (i.e. yeast, starch) may lead to increased fungal growth in soil or test media. Additionally, the need to test at high concentration levels, leading to negative effects of particles (i.e. spores or co-formulants like kaolin) on the test organism which are not related to the active substance and are difficult to interpret. Differences between OECD and OCSP (former OPPTS) guidelines, and requirements of the analytical validation 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 mBCA and mBCP requirements.

Microbiological Quantiﬁcation Methods for MPCAs - Applicability to a Range of Microorganisms and Different Substances

M. Zetzmann, F. Klimmich; M. Zettmann, F. Kümich; C. Lang, Eurofins Agrosciences Ecoton GmbH / Aquatic Ecotoxicology

In the last decade the number of biopesticide registrations in the EU and US have steadily increased. In the EU biopesticides are regulated as plant protection products under 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 for 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/30309 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, microbiological methods need to be validated for each microorganism. Experimental data will be presented with focus on the applicability of microbial quantification methods considering different microorganisms and substances.

When ecotoxicology meets trophic ecology (PC)

Modelling bioaccumulation of persistent organic pollutants in Arctic food chains

R. Scherbert, Radboud University Nijmegen / Department of Environmental Science; A.M. Ragas, Radboud University / Department of Environmental Science; J.A. Hendriks, Radboud University Nijmegen / Department of Environmental Science

Persistent organic pollutants (POPs) are a group of chemicals with similar physical-chemical characteristics that are resistant to environmental degradation and biodegradation. Not only do these POPs bioaccumulate in the food chain, they are also known to cause adverse effects in fish, wildlife and humans. Although being banned in the previous century, many POPs are still present in high concentrations in Arctic areas, due to a combination of northward marine currents and their semi-volatile nature, high thermal stability and slow degradation turnover rates. As food webs in the Arctic are relatively simple, POP contamination may pose a great risk for animals at higher trophic levels, such as the polar bear (Ursus maritimus), hence the growing interest in studying bioaccumulation in the Arctic. Despite the large interest in bioaccumulation of Arctic food chains, the OMEGA model, as well as similar bioaccumulation models, are predominately validated on temperate food chains or relatively straightforward Arctic food webs. In the present study, we aim to model bioaccumulation of multiple persistent compounds in the Arctic encompassing multiple species, using the OMEGA (Optimal Modelling for Ecotoxicological Application) bioaccumulation model. In this study, we aim to validate the model on Arctic areas by using a binning approach to include multiple species, in which species of a similar trophic level were binned.

Distribution and Trophic Magnification of Dechloranes, HBOCs, PCBs, and Other Legacy POPs in the Maritime Antarctic Ecosystem

J. Kim, Korea Polar Research Institute / Division of polar Environment; Y. Choi, POSTECH Pohang University of Science and Technology; M. Barghi, POSTECH; J. Kim, J. Jung, Korea Polar Research Institute; Y. Chang, POSTECH Pohang University of Science and Technology

This study investigated distribution and trophic magnification of emerging persistent organic pollutants (POPs), including PCBs, HBCDs, Dechloranes, polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) in the maritime ecosystem in King George Island, Antarctica. The samples were collected in the Baton Peninsula in King George Island, Antarctica. From December 2013 to January, and included Antarctic coda, redfish, limpet, amphipods, leopard seal, Gentoo penguin, Chinstrap penguin, kelp gull, and south polar skua. PCNs, HBCDs, Dechloranes, DDTs, HCHs, Pentachlorobenzene (PCBz), Hexachlorobenzene (HCBz), Chlorodanes, PCBs were detected in all samples, and the levels were the detection rates for the legacy POPs were more than 90 %, but those of some new POP compounds were only 50%. The detected POP levels in this...
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 correlation with SI for aquatic and terrestrial food web models. TMF values showed different trends compared to the TMFs in whole sample model. The inclusion of migrating animal, 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 Dechlororanes, emerging contaminants, appeared not to enough TMF values. The insufficient detection rate of Dechlororanes, compexity 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.
T. Masse, Universite Savoie Mont Blanc; M. Perga, University of Lausanne / Faculty of Geosciences and Environment; N. Cottin, Universite Savoie Mont Blanc; S. Cachera, CISALB; C. Piot, E. Naffrechoux, Universite Savoie Mont Blanc.
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 d15N) and the influence of trophic 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
M.E. Loste, The Norwegian University of Science and Technology / Biology; N. Briels, Norwegian University of Science and Technology / Biology; I. Eulaers, University of Antwerp / Biology; T. Nygård, T.V. Johnsen, J.O. Bustnes, Norwegian Institute for Nature Research NINA; D. Herzeke, NILU - Norwegian Institute for Air Research / FRAM Centre Tromsø; G. Pom, G. Malavanan, University of Antwerp / Toxicological Center; A. Cavaci, University of Antwerp, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; B.M. Jenssen, Norwegian University of Science and Technology / Biology; V. Jaspers, Norwegian University of Science & Technology / Biology
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 potentially resulting in biomagnification of OHCs. The nestlings 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 contaminants are reduced. The age and increase in body mass when monitoring OHCs in nestlings. The aim of the present study was to investigate how differences between years, locations and dietary tracers can explain variation in OHC accumulation in plasma of WTE nestlings. Stable isotopes (SI) of nitrogen (d15N) and carbon (d13C) were applied as proxies for trophic level and dietary carbon source, respectively. In addition, we included the possible confounding effects of age and body mass on the contaminant variation. Samples were obtained in 2015 and 2016 from 70 WTE nestlings from two archipelagos in Norway, Smøla and Steigen. In total, 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polybrominated 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 ingested 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 year, suggesting that nestlings may not always share prey.

We hereby emphasize 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
A. Goutte, F. Alliot, EPHE / UMR Meteor, H. Budzinski, University of Bordeaux; M. Chevreuil, EPHE / UMR METIS 7619; R. Santos, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; P. Labadie, UMR CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC.
Trophiic magnification factors have been extensively assessed for persistant 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 trophiic 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)
WEPG01
Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure?
H. Littler, University of Exeter / Biosciences College of Life and Environmental Sciences; L.V. Laing, University of Exeter / Biological Sciences; R. Boreham, M. Griffiths, University of Exeter / Biosciences College of Life and Environmental Sciences; M. Trzadzel, University of Exeter / Biosciences; J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; G.C. Paull, University of Exeter; R. van Aerle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences.
Bisphenol A (BPA) is a commercially important 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 0-72hpf 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 (amh) was significantly downregulated only in fish receiving repeated exposures 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...
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 amth 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. Studies on stress 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 Viola tricolor, and these changes could be linked to gene pathways that are associated to those compounds, such as embryonic development and obesity. Subsequent analysis in two following generations lead to the conclusion that some regions were persistently changed. Concerning ionizing radiation, in F1 embryonic offspring from irradiated parents, many changes of DNA methylation were observed. These changes could be linked to effects that were found in the parental generation such as DNA damage. Follow up analysis in the second and the 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 transcriptional 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?  
N. Heremans, Belgaen Nuclear Research Centre (SCK-CEN) / Biosphere Impact Studies; S. Cakmak, SCK-CEN / Centre for Environmental Research GmbH; M. Van Hees, SCK-CEN / Centre for Environmental Radioactivity; R. Nauts, SCK-CEN  
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 non-exposed transgenerational setup. In these studies, 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 Brüssicaceae plants, Arachisholis 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 Arachisholis 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 Arachisholis 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 harvested for that evaluation, photosynthesis, carbon and oxygenative 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 radiation gradient present in the field but rather to 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  
S.E. Crawford, RWTH Aachen University / Institute for Environmental Research, Institute of Environmental Toxicology; D. Ouwerkerken, RWTH Aachen University / Department of Ecosystem Analysis; M. Hinderer, Technische Universität Darmstadt / Institute for Applied Geoscience; A. Schwabl, Technische Universität Braunschweig / Institute for Geosystems and Biodegradation; H. Hollert, RWTH Aachen University / Institute for Environmental Research  
This research will utilize environmental reconstruction methods along with palaeoecological, palaeontological, and palaeogenetic 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 toxicology 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 insights into the sensitivity and fitness of organisms in response to environmental contaminant exposures and the micro-evolutionary adaptations of genes that evolve in response to contaminant exposure. 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.

**WEPC05**  
Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations  
P. Inostroza, 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 UEFZ / 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 one single stressor in the environment, but rather to multiple human-derived threats working simultaneously. Environmental pollution can modify population genetic structure via ecological bottlenecking, or by altering the genetic composition of populations. 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 archves 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.

**WEPC06**  
Histone methylation as exposure biomarker of environmental chemicals  
D. Otter, RWTH Aachen University / Department of Ecosystem Analysis; H. Hollert, RWTH Aachen University / Institute for Environmental Research  
We have quantified and presented changes in histone post transcriptional modifications and gene expression, potenti...
What's your take on communication? Don't Panic! Reports on how to accurately communicating science and risk (PC)

WEPC07
Dangerous misconceptions - Consumers need help!
U. Klawakha, 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 preferentially 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 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 reformation on markets and safety aspects of nanomaterials in the EU market. In spite of this, there is a perception that there is insufficient information available in the public regarding the safety of nanomaterials. As a result, the European Commission entrusted ECHA with the creation, management, and maintenance of the European Union Observatory for Nanomaterials (EUON) [1] via a delegation agreement in December 2016[2]. The aim of the Observatory is “to give objective and reliable information on markets and safety aspects of nanomaterials in the EU market”. The presentatin will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments. In

WEPC09
Roadmap for the unknown
M. Luitwiler, M.H. Wagenma, Bioclear earth

The main environmental themes have been addressed in the last decades. Think about acidification, nutrients and bulk industrial chemicals for which environmental guideline values have been derived within legal frameworks. Changes are ongoing in the scale level at which environmental problems are regarded as well as the scale level of industrial production. In the past large volumes of bulk chemicals were produced, now and in the future lower volumes of more specialised compounds are and will be produced. That means that more and more compounds will enter the environment in low volumes. Also time-to-market of new developments and technologies decrease which leaves less time for a thorough risk assessment. Last but not least, techniques for measuring compounds are improving. More and more compounds can be measured in increasingly low concentration while the risks of these compounds in low concentrations are not known or just being studied. For the Province of Groningen en the Water Company Groningen there is the reason to develop a policy for emerging contaminants in the environment with the main question: What to do when emerging contaminants are found in soil or water. Bioclear earth has developed a roadmap for policy and/or actions by the province, municipalities, water company and water boards for emerging contaminants in the soil-water system. Our framework was: compounds and organisms that enter the environment or can be spread by human actions and that consequently have a negative effect on humans, nature or agriculture and for which no guideline values have been derived within the Soil Law, Water law (Water framework directive) and Drinking water decree. The first step in the roadmap is to determine if a compound or organism in the environment can cause an actual or large risk. If no risks are present, no further investigation is needed. In all other cases, the roadmap needs to be followed. In the presentation we will describe the process that has been followed to come to this roadmap as well as the background information. In the roadmap we describe the role of different stakeholders, including communication, enforcement, measurements to further prevent contamination or spread. In the presentation these roles will be further highlighted. Additionally we will organise a workshop regarding to discharge in January for province, municipalities, water boards, water company and RWS. The results of this workshop will also be highlighted.

WEPC10
EVOEKED: enhancing the value of climate data - translating risk and uncertainty utilizing a Living Labs approach
A. den Berg, Norwegian Geotechnical Institute / Environmental Technology; B. Kalsnes, Norwegian Geotechnical Institute / Natural Hazards; L. Van Well, M. Zetterlund, Swedish Geotechnical Institute; G. Ellen, R. van der Brugge, DELTARES; J. Khoerth, B. Vollstedt, Christian Albrechts University of Kiel

The impacts of climate change are broad and although much focus has been on disaster risk reduction and coastal management, climate change will also have consequences for environmental management where the transport of contaminants, organism acclimation and vulnerable communities will be important to consider for future human and ecological 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. 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-evaluation. The EVOEKED 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 scope 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 the perceptions of risk is a prerequisite for communicating risk. Thus, EVOEKED supports the development of the field of climate services to improve our capacity to manage climate-related risks.

WEPC11
Communicating monetary values of environmental impacts - case studies related to ISO DIS 14044
B. Steen, Chalmers University of Technology; K. Hallberg, AkzoNobel; P. Hanarp, Volvo Group; J. Lindberg, IVL Swedish Environmental Research Institute; E. Riese, Essity; M. Romare, IVL Swedish Environmental Research Institute; T
WEPC14 Improving transparency, consistency and efficiency of ecotoxicological textbook development through e-textbooks. Inspired by SETAC initiatives.

The development of new technologies has enhanced the use of fossil fuel is rather insensitive to how the valuation boundaries of impacts may vary in time, and objectives. ISO TC 207/SC1 has set up a technology, a picture of the acceptable use of the 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 alternative testing methods are frustrated by slower access to potentially lucrative markets. Beyond human welfare, environment due to a lack of data. On the other hand, the chemical industry is being agencies are being sub...
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

vitro cell- or genomics-based testing strategies (Waters and Fostel 2004). For more than a decade, these alternatives have been discussed and debated in a range of high profile forums (National Research Council 2007) as offering potential answers to the various challenges facing chemical risk assessment. However, the accepted regulatory approaches to determining the risk of chemicals in environmental toxicology have remained, for the most part, unaffected. This poster explores the role of SETAC in policy learning using primary survey data collected from participants in previous SETAC forums. We will summarize the instrumental and core policy beliefs concerning alternative testing methods of respondents and assess their self-reported policy learning experiences at SETAC. We will then consider the significance of SETAC as a professional forum through which policy actors learn and adapt to emerging challenges in regulatory science.

WEPC17
Biochar-mortar composites for construction materials
S. Ohl, T. Seis, University of Ulsan / Department of Civil and Environmental Engineering; Y. Soo, 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 electrical conductivity. Biochar mortar containing biochar mortars, benzene concentration in air was accordingly reduced, suggesting that biochar may be favorable to removing 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.

WEPC18
Complex Formation Trends of Ligand Binding toward In(III) and Ge(IV)
D. Wondrousch, 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. Dwinding resources and growing demand necessitate new recycling strategies and the reassessment of existing repositories in the light of newly developed technologies. In this context, QASAR methods can be utilized in the determination of chelating ligands designed for affinity toward strategic elements. Through this, novel ligand concepts can be rapidly assessed and synthesis can be prioritized toward 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 In(III) and Ge(IV) 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 In(III) and Ge(IV) is investigated in comparison to Fe(III), Cr(III), Cu(II), and Zn(II). 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 “Biohydrometallurgical Center for Strategic Elements” BHMZ (Nr. 0210205) is gratefully acknowledged.

WEPC19
Cellulose Nanofibers as building blocks for innovative materials for remediation
A. Fioratti, INSTM local unit / Politecnico di Milano / Department of Chemistry, Materials and Chemical Engineering G. Natta and INSTM 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. Grassi, 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 polyethyleneimine (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 pNO2-phenyl-urea units it is possible to obtain a material that can be employed for the heterogeneous and selective sensing of fluoride anions.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–1) from methanol solution. Interestingly, the presence of CA led to slower kinetic release in aqueous environments if compared with materials obtained without CA.7 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+, Cr3+ and Cu2+) and organic contaminants (e.g. dyes in bootstraps/mineral).8,9 It is known regarding the affects to obtained organisms (Avelelas et al. 2017; Martinis 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 (Isochrysis galbana), Nannochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii (Paracentrotus lividus). Acute and short-term chronic exposure tests followed standard or well described guidelines, with appropriate adaptions 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 was observed in bivalves and crustaceans. Water samples were collected in the 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. Yousef, 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. Fleece fabrics have 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 microfibres released. In the current study, we assess the release of microfibres 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 (140 cm x 90 cm) was prepared by overlapping the edges to prevent loss of fibres due to washout. For each test, a standard synthetic clothing program (110 rpm, 40°C) was run for 30 minutes. 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 filter was first washed to study release in new clothes, and then washed a second time to determine release after prolonged washing. 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 hose connecting the filters contained residual microfibres after washing; these were collected after each wash by cleaning the hoses manually. The pre-weighted 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.

WPEC22 Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)

F. Schwab, Adolphe Merkle Institute / Materials Science; M. Maceroni, Adolphe Merkle Institute / BioNanomaterials; A. Petri-Fink, B. Rothen-Rutishauser, Adolphe Merkle Institute / BioNanomaterials Group

Nano-agrochemicals promise higher efficiency than conventional pesticides, but much has to be learned about the gain of efficiency compared to conventional products, and the risk of directly applying such new types of yield enhancers on agricultural soil. Due to the relatively low acute toxicity and high natural abundance of silica nanoparticles (SiO\_2-NPs), they are highly attractive for benign-by-design strategies in agriculture. Here, we present initial results of experiments that are in the process of being conducted on a laboratory scale to compare the effects of SiO\_2-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO\_2-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substance for conventional pesticides, the broadband fungicide tebuconazole was tested. Seed germination and infection tests, and a plant growth test were conducted. The Si was quantified by inductively coupled plasma emission spectroscopy (ICP-OES). Beneficial effects of SiO\_2-NPs were found for the fungal infection and germination rates in alfalfa, while the growth rates in the seedlings transferred to and grown in soil remained largely unaffected. The results confirm the moderate protective effects of silica nanoparticles on plants that have been reported previously, likely linked to the release of orthosilicic acid (Si(OH)\_4) acting as a phytostimulating micrometeor. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops.

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

WPEC23 Environmental Footprint for pasta production - the PEF pasta pilot

L. 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, the 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 directly part of the Technical Secretariat. The proponents of the pilot for pasta decided to be the main proponents of the EU pilot on PEF for pasta production. Furthermore, the 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.

During the PEF pilot, an average impact value, representative of the category of dried pasta has been obtained to allow the environmental performance comparison among different products in the same category. This benchmark impact highlighted the process hotspots as cereals cultivation, pasta production and cooking phase. All advanced rules and hypotheses in the PEFCR document have been established in order to allow 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.

WPEC25 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 food and 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 little 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.

WPEC26 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. 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 increased Algal Oil risks as low fruit, vegetable, nut and seed, or omega-3 intake and high red meat or processed meat intake. The relationship between the environmental impacts from producing foods classified in the dietary risk factor categories are compared to the health impacts associated with consuming these foods. From this investigation, we can estimate the magnitude of the health benefits associated with additional food production, as is shown in the example of whole grain consumption. 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.

WEPC27
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 Sustainably Development (WBCSD); D. Pollard, Nestlé; K. Cooper, A. Cairns, World Business Council for Sustainably Development (WBCSD); X. Bengoa, S. Humbert, M. Vargas Gonzalez, A. Ernstoff, 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) quantities, however halving food waste by 2030. Decision-makers, thus may prioritize FLW mitigation based on quantity, economical gain, and ease of implementation. To support multi-criteria sustainability decision-making we develop a framework and perform a global screening to prioritise 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.

WEPC28
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. Coloné, 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. Miquel, 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.
Human health.

Endocrine disruption.

Herbicides.

Metabolism.

Mixture toxicity.

Monitoring.
Multimedia.

Policy analysis.

Regulation.

Natural resource damage.

Nutrients.

Partitioning.
Sediment. 

Soil. 

Roadway. 

Risk management. 

Sustainability. 

Toxicity.
Uncertainty.

Urban.

Waste water.

Water quality.

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