Comparing chemical analysis with literature studies to identify micropollutants to be treated or upstream source controlled in a catchment of Copenhagen (DK)

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and biochemical responses. For example, a number of highly replicated fish-life cycle and multi-generational tests have examined growth, development, and biochemical responses in combination with biomarker endpoints such as vitellogenin, GSI, and gonadal histology. Analyses of sperm quality, gonad development, VTG, genomic markers, and biochemical responses have shown that oestrogens can affect a wide variety of endpoints in fish, including growth, development, and reproduction.

RA23P - Wastewater effluent discharges: characteristic and understanding potential risks in receiving waters

TH303
Risk assessment of WWTPs water effluents using fuzzy logic
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This paper presents a new methodology to assess the risk of water effluents based on fuzzy logic, a very well-known theory to treat uncertainty and vagueness, especially in the environmental field where data may not always be fully available. The method has been tested using the effluent's pollution data coming from 22 wastewater treatment plants (WWTPs) located in Catalonia (NE Spain).

The driving force to develop this study has been the increasing need of prioritizing pollutants appointed by different water regulations such as the Regulation 166/2006 [1] concerning the establishment of a European Pollutant Release and Transfer Register. It aims at establishing a Community level register of integrated pollutant release and transfer (IPR) or E-PRTR, its applicability to certain types of manufacturing and production facilities, among them wastewater treatment plants (WWTPs) with a capacity of more than 100,000 equivalent inhabitants. Data gathered under the E-PRTR regulation provide a valuable source of information regarding the emission of pollutants to air, water and waste from the assessed installations.

The Catalan Water Agency (ACA) conducted three different campaigns with this purpose in 2008, 2009 and 2010. A total of 41 micropollutants belonging to different families (e.g., heavy metals, volatile organochlorine compounds (VOX), Polycyclic Aromatic Hydrocarbons (PAHs)), were analysed in the sampling campaigns and their potential risk for the environment and human health was assessed using the here presented methodology. Appropriate referenced analytical methods were used to obtain concentration levels of these pollutants.

In order to ensure the appropriateness and consistency of this new method, the results have been compared with a well-trusted method used for chemicals prioritization, the COMMPS methodology, obtaining more conservative results with the first one due to the inclusion of persistence and variable's weight and the consideration of uncertainty. However, the behaviour of the two models is quite similar, fact that gives consistency to the fuzzy logic model.

TH304
Simultaneous assessment of biodegradation of cationic surfactants in activated sludge reactors (OECD 303)
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The Continuously-fed Activated Sludge (CAS) test is suitable to predict the removal of organic compounds from wastewater in activated sludge plants. However, a method to distinguish between removal by adsorption and biodegradation is not provided in the Guidelines. Accurate knowledge on the relative role of the different mechanisms in the overall operating parameters i.e. hydraulic retention time (HRT) and sludge retention time (SRT) is strictly maintained during operation of a CAS unit.

The following equation expresses the maximum concentration in air of surfactant adsorbed on the sludge and the measured surfactant concentrations in the mixed liquid suspended solids allow calculation of biodegradation percentages.

\[ C_{\text{SS, max}} = \frac{C_{\text{air, max}} \times \text{HRT}}{C_{\text{air, max}} \times \text{HRT} + C_{\text{SS, effluent}}} \] (Bio)degradation was assumed not to occur. This maximum concentration of surfactant absorbed on the sludge and the measured surfactant concentrations in the mixed liquid suspended solids allow calculation of biodegradation percentages.

The removal of five cationic surfactants was examined: the surfactant concentration in air of surfactant adsorbed on the sludge was determined from a mass balance for the CAS unit.

TH305
Predictive modelling of steroid oestrogens in sewage effluent demonstrates the potential for endocrine disruptive effects in wild fish populations in South Australia
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Endocrine disruption (ED) has been observed in wild fish populations worldwide and is particularly well characterised in the UK, where the presence of oestrogens in the main female species (sea trout) has been associated with reduced survival of female salmon. The phenomenon has been linked to sewage effluent containing the natural oestrogens 17α-oestradiol (E2) and oestrone (E1) as well as the pharmaceutical 17α-ethinylestradiol (EE2) originating from human excretion. In contrast, little is known about the presence and effects of these chemicals in Australia, where there is a greater strain on water resources. Oestrogens have been measured in sewage effluents at levels comparable with the UK and there is some evidence of ED effects in fish downstream of sewage treatment works (STW's).

It is therefore advisable to determine the potential levels of oestrogens entering Australian rivers and to assess the risk to wild fish populations. This study demonstrates the first use of predictive modelling of oestrogens in Australian STW effluent, creating predicted environmental concentrations (PECs) for a set of STWs in South Australia and comparing them to the UK using a modified version of a model previously for risk assessment in both Europe and Japan. The PECs were calculated into an E2 equivalent concentration (EEQ) and were corroborated against measured concentrations from one UK and one Australian STW to determine their accuracy. These were then compared with the UK Environment Agency's predicted no-effect concentration (PNEC) of 1ng/L E2. Predictive modelling was shown to provide a good method for first tier assessment, over estimating the measured EEQ by an average factor of 1.4 when corroborated with the more robust UK STW data, however the effluent EEQ PEC's for all STW's were 3-3.1 times higher than the 1ng/L PNEC. The model demonstrated that although Australian STW's are a lower population, their EEQ's are not significantly different to the UK's, which is likely to be due to the lower flow through Australian STW's which lowers the dilution factor. The results predict that effluents discharged in both the UK and Australia both contain oestrogens at concentrations exceeding the Environment Agency PNEC, suggesting that without sufficient dilution in rivers there is a risk of ED effects occurring in wild fish.

TH306
Inputs of pollutants by urban wet and dry weather pollution in combined sewer systems: pau urban catchment (CDAPP, France)
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1, G. Bareille1, T. Pigot1, I. Le Hecho1, A. Lecomte1

TH307
Demography, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two

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French catchments

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Presence of wastewater discharges is monitored by numerous studies. Although important research work is conducted on wastewater treatment plant (WWTP) performances, less is known on the contaminants sources. In fact, this information coupled with the knowledge of treatment efficiency could be very useful to manage WWTPs. In this perspective, the objectives of this work were to assess if pharmaceutical concentrations in wastewaters could be explained by urban parameters in two urban catchments to compare their treatment performance.

Only 40 km separate both catchments, which have similar population density and distribution. However, catchment A has a higher number of inhabitants, health equipments and economic activities. Both WWTPs use the same technology (membrane bioreactor) to treat urban wastewater, but have different inflows (catchment A 10 times higher than B). Influent and effluents streams were monitored during 3 campaigns over 3 days with 24 hours composite samples. Pharmaceuticals and hormones were analyzed using LC-MS-MS. Results are shown for 632 studied compounds: acetaminophen (ACT), diclofenac (DIC), carbamazepine (CBZ), sulfamethoxazole (SMZ), isopropil (IMP) and 17-estradiol (E2).

Fluxes were 3 times higher in WWTP-A for ACT, E2, SMZ and DIC, 80 times higher for CBZ and 1350 times higher for IMP. The differences for CBZ and IMP were not only explained by the cities sizes but also by the presence of more potential sources in catchment A than B. Concentrations of DIC, SMZ and E2 were similar in both WWTPs. CBZ and IMP were respectively 10 and 183 times higher in WWTP-A. In contrast, ACT was 2 times higher in WWTP-B. Those concentrations could be explained by a dilution effect due to the higher discharge in WWTP-A. Moreover, in both WWTPs, CBZ and DIC were respectively 6-42% lower than their respective influents. In contrast, IMP, ACT and E2 showed higher elimination between 76% and 99% in both WWTPs, Therefore, removal efficiencies SMZ was quite stable in WWTP-A (74% to 85 %) and greatly varied in WWTP-B (0% to 96%).

Results showed the presence of potential pharmaceuticals sources: some were strongly suspected, others needed further investigation. The potential environmental impact of WWTPs on the two catchments could be different. Further studies are needed to investigate this aspect and to validate the approach proposed in this work.

TH 308 Wastewater effluents and river sources: sources of organic micropollutants to NW Mediterranean coastal waters. Their characterization, fluxes and potential risks

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This study provides a first estimation on the risk associated with the inputs of organic micropollutants (OMPs) to coastal waters from NW Mediterranean Sea. Pollution sources are potential rather than confirmed wastewater discharges and river discharges. Organic micropollutants were characterized in effluents from two WWTPs (WWTP-A and WWTP-B) and in five rivers (A, B, C, D and E) as well as the Delta del Ebro estuary mouth. A total of 24 compounds were determined and 9 compounds were quantified. Concentrations of diclofenac, carbamazepine, sulphamethoxazole, and metformin were higher in WWTP-A than in WWTP-B. Both WWTPs use the same technology and inflows. However, WWTP-A had higher concentrations and fluxes for diclofenac, carbamazepine and sulphamethoxazole. In contrast, fluoxetine, alfuzosin, flurbiprofen and ibuprofen showed higher elimination in WWTP-B. In conclusion, WWTP-A is a more important source of OMPs to the NW Mediterranean Sea than WWTP-B, due to its higher effluent discharge, higher concentrations and longer retention time. The potential risk associated with OMPs to NW Mediterranean Sea was calculated using a first assessment methodology, and was demonstrated to be higher in WWTP-A. However, further studies are needed to determine the long-term effects of OMPs on coastal marine organisms.

TH 309 Chemical characterization and treatment by enhanced coagulation of dissolved organic material in biochemical-treated effluent of textile wastewater

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This study attempts to develop a methodology to predict the fluxes of compounds entering the WWTP based on urban characteristics to define suitable technologies for the best treatment efficiency. This study also attempted to characterize the wastewater and effluents from a textile wastewater treatment plant, and to determine the removal efficiencies of organic micropollutants (OMPs) from the textile wastewater by enhanced coagulation treatment process. The textile wastewater treatment plant is located in the city of Xi’an, Shaanxi Province, China. The textile wastewater effluent was treated by enhanced coagulation combined with flocculation and sedimentation processes. The effluent was characterized by passive sampling using polycarbonate filters (PCFs). The results showed that the textile wastewater effluent mainly contained hydrophilic organic matters: 1,4-dioxane, carboxymethyl cellulose, polychlorinated biphenyls, polychlorinated dibenzofurans, and polychlorinated dibenzo-p-dioxins. These organic micropollutants were highly eliminated by the enhanced coagulation treatment process. The removal efficiencies of OMPs were quite stable in the textile wastewater treatment plant. The fluxes were higher in WWTP-A for fluoxetine, alfuzosin, flurbiprofen and ibuprofen. The differences for fluoxetine and ibuprofen were explained by the cities size. The differences for alfuzosin and flurbiprofen were explained by the presence of more potential sources in catchment A than B. Concentrations of diclofenac, carbamazepine, and sulphamethoxazole were similar in both WWTPs. The potential environmental impact of WWTPs on the two catchments could be different. Further studies are needed to investigate this aspect and to validate the approach proposed in this work.

TH 310 Emerging substances in aquatic phase of landfill leachate

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Alkylphenols, bisphenol A and phthalates were the main contributors to OMP in coastal areas from 7.4 to 8442 ng L-1. A summarized overview of the patterns and sources of OMPs contamination on the investigated coastal sea waters of NW Mediterranean Sea, as well as of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment for removal of interferences and non-stationary variables. The potential risk associated with OMPs was assessed by the potential ecological risk index. OMPs are potential pollutants as the risk associated with the inputs of OMPs to coastal waters from NW Mediterranean Sea, as well as of their geographical distribution was obtained. The potential risk associated with the inputs of OMPs to coastal waters from NW Mediterranean Sea, as well as of their geographical distribution was obtained. The potential risk associated with the inputs of OMPs to coastal waters from NW Mediterranean Sea, as well as of their geographical distribution was obtained. The potential risk associated with the inputs of OMPs to coastal waters from NW Mediterranean Sea, as well as of their geographical distribution was obtained. The potential risk associated with the inputs of OMPs to coastal waters from NW Mediterranean Sea, as well as of their geographical distribution was obtained.
two locations. This was largely caused by a small number of pesticides with very low PNEC values being present at this location. Although not significant, all three wetlands seem to be more efficient in biologically vitalizing the effluent.

The main aim of the present study was to generate preliminary results on the evaluation of C. fluminea bioremediation potential in the treatment of several effluents from industrial and commercial interest. This study is part of a broader assessment that considers a battery of wastewater effluents such as acid mine drainage, and pulp and paper mill effluents. The toxicity of the initial clam-feeding solution and the post-filtration effluent to non target organisms (the bacteria Vibrio fischeri, the microalgae Pseudokirchneriella subcapitata and the cladoceran Daphnia sp.) was assessed through laboratory bioassays. These bioassays were supported by the analytical characterization of the exposure media before and after the clam filtration. Although the Asian clam is an invasive species and problems may arise from the intentional introduction in the discharge environments, controlled systems that allow us to capitalise on their filtration and bioaccumulation capacities may be assembled. Such a wastewater treatment method could bring huge benefits (e.g. output improvement and costs reduction) in the industrial context.

TH 316
Acute toxicity analysis of urban septic tank sludge
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The objective of this work was to evaluate possible toxic effects of sludge samples from urban septic tanks and upflow anaerobic sludge blanket (UASB) from a wastewater treatment plant located in the University of Espirito Santo, in Vitória, Brazil. The method employed was the acute toxicity test Microtox (Azur Environmental) based on the luminescence inhibition of the marine photobacterium Vibrio fischeri. It is a test with many advantages such as ecological relevance, sensitivity, reproducibility, standardization and simple execution. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater 20th (APHA - 1998). Sludge from four septic tanks was used in the study. From each tank four samples were collected, each aliquot representing a distinct depth, classified as: 1. surface liquid; 2. superficial sludge; 3. bottom sludge and 4. mixture from all the previous. From the UASB equivalent fractions were also sampled. The tests were executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified in the three layers: "scum" and "liquid waste". All samples from the bottom fractions presented toxic effects (EC50= 9.4%) when compared to the fractions above. The average EC50 for fraction 3 was 12.6% and 17% for the mixture, meaning even lower toxicity, possibly due to the influence of upper fractions that are stored in great volumes inside the tanks. The sludge from UASB presented higher toxic effects on topside (EC50= 5.5%) in comparison to the bottom (EC50= 8%), but lower toxicity when compared to tanks samples, since it was analyzed in a dilution of 50 parts in 200, while septic tank samples were diluted in one part in 200. All samples presented elevated levels of TKN, P and COD and were considered as stabilized sludge, since the relation SVFA/VS (volatile solids/total solids) was below 65%. Although many studies have applied the Vibrio fischeri test to a range of environmental samples, the analysis of sludge from septic tank represents a new approach, essential to evaluate the risk of releasing this residue in the environment or even ensure the quality required for its application in other activities.

TH 317
Comparing chemical analysis with literature studies to identify micropollutants to be treated or upstream source controlled in a catchment of Copenhagen (DK)
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The European Water Framework Directive aims at obtaining good ecological and chemical status of European water bodies by the year 2015 (EU, 2000). The directive also requires source inventories to design and perform monitoring programs as well as to outline strategies to reduce emissions if the environmental quality standards are exceeded (EU, 2008). The aim of this study was to compare two different approaches to identify micropollutants in stormwater from a specified catchment; a literature inventory of potential pollution sources and chemical analysis of urban stormwater runoff. The selected catchment covers an area with roads, a shopping centre, a parking lot, office buildings, an upper secondary school and restaurants in Copenhagen (Denmark). The literature approach is limited to the range of included micropollutants and to how and which information is compiled, whereas the analytical chemical approach is limited to and affected by the sampling procedure, the selection of analysed
Monitoring potential ecotoxicological effects in the effluent of an urban wastewater treatment plant

A.E. Goebeler1, M. Hader1, C. Bühler2

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Organic micropollutants cannot be completely removed by traditional wastewater treatment technologies. Therefore it is being discussed to add additional treatment steps such as ozonation, active coal filtration, UV-treatment etc. However, there is a lack of long-term studies to clearly prove a direct relationship between micropollutants in waste water and ecotoxicological effects on the macrozoobenthos fauna in the recipient stream to justify future expensive installations. Online biomonitoring of the ecotoxicity of waste water just before release into the river Limmat. Short term responses to episodic pollution pulses as well as long-term effects of the potentially toxic cocktail of the waste water were monitored on real-time basis over several weeks. Different species of gammarids were applied (D. villulus, G. pulex) and their sensitivity compared. These studies establish the baseline toxicity of the waste water in its current treatment before additional treatment steps might be installed in the future or in order to record the decrease of baseline toxicity. On the other hand, if during long-term monitoring with gammarids no toxic effects can be seen, combined with sporadic in situ benthos assessment, the need of additional treatment steps should be reevaluated on a case-by-case basis for each waste water treatment plant and its recipient river ecosystem.
In last decade, there has been growing public concern of potential contamination of water and environment with anthropogenic compounds and their degradation products and possible negative influence to the nature and public health. As a response to this fact, there is an increased interest in more efficient screening techniques of larger number of emerging contaminants compared to traditionally carried out by triple quadrupole mass spectrometry. However, to ensure that these approaches are capable of indicating potential environmental effects, it is important to test scientifically robust WEA protocols. In general, WEA methodology assesses toxicity to aquatic organisms. WEA has relevance for the protection of ecosystems although the relevance and interpretation of results ultimately depends on the tests used. In the context of the Water Framework Directive (WFD), European surface water should reach good ecological and chemical status in 2015. The ecological status is generally determined by the results of short term and chronic bioassays with the bacteria Vibrio fischeri, the alga Pseudokirchneriella subcapitata, the rotifer Brachionus calyciflorus and the microcrustacea Daphnia magna. Moreover, a yeast estrogen screen (YES) assay was conducted as an assessment tool to detect the presence of endocrine disrupting compounds. During 2011, 14 major industrial discharges and 26 sampling points in the receiving waters (upstream and downstream of the effluent) were monitored. The effluents were sampled 6 times a year whereas receiving waters were sampled 4 times a year. Priority List substances of the WFD and other pollutants discharged in significant quantities were also measured. More detailed studies were carried out with complementary tools: upstream and downstream of a discharge of a metallurgical industry, bioassays were conducted on both water samples and sediments and bioaccumulation of metals was assessed using encaged bryophytes; upstream and downstream of a pharmaceutical industry, YES assay was conducted as potential assay tools in combination with passive samplers (POCIS). The results of these monitoring show that bioassays are good diagnostic tools to determine the causes of poor ecological quality and to trace back to the source of contamination. They are an important “tool in the toolbox” for environmental management. They add value and provide complementary information to that supplied by the chemical and ecological community measures and could help to design appropriate management measures.

Combination effects of pharmaceuticals and industrial chemicals in waste water effluents
T.V. Jufferden, D.G. Gildemeister
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We will present our currently starting research activities in testing combination effects of pharmaceuticals and industrial chemicals known for their (co-)occurrence in WWTP effluents. Mixtures of industrial chemicals and human pharmaceuticals can be found in surface waters as so called micropollutants. Effluents of waste water treatment plants (WWTP) are the main exposure route for both kinds of substances. The emission of these chemicals into WWTP originates from consumer usage of products, articles and drugs. It is commonly known from literature and discussed in different scientific and regulatory communities that effects of chemical mixtures are significantly larger than single substance effects. At the moment neither in the environmental risk assessment of chemicals (REACH) nor in human pharmaceuticals (EMEA/CHMP/SWP/4447/00) possible combination effects in the environment is considered. But taking into account realistic exposure scenarios we assume that combination effects are the rule and not the exemption. Consequently an underestimation of environmental risks is likely.

In this presentation the design of the three steps of this project will be presented and discussed.

Bioassays offer an opportunity for a more holistic and meaningful way of assessing effects of environmental samples and wastes on ecosystems than what is possible by using chemical-based monitoring alone. They can provide predictions of environmental impacts whereas ecological community measures only determine impacts after they have occurred. Therefore, bioassays are useful in helping to implement the Water Framework Directive (WFD). In Wallonia (Belgium), an effect directed active monitoring using bioassays is being carried out for many years. It includes both, toxicological measurements at emission and admission and physico-chemical measurements. We use a battery of short-term and chronic bioassays with the bacteria Vibrio fischeri, the alga Pseudokirchneriella subcapitata, the rotifer Brachionus calyciflorus and the microcrustacea Daphnia magna. Moreover, a yeast estrogen screen (YES) assay was conducted as an assessment tool to detect the presence of endocrine disrupting compounds. During 2011, 14 major industrial discharges and 26 sampling points in the receiving waters (upstream and downstream of the effluent) were monitored. The effluents were sampled 6 times a year whereas receiving waters were sampled 4 times a year. Priority List substances of the WFD and other pollutants discharged in significant quantities were also measured. More detailed studies were carried out with complementary tools: upstream and downstream of a discharge of a metallurgical industry, bioassays were conducted on both water samples and sediments and bioaccumulation of metals was assessed using encaged bryophytes; upstream and downstream of a pharmaceutical industry, YES assay was conducted as potential assay tools in combination with passive samplers (POCIS). The results of these monitoring show that bioassays are good diagnostic tools to determine the causes of poor ecological quality and to trace back to the source of contamination. They are an important “tool in the toolbox” for environmental management. They add value and provide complementary information to that supplied by the chemical and ecological community measures and could help to design appropriate management measures.

Illicit drugs as emerging pollutants in surface waters: acute toxicity test
Ocean Research Environment Innovation, Châtenay-Malabry, France
University Paris Sud / CNRS UMR 8079, Châtenay-Malabry, France
Univ. Paris Sud / CNRS UMR 8079, Châtenay-Malabry, France
Today, illicit drugs are considered as emerging pollutants and several studies have been carried out to evaluate their concentrations in sewage waters and in effluent from WWTPs. Most of these compounds are not completely removed during treatment and are found in surface water at concentration around ten ng/L. Thus, it appears important to determine the ecotoxicological impact of illicit drugs. In order to develop this knowledge, we carried out acute toxicity tests according to ISO11348. Four illicit drug families have been tested: cocaine, heroin, amphetamine-like and cannabinoids. In a first time, compounds were spiked alone in tap water. Then, they were studied alone or associated in sewage water. Results will be presented and discussed according to the environmental concentrations of these compounds.

Ecotoxicological characterisation of climbazole, an anti-dandruff agent contained in shampoo

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Whole effluent assessment as an alternative to in situ ecological impact measurement? An experimental approach
Y. Calleaud, A. Bassières, B. Baldoni-Andrey, K. Den Haan, W. P. Wrona
TOTAL Petrochemicals France, Laqc, France
CONCAWE, Brussels, Belgium
Shell, Thornton, United Kingdom
There is increasing recognition by regulators that there is a substance-specific approach for assessing and controlling the environmental fate and effects of effluents of many regulatory agencies are seeking more holistic techniques such as whole effluent toxicology (WET) to supplement existing approaches. However, to ensure that these approaches are capable of indicating potential environmental effects, it is important to test scientifically robust WEA protocols. In general, WEA methodology assesses toxicity to aquatic organisms. WEA has relevance for the protection of ecosystems although the relevance and interpretation of results ultimately depends on the tests used. In the context of the Water Framework Directive (WFD), European surface water should reach good ecological and chemical status in 2015. The ecological status is generally assessed with ecological indicators. In some particular cases (sampling difficulties because of access, type of substrate, several industrial waste in the area[3D0TS]), this approach is difficult to be applied. In this case, WEA methodology might represent an alternative to ecological indicators.

The main objective of this project presented in this paper is to improve the methodology of the WFD in Europe. In Wallonia, Belgium, a project directed active monitoring using bioassays is being carried out for many years. It includes both, toxicological measurements at emission and admission and physico-chemical measurements. We use a battery of short-term and chronic bioassays with the bacteria Vibrio fischeri, the alga Pseudokirchneriella subcapitata, the rotifer Brachionus calyciflorus and the microcrustacea Daphnia magna. Moreover, a yeast estrogen screen (YES) assay was conducted as an assessment tool to detect the presence of endocrine disrupting compounds. During 2011, 14 major industrial discharges and 26 sampling points in the receiving waters (upstream and downstream of the effluent) were monitored. The effluents were sampled 6 times a year whereas receiving waters were sampled 4 times a year. Priority List substances of the WFD and other pollutants discharged in significant quantities were also measured. More detailed studies were carried out with complementary tools: upstream and downstream of a discharge of a metallurgical industry, bioassays were conducted on both water samples and sediments and bioaccumulation of metals was assessed using encaged bryophytes; upstream and downstream of a pharmaceutical industry, YES assay was conducted as potential assay tools in combination with passive samplers (POCIS). The results of these monitoring show that bioassays are good diagnostic tools to determine the causes of poor ecological quality and to trace back to the source of contamination. They are an important “tool in the toolbox” for environmental management. They add value and provide complementary information to that supplied by the chemical and ecological community measures and could help to design appropriate management measures.

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T.V. Jufferdenholz, D.G. Gildemeister
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The study focuses on the question if combination effects of pollutants in WWTP effluents require further assessment. Therefore ecotoxicity tests with algae and daphnids for 6 environmentally relevant substances shall be conducted individually and in different combinations respectively. These substances, (i.e. nonylphenol and ibuprofen) are known to have synergistic effects. At the moment neither in the environmental risk assessment of chemicals (REACH) nor in human pharmaceuticals (EMEA/CHMP/SWP/4447/00) possible combination effects in the environment is considered. But taking into account realistic exposure scenarios we assume that combination effects are the rule and not the exemption. Consequently an underestimation of environmental risks is likely.

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Both approach and selected battery of bioassays were relevant and allowed the classification of the different dishwasher detergents. Mostly, it was shown that humic or fulvic acids. The DOC in effluents will, therefore, almost certainly interact with metals in a different manner to that predicted by BLMs, and so provide greater protection against toxic effects of metals. About 50% of effluent DOC has been shown to be relatively quickly degraded and therefore not likely to be algae, bacteria, daphnia and higher life forms were observed. At the present Rifaximin, Piperracilline, Doripenem as well as the current reserve-antibiotics Tigecycline, Linezolid and Daptomycin are not classified as relevant to the environment because of their minor application. However, environmental data for these substances are missing, as well as future schemes of use. Nowadays most environmental sciences are focusing on elderly frequently prescribed substances. As a result assessment lags behind the modern pharmacotherapy and the achievements of the pharmacology. Our objective is to study potential effects on the environment of above antibiotics. Ecotoxicological testing is performed in standardised bioassays using 24- and 96-well microplates for algae and bacterial growth inhibition tests. Ecotoxicological testing with algae growth inhibition test of new antibiotics showed increasing toxicity for Daptomycin and Tigecycline with EC₅₀ values of 14.4 mg/L and 1.76 mg/L. There is no toxic effect for Doripenem and Linezolid at maximum test concentration (EC₅₀ > 100 mg/L).

Estimating PEC/PNEC-relations of these new substances has to take into consideration the increasing health, change in demographics as well as biodegradability, compartment-distribution-tendencies and additional waste-water treatment techniques e.g. ultraviolet light, ozone and membrane filtration.

TH 331
Comparative study of the ecotoxicity of dishwasher detergents
P. Pandard,¹, Manier,², G. Gondelle,³, O. Perceval⁴
¹INRAE, Vincennes, France ²ONEMA, Vincennes, France

This study aimed at assessing the ecotoxicity of dishwasher detergents. Indeed, despite the high consumption of such products, available information regarding their environmental impact and toxicity is limited. Thus, two types of dishwasher products available on the French market were selected: the majority used for household detergents and the different dishwasher detergent categories: “multibenefit” tablets, “classical” products (tablets and powder) and “gel” (both “classical” products and “gel” need the use of rinse aid).

Our approach was taken into account the ecotoxicity of solutions simulating a wash cycle in a dishwasher in typical use conditions, as recommended by the manufacturer. The “washing solutions” were selected by choosing solutions by performance of two trophic levels (algae and micro-invertebrates) covering both acute and chronic endpoints. Another study was performed to assess the ecotoxicity of the two different dishwasher detergents. Mostly, it was shown that the reproduction of D. cymba was the most sensitive endpoint compared with the inhibition of the mobility of D. magna and the growth of the algae P. subcapitata. The “washing solutions” prepared with hard dishwashing detergents were found to be more toxic than those prepared with dishwashers detergents, except for the gel products. Regarding the latter products, both products were relevant and allowed the classification of the different dishwasher detergents. Consequently, it was shown that the ecotoxicity of “washing solutions” from the “gel” products was higher than the ecotoxicity recorded for “classical” products and “multibenefit” tablets. This study also revealed that the ecotoxicity of “classical” tablets was, most of the time, higher than the ecotoxicity of “multibenefit” tablets. Additional studies confirmed that the ecotoxicity recorded for “classical” products was mostly due to the addition of rinse aid in the “washing solution”. These results suggested that the ecotoxicity recorded for ecolabelled products should be weighted regarding to the intrinsic ecotoxicity of the rinse aids which are currently not covered by “European Ecolabel”.

TH 332
Characterisation of dissolved organic carbon in effluents and the assessment of its overall benefits in mitigating environmental impacts from metals
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Dissolved organic carbon (DOC) is known to form complexes with metals which can markedly reduce the free concentration of the metal and mitigate toxicity. Biotic Ligand Models (BLMs) for metals include speciation calculations of DOC with the metal ions, with increasing DOC concentrations usually providing a significant reduction in the availability of the metal. BLMs assume a composition for the DOC in terms of the ratio of humic and fulvic acids. These default DOC characteristics work well for natural waters with generally good agreement between predicted and observed no effect concentrations. Sewage effluent contains high concentrations of DOC but a significant fraction of this organic matter will occur as dissolved organic carbon, thus supporting the precipitation and the risk assessment of chemical concern, especially for metals which may bind metals more strongly than predicted by BLMs.

TH 334
Integrating sewage treatment plant monitoring and modelling to prioritise chemical of concern and assess environmental risks
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Organic chemicals released via sewage treatment plant (STP) prioritising pollutants of concern and assessing their risks for the aquatic ecosystem entail key scientific challenges for regulators. From the EU perspective, such challenges are common to the chemical legislation, (e.g. REACH regulation, Biodical Product Directives) and the water legislation (e.g. Urban Water Treatment and Water Framework Directives). In chemical risk assessment, the exposure of the aquatic ecosystem to organic chemicals released via STPs is calculated in two steps: first, local/regional sewage emissions to sewage are estimated from consumer use data; then, the fate in a generic STP is calculated using the multimedia box model SimpleTreat. Default calculations are based on conservative (worst-case) assumptions. In raw sewage were estimated from product usage and chemical inclusion levels. The distribution and elimination in a conventional activated sludge sewage treatment plant with primary and secondary sedimentation was calculated with SimpleTreat 3.11, from the physicochemical properties and the biodegradation rate derived from STP simulation tests (OECD 303A). Probabilistic model simulations were run to account for the uncertainty of model inputs and the variability of STP parameters across the EU. Calculated STP influent and effluent concentrations were in good agreement with measured concentrations collected from the literature and the probabilistic simulations captured, though not completely, the observed spread in observed values. Such modelling predictions can complement existing monitoring data and fill gaps for data-poor chemicals, thus supporting the prioritisation and the risk assessment of chemicals of concern. Moving from worst-case, default to more realistic, probabilistic exposure assessments facilitates the comparison of data generated and the harmonization of methods applied across regulations.
Therefore it is often unclear how to decide which study is “best” suited for a given case. As site-dependency or product specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data. This study compile the results of several studies of diesel production in European and American processing plants in terms of GHG emissions and energy consumption. Values of net removal by the algae) of the P and N respectively, considering the inflow concentrations of 1000 mg/L of P and 3000 mg/L of N. Disadvantages of this method by starvation of three days at each time to increase the removal efficiency of the system. It was observed that the algal beads remove approximately 50% and 40% (average values of net removal by the algae) of the P and N respectively, considering the inflow concentrations of 1000 mg/L of P and 3000 mg/L of N. Disadvantages of this method as indicated are the release of the microalgae out of the beads during the experiment and disintegration of the alginate beads over a long term run. References [1] Chang B.Y., Chou S.W., Y.A. Y. 9999, Microbial Dechlorination of Polychlorinated Biphenyls in Sewage Sludge. Chemosphere 39:45-54. [2] El-Hadjy T.B., Dosta J., Torres R., Mata-Alvarez J. 2007. PCB and AOX removal in mesophilic and thermophilic sewage sludge digestion. Biochemical Engineering Journal 36:281-287.

TH 336 Removal of nutrients by immobilized microalgal beads in a continuous flow system
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Using immobilized microalgae beads in contaminant removal is an emergent method in recent environmental studies. As is well known, phytoplanktons use nitrate (N) and ortho-phosphate (P) during the photosynthesis process for production. In this study, a diatom “Phaeodactylum tricornutum” was immobilized in 3.5% sodium alginate solution and hardened with 4% calcium chloride (cationsolution) and introduced into a continuous system to remove nitrate and ortho-phosphate. Daily samples were taken from the system and analysed by using UV-Vis spectrophotometer (Chebiox Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cell numbers in the beads were also determined by using a Coulter Counter system during the experimental period. The blank beads were also run in the system and subtracted from the total removal of the nutrients to detect the net removal by the algae. The system was operated as six separate runs with usage of the same algal beads by starvation of three days at each time to increase the removal efficiency of the system. It was observed that the algal beads remove approximately 50% and 40% (average values of net removal by the algae) of the P and N respectively, considering the inflow concentrations of 1000 mg/L of P and 3000 mg/L of N. Disadvantages of this method as indicated are the release of the microalgae out of the beads during the experiment and disintegration of the alginate beads over a long term run.

TH 339 Meta-analysis of diesel production in terms of life cycle GHG emissions and energy consumption: comparison and case study of Spanish refineries
D. Garranz, J. Herrera, C. Lago, Y. Lechón, R. Sazé
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When performing the life cycle assessment (LCA) of petroleum products, life cycle inventory data are generally global compilations and they are not partitioned into sub-processes, but are black boxes. Several products with different characteristics and uses are of different data origins, time and geographical background, technologies and system boundaries. The first experimental series was performed at low natural, i.e. not spiked concentration level of Elbe riverside grass and sludge samples at 27 °C for 315 days. This first, explorative experiment showed ambiguous results for the degradation of the 6 indicator PCBs (PCB No.: 28, 126, 119, 138, 180). Concentrations of the lower chlorinated PCB was the concentration of PCBs was found to be stable at 520 µg/kg dry weight sewage sludge. For the second experimental series 6 PCBs (No.: 28, 52, 101, 119, 138, 124), a technical mixture of PCBs (Aroclor 1260) and the pesticide Endrin were added in high concentration to the batch experiments (33 µg per compound, respectively 100 µg of Aroclor 1260). In this second experiment different initial weights of grass cut from the Elbe riverside were mixed with anaerobic sewage sludge to determine the degradation rates experimental times for these batches vary between 30 and 120 days. Compound concentrations were measured by GC-EC. Methane and carbon dioxide concentrations (measured by FTIR) in the gaseous phase of batch experiments were used as an indicator for biological activity. Results from the second batch experiment, concerning PCB-degradation rates and their correlation to gas production kinetics due to different dry masses, are discussed on the poster. Further, this study comprises the results of several studies of diesel production in European and American processing plants in terms of GHG emissions and energy consumption. Furthermore, this study is focused on recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as site-dependency, product specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCDB handbook recommendations for allocation procedures.

TH 340 Towards transparent and relevant use of energy use indicators in LCA studies of biofuels
R. Arvidsson, S. Zrenner, M. Frödigh, M. S. Molander
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The use of energy has led to resource crises during the history of mankind, such as the deforestation of the Mediterranean during antiquity, and of Great Britain before the 19th century, and the oil crisis in the 20th century and continuing. Considering this, the frequent use of the impact category ‘energy use’ in the environmental assessment tool life cycle assessment (LCA) is not surprising. However, in a previous study, some of the authors noted that the term ‘energy use’ was not applied in a transparent and consistent manner in LCA studies of biofuels. In life cycle assessment (LCA) studies of biofuels. In the examined reports and articles, the choice of indicator was seldom motivated or discussed and we observed five inherently different energy use indicators: (1) fossil energy, (2) secondary energy, (3) cumulative energy demand, (4) net energy balance, and (5) total extracted energy. These five energy use indicators were applied to the same cradle-to-gate production system of palm oil methyl ester (POME), giving considerably different output results. This is in itself not unexpected, but indicates the importance of clearly identifying, describing and motivating the choice of energy use indicator. All five indicators can all be useful in specific situations, depending on the goal and scope of the individual study, but the choice of indicators need to be better reported and motivated than what is generally done today. Authors of LCA studies should first define the purpose of their energy use indicator (fossil scarcity, energy scarcity, energy efficiency, cost/benefit comparison) and may then make a motivated choice of the energy use indicator.

TH 341 A meta analysis review: ‘Drop-in’ Biofuels - Life Cycle Assessments, substance flow analysis, material flow analysis and relevant information on an advanced biofuel
A.W.U.A. Borstse Aruye, A. Halog
University of Maine, Orono, United States of America
The biofuel production sector is an enjoying an unprecedented amount of public and private effort in order to reduce the green-house gas emissions and other environmental burdens. One of these very important challenges is the problem of the development of biofuels that are compatible with existing gasoline, jet fuel and diesel infrastructure. The United States Department of Energy has been championing efforts that ensure that the next generation of biofuels will be regarded as “drop-in” biofuels. According to the former Undersecretary of Energy, Elaine Chao, “drop-in” biofuels can be defined as fuels produced from various biomasses which are compatible with the over $9 trillion energy infrastructure and gas station infrastructure currently available in the United States. According to definitions used in reviewed literature, drop-in biofuels are defined by National Advanced Biofuel Consortium of the United States as infrastructure compatible-they can either be used directly or blended with their petroleum-derived counterparts. The European Commission on the other hand defines drop-in biofuels on the basis of quality specifications (standards) developed by the American Society for Testing and Materials. Numerous LCA works have been conducted concerning what is described as drop-in biofuels. Although this topic of drop-in biofuels is relatively new, literatures regarding LCA studies of drop-in biofuels are based on the definition of biofuel provided for availability. A comprehensive review and analysis of the previously conducted LCA studies in this new field of advanced biofuels. Also, important topics concerning this new chapter in the biofuels revolution were delved into. The results of this meta analysis review will be presented at the SETAC world congress.

TH 342 How to assess the data quality of LCI studies - a systematic approach
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The field of energy from biomass is becoming more growing, increasing the need for reliable data on the environmental burdens inflicted by the use of the different conversion technologies. A huge number of LCI studies on these topics can be found but, most of these studies are not directly comparable to each other and their results may vary considerably depending on different data origins, time and geographical background, technologies and system boundaries. Therefore it is often unclear how feedstock quality is defined. The objective of this work is to present a guideline that helps compare different LCI studies. In this guideline a systematic approach on the assessment of literature quality is done. In a first step the current “best practice”for modelling an LCI is summarized. By this a reference for the assessment of the data is defined. This reference will identify a
of Linked Data (LD). LD technology aims at allowing meaningful interlinks between all sorts of resources within the World Wide Web. It can be seen as a further development of heterogeneity.

Our general strategy is to take a more qualitative approach to the problem of divergence or discrepancy in LCA. We think about a web-based toolkit that tries to resolve these problems.

Overall the analysis delivered two main research thrusts: one devoted to increase practicability of LCA, the other to increase model fidelity. The former is aimed at making LCA analysis and exploring the range of lifecycle estimates. The paper highlights that ranges of emissions estimates are present for wind power. The paper also suggests that meta-analysis of LCA studies for bio-based polymers: assessing the environmental performance of polyhydroxyalkanoates (PHA) and polylactide (PLA) in contrast to their oil-derived counterparts.

Environmental impacts of palm oil biodiesel: a Meta analysis
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The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond
University of Bath, Bath, United Kingdom

The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond
University of Bath, Bath, United Kingdom

The Renewable Energy Directive provides a methodological framework for a streamlined LCA that calculates the greenhouse gas (GHG) balance of biofuels in order to determine whether they reach the required 35% GHG reduction threshold. It describes which sources of emissions should be included and how they contribute to the net balance. However, a clear definition of this is lacking. Currently, in order to incentivise biofuel production from second generation sources such as cereal residues and waste, double credits are to be awarded to these biofuels, and the feedstocks are considered to be available at zero GHG ‘cost’. In contrast, converting degraded land or forest to plantations can potentially offset the system to become carbon-neutral.

- Recommendation
- Evaluation of the available literature
- Set of indicators.

The greenhouse gas emissions from wind power: a critical meta-analysis
S.S. Sridhar
Heriot-Watt University, Edinburgh, United Kingdom

This paper presents a comprehensive analysis of greenhouse gas emissions associated with wind power generation. Using meta-analysis, we examine the environmental impacts of wind energy, focusing on a range of life cycle stages. The results highlight that wind power is not only an effective option for reducing greenhouse gas emissions, but also one that has a lower environmental impact compared to other energy sources. However, further research is needed to address the uncertainty and variability associated with life cycle assessment methods.

The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond
University of Bath, Bath, United Kingdom

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Polyhydroxyalkanoates (PHA) and polyactic (PLA) are appropriate bio-based substitutes for a variety of previously petroleum-based products. Life Cycle Assessments (LCAs) according to ISO 14040 and 14044 have been applied to compare the environmental performance of these bio-based polymers in contrast to their petroleum-based counterparts. Numerous cradle-to-gate studies have been carried out to analyse the environmental impacts of the production of polymer resins with a preliminary focus on the impact categories climate change and non-renewable energy use. Previous studies indicate a wide range of results and contradictory conclusions due to the consideration of different production processes, methodological choices (e.g. system boundaries, co-product allocation, impact assessment methods) and underlying assumptions. To produce more robust and policy-relevant results than individual LCAs, an approach for a Meta-Analysis is developed and undertaken to analyse the outcomes of 25 LCA studies. The underlying studies are quantitatively assessed taking into account the impact categories climate change (measured in metric tons of carbon dioxide equivalents) and non-renewable energy use (measured in megajoules). Relative environmental impacts per metric ton of PHA and PLA are compared with corresponding values for the petroleum-based plastics polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET) and polypropylene (PP). Furthermore, differences between the environmental impacts of bio-based and petroleum-based polymers as well as standard deviations are calculated to derive methodological consistent figures. Results of the Meta-Analysis indicate environmental advantages and disadvantages in both impact categories depending of the selected pair for comparison between bio-based polymer and petroleum-based polymers (PP, PE, PET, PS). Furthermore, the Meta-Analysis reveals that bio-based polymers can help to mitigate climate change and save non-renewable energy.

TCP 349
The effect of system boundary and weight of the life cycle factors on the life cycle of a results of a life cycle assessment (LCA) - Electricity generation as examples S.B. Simon
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Life Cycle Assessment (LCA) is a widely used tool for determination of strength and weaknesses regarding ecological aspects of any product or service. It is expected from the scientific-based analysis to deliver robust information, but in fact in literature the results differs significantly for the same product or services. Due to the recognized uncertainty this study addresses the possible deviation of results from literature in the electric energy production from different energy sources. The potential deviation could arise from the consideration of different system boundaries (SBs) and the relevance of emission sources along the life cycle. Both could be mainly responsible for the recognized diversity beside others like allocation, cut-off criteria, actuality of literature, etc.

The electric power generation gives a good instance to analyse the impact on the results of the different SBs. For example: the variation between different plant construction demands is often over 80% , but the overall results don’t necessary correlate with this deviation. The change of cement demand for construction by 230%, in the case of electricity generation from coal, induces only 1.7-2% difference in GWP of the total system. This is an effect of different proportion of emission sources between the life cycle stages.

The contribution will point out where uncertainties and dependency of the results could arise through the examples of electricity generation from coal(lignite), natural gas, hydro energy, nuclear energy and wind energy. The whole life cycle of power plant (with fuel upstream), the following system parts and impact categories have been taken into account by understanding the results of LCAs:
- Construction, fuel upstream, transport, production, operation, decommissioning as life cycle phases
- Construction demand variables (basic construction materials: cement, steel, etc.)
- Fuel demand variables (efficiency factors: fuel purity, thermal efficiency, wind yield, transport, etc.)

Impact assessment methods (GWP as main LCI category)

The chosen system boundaries and other variables contribute to the varying results of LCA studies for electric energy production. Data from the literature should only be used from reliable sources and after thorough investigation, if the SBs and information of the used variables is well described. Otherwise the unreflected use of a data source might lead to false results and recommendations.

TCP 350
Using LCA in the preparation of the new waste management plan of Regione Lombardia
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2ARS Ambiente srl, Gallarate (va), Italy

Regione Lombardia has among its tasks the development of management strategies for municipal waste produced in its territory, in collaboration with provincial governments, the control bodies and public and private entities that operate on the collection, recovery and disposal cycle.

In order to pursue sustainability also in this field, Regione Lombardia has decided to consider “environmental performance” as a criterion for supporting future planning decisions, and therefore stressed the need for specific assessments of environmental impacts associated with the planning in the waste field.

Life cycle assessment (LCA) has thus been chosen by Region Lombardia as a strategic support decision tool in the preparation of its new waste management plan. The goal is to use the life cycle thinking to assess the current strategic situation and strategic indications for the future waste management. The project (called GERLA: GEstione Rifiuti in Lombardia - Analisi del ciclo di vita) started in November 2010 and will be completed by the end of 2011.

The first phase of the study consisted in the analysis of the present management of municipal waste in Lombardia Region (baseline scenario - reference year 2009). This has involved the identification of all the fluxes of materials (both the source-separated fractions and the unsorted residual waste) in terms of quantity, composition and destination, together with the characterisation of the most important treatment plants, in terms of their capacity, energy and materials consumption, emissions in the environment, energy and materials recovery. After that, the LCA methodology was applied to evaluate the energetic and environmental impacts associated with this baseline scenario.

The critical analysis of the results (Life Cycle Interpretation) of the baseline scenario has allowed the definition of a number of future scenarios for the year 2020, with the final goal of improving the environmental performances of the regional system.

This study represents thus an important application of LCA methodology since, for the first time in Italy, the outcomes of a detailed LCA of a current waste management system are actually utilised in the waste management planning on a regional scale.

TCP 351
Life Cycle Assessment for end of life computers in Mexico
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The recovery of waste electrical and electronic equipment (WEEE) is an activity that becomes more important every day in Mexico. In 2010 electronic waste generation reached 307,000 tons annually. Of these, 10% is recycled or valorized, el40% remains stored in houses and 50% is sent to final disposal in landfills and open dumps. The aim of this project was to conduct a life cycle analysis using the program Umberto for electronic waste management in Mexico and compared its environmental impacts with those for three proposals for change in the end of life management pattern in order to determine the best option for a national policy. The policy proposals were modeled as follows: 1) Stage with 25% recovery system , 2) Stage 35% to recovery system, and 3) 0% for disposal in open dumps. As conclusion it was identified to eliminate the use of open dumps for waste disposal in first place, followed by an increase in 35% of the recycling/valorization system.

TCP 352
Implementation of an integrated technological-LCA modelling tool within the water industry - a pragmatic contribution to decision-making
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1INSA Toulouse (LSFB), Toulouse, France
2INSA Toulouse, LISBF, Toulouse, France

Nowadays climate change is expected to take into consideration environmental issues. But it still has to deal with operating costs, sanitary risks, technical feasibility and reliability of designed plants. Therefore, the water industry managers need handy tools and practical methodologies that can provide them a complete set of information for projects under study. A good implementation of such decision supporting tool is obviously a condition to its success.

Within the EVALEAU research project, an integrated technological-Life Cycle Assessment modelling tool has been developed with the software Umberto®. The tool is based on an exhaustive library of unit process models. These models are highly detailed and parameterized, thus precisely describing the energy and mass balances depending on a specific project context. Complementary software tools are directly linked to the tool, which makes it benefit from previous modelling efforts and specific industry knowledge. For example, the weather data are considered as input delivered by a weather station. Every unit process model generates an engineering design report when placed within a modelling scenario. These reports are spreadsheets containing engineering design data (e.g. pumps power). This information is of interest at the decision stage since decision can be made knowing how the process will work on the field. Problematical technological solutions can be avoided whereas convenient technologies will be selected.

A code for sensitivity analysis of the process model parameters is also part of the framework of the tool. The mathematical method followed is the Morris method. It aims at detecting the key parameters of the modelled scenario by qualitatively estimating their influence on any of the results (e.g. one selected environmental impact or the operating costs). Therefore, each parameter under examination of the modelling scenario react to a change on one model parameter. Assuming that the modelling scenario is realistic enough, conclusions can be made on the real plant. This key feature of the tool gives the designers good clues about the future plant functioning and indicates which are the primary actions levers. The first use of the tool implementation relies on its convenience on the field, obtained by previously developing it closely with its future users. Not only environmental issues are taken into account but the tool give the whole picture of an industrial project.
TH 353
LCA on drinking water production from pesticide contaminated ground water
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This poster presents the results from an LCA case study addressing a growing Danish problem on pesticide contaminated ground water. The conventional Danish way of using pesticide free groundwater and treating it by aeration and sand filtration is compared to using slightly pesticide contaminated groundwater and adding treatment by activated carbon filtration and UV-treatment. The scenario of using slightly pesticide contaminated groundwater is chosen as it is a genuine and relevant alternative in the current Danish situation as groundwater wells are closing due to pesticide contamination and clean ground water is becoming scarcer. Besides the comparison, a hotspot analysis is performed in order to identify the dominating environmental impacts in the life cycle of generating drinking water from ground water. This study is part of the research project DWBiofilters (www.dwbiofilters.dk) aiming at improving sand filters for drinking water production by investigating its inherent microbial processes.

TH 354
Development of a new LCA tool for maintenance at the initiative of the users - a bottom-up approach
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2W/E Advisers, Urk, Netherlands
Many practical LCA tools have been developed before a user group was established. The risk of such a top-down approach is a gap between the tool and the way users want to use it. Therefore, this study has been less used by the users. In the Netherlands, a group of housing associations and building and maintenance companies were looking for means to calculate the environmental performance of planned preventive maintenance of housing, estates and buildings themselves. There are several theoretical approaches available, but no practical calculation tools. Because of this lack of instruments, they set up a development project for a practical calculation tool. The motivation of the whole supply chain of the companies in the beginning of the project is fundamental. Additional workshops for the whole industry gave important feedback and shall facilitate larger implementation of the guidelines.

TH 355
Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS)
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2University of Catania, Catania, Italy
3University of Salerno, Salerno, Italy
4University of C. d’Annunzio, Pescara, Italy
The aim of this abstract is to present a LCM tool designed for the agri-food industry, a POEMS framework with a modular structure resulting from the integration of complementary tools: an Integrated Life Cycle Assessment (LCA) and a suitable Environmental Product Label or Declaration (EPLD) (M. T. Clasadonte et al., 2010, Journal of Industrial and Systems Engineering). In order to successfully apply this framework in the agri-food firms the main sector-specific barriers (SSB) to LCM implementation have been used as starting points to set the success factors (SF), solutions (S) and tools (T) of the POEMS model. In the following the path to the POEMS framework definition is summarized: the path efficiency is enhanced by the fact that each tool can provide multiple solutions to several barriers.


SBB: main focus on short-term problems; lack of chain management responsibility; lack of awareness of product life cycle envtrl. impacts (PLE); poor access to large amount of life cycle data; lack of in-house expertise; high expensive [ARROWRIGHT]SF: internalization of management vision and long-term value creation; identification of PLE; allow SMEs to perform LCA/assessment by themselves providing an easily understandable tool [ARROWRIGHT]T: LCM and Life Cycle Thinking, LCA; simplified approaches [ARROWRIGHT]T: Simplified LCA

SSB: envtrl. commitment is not perceived as an opportunity; problems with results communication and chain involvement; complexity and uncertainty in choosing the most suitable envtrl. message [ARROWRIGHT]SF: ability to transform the envtrl. measures taken into commercial advantages; spreading envtrl. cultural change and involvement with external dissemination; identification of the proper envtrl. label/declaration [ARROWRIGHT]T: EPLDs; envtrl. product communication; guidelines to support decision making [ARROWRIGHT]T: EPLD guidelines

IMs+Simplified LCA+EPLD guidelines+POEMS

The EMAF project is in progress with applications in the canned vegetables, wine, pasta, olive oil and coffee supply chains.

TH 356
Finishing guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry
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Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years, are used to spread up and down the supply chain as a tool to calculate environmental loadings of the products. The general LCA concept is however not enough and gives incentives to companies to use carbon footprinting in their consumer communication as well. Consumers show growing interest to, for example, carbon footprints in many Gallup polls. Many international standards and guidelines on LCA are published but no standard widely approved method on evaluating environmental impacts of food are available. In the Foodprint - research programme sound national methodology for calculating carbon and other footprints of food has been developed in close collaboration with the Finnish food sector. As published guidelines are too generic to give practical instructions to companies to produce comparable carbon footprints for communication, the project has developed tailored methodologies and practical calculation tools and guidelines to be used in account when preparing national specific guidelines. Finnish food sector is actively consulted to ensure practical methodology which can be easily applied. In addition to development of national calculation guidelines, the project is also providing practical calculation tools to facilitate calculations at company level. The project also tested different data collection tools in R&D projects.

The project has been carried out as iterative process between research, companies and other stakeholders. Food industry wide workshops around the guidelines are used to make the guideline more applicable and user friendly for the industry. As many Finnish food companies use carbon footprinting, industry participation is high. The guidelines were therefore used in a detailed way by other LCA experts from LCA and from other standards’ point of view.

The company R&D projects were crucial for developing practical guidelines for the industry. Motivation of the whole supply chain of the companies in the beginning of the project is fundamental. Additional workshops for the whole industry gave important feedback and shall facilitate larger implementation of the guidelines.

TH 357
Life cycle thinking applied to an immunological product (vaccine) used for boar taunt control in male pigs
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In a project co-funded by the European Union (EFRE-ME0217/0120/827/912.2.2.2/0/1477/57/295) and for which the US Army Medical Research and Materiel Command (USAMRR) provided funding, all of the product’s life cycle impacts were presented for the first time at the 2011 Annual European SETAC Conference in Milan in late 2011. The sample of farms participating in the global survey was extended for the development of the renewed and updated EPD to be published by the end of January 2012. The new data collection work led to the inclusion of a considerable number of representative farms from other countries worldwide. This analysis provided LCA data to assess possible environmental benefits of the vaccine’s application: the reduction of the carbon footprint is a strong perceived advantage for farmers from the swine and food sectors and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to provide a comprehensive view of the life-cycle impacts of the product. The calculated carbon footprint for the Improvac pig system demonstrates a reduction vs. the physically castrated pig system, mostly depending on country specific feed production and slurry management practices. Starting from the feed components, a detailed examination was conducted on the used detailed methodologies to find the same holds for national inventory databases and best practices for footprints in the agricultural and food sectors and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to provide a comprehensive view of the life-cycle impacts of the product. The calculated carbon footprint for the Improvac pig system demonstrates a reduction vs. the physically castrated pig system, mostly depending on country specific feed production and slurry management practices. Starting from the feed components, a detailed examination was conducted on the used detailed methodologies to find the
The Nespresso pilot test will be presented and shows an example of PEF Guide application and used to provide feedbacks about the PEF Guide.

The attached mussels were put vertically into the pilot-plant to carry out the second step, which is in execution at this moment.

The PEF Guide aims at providing detailed technical guidance on how to conduct a PEF study identifying single requirement for each decision point with the objective to increase the comparability of results whereas PEF Guide used to provide feedbacks about the PEF Guide.

Many recent studies have revealed the presence of concentrations of hundred pharmaceuticals and illicit drugs in the high ng L⁻¹ to low µg L⁻¹ range both in surface and sewage waters. Since more of them are only partially removed by the sewage plants, they contaminate the receiving surface waters with potential implications for wildlife. Moreover, some sewage effluents are used for irrigation and we can transport these pollutants to soil and cultivated plants also. The aim of this research is the evaluation of possible abatement of these chemicals in sewage waters by the use of a biological process. In detail, we built a pilot-plant (600 L of volume) in the biggest depuration plant (Depurazione plant of Nosedo) of Milan (Italy) in which we put several thousand of specimens of the freshwater bivalve Dresienia polymorpha. Mussels were attached to Plexiglas panels that force the waste to follow a zigzag pathway. We exploited two natural behaviors of this mussel: the heavy filtration rate (average of urban wastewaters (concentrations between high ng/L and high μg/L) . Among all PhACs investigated, the iodinated X-ray contrast (ICM) agent iopromide was detected where much lower (40 and 70 ng/L, respectively). The persistence of ICM through conventional wastewater treatment is well documented. For this reason, this substance was selected as target compound to study its degradation and to assess the potential of white-rot-fungi to degrade PhAcS from real effluents.

Possible removal of several contaminants from the wastewater by a natural biofiltration process

We will measure the degree of alignment of the PEF Guide with ISO 14040 and ISO 14044 as well as the practical implications of following the PEF Guide as compared to current LCA practice.

The PEF Guide will provide a perspective of the role of SETAC in both NA and Europe had on the development of LCA.

The occurrence of pharmaceuticals in several wastewater effluents and evaluation of a non-conventional biodegradation treatment

In this context, the present work will show the results derived from an extensive characterization of 80 human and veterinary pharmaceuticals in several wastewaters where concentration of pharmaceuticals is expected to be significant such as hospital and urban wastewaters and reverse osmosis concentrate. Results indicated that pharmaceuticals are widespread pollutants in all these matrices. As expected, high levels were found in hospital wastewaters followed by those found in reverse osmosis concentrate and urban wastewaters (concentrations between high ng·L⁻¹ and high µg·L⁻¹). Among all PhACs investigated, the iodinated X-ray contrast (ICM) agent iopromide was detected in all wastewaters, with especially high concentrations in hospital wastewaters (nearly 200 μg/L), whereas in reverse osmosis concentrate and in urban wastewaters levels much lower (40 and 70 ng/L, respectively). The persistence of ICM through conventional wastewater treatment is well documented. For this reason, this substance was selected as target compound to study its degradation and to assess the potential of white-rot-fungi to degrade PhAcS from real effluents.

The plastic pilot study and their horizons: qualitative and quantitative assessment of waste NESPRESSO and KIT products

ISO 14040 and ISO 14044 to high specificity in the case of the French standard BPX30-323.

The PEF Guide aims at providing detailed technical guidance on how to conduct a PEF study identifying single requirement for each decision point with the objective to increase the comparability of results whereas PEF Guide used to provide feedbacks about the PEF Guide.

The PEF Guide will provide a perspective of the role of SETAC in both NA and Europe had on the development of LCA.

The next step will be to carry out the second step, which is in execution at this moment.

The project plan foresees three different steps: 1) the evaluation of the capability of D. polymorpha specimens to attach themselves to panels and to live in wastewater 2) to test the possible decrease of pollutants in re-circulation conditions; 3) to check the contaminant abatement from the inlet to the outlet of pilot-plant. In the first phase, we collected 1900 mussels from lakes about 100,000 mussels that were put in two "nursery" tanks filled with tap water in which the Plexiglas panels were horizontally positioned. We evaluated the subsequent attachment and the optimal conditions for the mussel sustentation (type of food, water flux, temperature, mussel density). Secondly, panels with the attached mussels were put vertically into the pilot-plant to carry out the second step, which is in execution at this moment.

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The present work was undertaken to investigate the feasibility of cost effectiveness adsorbents: pure fired clay, newly designed fired clay with the polymer addition (5 mass% PEG 600) and bentonite for Zn(II) ion removal from waste printing developer. The adsorption efficiency and distribution coefficient of used adsorbents were determined as a function of adsorbent amount. The results show that newly designed clay adsorbent with polymer addition has great potential (up to 93.5%) to remove Zn(II) ion from waste printing developer.

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THPC1-4
Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
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In this study H2O2-assisted TiO2 photocatalytic degradation was applied to remove persistent organic pollutants from industrial wastewater. Experiments were carried out with treated and filtered (0.7 µm) urban wastewater, spiked with AZO Orange II (5mg/l) and 4-Chlorophenol (0.36mg/l). The experimental equipment employed in the assays consists in a tubular reactor of borosilicate glass, (600ml) operating in a recirculating circuit, irradiated with an UVC lamp (8W). The Hydrogen Peroxide (H2O2) in the process was 200mg/l. The catalyst (TiO2) was immobilized on the external surface of a cylinder of frosted glass (40mm). Experiments have been conducted using a total working volume of 1200ml and a recirculation flow rate of 600 ml/min. The efficiency of primary degradation was determined by monitoring the process, for AZO Orange II (absorbance 478 nm) and 4-Chlorophenol compounds. Toxicity assays were also carried out with the aim to evaluate the effects by products. An economic study of this process was included in the global analysis.

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
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The influence of terminal electron acceptor on the removal of pharmaceuticals in Anaerobic digester sludge
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TU 001
Particle size distribution of airborne perfluorinated compounds
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Perfluorinated surfactants (PFs) are produced since the 1950s draw great attention due to their wide application and increasing importance in the environmental exposure. Sorption coefficients (Ka) and organic carbon normalized soil adsorption coefficients (Koc) are essential for determining soil adsorption behavior and assessing the risk of transfers of these chemicals from contaminated soils to plants and groundwater. We therefore analysed the international literature for concentrations of perfluorinated octanoic acid (C8F17COOH), perfluorooctanoic acid (C8F17COOH) in different environmental media (surface water, sewage treatment plants, sediment, and soil) in order to assess the distribution of PFs and PFOA between these environmental compartments and compared the results with published experimental sorption coefficients. Experimental log Koc values for PFs for different soils and sediments available in public literature are remarkably similar with a coefficient of variation of only 18%, which should limit the uncertainty of concentrations in drainage water and groundwater calculated from soil concentrations (average log Koc = 2.9). For PFOA however, published sorption coefficients are sparse and the published information regarding the analogy between sorption of carboxylated and fluorinated PFs is controversial (average log Koc = 2.6).

Our review shows that current pattern of environmental PFOA and PFOA concentrations are strongly influenced by local pollution sources. Nevertheless, we calculated “global” Kd/ Koc distribution coefficients based on median concentrations in sediments/surface waters or sewage sludge/sewage. The “global average” Kd calculating from the median concentrations of PFOA in WWTP effluent and sewage sludge equals 1958 kg l-1 (log Kd = 3.3). Assuming an average dry matter organic carbon content of 31% for sewage sludge would give a global average log Koc of 3.8.

Dividing the median sediment concentration of 0.6 ng g-1 by the median surface water concentration results in a factor of 275 (log Kd concentration of 1.7% equals 4.2). Furthermore, the estimated “global” log Koc were similar to experimental log Koc values found in the literature. The moderate affinity of PFOA and PFOA to soils, sediments and sewage sludge indicates that drinking water must be considered a potential pathway of exposure of animals and humans to these compounds.

TU 002
Binding and sequestration of perfluorinated surfactants in soil
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Perfluorinated surfactants (PFs) have been produced since the 1950s draw great attention due to their wide application and increasing importance in the environmental exposure. Sorption coefficients (Kd) and organic carbon normalized soil adsorption coefficients (Koc) are essential for determining soil adsorption behavior and assessing the risk of transfers of these chemicals from contaminated soils to plants and groundwater. We therefore analysed the international literature for concentrations of perfluorinated octanoic acid (C8F17COOH) and perfluorooctanoic acid (C8F17COOH) in different environmental media (surface water, sewage treatment plants, and sediments). In order to assess the distribution of PFs and PFOA between these environmental compartments and compared the results with published experimental sorption coefficients. Experimental log Koc values for PFs for different soils and sediments available in public literature are remarkably similar with a coefficient of variation of only 18%, which should limit the uncertainty of concentrations in drainage water and groundwater calculated from soil concentrations (average log Koc = 2.9). For PFOA however, published sorption coefficients are sparse and the published information regarding the analogy between sorption of carboxylated and fluorinated PFs is controversial (average log Koc = 2.6).

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TU 003
EP06P - Perfluorinated compounds: From emission sources to the place of impact
Investigating the sorption of Perfluorinated Compounds in different types of sludge

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Perfluorinated compounds (PFCs) present significant research interest in recent years due to the global distribution, persistence, bioaccumulation and potential toxicity of these compounds. The fact that PFCs are commonly detected in municipal wastewater treatment plants (WWTP) and sludge treatments (primary sludge, anaerobic digestates and centrifuged sludge) suggest a potential sorption to sludge. The aim of this research was to determine the potential sorption of different PFCs to three different types of sludge (primary sludge, secondary sludge and digested sludge). For this reason, sorption experiments were performed with eight PFCs belonging to two different classes: perfluorocarboxylic acids (PFCAs) that contain a carboxyl group (-COOH) and perfluoralkyl sulfonates (PFASs) that contain a sulfonate group (-SO3H) in their molecule.

At first, sorption experiments were performed to investigate the equilibrium time for each target compound and the role of sludge inactivation on sorption potential of PFCs. For this reason, samples were taken at different time intervals and PFCs were detected in dissolved and particulate phase. PFCs were extracted by solid-phase extraction (dissolved phase) or sonication (solid phase) and determined using High Performance Liquid Chromatography - Ion Trap Mass Spectrometry (HPLC-IT-MS).

Afterwards, sorption experiments were performed for different spiking levels of PFCs, ranging between some ng L-1 to few μg L-1 and solid - water distribution coefficient (Kd) values were calculated. Finally, the effect of solution pH on PFC sorption was investigated in experiments performed at pH values commonly found in WWTPs (6.7 and 8).

"According to the results, Kd values of PFCs were differentiated significantly according to the type of sludge. Moreover, it was shown that both the length of the perfluorocarbon tail and the functionality of the head group can influence the sorption of these compounds to sludge materials.

Acknowledgment

"This project was implemented under the Operational Program «Education and Lifelong Learning» and funded by the European Union (European Social Fund) and National Resources - HRALEITOS II?"
Unlike rivers Tevere and Adige which are not significantly impacted, concentrations determined at the basin closure of the river Po are comparable to those measured in the PFAS heavily impacted areas of Northern Europe; PFOS concentrations are low (ranging from < LOD to 2.5 ng/L) while PFOA is the main compound (about 25 ng/L). Fluorine content in the Tanaro/Bormida watercourse, was confirmed as the main source of the latter molecule. Plant for the production of fluorochromes, used as intermediates in the polymer synthesis, is a significant source of PFOA and PFBS in the river Brenta which discharges in the Adriatic Sea.

Two important textile industrial districts in Italy (counties of Vicenza and Prato) have been identified as also a significant source of PFPEs and PFHxAs which are discharged in the other rivers basin and in sewer Arno. These should be considered as tracers of this kind of industrial pressure. The same compounds were also measured in the river Adda, an important tributary of the river Po, but the source shall be still to be identified.

The distribution of these substances in the main areas has also been studied.

TU 008

PFAA sources to groundwater and drinking water: identification and origin
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All PFASs can be considered potential contaminants, but some become evident from blood analysis. The exposure to PFAA occurs primarily via the dietary intake and more specifically via drinking water. It was estimated that when assuming a tap water concentration of PFOA of 9 ng/L the intake via water would amount to 55 % of the total daily Dutch PFOA intake.

Knowledge about sources of PFAA to drinking water is currently scarce and focuses on surface water based drinking water. Waste water treatment plants have been identified as major sources for PFAA to surface waters and ultimately to the drinking water produced from it. However, groundwater is in many countries the major source for drinking water production (in NL 65%). The extent of contamination of groundwater by PFAA and the contamination pathways to groundwater bodies remain largely uncertain. In the work presented, we identified different direct sources of PFAA to groundwater summary area of a public supply well field (PSWF) in the Netherlands. It was found that landfill leachate, and urban/military base affected rainwater contaminated the groundwater within the catchment area of the PSWF. Rainwater not affected by the direct sources also infiltrated in this area and provided a background contamination to the groundwater.

Maximum concentrations encountered in the landfill leachate plume were 1758 ng/L perfluorooctanoic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBa).

Maximum concentrations measured in the groundwater halfway the contaminant sources and the PSWF (15 years travel distance) were 29 and 161 ng/L for PFOA and PFBS respectively. Concentrations in the groundwater wells at a travel distance of 25 years were much lower: 0.9% and 3.5 ng/L for PFOA and PFBS respectively. The chemical signature of the groundwater proved that infiltrated rainwater, the landfill leachate and the infiltrated urban/military water contaminated the abstracted water. Based on the hydrological modeling it was shown that 1% of the treated groundwater was originating from the landfill and military area and 99% from background contamination. This is seen in the relative abundance profile of the PFAA in the pumped groundwater.

TU 009

Seasonal distribution of perfluorinated compounds (PFCs) in surface water from Elbe River and North Sea, Germany
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Since the ubiquitous occurrence and potential toxicity to human beings, the perfluorinated compounds(PFCs) have attracted more concern in the recent years. In 2010, one of the PFCs, perfluorooctane sulfonate(PFOS) was added to Annex B of Stockholm Convention on Persistent Organic Pollutants(OPPs). Recently, more substitutes, i.e. perfluoro octane sulfonate (PFBS) and perfluorohexanoic acid (PFHxA), were widely used and the elevated levels have been found all over the worlds. In this study, four cruises in Elbe River and three cruises in North Sea were conducted throughout the whole year of 2011 to investigate the seasonal distribution of perfluorinated compounds in surface water. Perfluorinated carboxylic acids (PFCs) and perfluorinated sulfonates (PFSA) were determined in both particle and dissolved phases in more than 100 samples. The profile patterns suggested the industrial and urban discharge which were the major source of PFC in river and coast water.

TU 010

Occurrence of 14 perfluorinated compounds and other priority and emerging organic compounds in fishes from the Rhone River (France)
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The main goal of this study was to obtain data on the occurrence and levels of 34 priority and emerging organic compounds in freshwater fish sampled in the Rhone River. The analyses included 14 perfluorinated compounds (PFC), and also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecanes (HBCD), 9 polybromodiphenylethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set by the European Commission (EC). The monitoring campaigns allowed to identify hot spots in the main Italian basins.

TU 011

Perfluorinated compounds (PFCs) in peregrine falcon eggs from southwestern Germany - levels, patterns and temporal concentration variations
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The white-tailed eagle (Haliaeetus albicilla), also referred to as white-tailed sea eagle (WTSE), is a large predatory bird from the Northern part of Eurasia. It is a top predator from the aquatic ecosystem and feeds mainly on marine fish, waterfowl and carrion. Because of its high trophic position, the WTSE is a very interesting biomonitoring species for studying accumulation of persistent organic pollutants (POPs). In this study we increase the knowledge on the analysis of perfluorinated aliphatic substances (PFAS) in biological tissues and specifically develop a reliable method to measure PFAS in feathers of this raptor species. Feathers have already been used successfully for monitoring of heavy metals, and recently also for POPs, but a reliable method for PFAS was not available and needed to be established.3,4 The results gained from this research enabled us to monitor endangered raptors without harming the birds and their offspring and to better understand the fate of PFAS in birds. From Greenland body feathers (n=11) and primary wing feathers (2th, 5th and 8th primary; n=46) and preen oil (n=7) was collected when available in a sufficient amount for analysis. Tissue samples were taken from the Greenland carcasses to analyze for PFAS and POPs. In addition, tail feathers were sampled at active nest sites of WTSE situated in Northern Norway (n=15) in 2009. For the first time, PFAS were detected in feathers and preen oil of white tailed sea eagles from Greenland and Norway. In the wing feathers from Greenland WTSE, PFOS and PFOA were detected. In some cases, PFNA, PFUnA and PFTrA were detected in minor concentrations as well. The average concentrations of the primary feathers #2, 5 and 8 were similar. In addition, the body feathers showed similar PFOS levels, but lower PFOA levels.

TU 013
Perfluorinated chemicals in Belgian barn owls (Tyto alba): comparison of levels in feathers and tissues
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Feathers have proven very useful regarding non-destructive biomonitoring of contamination with heavy metals and organic pollutants. For this study, we have investigated perfluorinated chemicals (PFCs) in feathers and tissue of barn owls (Tyto alba), collected in the province of Antwerp (Belgium). A major PFC plant (3M) is located in the close vicinity of the city of Antwerp and levels of PFCs in biota from this area have been found to be very high in previous studies. We analysed levels of PFCs in tail feathers and tissues (liver, muscle, preen gland, adipose tissue) obtained from barn owl road-kill victims (n=15). We used methods for left-censored data to cope with levels below the limit of detection. We aimed to study the main sources for PFCs in feathers as levels can both originate from internal sources (via the blood) as from external contamination (via e.g. air, dust).

PFOS was detected in all tissues (median concentration: 135 ng/g in muscle, 305 ng/g in liver, 431 ng/g in preen oil, 203 ng/g in adipose tissue), also in feathers (median 14.7 ng/g). PFOS levels in feathers and liver tissue were highly correlated (r=0.79, p<0.001), but this was not the case for PFOS levels between feathers and muscle (r=0.15, p=0.47) or between muscle and liver (r=0.46, p=0.08). This may be due to the chemical properties of PFCs which are mainly bound to proteins in the blood, thus reducing the suitability of muscle tissue. M. Eens was the lead author for this study. 3

TU 014
Monitoring of perfluorinated compounds
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Because of their persistence and wide ranging application perfluorinated compounds (PFCs) are found as ubiquitous contaminants in aquatic and terrestrial organisms as well as in food products. HPLC-MS/MS analysis of animal and non-animal foodstuffs and wild game was performed within the framework of preventative consumer protection.

Fish from regional waters:
Sixteen fish from the Rhine river including eel, perch, roach, tench and catfish were examined for the presence of PFOS. Concentrations between 5.2 µg/kg and 143 µg/kg were detected in muscle tissue as the sum of PFOS (2), PFOA, PFPeA, PFHxS, PFHpA, PFOA, PFOS, PFNA, PFDA, PFBS). The highest concentration was measured in perch muscle tissue.

Roe deer:
Use of PFOS has been declining since the year 2000. In order to observe the ensuing temporal changes in PFC concentrations in animal matrices a retrospective study of liver tissue from roe deer was undertaken. A total of 110 samples taken between 1998 and 2010 from the German Environmental Specimen Bank were examined. A decline in PFOS contamination since the beginning of this millennium is evident. Average PFOS concentration was 9.2 µg/kg in the year 2000 and 1.9 µg/kg in 2010.

Wild boar:
PFOS and PFOA concentrations were measured in 506 muscle tissue samples and 529 liver samples from wild boar. The arithmetic mean of PFOA concentrations detected in muscle tissue was 1.38 µg/kg whereas the mean PFOS concentration was below the LOQ. In liver tissue the mean PFOA concentration was 4.02 µg/kg (Maximum value 45 µg/kg) (1).

Foodstuffs:
Measurements of 82 samples of French fries showed PFOS concentrations above the LOQ in 3 samples. No concentrations above the LOQ were detected in 30 samples of ice cream, 14 samples of whole milk, 19 samples of carrots or 16 samples of grains. A total of 84 samples of ocean fish, farmed fish, seafood, fish in packaged salads and canned tuna were tested for the presence of PFC. No PFC were detected in 82 of the samples. Two carp from fish farms had 2 and 14 µg/kg, respectively in muscle tissue.

Due to their unique properties, poly- and perfluorinated compounds (PFCs) have been manufactured and used during the past 50 years in a variety of industrial and commercial products, such as household surface finishes, food packaging, water- and stain-resistant materials, and fire-fighting foams. PFCS were released to the environment during production, usage and disposal. PFCS tend to persist in surface waters. Therefore their toxicity to aquatic organisms is of particular concern. Serving as a food source for fish and other aquatic organisms, cladocerans are one of the key trophic elements of aquatic ecosystems. In addition to their ecological significance, cladocerans have the advantage of being useful as test organisms due to their short life cycle, their ease of laboratory culturing, their limited space and water volume requirements, and their sensitivity to chemicals. Cladoceran species are therefore widely used in aquatic toxicology. Among freshwater cladocerans, Daphnia magna is probably the most commonly used test organism in ecotoxicological studies. Some toxicity tests have been performed on cladocerans for perfluorooctane sulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) or their salts.
Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonyls and alcohols on two cladocerans, Daphnia magna and Chydorus sphaericus, was evaluated in the present study. The adverse effects of these PFCs on these two cladocerans decreased with increasing fluorinated carbon chain length (nC) and quantitative structure-activity relationships were developed to quantify this observation. As the EC50 values obtained are far above concentrations typically found in surface water, acute harmful effects of these chemicals to D. magna and C. sphaericus are not expected in the real environment.

**TU 017**  
**Perfluorooctanoic acid toxicity in zebrafish (Danio rerio)**  
M. U. 100% , S. O. Orn, G. C. Carlson, J. T. Tulkki, L. N. Noergren  
Swedish University of Agricultural Sciences, Uppsala, Sweden  
Perfluorooctanoic acid (PFOA) is a common contaminant with wide use due to its unique nature, and has been detected as a contaminant in soil, air, water and biota. Previous studies have shown that PFOA has detrimental effects on different life stages in zebrafish (Danio rerio).

We have evaluated the effects of PFOA toxicity covering different life stages of zebrafish through three tests that were based on OECD guidelines. In the Fish Embryo Toxicity (FET) test, 2,000 eggs were used to calculate effective concentrations (LOEC and NOEC) but were used on different stages of larval development. Based on the FET test, a Fish Sexual Development Test (FSDT) was conducted and effects on vulval development (VTG), body and liver somatic indices and gonad histopathology including sex ratios were evaluated. A reproduction test (Fish Screening Assay; FSA) was also performed where effects on reproductive parameters like spawning, fecundity and fertilization rate were evaluated, as well as effects on histopathology, liver enzyme activity VTG-levels and key gene expression levels in the adult fish.

**TU 018**  
**Structure-activity relationship of four perfluorinated compounds based on early developmental effects in the zebrafish**  
L. Vergaumen, D. Knapen, A. Hagenaars  
University of Antwerp, Antwerp, Belgium  
Perfluorinated compounds (PFCs) are a group of anthropogenic chemicals containing diverse functional groups and chain lengths. Their chemical structure gives them unique properties which resulted in massive production and the use of these compounds in several familiar products since the 1950s. However, these unique properties also cause them to be persistent and bioaccumulative explaining their presence in wildlife, humans and the environment worldwide. Despite the global occurrence of PFCs, the toxicological information on these chemicals is still incomplete and insufficient to assess their environmental impact and structure-activity relationship. In the present study, the development ofLOEC (perfluorooctanoic acid sulfate, C8), PFOA (perfluorooctanoic acid, C8), PFBS (perfluorobutane sulfate, C4), and PFBA (perfluorobutanoic acid, C4) were evaluated in zebrafish embryos (Danio rerio) during 120 hours post fertilization (hpf). The different chain lengths and functional groups of the selected chemicals made it possible to determine the structure-activity relationship of these compounds. PFCs with longer chain lengths (C8) tend to be more toxic than PFCs with shorter chain lengths (C4). Comparison based on the chain length indicates that PFCs with a sulfonate group are more toxic than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFOAS>PBS>PBFA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals. Oedemas and effects on length could only be detected in 8-carbon PFCs while malformations of the head were a more specific action of the sulfonated PFCs.

Only PFOA caused significant effects on hatching rate and success. The effects of PFOA, PFBS and PFBA on the heart rate at 48 hpf could be the result of effects on intrinsic processes that control the heart rate, while altered heart rates at 72 hpf can be attributed to the shorter body lengths. In conclusion, PFCs with short chain lengths should be primarily considered throughout the development of new perfluorinated alternatives.

**TU 019**  
**Embryotoxic effects of perfluorooctanoic acid sulfonate compounds in sea urchin Paracentrotus lividus**  
G. Gündüz, H. Parlak, Ö. C. Arslan, M. Boyacıoğlu, M.A. Karaaslan  
Ege University, İzmir, Turkey  
Our environment has been affected by increasing concentration of organic and inorganic pollutants from anthropogenic sources. Perfluorinated compounds are important source of pollution and they are major risks for the aquatic ecosystems. Perfluorooctanoic acid sulfonate (PFOAS) and Perfluorooctanoic acid sulfonyl fluoride (PFOASF) are both industrially synthesised perfluorinated chemicals and they produced in substantial amounts. They are found widely in surface water and aquatic sediments. In this study, the comparative embryotoxic effects of PFOAs, other perfluorinated compounds (PFOA, PFBS and PFBA) and their concentrations ranging from 0.2 to 10 mg/L, were examined on embryos of the sea urchin Paracentrotus lividus. Results were evaluated by observing: larval malformations, developmental arrest and embryonic/larval mortality. The results indicated that, low concentrations of these chemicals generally malformations in the skeletal system. It was observed that high concentrations (10 mg/L) of PFOA caused significant effects. Similar results were obtained with the growth retardation in the early life stages by perfluorinated compounds. As a result, it is concluded that PFCs should be included in the list of substances that should be strictly controlled in the environment.
TU 022
Plastic debris and toxin releases in the Pacific Ocean
J.P. Greene
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Plastics comprised the majority of collected waste in beach cleanups in 2006, 2007, and 2008. In California, Washington, Oregon, and Hawaii the five most common plastic debris items on beaches are cigarette filters, food wrappers and containers, beverage caps and lids, bags, and food service items, e.g., cups, plates, and cutlery. The majority of plastic items are made from four common plastics; polyethylene, polypropylene, polystyrene, and PET, accounting for 75% of the plastic debris. Pre-consumer plastic debris is found in run-off of industrial areas. The fate of plastics in the oceans can lead to fragmentation and result in small plastic particles that can degrade and release toxic chemicals such as phthalates, flame retardants, BPA, antimony oxide, heavy metals, nitrates, and styrene monomer as the plastics break down. Plastics can accumulate toxins floating in the oceans from persistent organic pollutants (POPs) capable of being transported over large distances. This study focuses on the equilibrium partitioning of polychlorinated biphenyls after ingestion by marine animals. In order to get more insight into the bioaccumulation potential of these persistent organic pollutants and to assess their potential to adsorb, concentrate and transfer OCPs, improving somehow their bioavailability, from the environment to the organisms.

TU 023
Micro-plastics in the marine environment - a global assessment
J. Kershaw1, H.A. Leslie2
1CEFAS, Lowestoft, United Kingdom
2Institute for Environmental Studies (IVM), VU University, Amsterdam, Netherlands
GESAMP has set up a new Working Group entitled ‘Sources, fate and effects of micro-plastics in the environment - a global perspective’. With multi-agency support and with a multi-disciplinary membership, it is reviewing a wide range of information about the supply of plastics and microplastics to the ocean, and the biological, chemical and physical processes controlling fate, fate and effects of both microplastic particles and microbeads on the environment of our planet. It will provide an evidence base for use by policy makers, national bodies, other stakeholders, and help to develop research priorities. The poster will describe the Terms of Reference, work programme, membership and intended outcomes of the Group and will invite an issue to SETAC Europe participants to become involved in this initiative.

TU 024
Marine micro litter under the marine strategy framework directive - science and policy
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1European Commission Joint Research Centre, Ispra (va), Italy
2University of Plymouth, Plymouth, United Kingdom
3Plymouth University, School of Marine Science and Engineering, Plymouth, United Kingdom
The European Marine Strategy Framework Directive 2008/65/EC (MSFD) recognises Marine Litter as one of the indicators for the Environmental State of the European Seas. The MSFD sets the assessment criteria and methodologies for the good environmental status (GES) of marine waters (Commission Decision 2010/477/EU). Its specific indicators for assessment of Marine Litter. Indicator 10.1.3 regards marine micro-particles, in particular micro-plastics: “Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)“ “Trends in the average amount of litter in the water column (including floating at the surface) and deposited on the sea-floor, including analysis of its composition, spatial distribution and, where possible, source (10.1.2)“ “Trends in the amount, distribution and, where possible, composition of micro-particles and (10.1.3)“ “Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis)“ (10.2.1). A technical working group under the MSFD implementation strategy has prepared technical recommendations in support of the implementation of the directive by EU Member States. The group identified options and available tools for the monitoring of Marine Litter and developed a roadmap showing the necessary next steps in preparing the implementation of the directive. The poster is presenting specific information regarding marine micro litter under the MSFD.

TU 025
Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters
S.S. Sadri1, M. Edwards2, R.C. Thompson3
1University of Plymouth, Plymouth, United Kingdom
2Sir Alister Hardy Foundation for Ocean Science (SAHFOS), Plymouth, United Kingdom
3Plymouth University, School of Marine Science and Engineering, Plymouth, United Kingdom
Fragmentation of plastics debris into “microplastic” pieces is an emerging issue of concern. Our knowledge of distribution and accumulation of microplastics is patchy and in order to quantity and monitor the distribution and in particular temporal trends there is a need for a broad sampling programme and standardised methods. The aim of this research is to study the spatiotemporal abundance of microplastic debris in ocean surface waters and our preliminary investigation of microplastic contamination in Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alister Hardy Foundation for Ocean Science (SAHFOS) has confirmed the presence of synthetic polymers in several European locations (North Sea, Irish Sea, English Channel and the North Atlantic). We used Fourier Transform Infrared (FTIR) spectrometry to identify the unknown pieces. The most common plastic types were Polyethylene terephthalate (PET) followed by Nylon and Acrylic but mean abundance was typically less than one item per cubic meter of sea water.

TU 026
Microplastics in personal care products from Brazil: is this source relevant to the aquatic contamination?
G. Filiatti, F. Poleza
FURG, Rio Grande, Brazil
Microplastics in personal care products from Brazil is this source relevant to the aquatic contamination?

TU 027
International Pellet Watch: background levels, hot spots, pollution legacy, and temporal trends
H. Takada1, M. Heskett2, R. Yamashita3, M. Yoyama4, M. Itoh5, T.B. Geok6
1Tokyo University of Agriculture & Technol., Tokyo, Japan
2Surfrider Foundation, Oahu, United States of America
International Pellet Watch (IPW) is a volunteer-based global monitoring program designed to monitor the pollution status of the oceans and to understand the risks associated with plastic debris in marine places. Based on ongoing background pellets of persistent organic pollutants (POPs) have been tentatively determined. By comparison of POPs concentrations in pellets from industrially-developing countries (e.g., Ghana) with the background levels, POPs inputs from e-wastes were suggested. Through global comparison, hot spots of POPs pollution were identified, e.g., Le Havre (France), Athens (Greece), Tokyo Bay (Japan), Sydney Harbor (Australia), Los Angeles, San Francisco, Boston Harbor, New York Bay and Lake Erie (USA), Santos Bay (Brazil). Combination of IPW with passive air sampling indicates that legacy pollution is major contributor to most of the hot spots of PCB pollution. In addition to the spatial variation, pellet watch was applied to reveal temporal trend in POPs pollution in California coast and Tokyo Bay.

TU 028
Partitioning between water and plastics of polychlorinated biphenyls in marine animals
L. Golstein, M. De Klerk, A.J. Hendriks
Radboud University, Nijmegen, Netherlands
The presence of plastic debris in the oceans is a potential hazard for marine animal species in several ways. It is not only the plastics themselves that form a potential hazard. Chemicals like metals are added during plastics production in order to catalyze monomers into polymers and give it different properties. Some of these additives have been associated with carcinogenic and endocrine disrupting effects. Moreover, due to its hydrophobic nature, plastic debris can be a hazard to marine animal species because of accumulation of organic contaminants. An important part are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into non-toxic compounds. As a short time-frame, based on a wide range of health impacts on both wildlife and humans. This study focuses on the equilibrium partitioning of polychlorinated biphenyls after ingestion by marine animals. In order to get more insight in the bioaccumulation potential of these persistent pollutants, we compared plastic-water partitioning, a simplification of the partitioning of plastic additives in the gastric fluid, with octanol-water partitioning. The outcomes will be discussed within the framework of the current knowledge gap and we will describe challenges for future research on this topic.
Potential for increased exposure to persistent organic pollutants through ingestion of marine debris: the relevance of partitioning coefficients

D.P. Kay, J.L. Newsted, C. Berger, J.E. Phillips

Cardno ENTRIX, Okemos, United States of America

An important step in predicting the availability of plastic-sorbed persistent organic pollutants (POPs) to the marine environment is understanding the plastic:water partitioning coefficient (Kpw) for a great number of chemical and plastic combinations. While plastics have the capacity to absorb chemical substances from their surrounding environment, little is known about the factors affecting sorption and desorption of POPs to plastic debris, the abundance and bioavailability of POPs on plastic debris, and the amount of plastics marine organisms consume. One step in understanding the potential for exposure is an evaluation of relevant partition coefficients.

An extensive literature search was performed for this presentation. This review summarizes articles that calculated and presented plastic to water partitioning coefficients. Only published, peer reviewed literature was examined. The results of our review identified Kpw for 22 specific types of polymers and 198 individual compounds representing 24 different chemical groups. Analyses of this data showed a wide range of values (e.g., 0.91 to 7.8 log Kpw) among compounds for any given polymer. Of note, our data suggests a relationship between log Kpw and log Kow (octanol-water partitioning coefficients of POPs).

Consequently, log Kow may act as a surrogate for estimating log Kpw, which could allow for assessment of availability based on known properties of chemicals and plastics.

This finding is of particular importance because of the lack of log Kpw data for a wide array of plastics. A logical next step is to use log Kow to generate log Kpw through modeling of a wide range of plastics in order to understand the potential for these plastics to adsorb POPs in their environment. It would also be possible to further substantiate these findings by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.

TU 030

Determination of DEHP in culture media by GC-MS/MS using PCI Ammonia

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2Center for Environmental Science in Saitama, Saitama, Japan

McGill University, Montreal, quebec, canada

This method is a modification of the targeted phthalate, bis-(2-ethylhexyl) phthalate (DEHP), in culture media by gas chromatography and tandem mass spectrometry (GC-MS/MS) using positive chemical ionization (PCI) with ammonia reagent gas. Phthalates are routinely analyzed in electron ionization (EI) with 149 m/z as the principal ion. Since all phthalates have similar spectra, it is difficult to identify which phthalate is present. By using PCI, the molecular ion is formed. Culture media samples with varying concentrations of DEHP were analyzed on a GC-MS system consisting of an ion-trap series mass spectrometer and a gas chromatograph. Structural elucidation was achieved by performing PCI-MS/MS on the molecular ion. Next, the fragments formed were compared to those in Mass Frontier software, which predicts fragmentation and the mechanisms of product ion formation by comparing the scan results to existing library data. Ammonia was selected as the chemical ionization reagent gas to increase the yield of the molecular ion.

A calibration curve with points at 0.1, 1, 5, and 10 µM were analyzed. The correlation coefficient for this calibration curve was 0.9896. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.

TU 031

Selective uptake of microplastics by a marine bivalve (Mytilus edulis)

L. van Cuilenbergh1, M. Claassens, CR. Janssen

Ghent University, Ghent, Belgium

Microplastics are the degrade products of large plastic debris, are accumulating in marine habitats worldwide. Given their small size (<1 mm) these particles can potentially be ingested by marine animals. Data on the uptake of microplastics in invertebrates is however, scarce. In this study, we tested the hypothesis that the uptake of microplastics from the gut to tissues is size-selective and has an adverse effect on the energy allocation in the mussel. The experiment was carried out with a temperature ranging from two different sizes of microplastics simultaneously (10, 30 and 90 µm). 10 µm particles, as well as 30 µm particles, were added at 50 particles.ml⁻¹ and 90 µm-particles at 10 particles.ml⁻¹, resulting in a total concentration of 110 particles.ml⁻¹. Analysis of the faeces demonstrated that M. edulis filtered and ingested all particle sizes. In the faeces, the 30 and 90 µm-particles were detected in the same ratio as they were added to the seawater (i.e. 3:1). However, the 10 µm-particles were not detected in the faeces. Analyses of the absorption showed that 10 µm-particles were able to translocate to the circulatory system of the mussel. These experiments demonstrated that the energy assimilation from the adductor muscle and on average 15.3 ± 3.2 particles (n=15) were found in the hemolymph of the mussels. This uptake accounts for 0.3% of all 10 µm-particles ingested. The ingestion and uptake of microplastics showed no significant effects on cellular energy allocation. Exposed mussels did show a significant increase in energy consumption, indicating a rise in metabolic activity.

Although microplastics are a very widespread environmental concentration, no significant short-term adverse effects of ingestion and translocation were detected. Long-term exposure studies could however, provide more conclusive answers on the effects of ingestion and uptake of microplastics in Mytilus edulis.

TU 032

Presence of plastic debris in sea turtles stranded along the Tuscany coasts

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1University of Siena, Siena, Italy
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Marine debris has a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in community structure to direct death following blockage of intestinal tract or entanglement.

The main sources of marine debris are litter from ships, fishing and recreational boats, and garbage carried into the sea from land-based sources in industrialized and highly populated areas. Marine debris is an important threat for sea turtles and the evaluation of the impact of plastics on development, survivorship, health and reproduction of sea turtles is highlighted as one of the global research priorities for these threatened species. The loggerhead turtle (Caretta caretta) and the leatherback turtle (Dermochelys coriacea) are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

In this study, samples were collected from live stranded sea turtles and from the gut of dead sea turtles found in the area of Tuscany, Italy. The main portion of the samples was sampled in the dry or wet seasons. If we compare the results with the lowest PNEC found in the literature the 43% of the samples where triclosan was found the concentrations were above 1.4 ng/L. If we using the PNEC value 4,7 ng/L, 40% of the samples presented concentrations above that limit. And even If we apply PNEC of 50, 3 samples were determined as outliers. Further studies in other water bodies in Brazil are needed to determine the ocurrence of plastic debris worldwide.

EP039 - What is the current state of the science on the fate, exposure and effects of pharmaceuticals in the environment?

TU 033

Occurrence of Triclosan in fresh waters from São Paulo State, Brazil - the need for regulatory actions

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Triclosan, 5-chloro-2-(2,4-dichlorophenoxyl)phenol, is a broad-spectrum bactericide used in pharmaceuticals and personal care products of daily use. It is a non-volatile compound (I 10-4 Pa at 20 oC), relatively soluble in water (10 mg/L at 20 oC) with a log Kow of 4.8. Triclosan is highly toxic to aquatic organisms and some PNECs were higher than the lc50 of the plastic debris ingested by Brachydanio rerio (Corydoras paleatus) representing 24 different chemical groups. Analyses of these data showed a wide range of values (e.g., 0.91 to 7.8 log Kpw) among compounds for any given polymer. Of note, our data suggests a relationship between log Kpw and log Kow (octanol-water partitioning coefficients of POPs). Consequently, log Kow may act as a surrogate for estimating log Kpw, which could allow for assessment of availability based on known properties of chemicals and plastics.

This finding is of particular importance because of the lack of log Kpw data for a wide array of plastics. A logical next step is to use log Kow to generate log Kpw through modeling of a wide range of plastics in order to understand the potential for these plastics to adsorb POPs in their environment. It would also be possible to further substantiate these findings by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.

TU 034

First pilot study on the occurrence of UV screens and preservatives in a Victorian estuary

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2Center for Environmental Science in Saitama, Saitama, Japan

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SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
The sorption of chemicals to sorbents like soils or sediments typically depends on several parameters of the sorbent (e.g., pH, ion-exchange capacity, redox potential, organic SWP/4447/00).

Analytical methods sensitive, reliable and robust is an essential step for the characterization of emerging substances in sludge.

In this context, the aim of the study was to develop a method for the large screening of pharmaceuticals and hormonal steroids in sludge. Therefore, nearly two hundred substances were analyzed by liquid chromatography-time-of-flight mass spectrometry. The analysis of complex matrices such as sludge needed a rigorous sample preparation to obtain a repeatable and enough sensitive analysis to achieve the detection limits required. For this purpose, an extraction step using the QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method was set up. This analytical methodology was successfully applied to various kinds of sludge (limed, digested, dried, liquid, composted) collected in several sewage works in France.

Adoption of human pharmaceuticals to activated sludge: how many different sludges should be tested for an environmental risk assessment?

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for treatments. These drugs are excrated mainly via urine. As a result, they may reach the environment after waste water treatment, trough yellow water used as a fertilizer or by direct discharge. There is limited information on the fate of antimicrobials in the environment. It is believed that some of these drugs are rather persistent due to their organohalogon moeties. Hence, the fate of these drugs in the environment might be a subject of concern.

To properly analyze antimicrobial drugs in blood and urine has been published. However, only two methods have been published to analyze a few antimicrobial drugs (aminosarin derivates and chloroquine) in water or soil. For that reason, the first multi-residue method for the analysis of antimarial drugs and their metabolites in water has been developed. The analytical process combines SPE with LC-MS/MS and can be further developed to analyze soil samples. The presented method can be used to determine environmental fate profiles of antimarial drugs in the environment.

TU 040
Matching micropollutant loads of influent and effluent for reliable mass balances in WWTPs
M. Majewsky, J. Farlin, T. Galle, M. Bayerle
CRP Henri Tudor, Esch-sur-alzette, Luxembourg

The understanding of the fate of pollutants such as pharmaceuticals or hormones in a WWTP is usually evaluated by data from long-term time series where variation caused by transient flow and concentration are averaged out. The analyses of micropollutants is however work and cost-intensive and that is why measurement campaigns usually only cover short periods with a small number of samples available to establish a mass balance. Considering that biological reactor tanks are well-mixed systems, a sampling scheme comprising single 24-h composite samples was used to compare 24-h composite influent and effluent samples. The method was applied to determine the mass balances for 13 compounds with QuEChERS extraction for the screening of multi-families of pharmaceuticals and endocrine disruptors in river sediments. The molecules were chosen among the priority pollutants listed in a prioritisation for French surface waters [2], in the Water Framework Directive and within the potential or confirmed EDCs. This selection of 13 compounds allows to evaluate the accuracy of different sampling scenarios as a function of the sampling mode and frequency (Ort et al., 2010) and of the number of samples taken in the inlet and outlet of the WWTP. The aim is to maximally reduce the uncertainty and/or to explain the bulk of the effluent load origin. A relationship can be established between the infrequent pollutant loads that are captured by an effluent sample period and the mass hydraulic retention time (HRT). Based on these findings, we propose to develop a generic method to design sampling strategies in WWTPs without having to rely on prior hydraulic calibration.


Ort, C., Lawrence, M.G., Rieckermann, J., Joss, A., 2010b. Sampling for pharmaceuticals and personal care products (PPCPs) and illicit drugs in wastewater systems: are your conclusions valid? A critical review. Environmental Science & Technology 44 (16), 6024-6035.

TU 041
Occurrence and fate of triclosan and triclocarban during wastewater treatment and biosolid treatment
M.M. Hidalgo, E.P. Sagristà, M.G. Casademont, V.M. Salvador
University of Girona, Girona, Spain

Triclosan (TCS) and triclocarban (TCC) are broad spectrum antimicrobial agents extensively used in a wide variety of personal care products including antibacterial soaps and detergents, shampoos, deodorants, cosmetics, mouth rinses and toothpastes.

During wastewater treatment, the removal efficiency of triclosan and triclocarban from the aqueous phase can be considerable in activated sludge processes but is dependent on the operating conditions. Triclocarban is recalcitrant during the sewage treatment process and is detected in streams and sediments downstream of WWTPs. TCS, TCC and MTCS have lipophilic properties and hence partition to sludge during wastewater treatment and may be present in concentrations ranging from ng kg⁻¹ to µg kg⁻¹. The majority of TCS and TCC are associated to the algae and organic matrix present and the extent of removal during wastewater and sludge treatment. Moreover, the sludge accumulated WWTPs is often processed to produce biosolids intended for land application. Thus, the agricultural recycling of biosolids, the favored option for sludge management, may lead to adverse environmental impacts.

In the present study, TCS, TCC and MTS were monitored in both waters and sludge at different stages within the wastewater treatment process in two WWTPs with different characteristics located in the coastal area of Girona (NE Spain). Moreover, the influence of sludge digestion process on the degradation of target compounds was evaluated by analyzing the resulting digested biosolids under both aerobic and anaerobic conditions. The effect of the temperature on the occurrence of the studied compounds in the final biosolid was also investigated.

TU 042
Dominant time scale of antibiotic concentrations in water bodies through one-year field campaign study
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Among the long list of pharmaceuticals that can be found in the aquatic environment, antibiotics receive important and increasing attention, as they are suspected to foster bacterial resistance. But if many studies have listed their constant presence in water wastes, few of them curiously have focused on the temporal dynamics of their concentrations. In the present study, we compare the relative importance of monthly, weekly, daily, and hourly time scale when assessing the dynamics of antibiotics in waste waters. For this, a one-year experimental sampling campaign was conducted at the Vidy WWTP of Lausanne in Switzerland. One week a month during one year, hourly samples were taken from WWTP influent. Samples were aggregated together to obtain measured hourly variations, daily variations, monthly variations and seasonal variations. A total of more than 180 samples over year 2011 were analyzed using UPLC-MSMS, and the concentrations of 9 antibiotics (azithromycin, ciprofloxacin, ofloxacin, clarithromycin, clindamycin, metronidazol, norfloxacin, sulfamethoxazol, trimetopen) compared. We conclude that even if a seasonal trend for concentrations can be observed for several substances, the hourly time scale totally dominates the temporal fluctuations of concentrations. In other words, there is a high hourly fluctuation of antibiotics concentrations, which is superior in magnitude to other (daily or seasonal) time scales. Thus, more efforts in terms of modelling and treatment optimization should be conducted at this temporal resolution (hour) for antibiotics, in order to reduce the risk they can represent for the environment.

TU 043
Quantification of pharmaceuticals and endocrine disruptors in river sediments: results of a study and validation of a QuxECHERS based extraction
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Accessing exposure concentrations can be challenging for the analyst as environmental concentrations and toxicological or eco-toxicological effect induced quantities are often far from each other in the same matrix. Moreover, the measurement of these compounds is not a trivial task due to their high concentration and purification steps like Accelerated Solvent Extraction (ASE) and Solid Phase Extraction (SPE) to extract and analyse pharmaceuticals or hormones at the lower or sub ng/g level from solid matrices. A recent extraction method known as Quick Easy Effective Rugged and Safe has been developed for the analysis of pesticides in food matrices. This recent method was optimized and validated in our laboratory. We developed and validated a multiseries analytical method with QuxECHERS extraction for the screening of multi-families of pharmaceuticals and endocrine disruptors in river sediments. The molecules were chosen among the priority pollutants listed in a prioritisation for French surface waters [2], in the Water Framework Directive and within the potential or confirmed EDCs. This selection of 13 pharmaceuticals includes β-blockers, anti-inflammatory, hormones, anxiolitics, anti-depressants and anti-antagonists 24 EDCs includes pesticides, alkylphenols, hormones and phenolic derivates and. Quantification is performed on a 3200QTrap tandem mass spectrometer (MS/MS) coupled to Liquid Chromatography (LC) Agilent 1200 system with a Kinetex XB-C18 column (100x2.1mm, 1.7/µm).

Extraction was optimized to get acceptable recoveries (>60%) and the linearity of the method has been verified by statistical means. Acceptable Relative Standard Deviations of both injection and preparation steps (<20 to 30%) were calculated for intraday injections of 3 independent solutions. Repetition of a calibration over three days allowed to calculate good interday RSD. Limits of quantification were determined by injection of 5 independent standard solutions and were consistent with environmental balances lead to erroneous values.

References

TU 044
Developing a miniaturized push-pull test to study the transformation of pharmaceuticals in the hyporheic zone of rivers
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The hyporheic zone is a key compartment for the attenuation of organic micropollutants in rivers. The comparatively slow flow velocity, the continuous import of nutrients and oxygen, and the export of metabolic waste provide ideal conditions for microbial transformation processes. A better characterization of hyporheic processes would substantially improve the quantification of the self-purification capacity of streams. Unfortunately, measuring transformation rates of organic micropollutants directly in the hyporheic zone is often limited due to technical and/or experimental methods. Therefore, we are developing a miniaturized push-pull methodology that allows measuring transformation rates of pharmaceuticals directly in the hyporheic zone.

Push-pull tests are an established method of testing the transformation capacity of aquifers with respect to organic or inorganic contaminants. There, a solution containing a set of conservative and reactive tracers is injected (“push”) into an aquifer and after a certain time the groundwater is extracted (“pull”) through the same well. The difference between conservative and reactive tracer recovery can then be estimated to determine the transformation rates. The aim of our study is to downscale this approach so that it can be conducted at this temporal resolution (hour) for antibiotics, in order to reduce the risk they can represent for the environment.
be used on the spatial scale of centimetres to decimetres. The experimental concept is validated in a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, we applied the approach successfully to measure retention of several pharmaceuticals at residence times of up to 16 hours; longer residence times will be evaluated. Currently, we are testing the approach in in situ bioassays with a variety of pharmaceuticals and, in addition, with some reference compounds. Our contribution will summarize the experimental concept and the major finding of this method development study, and it will highlight the potential of the method for improving our understanding of hyporheic processes and thus of the environmental fate of organic micropollutants.

TU 045
Comparative analysis of emerging concern discharges from a centralized municipal treatment plant and on-site wastewater treatment systems receiving community wastewater input


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Though over 25% of the United States population employs decentralized on-site technologies for wastewater treatment, a comparative understanding of treatment efficiencies of these systems remains less understood than those from centralized municipal wastewater treatment plants. In fact, it is estimated that 10 to 20 percent of these systems malfunction annually, releasing untreated wastewater to groundwater and surface water, which can degrade water quality and result in impacts on surface waters in regions experiencing drought - surface water exchange. Even less understood is a comparative understanding of water contaminants of emerging concern (CECs) associated with these systems and subsequent loadings to the environment. The primary objective of this study was to assess the occurrence and removal efficiencies of select CECs among different wastewater treatment systems. Our study further examined the occurrence of CECs, including 69% of abused metabolites, between weekday and weekend sampling events. The studied CECs covered a variety of common pharmaceutical classes, including analgesic, anti-hypertension, antibiotic, psychostimulant metabolites, antimetanase, anti-seizure, benzodiazepine, anti-coagulant, anti-inflammatory, antilipemic, caffeine, and the artificial sweetener sucralose, which appears to represent a robust tracer of anthropogenic activity. In addition, CECs were analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS) method and classified with independent isotopically-labeled standards for quantification of each compound was applied to quantitate target analytes for all samples. ANOVA was performed to test differences of treatment type, and season on CEC concentrations and other routine water quality parameters. Results showed that concentrations of CECs are typically in the range of 10-100 ng/L in the effluent discharge, which are generally consistent with peer-reviewed literature reports for these CECs. CEC concentrations from advanced on-site systems were reduced relative to septic systems. The present study, which included CECs with varied physicochemical properties, provides an initial understanding of the range of environmental loadings from community on-site wastewater treatment systems.

TU 046
Water-sediment biodegradation: challenges in modeling and screening for pharmaceutical transformation products

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The current OECD 308 test is a water-sediment simulation test that is typically conducted over a 100 - 200 day period. It is intended to estimate the parent half life in the water phase, sediment phase and collectively in the total water-sediment system; determine the distribution and mass balance of the residues in the test system; as well as check for the transformation products formed. Given the length and cost of this test, it is an expensive and costs associated with conducting the test, it is often desired that a more rapid screen for assessing the potential transformation of pharmaceuticals would be available. Such information would be helpful in developing the ERA testing strategy especially when the identification of a key transformation product would be helpful early on in the risk assessment. The goal is to develop a sampling strategy for assessing the conditions under which the transformation products identified in the OECD 308 study and compares those to what may be predicted in an expert system to understand how selective the predictions may be and what additional information might be helpful in making a predicted pathway more realistic. Challenges in screening for water-sediment transformations in a laboratory test are also discussed to assess how such a test might be performed. For both situations, case studies will be presented to highlight some of the challenges present in advancing these further.

TU 047
A comparison of fish bioconcentration factors for several pharmaceutical compounds obtained following the standard OECD 305 Protocol and the estimated BCFs obtained using the reduced sampling method

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Understanding whether an active pharmaceutical ingredient is likely to be taken up by the aquatic environment by fish and bioaccumulate has triggered the need to conduct bioconcentration studies in fish. Such studies are typically considered appropriate for pharmaceuticals having a logD value > 3 and required, as per the EMA Guideline, for pharmaceuticals having logD values > 4.5. The standard OECD Guideline 305 includes an exposure (uptake) phase followed by a post-exposure (depuration) phase typically equal to the duration of the uptake phase. During the uptake phase, ranging between 14 and 60 days, water and fish samples are analyzed periodically until steady state has been established and the depuration phase may be initiated. During the depuration phase, analysis of water and fish samples continues until a plateau has been reached. Based on the sampling schedule outlined in the guideline, >100 fish per study may be required to determine a kinetic bioconcentration factor (BCF). In an effort to reduce the number of fish required to obtain a BCF, an approach to estimating the kinetic bioconcentration factor using reduced sampling has been developed (Springer, et al,2008). This reduced sampling approach aims to estimate BCFs using a minimum number of sampling time points and therefore a reduced number of fish. The goal of this project is compare the BCFs of several active pharmaceuticals obtained through standard OECD 305 test methods with those BCFs determined using the approach of estimating aquatic bioconcentration factors using the reduced sampling method.

TU 048
Waterborne beclomethasone dipropionate affects fish while beclomethasone is not taken up

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Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activity as well as being used in the treatment of chronic rhinitis. It is administered as the more lipophilic propdrug beclomethasone dipropionate (BDP), which is metabolized to the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborne BDP (1 µg/L nominal concentration) on plasma glucose levels in fish. Although levels of beclomethasone and its lipid esters in effluents or surface waters are not known, it can be assumed that most of the consumed product BMP has been realized into the less lipophilic forms before reaching the environment. We have therefore compared the potential of beclomethasone and BDP to bioconcentrate and to affect the physiology of exposed fish. Controlled flow-through studies with rainbow trout over two weeks to up to 0.65 µg of beclomethasone/L did not result in measurable plasma levels. Exposure to 0.65 µg/L BDP, on the other hand, led to accumulation of both beclomethasone, BMP and BDP in plasma, indicating a considerably more efficient uptake of the more lipophilic propdrug as well as metabolism within the fish. Accordingly, exposure to 0.65 µg/L of BDP significantly increased blood glucose levels, in agreement with previously published results. Furthermore, we could demonstrate a parallel increase in catalase activity in liver tissue, while exposure to beclomethasone had no effect on these endpoints. We are currently screening for beclomethasone, BMP and BDP in sewage effluents and surface water.

TU 049
The degradation of antidepressant pharmaceuticals in aerobic sludge

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The antidepressant pharmaceuticals sertraline and venlafaxine are common contaminants in both aquatic and terrestrial environments and are reported to produce adverse effects on a range of aquatic organisms. A key point of entry of pharmaceuticals into the environment is through wastewater treatment. To learn whether microbial communities in wastewater sludge have the ability to degrade sertraline and venlafaxine and, thus, consequently reduce their environmental loads, microcosms containing aerobic sludge were spiked with sertraline and venlafaxine. Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by micellar liquid chromatography followed by liquid chromatography tandem mass spectrometry (LC-MS/MS). Municipal aerobic wastewater sludge was found to degrade sertraline and venlafaxine by over 90% over the course of 36 days, whereas no change in the added sertraline and venlafaxine concentrations were observed in abiotic control microcosms.

TU 050
Time trend of cyclic volatile methyl siloxanes in Baltic herring

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Cyclic volatile methyl siloxanes (cVMS) were monitored in the fish from the Swedish environmental sample bank. Fish from a site from the Baltic Proper southeast of Stockholm (Landsort) and from the northern part of the Bothnian Bay (Harjufjärden) were analysed. Skinless dorsal muscle samples from six individuals were pooled. Two pooled samples were analysed from each site for every sample year from the period 1989 - 2009. Octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5) and dodecamethylcyclohexasiloxane (D6) were analysed. The D5 concentrations were of the 50 ng/g lipid weight, while the concentrations of D4 and D6 were lower and frequently below the MDL. The concentrations were generally lower at the beginning of the period and highest around 2005-2007. There were no marked differences in concentration in the time trends.

TU 051
Degradation studies of the ionophores lasalocid, monensin, narasin, and salinomycin


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Though over 25% of the United States population employs decentralized on-site technologies for wastewater treatment, a comparative understanding of treatment efficiencies of these systems remains less understood than those from centralized municipal wastewater treatment plants. In fact, it is estimated that 10 to 20 percent of these systems malfunction annually, releasing untreated wastewater to groundwater and surface water, which can degrade water quality and result in impacts on surface waters in regions experiencing drought - surface water exchange. Even less understood is a comparative understanding of water contaminants of emerging concern (CECs) associated with these systems and subsequent loadings to the environment. The primary objective of this study was to assess the occurrence and removal efficiencies of select CECs among different wastewater treatment systems. Our study further examined the occurrence of CECs, including 69% of abused metabolites, between weekday and weekend sampling events. The studied CECs covered a variety of common pharmaceutical classes, including analgesic, anti-hypertension, antibiotic, psychostimulant metabolites, antimetanase, anti-seizure, benzodiazepine, anti-coagulant, anti-inflammatory, antilipemic, caffeine, and the artificial sweetener sucralose, which appears to represent a robust tracer of anthropogenic activity. In addition, CECs were analyzed by liquid chromatography tandem mass spectrometry (LC-MS/MS) method and classified with independent isotopically-labeled standards for quantification of each compound was applied to quantitate target analytes for all samples. ANOVA was performed to test differences of treatment type, and season on CEC concentrations and other routine water quality parameters. Results showed that concentrations of CECs are typically in the range of <1-100 ng/L in the effluent discharges, which are generally consistent with peer-reviewed literature reports for these CECs. CEC concentrations from advanced on-site systems were reduced relative to septic systems. The present study, which included CECs with varied physicochemical properties, provides an initial understanding of the range of environmental loadings from community on-site wastewater treatment systems.
it was possible to assess the influence on sorption of: organic matter content; pH; moisture; fine fraction content and cation/anion exchange capacities. Other external factors

Sorption process of three sulfonylurea based of anti-diabetic drugs were tested on three various soil. Selected soils differed in their physical and chemical properties and thus,

anthelmintics, albendazole and flubendazole, were the most dominant. In some receiving water samples, veterinary anthelmintics showed higher proportion than human

HTPs, rivers and seawater. Additionally, the livestock wastewater treatment plants (LWTPs) were surveyed to assess the concentrations of anthelmintics. The LWTPs and

compared to measured concentrations obtained with POCIS passive samplers. Data on pharmaceuticals in the coastal zone are scare and PECs and diffusion model might

molecular transfer is a prerequisite for the uptake of organic pollutants by organisms, the bioavailability of a given compound and thus its rate of biotransformation, is

that huge amounts of these pharmaceuticals and their metabolites are deposited in the environment due to excretion from humans and because of the improper utilization

by these drugs is by sewage. Therefore, the most endangered are natural waters, soils and sediments. Composing the composition of these matrices it is obvious that the most dominant interaction are sorption and biodegradation processes. Transport of the compound in porous media, such as soils, sediments and aquifers, is strongly influenced by its tendency to sorb on to the various components of the solid matrix. Furthermore, since molecular transfer is a prerequisite for the uptake of organic pollutants by organisms, the bioavailability of a given compound and thus its rate of biotransformation, is affected by these processes.

SORPTION PROCESS OF THREE SULFONYLUREA BASED OF ANTI-DIABETIC DRUGS WERE TESTED ON THREE VARIOUS SOIL. SELECTED SOILS DIFFERED IN THEIR PHYSICAL AND CHEMICAL PROPERTIES AND thus, sorption process of these pharmaceuticals on soils is a relevant process for the fate of these compounds in the environment. Sorption is a complex and multistep process that depends on the physicochemical properties of the individual compounds, the soil properties, and several environmental factors. In this study, the influence of organic matter content, pH, moisture, fine fraction content, and cation/anion exchange capacities on the sorption of three sulfonylurea-based anti-diabetic drugs (sulfonylurea, glimepiride, and gliptidone) was investigated.

The results indicated that the sorption behavior of these drugs was influenced by the physicochemical properties of the soils. Organic matter content was found to be a significant factor affecting the sorption of these drugs. A higher organic matter content resulted in a lower sorption capacity of the soils. pH also played a crucial role in the sorption process, with higher pH values leading to increased sorption.

Moreover, the fine fraction content of the soils was observed to influence the sorption behavior of the drugs. A higher fine fraction content was associated with a higher sorption capacity. This is likely due to the higher surface area and greater number of functional groups available for sorption in these soils.

Cation/anion exchange capacities were also found to have a significant impact on the sorption of these drugs. The soils with higher exchange capacities showed higher sorption capacities for the drugs.

In conclusion, the sorption of sulfonylurea-based anti-diabetic drugs on soils is a complex process that is influenced by several factors, including organic matter content, pH, fine fraction content, and cation/anion exchange capacities. These factors should be considered when predicting the fate and transport of these drugs in the environment.
of photodegradation of two antibiotics often found in the environment: a veterinary drug, tylosin (916 g/mole, pKa = 7.1) and a human drug sulfamethoxazole (253 g/mole, pKa = 5.7). Two photocatalysts (titanium dioxide) have been used: PC500 (Millenium) and P25 (Degussa). Two modes of immobilization have been tested: on a glass plate in the lab for both photocatalysts or on cellulose fibers for PC500 only (Ahlstrom, Pont-Evêque, France). Antibiotics degradation was monitored by UV-visible spectrometry and HPLC. End products (organic carbon and nitrogen species) were also quantified. Degradation was observed, P35 being more efficient than PC500. Besides the mode of immobilization, other parameters have been investigated such as pH, position of the lamp, flowrate and antibiotic initial concentration.

TU 057
Direct and indirect photolysis of human metabolites of antibiotic sulfamethoxazole
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Both direct and indirect photodegradation processes have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX is transformed into human metabolites, yet their environmental fate is not known. In this study, we assessed the direct and indirect photodegradation kinetics at 3 different pHs of 5 human metabolites of SMX, namely, nitro-SMX, nitroso-SMX, acetyl-SMX, hydroxyl-SMX and SMX-glucuronide. Similar to SMX, all metabolites were photolabile, however, with the exception of SMX-glucuronide, half-lives were all greater than that of the parent compound. The photolysis rate constants and degradation rate. Slowest direct photolysis rates were observed at environmentally relevant pH 8.4, where the anionic form of the compounds predominates, except for SMX-glucuronide. The faster degradation of photolysis at the basic pH was attributed to SMX-glucuronide missing a basic functionality; therefore, in contrast to SMX and other metabolites, it remains in its neutral and more photoreactive form at environmental pH. In presence of sensitizers, humic acid and nitrate, which photoreducible and reactive O, and/or triplet excited state dissolved organic matter (DOM) and hydroxyl radicals, SMX metabolites degraded faster. The contribution of indirect photolysis to the overall photolysis was found to be greatest for nitro-SMX (70% in presence of 10 mg/L of humic acid). Experiments conducted in lake water (1.19 mg/L NO3-N; 2.43 mg/LTOC) showed degradation rates comparable to humic acid experiments. Furthermore, we examined the occurrence of SMX and metabolites in the proximity of a wastewater discharge in Lake Geneva, Switzerland. Two human metabolites of SMX, acetyl-SMX and SMX-glucuronide were regularly detected in wastewater effluent and lake water samples, in concentrations lower than that of the parent compound.

TU 058
Ubiquitous distribution of sulfamethoxazole in tropical Asian and African waters
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Human and veterinary antibiotics have been widely detected in municipal and agricultural wastewater and receiving waters. Antibiotics are biologically active and their ecological impacts have been of concern. Especially, induction of antibiotics resistance is of great concern. Very limited information is available on antibiotics in tropical waters. In this study, low-grade effluents and drainages and plant and animal production areas of the tropical areas. This includes sewage and livestock wastewaters of India, Indonesia and Philippines. Sulfamethoxazole (SMX) was selected as a model compound due to its low environmental mobility and dominance of SMX can be ascribed to lower price of the medicine. Concentrations and compositions of livestock and agricultural wastewater were highly variable. In many cases, sulfamethazine, oxytetracycline, lincomycin, and trimethoprim were predominant among the antibiotics.

TU 060
Environmental fate, occurrence and toxicity of the antiparasitic pharmaceutical toxtrazuril
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Toltrazuril (Tol) is an organohalogenic endoparasitic pharmaceutical used in the acute and prophylactic treatment of livestock such as poultry, piglets, sheep and cattle against parasites [1] as a result the use of toltrazuril is expected to be escalating. Comprehensive evaluation of the impact of Triclosan in the terrestrial environment
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Triclosan is a chlorinated aromatic compound which is used as an active ingredient in numerous household products and toothpastes. Due to its widespread use, Triclosan is known to be present in the environment in many countries worldwide. However, the fate of Triclosan in the environment is not well understood. The objective of this study was to investigate the environmental fate of Triclosan in different environmental matrices using pressurized liquid extraction (PLE) and liquid chromatography-tandem mass spectrometry (LC-MS/MS) analysis. The results showed that Triclosan is highly persistent in environmental matrices and is resistant to degradation by natural processes such as photolysis and hydrolysis. The findings of this study have important implications for the environmental risk assessment of Triclosan and similar compounds.
A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment was performed. This evaluation included the effect of TCS on soil microbial respiration and metabolism, effects on terrestrial arthropods, and effects on plants. It has been found that TCS can inhibit microbial respiration and metabolism, affect soil microbial communities, and have adverse effects on terrestrial arthropods and plants. However, the overall risk assessment of TCS in the terrestrial environment is still limited and requires further investigation.

PET 069
Environmental risk assessment for the polymeric musk AHTN and HHCB in the Molgora river (Lombardia Region, Italy)

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Polymeric synthetic musk (PCMs) compounds are used as fragrances in a wide array of personal care products. The two most important PCM compounds are galaxolide (HHCB) and tonalide (AHTN), which partition to sewage sludge during municipal sewage treatment, and following application of sludge to land as fertilizer. There is a potential for chemical residues in soils. With the rapid growth of the human population, water use re-use practices are diverse and increasingly global. The irrigation of crops with raw or treated wastewater could act as a potential source of APIs to the food chain. Exposure via this route and its significance is not currently considered within ERA guidance. The disposal of unused medicines is also of interest, and recent monitoring studies have shown that drugs disposed to landfill can potentially leach out and contaminate local groundwater and surface water. This poster presentation describes a risk assessment for pharmaceuticals associated with emission potential routes to the terrestrial environment: application of biosolids to agricultural land; leaching of diffuse natural soil; leaching of unused medicines to landfill. The potential risks have been evaluated with modelling techniques contained within the European Commission’s technical guidelines, and where input parameters are not available, estimation methods have been adopted. The assessment highlights the relative risk between each of these emission routes and how uncertainty in key parameters can affect the outcome. This indicates the potential need for additional pharmaceutical fate study data in order to carry out robust risk assessments associated with the terrestrial environment.

PET 070
Does price pressure on medicines result in more pollution?

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Pharmaceutical industries own and market more of their active pharmaceutical ingredients (APIs) to low income countries. We have previously shown that some bulk drug manufacturers in Patancheru, India pollute the surrounding environment with very high concentrations of a variety of APIs, including broad-spectrum antibiotics and corticosteroids, in sewage sludge. Studies of the world suggest that this is not an isolated problem. However, information on whom, where and under what circumstances the API of a given pharmaceutical product is produced is not publically available. This effectively prevents prescribers and consumers to make environmentally informed decision, and thus reduces incentives for API manufacturers to invest in green production technologies. The Swedish Medical Products Agency has information on where and by whom the API is produced for products approved for the Swedish market, data which can be accessible for research purposes. A smaller, previous study of ours demonstrated for AHTN that price and environmental performance indexes in the manufacturing plant. Such surrogate measures are used as conclusive information on pollution level is lacking for most

PET 068
A concordance assessment of Predicted-No-Effect-Concentration (PNEC) aquatic toxicity data for pharmaceuticals

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3|Pharmaceuticals

Environmental safety assessments are required for market approval of new Active Pharmaceutical Ingredients (APIs) (in the EU and to a lesser extent in the US), however, such assessments may be lacking for older drugs. To determine whether available environmental toxicity data can be used to make PNEC predictions for APIs for which effect data are lacking, we analyzed publically available data for 197 APIs. The APIs included in the Stockholm County Council booklet, Environmental Protection Agency’s 2013 Edition were used as representative APIs for the purposes of the analysis. For each of the compounds in the booklet as having a PNEC generated (195), and an additional two, the supporting data were extracted from the Swedish National Formulary website (www.FASS.se) and parsed to facilitate statistical treatment. Following an outlier analysis, the dataset was used to evaluate statistical correlations between the PNEC and trophic level (alga, fish, invertebrate), water quality, chemical type (EC50, NOEC, LOEC) assessment factor, and Anatomical Therapeutic Chemical (ATC) Classification System group. Based on the findings of the statistical analysis, we calculate two potential approaches for generating PNECs for APIs for which no effect data are available, discuss their strengths and weaknesses and future development needs.

PET 066
The ScenAT exposure model: a novel spatial method to inform environmental risk assessments of personal care products in China

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Pharmaceutical industries outsource more and more of their manufacturing of active pharmaceutical ingredients (API) to low income countries. We have previously shown that a concordance assessment (PNEC) aquatic toxicity data for pharmaceuticals. In China, the economy has grown significantly and so has the demand for personal care (HPC) products. The detection of chemicals used in HPC products is increasing in profile as China develops models for use in prediction of environmental concentrations (PEC). Data required to accurately determine PECs of HPC chemicals include product usage information, physicochemical properties, environmental behaviour (e.g. persistence, adsorption) and use of environmental information (e.g. receiving water bodies, contamination type). There is a lot of variability in the data types and sources used in evaluation of PECs allowing PECs to be generated at a more spatially resolved level (e.g., 2769 counties in China). Per capita water use values were sourced at the province level and the population connected to STPs were calculated using per capita water use and the STP domestic consumption discharge. Dilution factors were calculated per capita using the contribution area and waste flow. Predicted environmental concentrations were determined using the fraction removed in STPs or in the river, the domestic water use per capita, the annual tonnage of ingredient used, the population dilution factors in receiving waters. The highest PECs can be seen in North and East China. These areas have increased water scarcity and contain larger densely populated cities like Beijing and Shanghai that will contribute to the increased concentrations. Model validation is difficult due to the short term measures. Therefore a qualitative assessment was performed to determine if spatial patterns of water quality were consistent with data published by the Ministry of Environmental Protection. The results show the PECs are qualitatively consistent with other spatial assessments of water quality. The model fits neatly within a unit world approach (e.g. EUSES, RAIDAR and USEtox), which is quick and easy to run and catchment scale models (e.g. GREATER and PlaTe) which give a better approximation of real world but are complex and data heavy.

TU 065
Risk assessment of pharmaceuticals incidentally discharged to the terrestrial environment

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Setac Environmental Impact Assessment (ERAA) of pharmaceuticals mainly considers the aquatic compartment, since the majority of active pharmaceutical chemicals (APIs) are hydrophilic with more than 80% solubility in water. Therefore, soil and sewage sludge during municipal sewage treatment, and following application of sludge to land as fertilizer is a potential for chemical residues in soils. The Rapid growth of the human population, water use re-use practices are diverse and increasingly global. The irrigation of crops with raw or treated wastewater could act as a potential source of APIs to the food chain. Exposure via this route and its significance is not currently considered within ERA guidance. The disposal of unused medicines is also of interest, and recent monitoring studies have shown that drugs disposed to landfill can potentially leach out and contaminate local groundwater and surface water. This poster presentation describes a risk assessment for pharmaceuticals associated with emission potential routes to the terrestrial environment: application of biosolids to agricultural land; leaching of diffuse natural soil; leaching of unused medicines to landfill. The potential risks have been evaluated with modelling techniques contained within the European Commission’s technical guidelines, and where input parameters are not available, estimation methods have been adopted. The assessment highlights the relative risk between each of these emission routes and how uncertainty in key parameters can affect the outcome. This indicates the potential need for additional pharmaceutical fate study data in order to carry out robust risk assessments associated with the terrestrial environment.

TU 067
Risk assessment of pharmaceuticals in the aquatic environment

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Environmental safety assessments are required for market approval of new Active Pharmaceutical Ingredients (APIs) (in the EU and to a lesser extent in the US), however, such assessments may be lacking for older drugs. To determine whether available environmental toxicity data can be used to make PNEC predictions for APIs for which effect data are lacking, we analyzed publically available data for 197 APIs. The APIs included in the Stockholm County Council booklet, Environmental Protection Agency’s 2013 Edition were used as representative APIs for the purposes of the analysis. For each of the compounds in the booklet as having a PNEC generated (195), and an additional two, the supporting data were extracted from the Swedish National Formulary website (www.FASS.se) and parsed to facilitate statistical treatment. Following an outlier analysis, the dataset was used to evaluate statistical correlations between the PNEC and trophic level (alga, fish, invertebrate), benchmark type (EC50/NOEC), assessment factor, and Anatomical Therapeutic Chemical (ATC) Classification System group. Based on the findings of the statistical analysis, we calculate two potential approaches for generating PNECs for APIs for which no effect data are available, discuss their strengths and weaknesses and future development needs.

TU 069
Risk assessment of pharmaceuticals in the aquatic environment

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Pharmaceutical industries own and market more of their active pharmaceutical ingredients (API) to low income countries. We have previously shown that some bulk drug manufacturers in Patancheru, India pollute the surrounding environment with very high concentrations of a variety of APIs, including broad-spectrum antibiotics and corticosteroids, in sewage sludge. Studies of the world suggest that this is not an isolated problem. However, information on whom, where and under what circumstances the API of a given pharmaceutical product is produced is not publically available. This effectively prevents prescribers and consumers to make environmentally informed decision, and thus reduces incentives for API manufacturers to invest in green production technologies. The Swedish Medical Products Agency has information on where and by whom the API is produced for products approved for the Swedish market, data which can be accessible for research purposes. A smaller, previous study of ours demonstrated for AHTN that price and environmental performance indexes in the manufacturing plant. Such surrogate measures are used as conclusive information on pollution level is lacking for most
TU 074

Transcriptome analysis of the brain of the gilthead sea bream (Sparus aurata) after exposure to environmental concentrations of human pharmaceuticals

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Atenolol (AT) were used as model compounds to assess the effects of low level, long term exposure on the expression of the brain transcriptome.

TU 075

Chronic effect of atenolol on physiological indices in rainbow trout (Oncorhynchus mykiss)

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Atenolol (AT) were used as model compounds to assess the effects of low level, long term exposure on the expression of the brain transcriptome.

TU 076

Functional annotation clustering and enrichment analysis of APAP and CBZ candidate genes in DAVID revealed treatment specific activation of different pathways and degradation mechanisms based on piperazinyl dealkylation and decarboxylation are proposed. Furthermore, their genotoxicity using the cytokinesis-block micronucleus assay with the hepatocellular liver carcinoma cell line (HepG2) was studied and demonstrated that a long irradiation time (greater than 30 min) is required to eliminate possible genotoxic effects.

TU 077

Ecoxicity of 14 serotonergic pharmaceuticals in the crucian daphnia magna, the microalgae Pseudokirchneriella subcapitata and the marine gastropod Halititus tuberculata

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The serotonin, also named 5-hydroxytryptamine (5-HT), acts both as a neurotransmitter or as an hormone, depending on its localization. The presented work investigated the ecotoxicological effects of 14 pharmaceuticals, which are being used to treat several diseases, such as depression, anxiety, and other neurological disorders. The results showed that some of the tested pharmaceuticals had significant effects on the growth and reproduction of Daphnia magna and the microalgae Pseudokirchneriella subcapitata. The findings highlight the potential risks of these compounds to aquatic ecosystems.
molecules are mainly antidepressants (fluoxetine, sertraline, paroxetine, fluvoxamine, citalopram, clomipramine, amitriptyline, mianserin, mirtazapine, duloxetine, venlafaxine) but also antipsychotic drug (clozapine), cough suppressant/hallucinogen drug (dextromethorphan) or beta-blocker (propanolol). But these molecules have the common property to play directly or indirectly a role on the serotonin transporter and/or serotonin receptors. The 14 molecules were tested for their ecotoxicological effects using chronic and acute protocols on the microalgae Pseudokirchneriella subcapitata and the crustacean Daphnia magna. Additionally to these conventional bioassays, a novel bioassay was developed using primary cell culture of hemocytes from the marine gastropod abalone (Halostis tuberculata). This assay was used in order to address the question of pharmaceuticals effects in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to (1) determine if the chemical properties of the molecules can explain their toxicity, (2) identify the mode of action of the selected pharmaceuticals.

TU 079
Environmental effects of anticholinesterase therapeutic drugs on a crustacean species, Daphnia magna

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The environmental presence of pharmaceutical drugs is nowadays an important field of toxicology, since the presence of such residues can cause a series of deleterious effects on exposed biota. This study assessed the ecotoxicological effects of two anticholinesterase therapeutic drugs, neostigmine and pyridostigmine in Daphnia magna. This evaluation was performed in the context of a sublethal chronic bioassay (growth rate, feeding inhibition and reproduction) and for different concentrations of the two compounds. The pharmacological effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to treat the human disease myasthenia gravis. We observed alterations at the individual parameter directly related to the anticholinesterase activity. Our study calculated 48 h-EC10, values in the immobilization assay of 167.7 μg L\(^{-1}\) for neostigmine, and 8.5 μg L\(^{-1}\) for pyridostigmine, respectively, followed by the fecundity (LOEC of 41.9 μg L\(^{-1}\) and 11.4 μg L\(^{-1}\) for neostigmine and pyridostigmine, respectively). We also determined a 48 h-EC10 for cholinesterase activity of 1.7 and 4.5 μg L\(^{-1}\) for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for D. magna at concentrations in the order of μg L\(^{-1}\) . By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L\(^{-1}\)), it is possible that this compound can significantly affect the feeding behavior of D. magna. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

TU 079
Acute and chronic tests of Tamoxifen and its metabolites on Daphnia pulex

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Drugs administered in aquatic systems are eliminated through the excreta in either intact or metabolized form. As other drugs, chemotherapeutic drug residues were measured in wastewater and nitrate exufluent effluents. They reach the differently the environment where they have the potential to persist. Consequently, their prolonged presence in surface water exposes the fauna and flora to potential adverse effects.

Tamoxifen is a synthetic non-steroidal anti-estrogen analog inhibiting competitively estrogen receptors. This drug is mostly metabolized into metabolites such as Endoxifen and 4-hydroxy-tamoxifen (4-OH-Tam). It was recently discovered that the pharmacological activity of those two metabolites are more potent than the original molecule in vitro. As no literature exists on acute and chronic effects of these metabolites on aquatic organisms, Daphnia pulex have been exposed to Tamoxifen and its two metabolites in acute and sub-acute tests. In acute tests, the concentrations that induced an effect on 50% of the tested organisms (EC50) were quite similar for Tamoxifen and 4-OH-Tam, i.e. 0.52 and 0.60 μg/ml respectively. Even if endoxifen showed higher EC50 (1.09 μg/ml) signs of distress were observed on daphnids exposed to low concentrations of its metabolites on aquatic ecosystems. Days, and the viability of the neonates is also evaluated. Such tests should give a better assessment than acute tests of the potential ecotoxicological impact of Tamoxifen and its metabolites on aquatic ecosystems.

TU 080
Calmodulin inhibition as a mode-of-action of antifungal imidazole pharmaceuticals in non-target organisms: implications for mixture toxicity assessment

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Imidazoles are known as antifungal agents interfering with synthesis of ergosterol in fungi. However, imidazoles are also competitive antagonists of calmodulin (CaM). CaM is a calcium binding protein expressed in all eukaryotic cells, where it participates in many signalling pathways (e.g. nitric oxide signaling), thereby affecting many different cellular functions, particularly neurosecretory activity. Invertebrates are unable to synthesize sterols relying on dietary sources; the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothesized that exposure to imidazoles disrupt CaM-dependent nitric oxide synthesis in microcrustaceans. Further, assuming CaM inhibition to be the primary MOA for these substances, we evaluated CA model as a tool for assessing mixture toxicity of imidazoles.

We investigated in microcrustacean P. micans the single and combined effects of four imidazoles (esaconazole and ketoconazole) in adult specimens of the crustacean Nitocra spinipes (Copoeoda, Harpacticoida). The mixture was tested using fixed ratios of each individual substance (LC50 value). This exposure resulted in a calculated median lethal concentration (based on Toxic Units) of 0.86 (95% CE: lower 0.74; upper 1.01), which shows that the mixture displays concentration additive toxicity. These results highlight the role of CaM as the primary target for these compounds in the crustacean. Moreover, the CaM inhibition mode of action was confirmed by CuSO4, which protected the microcrustacean against the mixture exposure.

TU 081
Behavioural and physiological responses to pharmaceutical exposure in Gammarus spp. and Fucus vesiculosus

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The presence of pharmaceuticals in aquatic environments and can co-occur with psychiatric pharmaceuticals it is important to assess this possible interaction but also antipsychotic drug (clozapine), cough suppressant/hallucinogen drug (dextromethorphan) or beta-blocker (propanolol). These molecules have the common property is addressed to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies
Assessing the environmental hazard of mixtures of pharmaceuticals: combined acute toxicity of fluoxetine and propanolol to the crustacean Daphnia magna

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The aim of the present work is to evaluate the acute toxic response of the crustacean Daphnia magna exposed to individual pharmaceuticals and mixtures. We tested fluoxetine, a selective serotonin reuptake inhibitor widely prescribed as antidepressant, and propanolol, a non-selective β-adrenergic receptor-blocking agent used to treat hypertension, in single and mixed exposure tests according to OECD 202 and ISO 6341 guidelines. Less than 24 h old daphnias were exposed for 48 h. Six replicate vessels with five individuals per vessel were tested at each treatment level. Single chemicals were first tested separately; estimated EC50 were 7.0 mg/L for propanolol and 7.8 mg/L for fluoxetine. Toxicity of binary mixtures was then assessed using a fixed ratio experimental design. Five concentrations (from 0.5 to 2 total toxic units) and 5 percent ratios were selected. The used ratios were based on the metabolite ratio for the drug combination. EC50 were used to analyze the mixture effects. Results showed that if and how observed data deviate from the CA (Concentration Addition) or IA (independent Action) models, and tests if significantly better descriptions of the observed data can be achieved using a set of deviation functions. These functions allow a differentiation between synergism and antagonism, along with deviations based on the dose-level and concentration of the components. The Concentration Addition (CA) model was assumed to be the mixture effect tool that allows an easier comparison among their toxicity and gave useful information on their current hazard towards bivalves. The induction of genotoxic effects was investigated using a multi-biomarker battery applied to the freshwater bivalve Dreissena polymorpha. According to a semi-static in vivo approach, zebra mussels were exposed for 96 h to an environmentally relevant concentration (1 nM) similar for each drug, corresponding to the level measured in surface waters. This choice allowed us to take into account their presence in the environment, their ability to bioaccumulate drugs and to assess the toxicity of the proteins and the metabolites. The induction of genotoxic effects was investigated on mussel hemocytes by three well-known biomarkers: the Single Cell Gel Electrophoresis (SCGE) assay evaluated primary DNA lesions, while the DNA diffusion assay and the micronucleus test (MN test), which investigated fixed genetic damage. The Neutral Red Retention Assay (NRRA), by evaluating the lysosome membrane stability, was used to assess cocaine cytotoxicity. 96 h exposures to three increasing nominal concentrations of cocaine (40 ng/L, 200 ng/L, 10 µg/L), comparable to those currently measured in environment, were performed under semi-static conditions. Our results highlighted that cocaine exposure induced significant (p<0.05) increases in both primary and fixed DNA damage. These data suggest that cocaine can lead to a cell cycle arrest, according to the model of Concentration Addition (CA) model that indicated antagonism. Concentration additions were much higher than those detected in the environment; however these results are to be considered as a first step in an ongoing project aimed at assessing chronic ecotoxicological effects of mixtures of pharmaceuticals and personal care products on the representatives of different trophic levels also depending on their structure, mode of action and chemical ratio dependency. The conceptual model of Concentration Addition was adopted in this study, as we assumed that the mixture effect mirrors the sum of the single substances for compounds having similar mode of action. This analysis showed a significant deviation from the CA model that indicated antagonism. Tested compounds were much higher than those detected in the environment; however these results are to be considered as a first step in an ongoing project aimed at assessing chronic ecotoxicological effects of mixtures of pharmaceuticals and personal care products.
action and physical-chemical properties. Next to this, endocrine-disruptive activities have been observed for a few of the tested PPCPs. The obtained data indicate which of the measured GST activity. No changes in LDH activities were notice for embryos and adults exposed to AMX. Antibiotic seem not provoke alterations in liver xenobiotic enzymes (CAT in head tissues (96 h-LOECCAThead = 25 mg/L) and an increase in the detoxification phase II enzyme GST (96 h-LOECGSTmuscle =10 mg/L). OTC exposure mortality rate were observed between embryos and adults for AMX and OTC tested concentrations. Adults exposed to OTC showed inhibition of the oxidative stress action and physical-chemical properties. Next to this, endocrine-disruptive activities have been observed for a few of the tested PPCPs. The obtained data indicate which of the measured GST activity. No changes in LDH activities were notice for embryos and adults exposed to AMX. Antibiotic seem not provoke alterations in liver xenobiotic enzymes (CAT in head tissues (96 h-LOECCAThead = 25 mg/L) and an increase in the detoxification phase II enzyme GST (96 h-LOECGSTmuscle =10 mg/L). OTC exposure mortality rate were observed between embryos and adults for AMX and OTC tested concentrations. Adults exposed to OTC showed inhibition of the oxidative stress

EPA was applied and three routes of exposition were considered, namely dermal, oral and inhalation. For the compounds under analysis, reference doses were not available in

Incomplete removal during wastewater biological treatments is the main source of surface water contamination by pharmaceuticals. Degradation of a chemical in the aquatic environment.

Toxicity of Ciprofloxacin and Sulfamethoxazole on marine biocidal communities

Tu 091

Gemfibrozil and naproxen biodegradation in a river water ecosystem

Tu 092

An automated respirometer for measuring activated sludge respiration rates in OECD Method 209

Tu 093

Evaluation of the potential risk due to exposure of children to allergens during bath

Tu 094

Comparative biomarker responses of zebrafish life stages exposed to oxytetracycline and amoxicillin

Tu 095

Gemfibrozil and naproxen biodegradation in a river water ecosystem

A. Barra Caracciolo, P. Genni, M. di Lenola, L. Patrolocco

National Research Council, Montorrotolo, rme, Italy

Incompleteremovalduringwastewaterbiologicaltreatmentsisthemainsourc eof surface water contamination by pharmaceuticals. Degradation of a chemical in the aquatic environment.
ecosystem depends on a variety of factors, including compound properties and environmental factors and above all the presence of a natural microbial community able to degrade it via metabolic and/or co-metabolic pathways. Although pharmaceutical and therapeutic products are widely found in the natural environment, the ecological effects on receiving ecosystems remain largely unknown.

Naproxen, a nonsteroidal anti-inflammatory drug and gemfibrozil, a fibrate drug used as lipid regulator, have been found in several natural waters. They were also found in influent-effluent from a municipal wastewater treatment plant inside the city of Rome in and in the receiving River Tiber. Moreover, the degradations of naproxen and gemfibrozil were also evaluated in microcosms simultaneously treated with both pharmaceuticals in order to evaluate if their co-presence could affect their environmental fate and the degradation activity of the microbial community. The overall results show that both pharmaceuticals were biodegraded. Gemfibrozil (DT50 > 70d) was more persistent than naproxen (DT50 > 27 d). In the presence of naproxen the degradation of Gemfibrozil slowed down and its persistence increased to more than 70%.

TU 096
Determination of emerging substance as human waste indicator in the Danube River samples
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Caffeine, methylxantine derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heart rate, dilates blood vessels and works as a weak diuretic. It is present in many beverages, foods and beverages and is considered to be one of the most commonly consumed drugs in the world. Caffeine can enter aquatic environment via human sewage and it is often found in surface waters. The objectives of this study were to determine caffeine presence in the Danube River samples and to evaluate its stability during two months storage of samples on 4°C. Analysis was performed by standard phase-extraction (SPE) followed by new developed reversed phase high performance liquid chromatography (RP HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (4.6 mm x 150 mm, 5 μm particle size) at 25°C, with a mobile phase of 0.1% TFA in water (pH 8) - acetonitrile (85:15, v/v). The flow rate was 1 mL/min, and detection by DAD at 273 nm. Samples were collected in July 2011 on seven different locations of the Danube River on a territory of Novi Sad, Serbia. Caffeine amount ranged 0.84-2.2 ng/L on the 1st day and 0.52-5.0 ng/L on the 30th day after sample collection. On the 60th day after sampling caffeine was under the limit of detection in all water samples. Presence of caffeine confirmed the existence of human waste in the Danube River. Highest values were obtained in sample collected from location near the water supply source “Ratno ostrovo”, Novi Sad. Obtained results due to caffeine amounts significantly decreased during two months storage of samples on 4°C most likely due to its degradation.

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TU 097
The effects of ibuprofen exposure on fathead minnows (Pimephales promelas)
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Ibuprofen, a widely prescribed medication and over-the-counter drug, treating pain, inflammation and fever by reducing the level of prostaglandins through non-selective inhibition of the enzyme cyclo-oxygenase (COX). COX exists in two isoforms; the constitutively expressed COX-1 and the inducible COX-2. In order to evaluate whether pharmaceuticals pose risks to aquatic ecosystems, we are testing the hypothesis that any potential effects will be related to the Mode-of-Action of the drug and will be seen at plasma levels in non-target organisms similar to human therapeutic levels. We have identified the COX-1, COX-2a and COX-2b genes in the fathead minnow (Pimephales promelas). To assess the uptake and effect of ibuprofen exposure, fathead minnows (Pimephales promelas) were exposed to ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µg/L) and 360-fold (500 µg/L) higher than the nominal concentrations. Ibuprofen exposure was confirmed by using qPCR to test COX expression following ibuprofen exposure. Plasma and water samples were also collected to determine ibuprofen concentrations in the fish and the fish water exposure, using mass spectrometry. This confirmed that fish were exposed to ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µg/L), respectively. Analysis of the plasma revealed uptake of ibuprofen to be up to 9-fold greater than in the water exposure. Very limited ibuprofen uptake was noted between individual fish in the high concentration group (range 120-700 fold) and current work is focused on relating this to changes in COX gene expression.

EM02P2 - Fate and exposure modelling

TU 098
Large-scale spatial-temporal modeling of historical pesticides applications
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With increasingly more detailed data and faster computers, it becomes easier to model pesticide mass loadings into aquatic systems at a high resolution with temporal variations that are on the scale of a few weeks. A large-scale, high-resolution glucosidase activity was conducted to quantify spatial and temporal mass loadings of pesticides into tributaries to the Sacramento River, San Joaquin River, and Bay-Delta estuary California. The aim was to guide future risk assessments for sensitive and endangered species. As part of this project, ten years of daily mass loadings were simulated for 40 chemicals in a 164,000 km2 area of California’s Central Valley. Environmental fate and transport model outputs were validated against measured concentrations and concentrations at inputs and outputs, illustrating how the model was calibrated and validated. Model inputs included historical pesticide use data from the California Department of Pesticide Regulation’s Pesticide Use and Registration (PUR) database, daily weather data from 19 stations in the California Irrigation Management Information System, detailed soils information (SSURGO) from the NRCS, and high resolution land use maps from California Department of Water Resources. The results showed that most of the simulated compounds (EM02P2 - Fate and exposure modelling)
The objective of this work is to present a case study where apparent conflicting results were obtained between US-type soil metabolism and EU-type soil metabolism studies: In the US study, additionally to one major metabolite M, two metabolites (m1 and m2) were considered to be formed directly from the parent in the metabolic pathway proposed by the laboratory in amounts continuously increasing up to around 7% of the applied radioactivity until the end of the one year incubation. These results were contrasted with the studies where only M was identified. Kinetics optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed.

The case study demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolites were found not to be environmentally relevant according to EU guidance. This justifies the need to perform additional kinetic investigation of the metabolism of pesticides so as to set up properly the degradation pathway.

TU 102

Determination of plant uptake factors for pesticide fate modelling

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The plant uptake factor (PUF) is defined as the concentration of a compound in the solution taken up by the roots divided by its concentration in the soil porewater.

Numerical leaching models applied for the environmental exposure assessment of pesticides use the PUF to calculate the amount of a compound taken up by a plant together with its roots. The PUF is therefore an important parameter for a realistic leaching assessment.

PUF values have been experimentally derived for four substances covering a wide range of polarity (ionic, polar, medium polar, lipophilic) in three different crops (Tomato, Wheat and Maize).

In the hydroponic experimental set-up intact plants were exposed between 8 and 11 days to a nutrient solution (pH 6) spiked with the radiolabelled test compound. Volume uptake and concentration in the nutrient solution were measured regularly over the experimental period. By sealing the test vessel it was assured that the only loss process was from the system for water and chemical was plant uptake.

As a result of the study, the PUF was always well above the FOCUS default value of 0.5 (FOCUS, 2009). Generally, a small variation between plant species was observed. The experimental results could be verified with a simple plant uptake model.

The data on PUF show that the use of the FOCUS default of 0.5 is a very conservative approach in terms of leaching assessment. For the test compounds exhibiting ionic to lipophilic properties sub-mixed in three diverse crops representative for cereals, small grains and vegetables all measured PUF values were well above 0.5. It is expected that these high uptake values can be generalized to other compounds within the same range of polarity, as the plant uptake model successfully applied to confirm these values only uses generic compound parameters as input (e.g. lipophilicity).

TU 103

Development of a French national tool for pesticide risk assessment in the context of the water framework directive

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The main objective of the Water Framework Directive (2000/60/EC) is to achieve good ecological status in all surface and groundwater bodies in the EU by 2015. However, it is already evident that this goal cannot be achieved by 2015 for a number of reasons. It is therefore urgent to develop powerful exposure assessment tools which are able to link the observed contamination of water bodies with agricultural pesticides with the agro-pedo-climatic conditions and pesticide application practices responsible for the contamination, and to explore the effect of risk mitigation measures to a priori in order to determine the most effective and environmentally friendly applications and implementation in practice.

FOOTWAYS has been charged with the development of a national pesticide exposure and risk assessment tool for France to be applied in the context of the Water Framework Directive. The tool will produce results at two different scales: i) river water bodies and groundwater bodies, for the purpose of risk assessment and global testing of the effectiveness of measures, and ii) edged water bodies, for more specific testing of the effect of mitigation measures. The tool will be part of the FOOTWAYS Pro web platform for pesticide risk assessment and management.

While the first phase of the project is focusing on an evaluation of the current situation, in the second phase also scenario simulations exploring the effects of the implementation of mitigation measures will be considered. Results from the first two phases of the project will be presented, including exposure and risk estimates for the widely used substance glyphosate and its main metabolite AMPA.

TU 104

Pesticide exposure assessment in flowing waters - Approaches to dynamic predicted environmental concentration

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Pesticide risk evaluation for surface waters in the EU is based on FOCUS standard scenarios ditch, stream, and pond, which are characterized by fixed amounts of water for dilution of pesticide input. The representativity of this water bodies for existing water ecosystems in real landscapes of the EU was never verified, and there is some doubt that the FOCUS standard scenarios reflect the "realistic worst case" appropriate. Given the fact, that the vast majority of water bodies are flowing waters and not stagnant ditches, a more realistic pesticide exposure assessment has to respect some basic properties of flowing rivers.

(i) In flowing waters, the hydrodynamic dispersion lowers the peak concentration but spreads the long-term extension of an initial substance pulse.

(ii) Pesticides are often introduced into flowing waters at a point of a river stretch fluvial, depending on the temporal and spatial pattern of the pesticide input upstream. For the registration procedure these concentration oscillations has to be transformed into an operational exposure indicator, comparable to a regulatory acceptable concentration (RAC). For this purpose the GeoRisk project introduced the quantity PEC(1h), the maximum of predicted environmental concentration averaged over a 1 h time period. The distribution pattern over the entire period of applications is scanned with a moving temporal window of 1 h and then averaged to the 1 h mean. The posterior presents results of the PEC(1h) between Monte-Carlo (MC) simulations for generic water courses with layers combinations of the factors flow velocity, discharge volume, width-depth ratio, percentage of river stretch receiving spray drift deposition, and duration of exposure time. The timing of the spray drift depositions along the water course was randomized for each MC-realisation of the combinations. Additionally the sensitivity of the variables is depicted. The presentation of Trapp et al. demonstrates the application of the PEC-dynamic approach to a real brook in Germany.

TU 105

Plant uptake of eight pesticides / metabolites as a function of log Kow and of pH in a hydroponic test system

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The objective of this work is to present a case study where apparent conflicting results were obtained between US-type soil metabolism and EU-type soil metabolism studies: In the US study, additionally to one major metabolite M, two metabolites (m1 and m2) were considered to be formed directly from the parent in the metabolic pathway proposed by the laboratory in amounts continuously increasing up to around 7% of the applied radioactivity until the end of the one year incubation. These results were contrasted with the studies where only M was identified. Kinetics optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed.

The case study demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolites were found not to be environmentally relevant according to EU guidance. This justifies the need to perform additional kinetic investigation of the metabolism of pesticides so as to set up properly the degradation pathway.

TU 106

Exposure and risk assessment for pesticide inputs into surface waters via surface runoff, erosion and drainage: developing a new concept for German national pesticide authorization

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The new EU regulation 1107/2009 concerning the placing of plant protection products on the market requires a harmonization of the various national pesticide exposure and risk assessment approaches with each other. As a first step towards harmonization among member states, the German Federal Environment Agency (UBA) launched a project to harmonize the German national exposure and risk assessment procedure for surface waters with the procedure used at the EU level and in various other member...
The general outline of the project and results of Work Package 1 (Evaluation of the FOCUS surface water modelling concept with respect to representativity and protection) of the included scenarios for German conditions in comparison to the current assessment methods in the German national authorization procedure) will be presented.

Impact of recent EFSA guidance on soil degradation rates and environmental exposure modelling

The general procedures for calculating degradation rates are well known but the assumptions made during this process can appreciably affect the results. In the field, the persistence of pesticides is affected by the varying environment, i.e. soil moisture and temperature having a significant effect on the bioactivity of the microflora. Normalisation of field degradation data may need to be performed to obtain reliable degradation rate parameters and to be used for modelling purposes.

The time-step normalisation procedure as described by FOCUS (2006) has become popular in the EU registration. This procedure assumes that the decline in the field can be described well by numerical models that assume first-order degradation kinetics. The procedure implies that the decline curve after normalisation can be used directly to estimate the DegT50 of the top soil at 20°C and pF = 2.6.

Many pesticides are soil applied, including residual herbicides, soil insecticides and seed treatments incorporating fungicides and/or insecticides. They are under intense regulatory pressure with regard to water contamination. The pressure of regulation of pesticides within the EU is such that registrants are examining the option of using application strategies such as seed treatments and slow release formulations as a means of reducing environmental impacts due to off-site movement of pesticides.

Further investigation is planned on the critical points, how the short duration of lysimeter studies in combination with a single application finally affects the prediction of the leaching behaviour. The methodology of the derivation of kinetic parameters linked to the leaching potential of such compounds is probably the most advanced in the Regulatory arena world-wide. This poster is dealing with the estimate of DegT50 which has to be used not only for the soil exposure assessment but also for the assessment of potential leaching to groundwaters and surface waters.

The impact of the rainfall criterion in the new EFSA soil persistence guideline on the results of field degradation trials

In the proposed poster, we will show for an existing substance how the methodology is being used (according to the new EFSA (2010) guideline) to derive degT50 and we will discuss the impact of this new guideline on the results and on exposure estimation.
full-field environmental programme is barely affordable for a new active ingredient let alone for a single formulation. Simulation models are the primary basis for regulating pesticides against EU ground- and surface-water protection standards, but the current models cannot explicitly represent plants or their roots, or the effects of formulations and formulation placement strategies (e.g. slow-release microcapsules and seed treatments). Other models exist that represent individual components of the system in a more satisfactory way.

Current models used for pesticide registration within the EU are 1-dimensional and have a simplified representation of root development and uptake of pesticides. Conversely, plant growth and uptake models can have sophisticated representation of plant processes, but often do not consider pesticide dynamics. An ongoing project has created a conceptual framework for representing local pesticide concentrations in the whole soil-plant system, and will next produce a spatially-explicit simulation model. By relating local concentrations of pesticides to product efficacy, it will be possible to use the model to design better active ingredients, formulations and placement strategies. The new model will also enable the environmental benefit of advanced formulations and placement strategies to be quantified in a cost-effective way for the first time. This presentation will introduce the project to the scientific community, overview results from the first year of work, and discuss anticipated outcomes and the potential benefits to the scientific and regulatory communities.

The project co-funded by the Technology Strategy Board, the Department for Environment, Food and Rural Affairs (DEFRA), and the Biotechnology and Biological Sciences Research Council (BBSRC).

TU 112

Last advances and perspective for a better risk assessment of the tropical use of Protection Plant Products in France

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Risk assessment of water contamination required prior the pesticides registration for French overseas territories is currently conducted using tools and guidance documents established for EU context although the agro-pedoclimatic conditions and transport of pesticide in these regions underlines that (1) a minimum of four scenarios (2 soils: andosol and nitisol and 2 crops: banana and sugar cane) would be necessary for the risk assessment of the main uses of the French overseas territories and (2) the models to be used for predicting transport of pesticide have to account for preferential flow and specific redistribution of rainfall by crops canopy for banana. For water surface contamination, the module for surface water fate would likely to be initially simplified to a simple static receiving water body of dimensions defined consistently with French overseas territories and protection goals. Finally, the main features of two models - currently under test- representing surface and subsurface flow of water and pesticides in banana crops on tropical volcanic soils are summarized and the schedule of a 2 year research project (2012-2014) to adapt them for regulatory purposes introduced.

TU 113

Simulation of the herbicides flufenacet and metazachlor in a lowland catchment with the model SWAT - A sensitivity analysis

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TU 115

Spatial differentiated impact assessment of chemicals in freshwater ecosystem at multiple scales

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Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Impact Assessment (LCIA). A key issue to be addressed in the impact assessment methods and corresponding impact factors is the level of spatial detail required and uncertainties related to the use of generic impact factors when the exact location of the activities is unknown. For freshwater ecotoxicity evaluations were performed in order to assess the relative influence of scale in calculation of LCIA characterization factors, comparing them with the result of site specific risk assessment. In this work, we applied the spatial differentiated multimedia model MAPPE in order to highlight the site specific impact factors such as USEtox ERA results are calculated following a site-specific ecological risk assessment procedure that integrates in the assessment the spatial distribution of aquatic ecosystem. ERA results at different scale present higher variability: key drivers of variability and relevant differences in addressing spatial differentiation will be presented and discussed. Key driving forces for spatial differences were identified and discussed.

TU 116

Combination of SFA and multi-media fate modeling to assess the consequences of global trade and informal recycling of WEEE in China


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The flow of obsolete electric and electronic devices is constantly growing, according to a prediction of Zoeteman et al. (2010) by 3 to 5 % each year. It is suspected to add up to a volume of 20 to 50 million tons every year (Brigden et al. 2005). A large amount of waste electric and electronic equipment (WEEE) containing a variety of hazardous substances such as PBDE and Pb is shipped overseas to China, India and Western Africa for recycling. In these countries, WEEE is often processed by “informal recycling” without proper equipment for metal extraction, and labor safety. Thus it heavily affects the health of workers and people living in the vicinity, as well as the environment.

In order to quantify mass flows of WEEE from the developed to developing states, and assess the impact of these transports on local scale, substance flow analysis (SFA) followed by multi-media fate modeling were applied. In the frame of the SFA the following information was gained: a) Global transportation routes and mass flows of WEEE b) Data on the composition of typical e-wastes exports with regard to the European WEEE-Directive categories c) Chemical composition of the single categories with a special focus on lead and brominated flame retardants (PBDEs and TBBPs) d) Estimated emissions of Pb and PB in the environment as a consequence of different informal recycling techniques. In a second step, results from the SFA were used to a feed multi-media fate model that was applied to assess the environmental distribution of the selected hazardous substances and to perform an estimation of human and environmental risk. For this, Guiyu region in China was chosen as a local case site as it is one of the largest informal recycling areas. References: Brigden K, et al. (2008). Chemical contamination at e-waste recycling and disposal sites in Accra and Korforidua, Ghana. Greenpeace Research Laboratories Technical Note. Greenpeace, Amsterdam, The Netherlands, 2010. Zoeteman et al (2010). Handling were waste flows: on the effectiveness of producer responsibility in a globalising world. Int J of Advanced Manufact. Technol. (2010) 47: 22.

TU 117

Modelling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA

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Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Assessment (LCA). These methods suffer when it comes to the impact assessment of complex chemical mixtures, such as industrial effluents, as the list of constituent compounds is rarely known in its entirety, leading to under- or overestimation of ecotoxicological effects. A more holistic and meaningful method of evaluating the environmental impact of industrial effluents in LCA would be to model the fate and effect of comprehensive and commonly measured sum-parameters, such as total organic carbon (TOC) or total nitrogen (TN), using ecotoxicity characterization factors (CF) for waterborne organic bulk emissions from different industries, based on whole effluent assessment (WEA) and the principles of mixture toxicity. We discuss the advantages of the methodology, its complexities, as well as the need for spatial differentiation, and we present some preliminary results.

TU 118

Globally applicable, spatially explicit assessment of non-toxic air pollutants regarding health impacts due to ozone

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1. Introduction
This poster presents intake factors (iF) and characterization factors (CF) regarding human health effects for the pollutants NMVOC, NOx and SO2 accounting for health impacts due to ozone. Research on life cycle impact assessment (LCIA) for transboundary pollutants have been reviewed and it is suggested that spatially differentiated fate models for crops should be considered. The present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and by integrating the findings of this work within the ongoing EU-funded project LC-IMPACT (2010-2012) the “Development and application of environmental Life Cycle Impact Assessment Methods for imProved sustAnibility characterisation of technologies” is pursued. Within the area of “Non-toxic pollutant impacts” the objective is to develop globally applicable, but spatially explicit, LCIA methods and characterization factors.

2. Materials and Methods
Within the ongoing EU-funded project LC-IMPACT (2010-2012) the “Development and application of environmental Life Cycle Impact Assessment Methods for imProved sustAnibility characterisation of technologies” is pursued. Within the area of “Non-toxic pollutant impacts” the objective is to develop globally applicable, but spatially explicit, LCIA methods and characterization factors.

3. Results
A detailed comparison will be made between iFs derived from the TM5-FASST model and the EcoSenseWeb integrated assessment tool in order to assess the inherent uncertainties and implicit variability in the estimates. iFs and CFs are calculated for several countries and larger regions. Finally, iFs and CFs suggested in different LCIA methods have been compared with the findings of this work.

Acknowledgements
The author thanks the colleagues of the LC-IMPACT and the European Union for funding. The author thanks the JRC-ISPRA, Institute for Environment and Sustainability (IES), Climate Change Unit (CCU) for kindly making the global scale assessment based on the TM5-FASST tool possible.

TU 119
Environmental impacts of thermal emission to freshwater: Spatially explicit fate and effect modelling
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Power production is a crucial sector causing heavy impact on freshwater bodies by releasing enormous amounts of heat in once-through cooling systems. So far only few approaches have addressed impact on aquatic environment related to this issue and there is no study providing fate and effect model for assessing the impacts on a spatial explicit level and broad coverage. We started our research based on a detailed study assessing impacts of thermal emissions from a specific nuclear power plant in Switzerland and extracted the most sensitive parameters to derive a generic model of combined fate and effect model for the US. We created a 0.5 arc degree grid accounting for water temperatures, river flow, river width, flow velocity and distance to sea in order to model fate and effect of thermal emissions from different sizes of power plants. Various data sources were tapped and different interpolation methods were applied to cover points without measured data, allowing accounting for uncertainties. We further investigated uncertainties of the characterization factors by varying input parameters and the model assumptions, including the assessment of the affected species. The thermal impacts show significant spatial variability depending on the water body where the cooling water is discharged and the amount of heat released, because the impacts are non-linear. Furthermore this project illustrates how fate and effect model can be integrated to improve the assessment of spatially differentiated impact assessment considerably.

TU 120
Including the influence of worldwide crop cultivation on ecosystem services in life cycle assessment
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Land use is increasing worldwide leading to changes in ecosystems. To measure these changes allows for quantification of the impact that each land use activity causes to the environment. This can be achieved through the quantification of changes in ecosystem services. Ecosystem services include carbon sequestration, nutrient cycling, erosion regulation and biotic production potential. The goal of this research is to develop indicators that estimate changes in ecosystem services due to changes in selected land use activities namely, cultivation of rapeseed, soybean and sugarcane, on a global scale. In Life Cycle Impact Assessment (LCIA) these indicators are known as characterization factors. This research focuses on the determination of these factors. In the present work we focus on erosion potential. The cultivation of the crops is simulated using the Environmental Policy Integrated Climate model (EPIC). EPIC is a spatial and temporal agri-environmental model which simulates the biophysical impacts on homogenous response units characterized by altitude, slope and soil class. Inputs for EPIC simulations include weather and soil profile data, and information on land use, land cover, and crop management. By simulating processes of crop growth, water and nutrient cycles, EPIC produces, among its outputs, estimates of crop yield, sediment transportation and soil carbon sequestration. The characterization factors will be aggregated to country or biome level. Comparisons will be made between results from different spatial aggregation levels, and different management systems regarding input of fertilizer or irrigation.

RA02P - Approaches for comparative hazard and risk assessment of chemicals
TU 121
Health risk assessment of chlorpyrifos with rice farmers in Vietnam
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Vietnam is an agricultural developing country with over 80 per cent of workers employed in agriculture, mainly rice farming cultivation. Farmers use back-pack reservoirs with hand pumps to apply pesticides, but their knowledge of safety in pesticide application is low. Chlorpyrifos is the most common organophosphate insecticide registered for agricultural use in Vietnam, but health risk assessment of chlorpyrifos use has not been carried out and limited investigation in Vietnam and other developing countries.

The objective of this study is to evaluate the health risk of chlorpyrifos exposure to a typical group of rice farmers after application in Vietnam, using a probabilistic approach.

The author thanks the colleagues of the LC-IMPACT and the European Union for funding. The author thanks the JRC-ISPRA, Institute for Environment and Sustainability (IES), Climate Change Unit (CCU) for kindly making the global scale assessment based on the TM5-FASST tool possible.

TU 122
A soil ingestion pilot study of a population following a traditional lifestyle typical of rural or wilderness areas
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The relatively few soil ingestion studies underpinning the recommended soil ingestion rates for contaminated site human health risk assessments (HHRAs) that have been conducted to date assessed soil ingestion in children living in urban or suburban areas of the United States, and to a lesser extent, Europe. However, the lifestyle of populations living in North American urban and suburban environments is expected to involve limited direct contact with soil. Conversely, many populations, such as indigenous and Aborigin peoples residing in rural and wilderness areas of North America and worldwide, practice traditional land use, and participate in activities that increase the frequency of direct contact with soil. Qualitative soil exposure assessments to estimate ingestion rates for Aboriginal populations inhabiting wilderness areas suggest that high levels of soil ingestion (i.e., 400 mg d-1 quantities) may occur, and these levels are many times greater than those recommended by regulatory agencies for use in HHRAs. Accurate assessment of exposures selected from a wilderness population in Canada was carried out using mass balance tracer methods to estimate soil ingestion and the results compared with previous soil ingestion studies and regulatory guidelines for the soil ingestion rates used in HHRAs of contaminated sites. A pilot study of 7 subjects belonging to the Xeni Gwet’in First Nation community living in the Nemiah Valley of British Columbia was conducted over a 3-week period. The study provided the first quantification of soil ingestion rates in this community type. The soil ingestion rates estimated in this study were higher than those currently recommended for HHRAs of adults, and higher than those obtained in most previous studies of adults. However, the soil ingestion rates measured were much lower than earlier qualitative assessments of subsistence lifestyles.

TU 123
Health risk assessment and economic damage due to environmental pollution in a large industrial centre
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A health assessment in Perm, an industrial city in European Russia, has been performed using the WHO methodology. The findings indicate spatially differentiated environmental exposure of 95% of the Perm citizens to various chemicals (formaldehyde, ethyl benzene, benzene, nitrogen dioxide, etc.) at concentrations exceeding maximum permissible concentrations (MPC) (acute exposure) and maximum permissible average daily concentrations, by 16.7 and 13.5 fold, respectively.More than 65% of the exposed population use drinking water which does not meet the standards, i.e. trichloromethane, residual chlorine, iron, manganese and other impurities levels exceed MPC by 2.3 fold. We have observed an increase in acute and chronic hazard indices up to 30 fold for 14 out of the 17 analysed critical body systems and organs. Almost all of the city population is at an unacceptable environmental risk for respiratory, eyesight, hematological and immune disorders as well as central nervous system impairments.More than 173,000 children below 17 years (99.4%) and all of the 809,000 adults are at an unacceptable carcinogenic risk. The presence of above mentioned risks has been proven by the identification of contaminants in the blood of the exposed subjects and the deterioration of laboratory, clinical and functional health parameters. We have revealed a new relationship between elevated blood levels of acetaldehyde, formaldehyde, manganese, nickel, chromium, etc. and blood, immune, hematological and other health indicators. We have determined reference levels of the risk of the chemical compounds in blood, i.e. acetaldehyde - 0.049 μg/ml, formaldehyde - 0.59, benzene - 0.0013, manganese - 0.039, chromium - 0.021, nickel - 0.077 and chloroform - 0.0021 μg/ml. We have identified NOAEL values in the air: Ni - 0.00009 mg/m³, Cr - 0.0001, Mn - 0.00005, formaldehyde - 0.003, acetaldehyde - 0.002, benzene - 0.03 mg/m³, chloroform reference dose in drinking water - 0.01 mg/l. We suggest that priority environmental risk assessment cause 1,246 new cases of respiratory diseases. The total economic damage for respiratory diseases is € 1.3 million. Approximately 10% of water quality parameters can be reached by reducing emissions of industrial companies, using traffic optimisation and clean fuel and improving the water supply system quality and water treatment.

TU 124
Snail watch: a tool to assess the risk of metal transfer taking into account their bioavailability
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INRA, Saulces-Grimon, UMR AgroParisTech IEG - Environnement et Grandes Cultures, Thuerville-grimon, France

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Current evaluation of soil quality, generally based on physico-chemical characteristics, does not integrate the biological aspect and so the risk of metal transfer to organisms. The goal of the presented soil quality assessment allows evaluating the bioavailability of metals and then their risk of transfer.

The aim of this study is to firstly determine the internal concentrations of reference (CIRef) for metallic contaminants (Cd, Pb, As, Cu, Cr and Zn) in Canarres asperus snails. Then, CIRef are used to identify abnormal metal transfer to snails. Secondly, to estimate the soil characteristics influence on metal accumulation using multivariate equations. A third objective is to develop a practical procedure to Evaluate the Risk of Transfer of MEtalS (ERTIME) to snails to determine management priorities that take into account physico-chemical and biological parameters of metal bioavailability.

CIRef have been established on the basis of concentrations in the snails exposed on unpolluted sites for 28 days i.e. snail watch. In snails exposed on other sites, when the values, bioavailability and other above the CIRef, the site will be considered as polluted and the concentrations is of metal transfer. Most of the time, the use of these equations have enabled to determine the risk for the aquatic environment, and that emerging contaminants are adequately considered. Various methods for prioritising chemicals have been described, incorporating both exposure and effects. Approaches that prioritise on the basis of risk often require significant inputs, even a draft EQS, or detailed exposure modelling. We describe a simple approach to prioritisation that requires only modest inputs and assigns chemicals to different risk assessment.

Unlike more sophisticated schemes, this method does not require a draft EQS in order to prioritise chemicals. Rather, it categories chemicals in terms of their likely (or actual) environmental occurrence based on use and monitoring data, and the hazard they pose to aquatic life, based on persistence, bioaccumulation and toxicity criteria.

Classifications based on exposure and hazard are then combined and chemicals assigned to risk categories. Those assigned to the highest risk category are taken forward as potential candidates for ESQs development.

Almost a third of the chemicals considered could not be assigned a risk ranking due to a lack of data. This is of particular concern for emerging contaminants where both tox unit and exposure data are often limited. Lack of exposure or hazard data contributed equally to the assignment of 'Insufficient information'. Predictive tools such as QSARs or 'read across' techniques may have a useful role in filling some gaps in hazard data. Gaps in exposure data may be filled by gathering monitoring data; in this respect the project has helped identify monitoring needs that may lead to identifying future EQS-candidates.

The prioritisation methodology is not suitable for metals and other inorganic chemicals because of biases in the way that fate and behaviour are dealt with e.g. measures of degradation and bioaccumulation. A separate approach for such chemicals may need to be developed.

Further details can be found in the final publication of the project. For more information please contact the authors.

TU 125
Prioritising chemicals for EQS development
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Environmental Quality Standards (EQSs) are a key tool under the Water Framework Directive (WFD) to help assess the chemical status of water bodies. However it is important that EQSs are developed for substances that pose the greatest risk to the aquatic environment, and that emerging contaminants are adequately considered. Various methods for prioritising chemicals have been described, incorporating both exposure and effects. Approaches that prioritise on the basis of risk often require significant inputs, even a draft EQS, or detailed exposure modelling. We describe a simple approach to prioritisation that requires only modest inputs and assigns chemicals to different risk assessment.

Unlike more sophisticated schemes, this method does not require a draft EQS in order to prioritise chemicals. Rather, it categories chemicals in terms of their likely (or actual) environmental occurrence based on use and monitoring data, and the hazard they pose to aquatic life, based on persistence, bioaccumulation and toxicity criteria.

Classifications based on exposure and hazard are then combined and chemicals assigned to risk categories. Those assigned to the highest risk category are taken forward as potential candidates for EQS development.

Almost a third of the chemicals considered could not be assigned a risk ranking due to a lack of data. This is of particular concern for emerging contaminants where both tox unit and exposure data are often limited. Lack of exposure or hazard data contributed equally to the assignment of 'Insufficient information'. Predictive tools such as QSARs or 'read across' techniques may have a useful role in filling some gaps in hazard data. Gaps in exposure data may be filled by gathering monitoring data; in this respect the project has helped identify monitoring needs that may lead to identifying future EQS-candidates.

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Further details can be found in the final publication of the project. For more information please contact the authors.

TU 126
Klimisch 2.0 - raising the bar to increase the scientific quality of environmental risk assessments
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Economic risk assessment and reporting are needed to support European legislations and regulations, e.g. REACH, EMEA or the Water Framework Directive. Criteria developed by Klimisch et al. (1997) are widely used to assess data quality. This assessment relies heavily on the completeness and quality of the data set and as such, is sensitive to scientific and cognitive variations. Assessments based on data with low reliability could lead to incorrect conclusions and may underestimate risks in the environment or lead to unnecessary risk mitigation measures being introduced.

Several recent studies (e.g. Duchemin et al. 2010, Durou et al. 2011, Junghans et al. 2011, Agerstrand et al. 2011) have shown that the Klimisch system is not accurate and does not provide evidence of consistency between different risk assessors. This presents a general problem in the data quality evaluation of all chemicals, and is not limited to specific substance groups.

We therefore recommend to amend the Klimisch system by adding a scoring system for the criteria for reliability and relevance of the data, to ensure a more consistent evidence approach for the whole dataset. The detailed methods developed by Kuster et al. (2009, 2010) and Agerstrand et al. (2011) provide a useful basis for refining the quality assessment criteria and could be adapted for all substance groups. Additionally, the assessment should also consider if a critical study is plausible in the context to the whole dataset. To test plausibility, we propose that critical information distributed across different studies should be evaluated with a weight of evidence assessment, e.g. Gross et al. (2011).

In conclusion, we propose a more structured reliability and relevance evaluation of critical ecotoxicological studies together with a plausibility assessment based on a weight of evidence approach for the whole dataset. This should increase the scientific quality of environmental risk assessments of substances, e.g. in Environmental Quality Standard (EQS) derivation according to the Technical Guidance Document for EQS (European Commission 2011).

The proposal is to provide guidance for different interests from science, hazard assessment and regulation. However, we recognize that the weighting assigned to criteria might vary between different chemical assessment regulations.

TU 127
EQS derivation for metals in EU and USA: a comparison using copper
318
SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
We present actual time trends and levels for PCDD/F and dl-PCB in breams from seven major rivers in Germany between 2003 and 2008. Levels are notably going down used for 3 different trophic levels (algae, invertebrates and fish). Once normalized for bioavailability safe threshold concentrations are calculated as the lower 5th percentile of the whole species sensitivity distribution SSD in the EU while only the 4 most sensitive genus mean values are used to derive the 5th percentile using least square regression analysis. The influence of such differences in both frameworks on the EQS setting will be illustrated using Cu as an example. EQS for different surface waters (with different bioavailability) will be demonstrated. In most cases it seems that the differences in EQS values between both frameworks are within a factor of ±2.3. Therefore, although there is a general tendency to incorporate such concepts in regulatory frameworks for metals there is a clear need for harmonization of frameworks as highlighted by the OECD.

TU 128
Efficient toxicity testing when test information is uncertain: a stochastic cost-effectiveness analysis
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Changing policy settings for chemicals’ risk management, for example in Europe and in the U.S., have led to increasing awareness of the urgent need for more efficient testing of chemicals. The economic concept of efficiency calls for allocating scarce resources (e.g. money, time, human skills) such that output is maximised. Hence, if a toxicological endpoint different testing options exist, a decision maker must identify the testing strategy that provides the highest information gain per unit of cost. This clearly, requires to weigh the costs associated with a testing strategy, usually measured in monetary terms, against the information gains from testing. The latter are commonly expressed in terms of a the test’s predictive performance. Cost-effectiveness analysis (CEA) provides a powerful tool for solving this problem. CEA allows for a comparative evaluation of different testing trade-offs and information gains for different testing methods and strategies. While CEA has become widely used in different domains, for example in medical decision-making, there are only few attempts to apply CEA to testing in toxicology. These studies share the assumption that information gains from testing, measured in terms of a test’s predictive performance, are known. The predictive performance of testing methods is, however, uncertain, irrespective of what type of testing method (e.g. a “gold standard” in vivo test, an in vitro test, or a “non-testing” method) is used. Our study, therefore, moves beyond existing deterministic CEA modelled in toxicology by developing a stochastic approach to CEA that accounts for the uncertainty about the quality of test information. The aim is to allow for a more robust and transparent evaluation of testing methods and strategies both within and across endpoints. This guides decision-makers in coherently selecting the testing method or strategy that provides the highest information gain per unit of cost. Another contribution of the study is to offer a critical synopsis of data and research needs in order to apply this approach to various endpoints and to make it operational in the regulatory context of REACH.

TU 129
IFRA Environmental Standards: risk and hazard assessment update for 2012
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The International Fragrance Association expanded the fragrance industry’s voluntary safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessment standards 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 screening criteria. In contrast to other frameworks for this evaluation and refinement, the framework was published in Environmental 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 priority materials for risk assessment refinement. In an effort to provide greater transparency to the developing IFRA Environmental Standards, reported here are the results of these preliminary screening and hazard assessment efforts. These studies include persistent 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. IFRA and RIFM have decided to present an annual update of this test program and the IFRA Environmental Standards. This work represents the latest effort for 2011-2012.

TU 130
The HEROIC project: coordinated efforts towards the harmonization and cross-fertilization of human and environmental risk assessment of chemical substances
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9UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany
10SIB, University of Basel, Basel, Switzerland

Today, human risk assessment (HRA) and environmental risk assessment (ERA) are typically separated. There is a lack of mutual understanding between experts and data from toxicological and ecotoxicological studies are not readily accessible by risk assessors of the two disciplines. The need for RA will continue to increase (e.g. REACH or toxicity of mixtures) along with budget restrictions and public and political pressure to reduce the number of animals tests. Therefore more cost effective, predictive and rapid testing methods with high quality sustainable RA are needed, including a better exploitation of existing data. The HEROIC project (Coordination Action of FP 7 - FP 8) will provide a platform for networking among all the relevant stakeholders in the RA value chain and will provide them with the most relevant background information to contribute to the development of harmonised approaches which meet the challenges of RA. The project will enable the improvement and harmonisation of tools and methods in RA, by exploring how data generated in ecotoxicology and human toxicology can be applied across disciplines, regions and frameworks, and develop a harmonised tiered approaches for RA. This will increase transparency in RA and allow better risk communication to maintain public trust and provide unambiguous guidance for improved risk management.

HEROIC starts with a comprehensive landscaping exercise to identify common methodological and data needs in current human and environmental risk assessment practices, by identifying existing in-vivo, in-vitro and in-silico methods and exposure assessment. The selection process ranks and weights data based on their reliability and relevance and uses a Weight-of-Evidence Approach to integrate such information to develop an Integrated Testing Strategy (ITS) for decision making. A dedicated web portal called ‘Tox-Hub’ that presents information from diverse sources and that functions as a central point of access to the most relevant toxicological and environmental risk assessment information will be created. A diverse range of dedicated activities is planned for information, dissemination, capacity building and communication. These coordinating activities will result in enhanced sharing of knowledge, building consensus and development of clear, easily understood, transparent and unambiguous integrated RA procedures.

RA03P
Are Environmental Specimen Banks ready to face future challenges of environmental chemistry and regulatory toxicology?

TU 133
Fish from the German environmental specimen bank - patterns, relations and time trends of PCDD/F and dl-PCB in breams (abramis brama) from German rivers
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Environmental specimen banks (ESB) are collections of samples which contribute widely to the understanding of connections within regional as well as global ecosystem behaviour. Furthermore they deliver valuable understandings not only of retrospective time lines but also of similarities and differences within the collected information as well as giving opportunity for the discussing trends. The German ESB is one of the largest specimen collection programmes worldwide, monitoring the persistent and highly toxic polychlorinated dibenzo-p-dioxins and -furans (PCDD/F and PCDF) for 99 congeners and the polychlorinated biphenyls (PCBs) in aquatic ecosystems in order to evaluate the overall state of environmental protection within the tributary system of the main rivers in Germany. Serving this purpose, the common bream, abramis brama, has been selected as a specimen for this monitoring. It is common, widespread, and a useful method of long-term monitoring. The collection process ranks and weights data based on their reliability and relevance and uses a Weight-of-Evidence Approach to integrate such information to develop an Integrated Testing Strategy (ITS) for decision making. A dedicated web portal called ‘Tox-Hub’ that presents information from diverse sources and that functions as a central point of access to the most relevant toxicological and environmental risk assessment information will be created. Furthermore the single compound data for the analyte groups give additional understanding of patterns of PCDD/F and PCDF as well as their correlation. The presented data show for example the differences for the two groups of PCBs being fairly unique for the sampled river system. Discussion could point as well towards different or similar industrial influences of the different tributary system as towards unification of pattern, e.g. by metabolic influences.

TU 134
A 10 year retrospective study of mussels condition in North Beringian Peninsula based on the ‘mussel shell section’ of the Biscay Bay Environmental Biospecimen Bank
L. Garmenda, I. Izagirre, M. Soto, I. Marigómez

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
An environmental specimen bank (ESB) is an archive for biological samples that can be used to perform (traditionally chemical) analyses to obtain information about long-term variability and temporal trends in the chemistry of the biota and the ecosystem quality. Aware that chemical endpoints alone are not enough for ecosystem health assessment, the Biscay Bay Environmental Bioespecimen Bank (BBEB) has been designed including specimens for molecular/cellular analysis, and dried mineralized tissues (shells/otoliths) for biometric determinations. Banking methods and specimen sampling and processing are being adapted for these needs. In a first practical application, a retrospective study was performed using the ‘Mussel Shell Section’ of the BBEB (2001-2010) localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Bering Sea. Changes in shell size (L, width, W, height, H), allometry and shell weight (SW) were analyzed, and the shell thickness was estimated after regression of the log SW against SSF (Shell Size Factor, LxWxH in mm). Overall, shell growth exhibited a decreasing trend during the study period with a seemingly more marked arrest growth in 2003-2006. These results are discussed in terms of interactions between the local environment and the global consequences of the Prestige oil spill. However, since only specimens of L>3.5-4.5 cm were analyzed in most cases and mussels of the same shell length can belong to different age classes depending on the geographical variability and the influence of environmental conditions for a given locality, the incidence of the age in the interpretation of the obtained results is also discussed. In summary, the development of Mussel Shell Sections in environmental bioespecimen banks is highly recommended as they may offer an excellent opportunity for retrospective monitoring after low cost processing and storage. In addition, our results also suggest that mussel watch monitoring programs and ESB archives should be supported on the basis of samples of same-age rather than same-length mussels. This study was supported by the Government of the Basque Country through E-GORKITZEN project.

TU 135

Using banked seabird eggs for determining geographic patterns of trace elements in marine regions
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Seabirds and seabird eggs are collected worldwide and samples are often archived in the Environmental Specimen Bank (ESB) for future research and monitoring programmes. In recent years, trace elements have been measured in eggs, and the results have been used for environmental assessment. However, studies that compare the trace element content of eggs from different regions have been rare, and the data on the geographic variability of trace element concentrations in eggs are not yet well documented. This study was carried out to examine the geographic variability of trace element concentrations in eggs from different regions of the world. The data were analysed using discriminant function analysis to determine whether the eggs from different regions could be distinguished from each other. The results showed that the eggs from different regions could indeed be distinguished from each other, and this indicates that the geographic variability of trace element concentrations in eggs is significant. These findings have implications for the interpretation of egg data and for the development of future monitoring programmes.

TU 136

Specimen security in long term specimen banking - zebra mussel example in the German ESB
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In the 21st century, the zebra mussel (Dreissena polymorpha) established itself as an invasive species - sometimes in huge numbers - in large parts of Europe and the USA. Due to its high growth rate, it is able to dominate aquatic habitats, which makes it a serious biological invader. One way to monitor the impact of this species is by using environmental specimen banks (ESB). These banks store biological samples for future research and monitoring programmes. In this study, the security of zebra mussel samples stored in the German ESB was investigated. The results showed that the samples were secure and could be used for future research.

TU 137

Organic compounds in suspended particulate matter - results from the German environmental banking specimen bank
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Since 2005 suspended particulate matter (SPM) in the river systems of Rhine and Elbe has been sampled, processed and archived in the frame of the German Environmental Specimen Bank (ESB). Sampling is carried out with sedimentation boxes which are emptied monthly. At the end of the year monthly samples are lyophilized and pooled to a homogenate. From every homogenate about 200 subsamples are produced and stored in the ESB. The whole processing is conducted under deep frozen conditions. Some sub-samples are chemical characterized for inorganic substances, CHCs and PAHs.

The results of the five years period 2005-2009 show considerable differences between the two river systems. The concentrations of PAHs as well as of PCBs and DDX increase downstream the river Rhine whereas in the Elbe system only few differences of concentration are observed between the single sampling sites. One exception is the sampling site ElbeBlankensee near Hamburg harbour which represents the passage of the Elbe into the North Sea and is tidal influenced. Here, lowest concentrations for all substances are observed. For the most substances the concentrations at Blankensee are less than 20 % of the concentrations at some other sampling sites. This is probably caused by dilution of the Elbe water with salt water of the North Sea.

With exception of Elbe/Blankensee concentrations for most substances are significantly higher in the river Elbe compared to the river Rhine. Especially the concentrations of DDX and HCHs are much higher in SPM from the Elbe than in SPM from the Rhine.

Within the observation period significant reductions of B(a)P, B(b)P and B(a)P concentrations in the river Rhine could be observed.

TU 138

Standardized freshwater mussel watch for monitoring of aquatic environments: implications and possibilities
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Mussel Watch is one of the most effective approaches to study the dynamics of aquatic pollution. Unfortunately, it is usually limited to the dependent on collection sites and it is impossible to get a sufficient number of specimens for large samples. The most possible cause is the eutrophication level of the waters and the resulting lack of food. Another invasive species, the quagga mussel (Dreisena bugensis), which has a stronger presence in many areas, is increasing the pressure on the zebra mussel populations too. Recent research has also shown that fertile hybrids between D. polymorpha and D. bugensis are possible in the wild - making biomonitoring even more difficult. This makes clear that, along-side D. polymorpha, D. bugensis and hybrids of both species have to be excluded from the results of monitoring studies using D. polymorpha for them to be comparable. Investigations into the current significance of the zebra mussel in long-term monitoring projects and environmental specimen banking programmes in the German ESB show the tremendous age of the zebra mussel provides. This makes clear that, alongside the common bream (Abramis brama) and suspended particulate matter, it is an important component of the limnic sample set. Loss of this sample type would result in a huge loss of information.

Therefore, the most important task concerning D. polymorpha as a biomonitoring tool is:
- first, to understand how substances accumulate in D. polymorpha and D. bugensis;
- discover whether there are wild hybrids; and
- develop a method to differentiate unequivocally between both species for large samples.

TU 139

Contaminated sediments in a changing environment
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An environmental specimen bank (ESB) is an archive for biological samples that can be used to perform (traditionally chemical) analyses to obtain information about long-term variability and temporal trends in the chemistry of the biota and the ecosystem quality. Aware that chemical endpoints alone are not enough for ecosystem health assessment, the Biscay Bay Environmental Bioespecimen Bank (BBEB) has been designed including specimens for molecular/cellular analysis, and dried mineralized tissues (shells/otoliths) for biometric determinations. Banking methods and specimen sampling and processing are being adapted for these needs. In a first practical application, a retrospective study was performed using the ‘Mussel Shell Section’ of the BBEB (2001-2010) localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Bering Sea. Changes in shell size (L, width, W, height, H), allometry and shell weight (SW) were analyzed, and the shell thickness was estimated after regression of the log SW against SSF (Shell Size Factor, LxWxH in mm). Overall, shell growth exhibited a decreasing trend during the study period with a seemingly more marked arrest growth in 2003-2006. These results are discussed in terms of interactions between the local environment and the global consequences of the Prestige oil spill. However, since only specimens of L>3.5-4.5 cm were analyzed in most cases and mussels of the same shell length can belong to different age classes depending on the geographical variability and the influence of environmental conditions for a given locality, the incidence of the age in the interpretation of the obtained results is also discussed. In summary, the development of Mussel Shell Sections in environmental bioespecimen banks is highly recommended as they may offer an excellent opportunity for retrospective monitoring after low cost processing and storage. In addition, our results also suggest that mussel watch monitoring programs and ESB archives should be supported on the basis of samples of same-age rather than same-length mussels. This study was supported by the Government of the Basque Country through E-GORKITZEN project.

TU 140

The impact of high water discharges on sediment quality in the Elbe estuary
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The Elbe estuary is characterized by the Hamburg Port, the second largest port in Hamburg, about 100 km upstream of the mouth of the river. Even though the river analysis. The results revealed that mobility of metals from sediment to water column depended on the site, metal and time. Metals concentrations generally increased with time of exposure to CO₂ injection. The test lasted 10 days and samples were collected on the beginning and end of the experiment for metal analysis. The results revealed that mobility of metals from sediment to water column depended on the site, metal and time.

TU 141
Toxicity of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers
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Deltas, Delta, Nederland

Climate change may not only affect river water discharges in terms of water quantity, but also in terms of water quality. During flooding periods, for instance, higher water discharges may dilute a collision of normal pollution levels, while on the other hand, higher discharges may also result in an increased mobilization of polluted sediments and in suspended particulate material (SPM) from sediment to water column. Elevated discharges did not lead to any significant increase of contamination fluxes may be recorded. Long term projections of regional climate models are variable and tend to predict more extreme rainfall and dry episodes but with a limited overall increase in river discharges and suspended particulate matter (SPM) loads to the North Sea. To study the possible impact of climate change on the quality of urban and coastal waters, a battery of in vitro bioassays was applied to determine the toxicity profiles of environmental samples collected during climate change related events. SPM and sediment samples were collected in rivers from Norway, Sweden, Denmark, and The Netherlands during periods of dryness, flooding and extreme run-off. In addition, passive sampling was performed using silicone rubber sheets to evaluate the effects on dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like activities, (ant)androgenic, (ant)estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to climate conditions were noted both between different rivers and different seasons. Significant differences were observed for episodic episodes of melting of ‘black snow’ (Akerselva river, Oslo) and overflow of mixed sewer systems (Harrestrup river, Copenhagen). Combined concentrations of SPM and sediment were classified based on a toxic-unit approach and will be compared to the in-vitro toxicity profiles. Results of multivariate statistical analysis (PCA, cluster analysis) and different toxicity ranking and classification approaches will be presented. The results will be included in a web-based communication tool (Open Earth) open to the general public. The work described was performed within the context of the DiPol project (Impact of Climate Change on the quality of urban and coastal waters - Diffuse Pollution), which is funded by the Interreg IVB North Sea Region Programme.

TU 142
The effects of CO₂ leakages from marine stable geological formations on the mobility and availability of metals
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Carbon dioxide capture and storage (CCS) in marine sub-seabed geological formations, is already contemplated in international conventions as a mitigation measure to reduce the impact of the concentration of CO₂ in the atmosphere. Although this technology is currently considered to be technically feasible there is lack of information on the environmental impact of CO₂ seepage. CO₂, sorbed in the sediment, sedipore pore water, sediment-water interface and finally in the water column. Increase in acidity will lead to several biogeochemical alterations that can result in detrimental effects on the ecosystem. Changes in the solubility, speciation, mobility and bioavailability of trace metals is expected as a direct result of pH decrease.

Laboratory-scale experiments were performed, involving direct release of carbon dioxide into sediment, inside non-pressurised chambers, in order to provide data on the possible effects of CO₂ leakage from geological storage sites on the fate of several metals. Marine sediments from two contaminated sites located in the south of Spain were collected and submitted to acidification by means of CO₂ injection. The test lasted 30 days and samples were collected on the beginning and end of the experiment for metal analysis. The results revealed that mobility of metals from sediment to water column depended on the site, metal and time. Metals concentrations generally increased with time of exposure to CO₂ injection. Within the results tested zinc, copper, cobalt, lead and iron were most greatly influenced by acidification.

TU 143
Changes on the biogeochemistry of synthetic surfactants from river to marine sediments
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Aquatic systems are subjected to the influence of both urban and industrial wastewater discharges, which are among the main sources of organic contaminants. Due to their extensive use in a wide variety of applications, significantly high concentrations of surfactants can be found in freshwater bodies. Once they reach water bodies, a significant fraction of these compounds can be detected in sediments due to their moderate sorption capacity. It is often assumed that surfactants are well preserved in the sedimentary column once anoxic depths are reached, which can happen within a few millimetres to centimetres depending on the aquatic system. In this work we have studied the diagenetic fate of the most commonly used surfactants: alcohol polyethoxylates (AEOs) and nonylphenol polyethoxylates (NPESs), both non-ionic, and linear alkylbenzene sulphonates (LAS) and alkyl ethoxylates (AES), both anionic. Their concentrations in sediment and pore water were determined along the sedimentary column by sampling cores in three different aquatic systems from SW Spain: the salt-marsh environment of the Bay of Cádiz, the middle stretch and the estuary of the Guadalete River, and the Bornos water courses. The surfactant concentrations were observed according to the respective uses, production volumes and physicochemical properties of each surfactant. Levels of non-ionic surfactants (up to 12 mg/kg) were twice as high as those for anionic surfactants near industrial areas and ports, whereas the opposite was found near urban wastewater discharge outlets (up to 18 mg/kg). The most remarkable result was that sulfophenyl carboxylic acids (SPC), LAS degradation products, were identified in anoxic pore water. However, this was observed only in marine, and, to a minor extension, estuarine sediments. No SPC were detected in sediments from freshwater systems. The presence of sulfate-reducing bacteria might be directly related to higher bioavailability too, as their calculated sediment-pore water distribution coefficients showed much higher values when compared to those for most popular anionic surfactants (e.g., 5.5 ± 98 for NPESs vs. 11 ± 7 for AES).
Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus

L. T. H. Nguyen1, M. B. Vandegeuchte2, B. Muyssen1, J. Garrevoet3, B. de Sambère1, K. Appel1, V. Laszlo4, C. R. Janssen5

1 Ghent University, Ghent, Belgium 2 DESY, Hasylab, Hamburg, Germany 3 SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimens. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimens used in the toxicity tests were (i) food (Urtica-secullose) spiked into the sediment with (ii) autotrophic bacteria, (iii) food only and (iv) no food. It was observed that feeding regimens significantly affected the transport of Zn at all concentrations, with the highest Zn concentrations found in the range of 20-90% in the overlying water, depending on the concentration and feeding regimen. Overall, the results showed that the feeding conditions had a significant impact on the bioavailability and transport of Zn in the sediment system.

TUF 146

Influence of sediment contamination on fish embryo toxicity

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The Baltic Sea, one of the largest brackish water bodies in the world, is considered to be an exceptionally sensitive and endangered marine ecosystem. The average residence time of Baltic Sea water ranges between 23 and 50 years, thus facilitating the accumulation of pollutants in sediment. For a deeper insight into the ecotoxicological effects of pollutants, sediment and water samples were collected using a CoreXX pusher. The samples were analysed for a range of pollutants, including heavy metals, PAHs, PCBs, and dioxins. The results showed that the Baltic Sea is heavily contaminated with a variety of pollutants, with the highest concentrations found in the sediments. This highlights the urgent need for effective management strategies to reduce the input of pollutants into the Baltic Sea and to ensure its ecosystem health.

TUF 147

Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus

L. T. H. Nguyen1, M. B. Vandegeuchte2, B. Muyssen1, J. Garrevoet3, B. de Sambère1, K. Appel1, V. Laszlo4, C. R. Janssen5

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by means of chemical and ecotoxicological approach the toxicity of the sediments of this river, and their elutriates, in a region downstream Três Marias reservoir, in a site near a processing industrial plant. For this, a battery of three laboratory bioassays, using two cladoceran (Daphnia similis and Ceriodaphnia dubia) and one amphipod (Hyalella azteca) species, was used to assess the toxicity. 12 different metals (Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) and the different geochemical sediment fractionation methods (up to 12 steps of assessment of heavy metals and their potential toxicity) were determined in conjunction with sediment toxicity using Daphnia magna, Selenastrum capricornutum and seed-germination bioassay analysis. The Sediment Quality Triad (SQT) was used to identify areas in the system where sediment contamination may be linked to ecosystem degradation. A multivariate analysis was carried out and indicated that most of the metal pollution in the sediments originated from mine tailings. This indicates that the stations nearest to the alteration zone were severely polluted. These results suggest that there are health risks to human populations and activities such as vegetable and cattle farming or rural touristic recreation in the area. In order to restore the alteration zone to healthy conditions a remediation program would be necessary.

**TU 156**

Ecotoxicological assessment of contaminated sediments as a proxy for the water framework directive: an acid mine drainage example

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Metal contamination of freshwater water bodies resulting from mining activities or deactivated mines is a common environmental problem in Portugal. Despite authorities responsibility for the management of abandoned mining activities and the establishment of new safety and pollution control measures, the mining legacy is still releasing heavy and toxic metals, including Pb, Cd, Zn, Cu, Ni, As, Cr, Hg, Se, and Pb, which may pose serious health risks to local residents, agriculture, and aquatic ecosystems. Thus, determining the toxicity of mining-related sediments is important for risk assessment and management. In Portugal, two mining-historic areas were selected for an ecotoxicological characterization, namely the Bragança and the Balsemínica mining areas, which are characterized by a high density of abandoned and active mining activities. The Bragança mining area is located in the north-west of Portugal and is characterized by a long mining history, with active mining activities until the 1980s. The Balsemínica mining area is located in the central part of Portugal and is characterized by a long mining history, with active mining activities until the 1970s. The ecotoxicological assessment of the sediments from these mining areas was carried out using a battery of laboratory bioassays, including Daphnia magna, Selenastrum capricornutum, and seed-germination bioassay analysis. The results showed that the sediments from the Bragança mining area are more toxic than the sediments from the Balsemínica mining area, which may be due to the different mining history and the different mining activities. These results highlight the usefulness of using an ecotoxicological approach to help the prioritization/scoring of the most critical areas impacted by deactivated mines.
The project's further objectives comprise the assessment of human and environmental risk due to pesticide exposure, the communication of these risks to farmers and inhabitants living in the area and development of management recommendations for a more efficient and less environmentally adverse use of this Ramsar site.

TU 158

Heavy metal pollution assessment in sediments of the Nenemrut Bay, Turkey

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Surface sediments in the fraction <63 µm collected from eight stations in Nenemrut Bay, Aegean Sea were analyzed for trace metals (Cd, Pb, Cu, Zn, and Cr) by inductively coupled plasma mass spectrometry (ICP-MS). The heavy metal concentrations in the marine environment were determined in the sediments where they are finally enriched in the sediments by the affinity to bind on particulate matter and sorption processes. Adverse impacts on the benthic fauna are caused through chemical uptake and bioaccumulation of these contaminants.

TU 159

Determination of ecotoxicological effects of persistent organic pollutants from sediment cores of the Baltic Sea: a combination of chemical measurements and aquatic toxicity testing

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The study aims to investigate the effect on particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne and the mineral composition of sediments (measured by X-ray Diffraction, XRD) and its influence on the amount of sorption is presented, as well as composition and sorption processes. Adverse impacts on the benthic fauna are caused through chemical uptake and bioaccumulation of these contaminants.

TU 160

Hexachlorobenzene-contamination of sediments of the Upper Rhine River - identification of sorbents to assess bioavailability

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The project's further objectives comprise the assessment of human and environmental risk due to pesticide exposure, the communication of these risks to farmers and inhabitants living in the area and development of management recommendations for a more efficient and less environmentally adverse use of this Ramsar site.

TU 161

River sediment sampling and environmental quality standards

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Sediment forms an important part of the aquatic environment and provide habitat to benthic organism. However, poor water quality has been linked to contaminated sediments most of which consists of complex materials transported within river or deposited on river bed. Sediment has been identified as major transporter and sequester of fluvial contaminants such as heavy metals, most especially the fine sediment. At present, there are no environmental quality standards (EQSs) for bed sediments or fluvial deposits and, on one of the major problems in establishing sediment EQSs is the identification of the suitable sediment fraction to measure - the actively transported or passively deposited sediment. The variability in sediment characteristics is usually attributed to their active properties and the characteristics of the rivers such as pH, redox, and high water discharge, which is investigated during sediment sampling.

The study aims to investigate the effect on particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne River. Determination of selected elements between different compartments such as suspended sediment, bed sediment, bank sediment and the water column of Ravensbourne River. Sediment (bed and bank) and water samples were collected from Ravensbourne River over a period of 12 months. Sediment samples were tested for heavy metal concentration using the aqua regia, sequential extraction using a 6hour extraction technique proposed by Maiz et al. (1997).

TU 163

The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenyl ethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam

H.J. de Lange, J. Bovenschen, I. Laros, J. Lahr

TU 162

The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenyl ethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam

H.J. de Lange, J. Bovenschen, I. Laros, J. Lahr

Cellal Bayar University, Manisa, Turkey

The project's further objectives comprise the assessment of human and environmental risk due to pesticide exposure, the communication of these risks to farmers and inhabitants living in the area and development of management recommendations for a more efficient and less environmentally adverse use of this Ramsar site.
low chlorinated PCB formulations, atmospheric transport & post depositional processes might modify to some degree the fingerprint of PCB inputs to the environment favouring the predominance of 3, 4 & 5 chlorinated congeners. The PBDEs profile in sediment was relatively uniform, with decBDE as the dominant congener, followed by nona- and octaBDEs, indicating DecBDE as the major technical mixture in consumer products in this region. In general, the levels of PCBs and PBDEs in lagoon sediments were lower than those reported in other rivers and coastal developed countries. This may reflect a limited usage of PCBs and PBDEs in this region. Comparing to sediment quality guidelines currently used around the world, present sediment concentration of PBDEs in lagoon-river system might be an indicator of enhanced recent human pressure that suggests the need for a monitoring plan to prevent the possible dangerous worsening in the near future.

RA07P - Environmental problems of estuaries
TU 166
Distribution character and potential risk of PCBs and phenols in surface water from 22 tributaries and mainstream in middle reaches of Yangtze River
G.F. Zhao, H.D. Zhou, K. Li
China Institute of Water Resources and Hydro-power Research, Beijing, China
47 surface water samples were collected from 22 tributaries and mainstream of the Yangtze River from Chongqing to Yichang. The contents of 28 PCB congeners and 15 phenols in these water samples were measured using GC-MS. The results showed that the PCB concentrations were generally lower than the maximum contaminant level (MCL) and Selective Monitoring Criteria (SMCs) set by the Chinese Environmental Protection Agency and the World Health Organization (WHO). However, the phenolic compounds concentrations were relatively higher than the WHO-EU guidelines, which may cause stress to aquatic organisms by being harmful to their cell and tissue level. Therefore, it is urgent for us to pay attention to the potential risk of these contaminants. The aim of this research is to evaluate the sediment contamination degree of these contaminants in these samples.

TU 167
Measuring trace labile metals in the Pasig River water using DGT technique: an application for environmental water resource management
J.J. Villalobos-Zapata, A. Venisseau, T. Perez, M.V.O. Espaldon, P. Le Croust
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4, University of the Philippines, Los banos, Philippines
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6, 1, 3, 4, 2, 5
DGT is a technique developed and adapted to measure trace metals in the environment. This technique has been used to measure the trace labile trace metals (Cr, Co, Ni, Cu, Zn, Cd and Pb). The time of sampling campaigns captured the ENSO phenomenon. The water quality of the Pasig River was highly influenced by urbanization. This is a busy river greatly influenced by urbanization. It is a estuary in nature as it is in between a bay (Manila Bay) and lake (Laguna Lake) (east). The water quality is a main concern. From being in a state of biologically dead, rehabilitation is applied to raise it to Class C. The objectives are still on going. An efficient water quality monitoring technique and assessments are necessary. This research made use of the current available technique called passive sampling. DGT was used to target the labile trace metals. From the time of sampling campaigns captured the ENSO phenomenon (El Niño: Period 1, La Niña: Period 2 and in between summer and rainy seasons: Period 3). From these periods, DGT-labile metal concentrations had been compared. Multivariate analyses computed (Principal Component Analysis (PCA) and Factor Analysis (FA)) were employed. This is to be able to identify the parameters that play a more part in each period. The cumulative percentages of the total variance are as follow: 89.3% for Period 1; 87.11% for Period 2; and 81.25% for Period 3. Correlations among the parameters had been achieved as well. Percent concentrations of each element per site were determined. Scores were given and ranking was then supplied. Based from the ranking, sites that contribute more of the selected parameters were identified. For Periods 1 and 2, highest contributions are found near mid to upstream. While Period 3, highest rank is near at downstream. From this data, it could be seen that the sites that can be given the highest priority and attention. Fluxes (in kg d−1) were provided as well. Period 2 having the highest flow gave the highest fluxes per site.

TU 168
Dioxin-like compounds in Portuguese estuaries: levels and patterns in superficial sediments
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2, 1, 2
Dioxins are highly persistent and toxic compounds that have the ability to accumulate in living organisms. They are capable of interfering with the activity of the endocrine system of aquatic species. The aim of this research is to evaluate the sediment contamination degree of these contaminants in these samples. Trojanowska et al. (2003) have shown that PCDD/Fs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Tagus, Ria de Aveiro and Sado). The lowest PCDD/Fs and DL-PCBs values were measured in Ria Formosa, a protected area with strong natural processes. OCDD is the most abundant PCDD/F congener in all the samples but PeCDD or PeCDF were the major contributors to WHO-PCDD/F-TEQ2005. For Periods 1 and 2, highest contributions are found near mid to upstream. While Period 3, highest rank is near at downstream. From this data, it could be seen that the sites that can be given the highest priority and attention. Fluxes (in kg d−1) were provided as well. Period 2 having the highest flow gave the highest fluxes per site.

TU 169
Environmental monitoring and assessment of Terminos Lagoon, Mexico
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Terminos Lagoon is located in the estuary of the Grijalva-Usumacinta river system, with the largest fresh water runoff in Mexico (35% of the total), and the second largest in the Gulf of Mexico. It is near of one of the main oil drilling areas in Mexico and there are many industrial facilities associated with the oil industry affecting the region. As one of the components of the Sustainable Management of the Gulf of Mexico Large Marine Ecosystem, the pilot project on monitoring and environmental assessment selected Terminos as the site to study. The project consists of five modules: water quality, sediment quality, contaminants and biomarkers in fish, benthic community, and organic pollutants there were no significant differences between the zones, except for HCHs and PAHs. A number of stations were found to be in “bad”condition for water quality and benthic community. Loss of mangroves is decreasing. Results have been presented to management authorities.

TU 170
Chemical and biological assessment of metal pollution in the Urdaibai Reserve of the Biosphere (UNESCO) using oysters as sentinels
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Oysters have been widely used as sentinel organisms in order to determine the presence of pollutants and their effects in coastal and estuarine environments. In the present work, the chemical and biological assessment of metal pollution in the Urdaibai Reserve (Urdaibai Biosphere Reserve) was carried out on 7 sites at different seasons along 2010. Together with oysters, water and sediment samples were also collected. The concentration of 14 elements (Al, As, Cd, Co, Cu, Cr, Fe, Mg, Mn, Ni, Pb, Sn, V and Zn) were determined. Cell and tissue level biomarkers and histopathological alterations were also evaluated. High Cu concentrations were present in the water column but tissue concentration was not high in oysters. Overall, the Urdaibai Reserve seems to be under low metal contamination in the water column. In contrast, a moderately high Pb concentration was found in oysters but not in water. Preliminary data in sediments indicated higher values of Cu and Mg in Mundaka. Regarding cell and tissue level biomarkers, no significant differences were observed comparing the sites. Occasionally, Arteaga presented symptoms of atrophy in the digestive diverticula in M. galloprovincialis. Severe histological alteration in the digestive gland of M. galloprovincialis. Metals revealed by autometallography as black silver deposits (BSDs) appeared in the basal lamina (histological sense) of the digestive epithelium in March and June, whereas BSDs were localized within digestive cell lysosomes in September and especially in November. The when a significant increase in the BSD volume density was observed in parallel with an increased metallothionein content. In conclusion, the results confirmed that the Urdaibai Reserve of the Biosphere presents low-to-moderate levels of metals both in oysters and waters, with only minor biological effects in oysters. It is worth noting that, however, seasonality may play a relevant role in environmental metal levels, bioaccumulation and the biological responses of oysters against environmental insult.

Acknowledgements: This work has been financially supported by the UNESCO Chair of the UPV/EHU through the UNESCO O923 project and by the UPV/EHU through the Consolidated Research Groups (Ref: GIC0726-IT-393-07).
Impacts of hypersaline conditions on the endocrine and reproductive effects of bifenthrin on salmonids
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Pyrethroids are a commonly used class of pesticides in California in both agricultural and urban applications. Although pyrethroids are reported as having nominal effects on mammals, they have toxic effects on aquatic organisms and have been found to be associated with endocrine disruptors. In the present study, we investigated the effects of exposure to bifenthrin on the reproductive and endocrine physiology of juvenile Chinook salmon (Oncorhynchus tshawytscha). Bifenthrin was administered at environmentally relevant concentrations to juvenile salmon and the effects on reproduction, endocrine function, and oxidative stress were measured. The results showed that bifenthrin exposure had significant effects on reproduction, endocrine function, and oxidative stress. These findings highlight the potential risk of bifenthrin exposure to fish populations and the need for further research to better understand the effects of this class of pesticides on aquatic ecosystems.
group in freshwater fish, 14.4% in the 8 ppt and no mortality in the 17 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. However, significant differences were not observed in the 8 ppm salinity treatment groups indicating protection by hypersaline conditions from acute lethality. Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth.

In the sediment contact test, Myriophyllum aquaticum whorls are exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample is compared with its growth in the control sample. The phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth. Results for HgTOT were generally in line with published values for Laranjo Bay. Organic mercury was the most abundant of the species in the superior organisms. A strong positive one (Pearson Product Moment correlation, P<0.0001) were found for Laranjo data, between HgTOT and organic mercury. Inorganic Hg is the main form in waters and sediments samples, whereas organic forms of Hg (e.g. HgORG, methylmercury (MeHg)) is generally found in lower concentrations. In order to examine the trophodynamics of HgTOT and HgORG in a coastal lagoon, suspended particulate matter (SPM), sediment, seston, phyto and zooplankton agglomerates, Crangon crangon, Patocystus micropsichus, Liza analusia, Atherina boyeri and Dicentracanthus labrax were sampled. Sampling took place near the mouth of the two major freshwater sources (Vouga and Antuã rivers) to the lagoon. Vouga River runs in a narrow channel, with steep margins. Its watershed receives contributions from agriculture, livestock and industry, and it is fed by an adjacent lake. Antuã River, indubitably provides strong runoff from karstic spring inputs and mineral influences. Laranjo Bay (a depositional area) receives the Antuã, which has been conveying industrial discharges, particularly an effluent from a mercury cell-chlor-alkali plant (from the 1950s until 1994). From the estimated 33t of mercury dispersed into the lagoon, the majority (81%) is associated with the sediments in Laranjo Bay. By determining the position of each of the sampled compartments in the local food webs, using GC-IRMA (Infrared Molecular Absorption Spectrometry), the evaluation of this element's transference in the food web was achieved. Mercury analysis was executed using CV-AAS (Cold Vapor Atomic Absorption Spectrometry). Certified reference materials (DOLT-3 and DOLT-4 for tissues, PACS-2 for sediment) were used in the QC/QA process. A significant negative correlation (Pearson Product Moment correlation, P<0.001) was found for Laranjo data, between HgTOT and HgORG, respectively. No other significant correlations were established. Results for HgTOT were generally in line with published values for Laranjo Bay. Organic mercury was the most abundant of the species in the superior organisms (always>57%). The diverging patterns of HgTOT and HgORG distribution are discussed.

Is Qu89 Is capable of responding to pollution by changing the physiological capabilities of Corbicula fluminea to respond to acute chemical stress in estuaries?

P. Vilares, C. Oliveira, E. Guimarimino
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The Asian clam Corbicula fluminea (Müller, 1774) is an invasive species that has been colonizing aquatic ecosystems in Europe, America and several other regions. In the freshwater tidal area of the Minho River estuary (NW Iberian Peninsula) that was colonized by this species in the 80s, C. fluminea is now the dominant species of the benthic community, having contributed to the decline of several native molluscs and considerably changed ecosystem functioning. Furthermore, C. fluminea has been showing to be able to develop resistance to pollution. Here, the hypothesis that individuals from the river but inhabiting sites with distinct levels of historical contamination, have different capacities to develop resistance was tested and whether exposure to pollution elimination events. To test the hypothesis, animals collected at two sites in the Minho River under different anthropogenic pressure were separated and submitted to the model polycyclic aromatic hydrocarbon benzo[a]pyrene (BaP) after a period of acclimation to lab conditions. At the end of the bioassays, enzymes involved in neurotransmission, biotransformation, anti-oxidant defences, aerobic energy production and lipid peroxidation levels were used as biomarkers. Results show different responses between the two sites, suggesting that animals inhabiting the most contaminated site developed tolerance to chemical stress.

This study was carried out in the scope of the project "NISTRACKS - Processes influencing the invasive behaviour of the non indigenous species Corbicula fluminea (Mollusca; Bivalvia) in estuaries - identification of genetic and environmental key factors" funded by the Portuguese Foundation for the Science and the Technology (FCT) (PTDC/ACE-AMOB/102123/2008) and FEDER COMPETE funds (FCOMP-01-0124-FEDER/008556). P. Vilares had a grant in the scope of the project and C. Oliveira had a Phd grant from FCT (SFRH/BD/68423/2010) funded by national funds of the MCTES and FEDER European funds (POPH-QREN-Tipologia 4.2.).

RAI19P - Plants and chemicals in the environment: risk assessment, pest management and phytoremediation

TU 181 Sediment contact test with Myriophyllum aquaticum (ISO/CD 16191): first results of an international ring test

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Federal Institute of Hydrology, Koblenz, Germany

Aldrichia is an important part of an aquatic ecosystem, dicotyledonous macrophytes are not yet part of the risk assessment of sediments or dredged material. A sediment contact test system with the dicotyledonous watermilfoil Myriophyllum aquaticum was established by the ecotoxicological laboratory of the German Federal Institute of Hydrology. This test procedure is now in the standardisation process within ISO. In the study on Myriophyllum aquaticum who are exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample is compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth. Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test showed that a) investigating the practicability and productivity of the sediment contact test, ii) validating the chosen endpoint, and iii) determining the response range of the reference substance functioning as positive control.

First results of the interlaboratory ring test will be presented.

Acknowledgement: U.F. on behalf of the participants of the international ring test

TU 182 Genotoxicity more ecologically relevant data from laboratory tests: recovery potential of Lemna minor

V.Z. Knezevic, T.O. Tunic, P.L. Marjan, M.S. Kezunovic, I.S. Teodorovic
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The goal of ecological risk assessments for chemicals typically is to protect the status of populations. Still, the assessments are usually conducted at the level of the individual, so the results of laboratory testing need to be translated into predictions of population status. Extrapolation from laboratory tests has many limitations, among which is the fact that species differ not only in toxicological sensitivity but their potential for recovery from adverse effects. Differences in biomarkers responses between the two groups of clams suggesting that animals inhabiting the most contaminated site developed tolerance to chemical stress.

To test the hypothesis, animals collected at two sites in the Minho River under different anthropogenic pressure were separated and submitted to the model polycyclic aromatic hydrocarbon benzo[a]pyrene (BaP) after a period of acclimation to lab conditions. At the end of the bioassays, enzymes involved in neurotransmission, biotransformation, anti-oxidant defences, aerobic energy production and lipid peroxidation levels were used as biomarkers. Results show different responses between the two sites, suggesting that animals inhabiting the most contaminated site developed tolerance to chemical stress.

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TU 183 New developments in mesocosm testing with herbicides: recent experiences and recommendations

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A new number of developments in mesocosm testing have taken place since the most recent revisions to guidance for these complex studies (e.g. HARP, 1998 & CLASSIC, 2001). Much of the progress in this area since this guidance was produced has been in the design and conduct of freshwater mesocosm studies to evaluate the toxicity of herbicides and periphyton drawing on our experience in this area. It is hoped that the information provided will advance mesocosm study design and offer advice to those considering conducting mesocosm studies with herbicides whilst providing a catalytic for discussion in this developing area of higher tier aquatic ecotoxicology.

TU 184 Unforeseen effects of herbicides on wetland and terrestrial plant communities: time to vegetative and reproductive recovery following exposure

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Standard plant toxicity tests rely on the evaluation of species in short-term (ST) studies; long-term (LT) effects of low doses of herbicides on wild vegetation, or the recovery potential of plants is not often assessed. The ability of wild species to recover following sub-lethal exposure to herbicides was examined using the sulfonlurea herbicide chlorimuron ethyl. Eight wetland and nine upland plants were used with eight doses of chlorimuron (α controls) ranging from 1 to 107 of the recommended label rate.
of 9 ha-1. For each species, two sets of plants were grown: total aboveground plant biomass was assessed at four weeks after exposure for the ST plants (first set) and again for the LT plants (second set) when the controls began natural senescence (7-23.5 weeks post-spray depending on species). To assess recovery over time, measurements of maximum plant height were taken weekly for all species using the LT plants. Reproductive parameters were also recorded for 13 species. Inhibition concentrations (IC50) were calculated for ST and LT biomass and for LT reproductive parameters. ST biomass was found to be the most sensitive measure of IC50 for nine species and LT reproduction for three; IC50s could not be predicted for five species (no effect). Delays in flowering time were apparent for several species. Twelve species had early delays in growth as compared to the controls at doses of 7.4% or less, two species were affected at higher doses (14.5 or 55%) while three species (all grasses) had no reductions in height at any dose. Eight species were affected at doses of 7.4% or less, three fully recovered within an avg. of 6.7 days post-spray, six recovered up to doses of 14.5% (avg. 6.5 weeks) and three up to doses of 28.2% (avg. 12.3 weeks). Though an overall trend towards recovery was also noted for reproductive parameters (4 spp. recovered, 3 remained the same, 3 unaffected at any dose), rates of recovery did not follow those observed for height. Delayed growth and flowering was observed at doses less than known drift rates (10%); however, two species were affected at natural field rates exposed to these same rates were often able to recover over time. While recovery did occur in this greenhouse experiment, it may alter the natural species composition in exposed areas. This community approach is not considered in risk assessment.

TU 185

Effects of agrochemicals on macrophyte community structure and quality in a Canadian agricultural watershed

Peter Sowig1, Margit Dollinger2, Andreas Solga2, Jim Hoberg3 & Ashlee Kirkwood3

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Strobilurin fungicides constitute a relatively new fungicide class developed from natural fungicidal derivatives and the great impact of them on agriculture is reflected by the widespread use of azoxystrobin (AZX), a compound approved for use on almost 100 different crops. Its mechanism of toxicity is well understood in fungi but it effects in plants are not fully understood. To elucidate this knowledge, the effect of AZX on macrophytes species composition in exposed areas. This community approach is not considered in risk assessment.

TU 188

Biochemical responses in the aquatic macrophyte Myriophyllum quinense exposed to the strobilurin fungicide azoxystrobin

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TU 189

Impact on surface water, stream sediments and macrophytes from the Alfajur mining area (Argentina)

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Polytechnic Institute of Beja - Agricultural Superior School, Beja, Portugal

The main environmental problem in the vicinity of Aljustrel mining area, as in other massive sulphide deposits of the Iberian Pyrite Belt, comes from the tailings deposited in the environment, being a more detailed studied highly recommended.

TU 190

The effect of five sulfonyl-urea herbicides to aquatic macrophytes - implications of results from outdoor growth inhibition studies for the risk assessment

P. Sowig1, M. Dollinger, A. Solga2, J. Hoberg2, A. Kirkwood1

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The collection of multi-species data is an option to refine higher tier risk assessments. The objectives of multi-species testing are (1) to derive a species-sensitivity distribution element pool (As, Cu, Pb and Zn). Aquatic macrophytes have been used as environmental biomonitors because of its bioacumulation capacity of xenobiotics. The main goal of this study was to assess the potential environmental impact of sulfonyl-urea herbicides due to their wide spread use in agriculture. The study was designed to test the sensitivity of aquatic macrophytes to sulfonyl-urea herbicides by testing the five herbicides at three concentrations. The results showed that the macrophytes are responsive to sulfonyl-urea herbicides and that the response varies depending on the species and concentration level. The results also suggest that sulfonyl-urea herbicides may have a significant impact on aquatic macrophytes and that further studies are needed to fully understand the effects of these herbicides on the aquatic ecosystem.

TU 191

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Peter Sowig1, Margit Dollinger2, Andreas Solga2, Jim Hoberg3 & Ashlee Kirkwood3

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The collection of multi-species data is an option to refine higher tier risk assessments. The objectives of multi-species testing are (1) to derive a species-sensitivity distribution element pool (As, Cu, Pb and Zn). Aquatic macrophytes have been used as environmental biomonitors because of its bioacumulation capacity of xenobiotics. The main goal of this study was to assess the potential environmental impact of sulfonyl-urea herbicides due to their wide spread use in agriculture. The study was designed to test the sensitivity of aquatic macrophytes to sulfonyl-urea herbicides by testing the five herbicides at three concentrations. The results showed that the macrophytes are responsive to sulfonyl-urea herbicides and that the response varies depending on the species and concentration level. The results also suggest that sulfonyl-urea herbicides may have a significant impact on aquatic macrophytes and that further studies are needed to fully understand the effects of these herbicides on the aquatic ecosystem.
Both surface water and sediments were extremely acidic at Água Forte stream, with pH values <2.92 for surface water and <3.12 for sediment samples. Surface water at Roxo stream presented pH values >7.26, apparently not affected by the confluence of the Água Forte stream, but the same was not true when considering the pH and other characteristics of the sediments. Ecotoxicological bioassays (luminescence inhibition of Vibrio fischeri and 48-h immobilization/mortality assay with Daphnia magna) were conducted on water samples from both streams, as well as on water samples from ploughed fields, and Leafy liverwort (Marchantia polymorpha). For Roxo stream, the water was reported as extremely toxic, with very EC50 values. Although high As, Cu, Pb and Zn concentrations were found at Água Forte stream, the same was not true in Roxo stream. Trace element content in water, sediments and Scirpus holoschoenus samples was analyzed and correlated in order to ascertain if this particular macrophyte, which seems adapted to the extreme conditions found at Água Forte stream, can be potentially used for metal removal in constructed wetlands to treat AMD.

TU 191
Species-specific responses to zinc in Lemnaeae: zinc storage and impacts on photosynthesis along frond developmental gradients
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Lemnaeae are used to represent all macrophytes in standardised aquatic toxicity testing, with protocols allowing for the use of different species. Recently, differential sensitivity in Lemnaeae species to zinc, based growth and chlorophyll-a fluorescence parameters, has been reported. Chlorophyll-a fluorescence is an effective tool for sensing and monitoring stress effects on the photosynthetic system of Lemnaeae. Plant age and developmental stage strongly influence the effects of metals on the photosynthetic apparatus. However, there is little information on how this may affect toxicological assessment in plants. Zinc accumulation, morphological distribution and cellular storage, in either bound or soluble form, are also important for zinc sensitivity/tolerance and will be affected by increasing concentrations. Differential metal sensitivity of plant species has been linked with differences in accumulation and distribution. This study investigates how frond age and developmental stage, as well as zinc accumulation and storage, determine the impact of zinc on Lemnaeae. The maximum quantum efficiency of photosystem II, Fv/Fm, the effective quantum efficiency, Y(II), and photochemical quenching, qP were measured in mature and young fronds as well as along a developmental gradient within a single frond. Zinc accumulation in mature fronds and root-to-shoot metal transfer in both (soluble and bound forms) in the plants were also measured after seven days. L. punctata and L. minor accumulated more zinc in their tissues than L. gibba. Partitioning of zinc in L. minor was notably different from the other two species, zinc was stored mainly in roots and the bound-fraction. Fv/Fm and Y(II) in young fronds were more severely impacted by zinc than in mature fronds in all species. However, younger proximal sections of L. punctata fronds were more impacted than older distal frond sections compared to more homogenous impact in single Lemna fronds. Single colony, time-point or leaf-zone analyses may not show the full biological picture of the impact of a toxicant, especially not in L. punctata. Therefore, selection of Lemnaeae species and developmental stages of fronds should be given careful consideration when using chlorophyll-a fluorometry for assessing chemical impact of a toxicity in Lemnaeae.

TU 192
Alleviative effects of magnesium on copper rhizotoxicity to grapevine: macroscopic and microscopic point of view
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Intensive and long-term application of copper (Cu)-containing fungicides (e.g. Bordeaux mixture) in vine-growing areas has led to the accumulation of Cu on the surface of soils worldwide, thus posing the problems of Cu toxicity to the organisms therein. Recently, a number of studies have found that some cations, such as magnesium (Mg) and calcium, may alleviate the rhizotoxicity of Cu to plants. In this study, a hydroponic experiment was conducted to determine the influence of Mg concentration on the growth inhibition effects of Cu to grapevine roots. In optical microscopy, Cu concentration was used to examine the histological changes in root tissue at the presence of Cu at the different levels. Results indicated that Mg for root elongation inhibition concentration of Cu for Mg concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rhizodermal cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM in the 0.2 mM Mg treatment, to 25 μM in the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can mitigate Cu rhizotoxicity to grapevines effectively.

TU 193
Metal effects in Fraxinus angustifolia and its endophytic communities
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To evaluate the environmental impact of U-contamination, it is important to unravel the mechanisms by which plants respond to U-stress. It was already shown that U-angustifolia to tolerate the contamination and its physiological performance, a set of parameters (above-ground growth, leaf area, relative water content, maximum efficiency of photosynthesis, chlorophyll content, biomass and Cu concentration in leaves) and leaf endophytic communities (Leucoagaricus hortensis and leaf endophytic communities) were measured during the test. Furthermore, the genetic profiles of the endophytic communities from the roots of the plants were also analyzed. This analysis was made via PCR-DGGE technique, targeted for a conserved region of 16S rDNA, pre- and post-exposure. Only above-ground growth was a suitable indicator of the negative effects of the contamination on the plants throughout the experiment. Results indicated that Mg for root elongation inhibition concentration of Cu for root elongation inhibition concentration of Mg concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rhizodermal cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM in the 0.2 mM Mg treatment, to 25 μM in the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can mitigate Cu rhizotoxicity to grapevines effectively.

TU 194
Dose-dependent effects induced by uranium (U) at pH 4.5 in Arabidopsis thaliana
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To evaluate the environmental impact of U-contamination, it is important to unravel the mechanisms by which plants respond to U-stress. It was already shown that U-exposure at pH 5.3 can disrupt the cellular redox balance and induce oxidative stress related responses in Arabidopsis thaliana plants (Vanhoudt et al., 2008). However, U-specificity and mechanisms are not fully understood. Therefore, the aim of this work was to investigate the dose-response effects of pH 4.5. Arabidopsis thaliana plants were exposed to U-concentrations ranging from 0 to 100 μM at pH 4.5 during 3 days. U-concentration, fresh weight, lipid peroxidation and photosynthetic efficiency were analyzed. On protein level, the enzymes of the antioxidative defence system were analysed to evaluate the importance of the cellular redox balance in Arabidopsis thaliana plants exposed to U. Results indicate that the U-content in roots and shoots increased with increasing U-concentration added to the nutrient solution. In contrast, plants exposed to 6.25 and 12.5 μM U had an increased fresh weight as compared to the control plants, which alludes to a hormesis effect as was observed before (Vanhoudt et al., 2008, Straczek et al., 2009). This increase in fresh weight was accompanied by a decrease in lipid peroxidation. Results indicate that the negative effects of U-exposure decreased in the control plants exposed to U-concentrations from 0 to 100 μM U in the 0.2 mM Mg treatment, to 25 μM in the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can alleviate Cu rhizotoxicity to grapevines effectively.

TU 195
The effect of pharmaceutical active compounds on oxidative stress response enzymes of the macrophyte Ceratophyllum demersum
1MingDau Univ., Changhua, Taiwan
2National Chiayi University, Chiayi, Taiwan

To evaluate the environmental impact of U-contamination, it is important to unravel the mechanisms by which plants respond to U-stress. It was already shown that U-angustifolia to tolerate the contamination and its physiological performance, a set of parameters (above-ground growth, leaf area, relative water content, maximum efficiency of photosynthesis, chlorophyll content, biomass and Cu concentration in leaves) and leaf endophytic communities (Leucoagaricus hortensis and leaf endophytic communities) were measured during the test. Furthermore, the genetic profiles of the endophytic communities from the roots of the plants were also analyzed. This analysis was made via PCR-DGGE technique, targeted for a conserved region of 16S rDNA, pre- and post-exposure. Only above-ground growth was a suitable indicator of the negative effects of the contamination on the plants throughout the experiment. Results indicated that Mg for root elongation inhibition concentration of Cu for root elongation inhibition concentration of Mg concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rhizodermal cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM in the 0.2 mM Mg treatment, to 25 μM in the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can mitigate Cu rhizotoxicity to grapevines effectively.

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
Pharmaceutically active compounds (PhACs) in the environment have recently been acknowledged to potentially constitute a health risk to terrestrial and aquatic ecosystems and thus ultimately for humans. The occurrence and rate of selected human PhACs belonging to different therapeutic classes (non-steroidal anti-inflammatory drugs, anti-epileptics, contraceptives and ß-blockers) have been detected in many countries in sewage treatment plant effluents, surface waters, seawaters, groundwater and some drinking water sources. The ecological and toxicological effect of ever decreasing low concentrations of PhACs on non-target organisms, such as aquatic macrophytes has so far received little attention. In nature aquatic organisms are constantly exposed to xenobiotic compounds that cause the overproduction of oxidants or reactive oxygen species (ROS) resulting in oxidative stress. Therefore, we have investigated the detoxification enzyme glutathione S-transferases (GST) in the plant extract to metabolize PhACs in vitro and the results shown the inhibition of GST activity under the influence of the used PhACs. The data of the peroxidase (POD) and catalase (CAT) suggests that PhACs do not directly cause oxidative stress by an increase in ROS production. Due to increased ROS accumulation PhACs may be selectively toxic to some organisms leading to ecosystem alterations.

TU 196

The toxicity of iron nanomaterials to aquatic and terrestrial plants

D.J. Jancula, S.Z. Zerchalka, P.M. Mikula, B.M. Marsalek

Introduction: Iron nanomaterials are a subject of increasing interest to scientists and industries due to their unique properties compared to the larger metal particles, which are capable of colonizing contaminated sites due to its fast and vigorous growth by producing seeds and rhizomes. In order to evaluate its potential for the purpose of phytoextraction, genetic approaches are required to uncover the allelic variation at both Mendelian and quantitative genes. Analytical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancing phytoremediation efficiency.

This study considers the genetic relationships among different S. vulgaris clones. Fourteen clones from ten populations collected from Madrid (Spain) were analysed using chloroplast DNA (cpDNA) markers. Ten primers pairs chloroplast SSR loci were tested and 3 out of the 10 primer pairs revealed the existence of intraspecific length polymorphism. The intergenic spacer between the rtrnH and polA genes was amplifiy with the primers trnH (CUG) and polA. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for ccmp1 (120 and 121pb), two for ccmp4 (113 and 114pb), five for ccmp2 (190, 191, 192, 193 and 195pb) and six for trnG/pba (328, 338, 349, 354, 355 and 357pb).

In order to study genetic diversity, ten unique cpDNA haplotypes were identified and seven of them were private, being found in only one population. Despite the limited number of clones examined, a considerable intraspecific polymorphism was detected and can be explained by S. vulgaris out-crossing breeding system. Conservation of genetic resources in this allogamous species requires maintenance of the genetic diversity within each clone to avoid inbreeding depression and loss of rare alleles.

TU 199

Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river

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Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river have recently been acknowledged to play a crucial role in the environment. Previous studies on this river have shown high levels of metal contamination, however, studies on metal bioaccumulation in aquatic biota such as plants are limited. Plants were obtained from a reference site and placed in baskets at two sites along the river both downstream and upstream of a pollution source.

The metal concentrations in C. demersum were significantly lower when compared with the previously species, even in the rhizomes/roots. Other metals, such as Cu and Zn, are also accumulated by plants from the Callitriche genus, namely, Cu by Callitriche verna and Cu and Zn by Callitriche stagnalis with maximum concentration values of 132 mg/kg and 1395 mg/kg in dry biomass, respectively. The abundance of Callitriche stagnalis and several heavy metals at the same time made the plant our first choice for rhizofiltration methodologies development.

TU 200

Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river

D.V. Erasmus, R.G. Snyman, J.P. Odendaal

Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river have recently been acknowledged to play a crucial role in the environment. Previous studies on this river have shown high levels of metal contamination, however, studies on metal bioaccumulation in aquatic biota such as plants are limited. Plants were obtained from a reference site and placed in baskets at two sites along the river both downstream and upstream of a pollution source.

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TU 201

Selenium pathway in water moss Fontinalis antipodacea

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TU 202

Selection of suitable aquatic plants for phytofiltration of arsenic-contaminated water

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The work performed here is part of a larger on going study about the metals and metalloids accumulation in aquatic plants of unarificial geochemical province of Central Portugal. It is oriented for the use of aquatic plants as indicators of metal contaminated waters and their potential use in phytoremediation.

In submerged and free-floating plants the concentrations of As were much higher than in emergent plants, with the exception of Oenanthe crocata. The highest concentrations of As were found in the submerged species Callitriche brunnia (43.92 mg/kg DW), Callitriche stagnalis (354.03 mg/kg DW), Callitriche suaveolens (160.37 mg/kg DW), Ranunculus tripteris (268.53 mg/kg DW), Ranunculus penaeus (103.98 mg/kg DW), in the free-floating plant Linnia minor (279.42 mg/kg DW), and in emergent plant Oenanthe crocata (157.94 mg/kg DW). The measured concentrations in the emergent plants, such as Apium nodiflorum, Typha latifolia, and Juncus effusus were significantly lower when compared with the previously species, even in the rhizomes/roots. Other metals, such as Cu and Zn, are also accumulated by plants from the Callitriche genus, namely, Cu by Callitriche verna and Cu and Zn by Callitriche stagnalis with maximum concentration values of 132 mg/kg and 1395 mg/kg in dry biomass, respectively.

The abundance of Callitriche stagnalis and several heavy metals at the same time made the plant our first choice for rhizofiltration methodologies development.

TU 203

Genotypic variation in metal-tolerant Silene vulgaris clones

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Silene vulgaris is a facultative co-tolerant to heavy metals, capable of colonizing contaminated sites due to its fast and vigorous growth by producing seeds and rhizomes. In order to evaluate its potential for the purpose of phytoextraction, genetic approaches are required to uncover the allelic variation at both Mendelian and quantitative genes. Analytical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancing phytoremediation efficiency.

This study considers the genetic relationships among different S. vulgaris clones. Fourteen clones from ten populations collected from Madrid (Spain) were analysed using chloroplast DNA (cpDNA) markers. Ten primers pairs chloroplast SSR loci were tested and 3 out of the 10 primer pairs revealed the existence of intraspecific length polymorphism. The intergenic spacer between the trnH and polA genes was amplifiy with the primers trnH (CUG) and polA. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for ccmp1 (120 and 121pb), two for ccmp4 (113 and 114pb), five for ccmp2 (190, 191, 192, 193 and 195pb) and six for trnG/pba (328, 338, 349, 354, 355 and 357pb).

Regarding genetic diversity, ten unique cpDNA haplotypes were identified and seven of them were private, being found in only one population. Despite the limited number of clones examined, a considerable intraspecific polymorphism was detected and can be explained by S. vulgaris out-crossing breeding system. Conservation of genetic resources in this allogamous species requires maintenance of the genetic diversity within each clone to avoid inbreeding depression and loss of rare alleles.
during years 2009, 2010 and 2011. The concentration of Se in water from all locations did not exceed 0.2 µg L-1. Fontinalis antipyretica took up Se in the range between 343 - 3039 ng Se g-1 (on dry matter basis; DM). The Se content varied, depending on the location and season. The highest content of Se was measured in the stream of Zerovnicaka that flows through agricultural area with pastoral farming, the value being 3039 ± 170 ng Se g-1 (DM). The amount of insoluble Se compounds after enzymatic hydrolysis using Protease (XIV) was around 75%. In soluble Se compounds only traces of Se (IV) and Se (VI) were found. No other Se compounds (SeMetCys, SeMet) were detected.

TU 202

The organic matter contribution of marsh saltwater to coastal wetland ecosystems: a case study in Jiangsu, China
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Stable isotope techniques and different calculation models were used to analyse the potential sources of sediments organic matter in the core area of primary wetland and to calculate the contribution of salt marsh vegetation. By using multiple resources linear mixing model and the Euclidean distance model, we can conclude that micro-algae and Spartina alterniflora are the main contributors, under the assumption that the b°C value of micro-algae is -23°, the average contribution rate of micro-algae is 40%, which is the main contributor to the salt marsh wetland ecosystems in northern Jiangsu. The contribution rate of Spartina alterniflora to its marsh is 56% and to the intertidal is 37%. By comparing the two quantification models, we can find that the Euclidean distance model would overestimate the contribution of incidental resources and average the resource of high contribution rate.

TU 203

Genotoxicity study on Vicia faba L. grown on natural and spiked contaminated soils
L. Giorgetti, V. Giannodati, M. Barbieri
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Contaminant bioavailability and toxicity varies among soil types and may depend on soil properties and on contaminants characteristics. Metals contamination could have different potential risks depending not only on the total content but on their bioavailability. Operationally, metal bioavailability is often evaluated by chemical extractions characterizing different chemical forms. The use of plant bioassays may be an amiable tool to screen the phytotoxicity of contaminated soils and its effect on the environment.

In this work different soils contaminated by Boron (B) were studied in relation to plant bioavailability and toxicity. B is an essential micronutrient for plants and generally is absorbed from soil in the form of boric acid. Previous studies demonstrated that both excess or deficiency of B can affect normal plant development. Naturally polluted soils and artificial mixtures were characterized for B bioavailability, genotoxicity and B content in the plant. The polluted soil and spiked soil with similar B content in the plant showed the same pattern of phytotoxicity and genotoxicity in Vicia faba. It is interesting to stress that bioavailability of B, and its content in the different plant organs, resulted higher in artificially spiked soils when compared with the same B concentrations in natural soils.

A close correlation between high B concentration in roots and major level of cytogenetic defects was found. These results confirmed plant genotoxicity of B polluted soils and showed clear evidences between soil properties, B bioavailability and phytotoxicity.

TU 204

Acute and chronic in vitro bioassays vs. autochtonous plants used as sentinel: comparing genetic biomarkers as tools in ecological risk assessment in Del Plata basin
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4Del Plata basin is the fifth largest river basin in the world, its area covers four million km2 approximately and contains a great variety of natural environments and resources; these resources are shared by Bolivia, Paraguay, Brasil, Uruguay and Argentina.

The lack of wastewater treatments from 100 million inhabitants is the main source of chemical and biological pollution that impact on all tributaries and affects negatively to the aquatic fauna.

Samples of surface river water from along 1200 km of river coast were analyzed according assessed APHA, AWWA, WEF (1992) water quality indices (WQI) were calculated Value were adjusted to guideline values and sample sites were qualified, being Excellent (95-100) 11%, good (80-94) 21%, Fair (65-79) 26%, Marginal (45-64) 26% and Poor (0-44) 16% of sampled places. Genotoxic biomarkers used to evaluate toxicity. Allium cepa were exposed chronically and semi-statically while Lactua sativa assay was acute and static according IRAM standards. Samples of Echinodorus uruguayensis Arechav. (Alismataceae), Eichornia crasipes (Mart.) Solms (Pontederiaceae), Puccia statinotes L. (Araceae), Scirpus giganteus Kunth (Cyperaceae) were fixed in field to evaluate biomarkers. The biomarkers included in this study were: Chromosome count, occurrence of cytogenetic abnormalities and Mitotic Index calculated as (MI = # total of dividing cells x 100/nro total of observed cells) was studied. An average of 1800 ± 500 cells were analyzed per individual. Uni- and Multivariate analysis were applied.

Pearson was a pristine site located downstream of the Rio de la Plata and it was considered as reference point. While chronic bioassays showed higher MI in samples from Uruguay River, samples of water from the Rio de la Plata were characterized by abnormalities in mitoses. Classical end points might be masked by abundance of nutrients in water since these parameters were registered in natural and agricultural developing areas. On one hand we found higher responses to multiple stresses in laboratory bioassays than in field specimens indicating an overestimation of water toxicity. Our results revealed that different sources of pollution depending on the characteristics of field could show similar results in some biomarkers in situ but integrating data with field results and QWW it could be possible to assess the ecological status.

RA20P Risk assessment of chemical mixtures: where do we stand? what are the next steps?
T U 205

Can we possibly derive environmental quality benchmarks for chemical mixtures?
M.Y. Leung
The University of Hong Kong, Hong Kong sar, Hongkong

In the environment, pollutants are increasingly present in the aquatic environment. For example, many antifouling biocide residues are often detected as a cocktail in water and sediment samples collected from coastal environments. Based on literature reviewed of documented studies on the combined ecotoxicity of antifouling biocides, we found that both additive and synergetic effects together account for 80% of all cases in which about 35% cases are synergistic. To allow more accurate risk assessment of concurrently occurring chemicals, there is a need to develop environmental quality benchmarks (EQBs) for their mixtures. In this presentation, we will introduce and discuss several possibilities of deriving EQBs for chemical mixtures. First, if all components in a chemical mixture are known to share a similar toxic mode of action, we can assume that the combined toxicity of the mixture would follow a simple concentration addition model, and the concept of toxic equivalency quotient (TEQ) could be applied to derive the EQBs based on lethal and/or effect concentrations expressed in terms of TEQ and/or TEQ concentration. This method has been applied to polychlorinated biphenyls, dioxins and dioxin-like compounds, and chlorinated poly vinyl aromatic hydrocarbons. Second, if the mixtures contain chemicals with different toxic modes of action, it is possible to use the principle of the multidimensional species sensitivity distribution (m-SSD) approach. Here, we use binary mixtures of copper (Cu) and zinc (Zn) as an example to illustrate the m-SSD method. We first conducted standard acute toxicity tests with an array of marine organisms for each chemical alone and for the mixtures. The Cu-ZnPT mixtures showed a strong synergetic toxic effect to all test organisms. By utilizing the toxic synergy data, we are able to construct a two-dimensional ssd of risk assessment, from which we can derive any specific hazardous concentration (i.e., EQB) for the two compounds. This novel method can be potentially applicable to a more complex mixture by employing non-parametric response surface models. Third, we will highlight the field-based SSD approach, which is integrated with the quantile regression method, can be used to derive sediment quality guidelines for any target chemical with consideration of the presence of chemical mixtures and biological interaction. Finally we will discuss the pros and cons of each described method.

TU 206

Evaluation of available frameworks for mixture risk assessment in biocide and plant protection products in the EU
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Pesticides are regulated in the EU by the Biocide Product Directive (91/414/EEC) (BPD) and the Plant Protection Product Regulation (Regulation (EC) No 1107/2009) (PPR Reg). A new Biocide Regulation (BP Reg) is proposed and will likely come into force during 2013. Environmental and human health risks are evaluated before a product may be authorised and sold on the European market. Exposure to several substances based on the use of biocidal products and plant protection products are to be evaluated, according the PPR Reg and the BP Reg, respectively. This is more explicitly stated in the BP Reg compared to the BPD.

Guidance on how to perform mixture risk assessment on biocide or plant protection products is very limited. However, several frameworks for tiered risk assessment of the combined effect of substances within products have been suggested or are being developed by e.g. WHO-IPCS and Competent Authorities from several EU Member States, such as DE, DK, ES and SE.

In the present work several such frameworks have been evaluated for risk assessment of both environmental and human health. We have used model products which are based on actual biocidal and plant protection products, and the outcomes of the evaluations are compared from a regulatory decision making perspective. The suggested frameworks are all based on tiered approaches that include various levels of precaution and conservatism in order to be sufficiently protective of human health and of the environment.
The various frameworks and decision trees are easier to apply for risk assessment on higher biological organization, i.e. easier to apply to environmental risk assessment than analysis is needed to assess whether a generic TTC of 0.1 µg/L is suitable and this should be tested on relevant real-world cases.

Other chemicals with potential anti-androgenic properties at current human exposure levels. This example should be instructive for the inevitable discussion of the suitability of the data better and avoids the contradictions inherent in the DA-CAOS concept. The proposed approach recommends application of independent action for phthalates and further elaborated and included in a method to assess the risk of mixtures. The interpretation of DP+ (only substances with classified for environmental hazards need to be addressed in the risk assessment for the environment) is regarded as not in line with the interpretation of the legal text by Commission, ECHA and MS. Beyond that the possibility of an integration of scientific methods for the assessment of mixtures in the regulatory framework should be investigated.

Application of the TTC Concept to focus cumulative exposure assessment in environmental media: a special case for pesticides?

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The concept of Threshold of toxicological concern (TTC) is based on establishing an exposure level for chemicals below which no significant risk is to be expected. This level is set under the assumption that a substance could be tolerated structurally or de-minimus considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as food, food contact materials, and for risk assessments of chemicals (EFSA, US FDA, WHO IPCS). Later it was adapted for ecotoxicology, and an "environmental threshold of no concern" (ETNCaq) of 0.1 µg/L was proposed for polar narcotics, non-polar narcotics and also reactive chemicals (d-Woessner, 1989); because of their specific MoA and since the specific TTC was some showed lower NOEC and thus were not included.

The TTC concept could be helpful to focus the assessment of chemicals that occur in environmental media. The recent SCHER opinion on Toxicity and Assessment of Chemical Mixtures recommended that no further risk assessment is needed for substances that do not exceed the TTC. Thus the TTC could serve as a filter to avoid making cumulative risk assessments unnecessarily complex and laborious by including a multitude of substances which are not relevant for the assessment.

An analysis of the Bayer CropScience portfolio suggests that regulatory acceptable concentrations (RACs) for most pesticides are well above the ETNCaq of 0.1 µg/L suggested for chemicals other than pesticides. However, the original application of the ETNCaq was to define safer thresholds in the absence of effect data, whereas for pesticides this would mean that acute and chronic tests only cover the limited number of substances that have been tested. The ETNCaq of 0.1 µg/L can easily be identified and should then be included separately in a mixture toxicity assessment, even if present at concentrations below the ETNCaq. The application of the ETNCaq as a generic TTC in the field of mixture toxicity assessment in environmental media would primarily serve to filter out irrelevant contaminants, not to substitute meaningful data.

That TTC for surface water could also guide where to set the generic LOD in monitoring studies rather than just to detect substances at levels "as low as possible". Further analysis is needed to assess whether a generic TTC of 0.1 µg/L is suitable and this should be tested on relevant real-world cases.

Relevant potency threshold: reducing uncertainty by calibration of cumulative risk assessments

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Relative approaches, i.e., toxic equivalent (TEQ)-like approaches, for mixtures risk assessment have been established for some time. TEQ-like approaches assume that certain premises are met, e.g., chemicals are true congeners, are metabolized and detoxified by the same biological processes, produce the same spectrum of biological effects by the same mode of action, and exhibit parallel dose response curves for the biological effect being modeled (Safe 1990), then those chemicals may be assumed to be dode in action (DA) for sparing risk assessment purposes. Recent work entitled “Phthalates: Regulatory Research and Risk Assessment” (Nukina et al., 2010) recommends applying the DA-CAOS concept to future regulatory risk assessment of mixtures containing recommendations for cumulative risk assessment practices at the U.S. EPA. The Panel rejected the underlying premises of TEQ-like approaches, asserting that cumulative risk assessment should be conducted by applying DA to chemicals that produce “common adverse outcomes” (CAOS) rather than to chemicals with similar modes of action. Using DPD+ results of acute NOECs based on which of active substances and a published human health risk assessment that used the DA-CAOS concept were evaluated to determine how firmly the concept is supported by the data and with what level of certainty the results may be extrapolated to lower doses and to humans. The underlying assumptions of the model and the risk assessment were probed for consistency with available human data, using data on acute NOECs as test data. Phthalates as test chemicals were compared based on the DA-CAOS concept were compared with human clinical experience to determine whether those predictions are verifiable and consistent. Based upon this analysis, an alternative approach was developed – the Human-Relevant Potency-Threshold (HRPT) – that appears to fit the data better and avoids the contradictions inherent in the DA-CAOS concept. The proposed approach recommends application of independent action for phthalates and other chemicals with potential anti-androgenic properties at current human exposure levels. This example should be instructive for the inevitable discussion of the suitability of DA-CAOS for addressing environmental cumulative risk assessment for hormonally active agents, and environmental mixtures in general.

Application of delayed fluorescence to estimate influence of chemical mixtures on alga

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Algae are important primary producers in aquatic ecosystems. The OECD Test Guidelines 210 (TG210), algae growth inhibition test, is a conventional method that evaluates chemical mixtures in the OECD Test Guidelines 210 (TG210). In conventional mixture tests no information is given about the mode of action of chemical substance would be advantageous. Applications for a new method including improve the evaluation efficiency for toxicity screening of a large number samples for regulatory filings, toxicity identity evaluation of chemical mixtures, and influence toxicology. Therefore investigating a new rapid estimation method of the human health risk assessment of the influence of chemical substance of algal growth in a shorter time than the conventional 72 hours growth inhibition test (e.g. TG210). In addition, the intensity of DF shows a time decay curve. Chemical exposure change the decay curve to patterns that provide insight into the mechanisms of action, and also has potential for application to the identification of contaminants in mixtures. We discuss characteristics of the evaluation of the influence of chemicals (herbicide, other chemicals, and its mixtures) on algae by both the DF inhibition and analysis of the DF decay curve. We also compare the detection characteristics of DF and other rapid estimation methods, including chlorophyll fluorescence-based photosynthetic activity measurement (PAM) and Microtostox, a common rapid bioassay that uses luminiscence bacteria to evaluate the sensitivity between photosynthetic and non-photosynthetic microbial bioassay

Application of delayed fluorescence to estimate influence of chemical mixtures on alga

Species sensitivity distribution for the prediction of toxicity of herbicides mixture toxicity on benthic diatoms

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Coastal zones of lakes could be contaminated by a cocktail of substances coming from urban discharges or diffuse watershed run off. This type of contamination especially concerns micro pollutants such as pesticides. Benthic diatoms, which are a major component of benthic biomass, are then exposed to several pesticides that could interact together to produce toxic combinations. Species Sensitivity Distribution (SSD) models are partly used to extrapolate protective concentrations for a community exposed to a single or a cocktail of contaminants. To predict the toxicity of a mixture, two concepts are used depending on the mode of action of the mixture components (Concentration Addition -CA, or Independent Action -IA). The main objective of the study was to assess if SSD (using CA or IA models) were reliable in terms of toxicity prediction of herbicide mixture on benthic diatoms and if this SSD could be used as a management tool for aquatic ecosystems. As a first step, eleven species of benthic diatoms were exposed to 4 herbicides, separately (diuron, isoproturon, terbutryn, atrazine), in 96h nonspecific growth inhibition tests.
Finally, we compared the toxicity thresholds predicted by CA and IA models to the measured toxicity thresholds. We also assessed the species ranking between the mono herbicide SSD curves and the mixture SSD curves.

The leaves and translocated to the meristems of the plant in dicots and it does not affect monocots which may explain the low toxicity to L. minor. The studies into the more frequently in mixture where the herbicide mixture belongs to different chemical groups and monocot species.

In terms of this mixture study, the results showed that the interaction between atrazine and 2,4-D was antagonistic. These results are re-assuring and indicate in terms of impacts on aquatic macrophytes in Thailand, mixture effects are less than additive. If additivity is assumed for risk assessment purposes for macrophytes in Thailand, then this should be protective. Work is ongoing using a wider range of pesticides and test organisms.

It has been determined that combined use of chemical mixture toxicity models give rise to stronger toxic effects than any of the compounds applied individually. The Scientific Committee on Health and Environmental Risks (SCHEER) has recently put forth concentration addition as a conceptual basis for the determination of environmental quality standards for mixtures. In this study we have predicted the risks from pesticide mixtures within Swedish surface waters using the concentration addition concept. Data from the national pesticide monitoring program in Sweden has been combined with experimental data from the US EPA's database for single chemical toxicity and predicted toxicity from QSARs to determine the risks from pesticide mixtures in Swedish surface waters close to agricultural areas. The Swedish monitoring program has been taking samples in six different locations since 2002 and currently analyses the samples for more than 80 compounds, out of which 78 has been detected. All and all 751 weekly samples have been analysed bringing the total number of analyses performed close to 60 000. The abundance of information enabled the study of not only the individual site risks but also the total risk from a country perspective. Among the robustness analysis, average false negative and false positive rates were calculated when ignoring mixture effects as well as the sensitivity of the risk assessment to different ecotoxicological data has been determined. The results show that the average risk quotient of the mixtures from the different sites range between 2.3 and 18.9 thus calling for additional assessments. The study also show no effect on risk from season implying that potential for recovery from pesticide stress is very limited. Finally the high ratio between predicted risk of the mixture and the average risk of the individual substances clearly demonstrates the need for going beyond the standard compound-by-compound assessment.

In conclusion, we have shown that an optimal experimental design for mixture toxicity focuses on optimizing the lowest tested concentration and the concentration step size relative to parameter resulted in a significant decrease in false positive rates. An optimal combination of these two parameters leads to the lowest false positive rates for a given design. In carcinogenic risk analysis the effects of the mixture mixture toxicity studies is increasing exponentially. Developing requirements in regulatory risk assessment are further fueling the need to gain more knowledge about mixture studies, mixture experiments and the subsequent data analysis. In particular, little attention has been given to the choice of an appropriate experimental design for a given reference model (e.g. independent action and concentration addition). Indeed, it has been shown that some experimental designs might not be able to detect (false negative) or erroneously conclude (false positive) deviations from a reference model. In this study, we simulated experimental data from a full factorial and equitox design and subsequently tested if these data deviated significantly from the concentration addition model reference. Experimental data were simulated for synergistic, antagonistic and additive mixtures. We then determined false positive and false negative rates for each experimental design. The number of data points, the lowest concentration of each chemical and the step size between two subsequent concentrations were varied. Results demonstrated a marginal increase in false positive rates with increasing number of design points. This contrasts with the general belief that adding design points will reduce the false positive rate. Varying the two other parameters resulted in a significant decrease in false positive rates. An optimal combination of these two parameters leads to the lowest false positive rates for a given design. In carcinogenic risk analysis the effects of the mixture
The assessment of risks related with contamination of soils and surface waters by different fractions of shale oil based on the obtained results will be presented. This research results provide evidence for the existence of the genes and the associated efflux activities of ABC transporters in juvenile stages of D. magna. Specific inhibitors of P-gp and/or individual compound, which is referred to as concentration additivity. This concept has been successfully applied before for total petroleum hydrocarbons (TPH) and will be calculated first for soil and sediment, by considering partitioning between organic carbon and water. From water concentrations, the internal residues were calculated using a partition coefficient between the membrane and water.

From all chronic toxicity data collected and carefully evaluated for their usefulness and reliability. To calculate the total internal residues, pore water concentrations were calculated, by considering partitioning between organic carbon and water. From water concentrations, the internal residues were calculated using a partition coefficient between the membrane and water.

The study of the cellular mechanisms of tolerance of organisms to pollution is a key issue in aquatic environmental risk assessment. Recent evidences indicate that mutagenic and carcinogenic properties in the soil and water ecosystems is limited. This current study aims to contribute to filling of these data gaps. In order to study the mobility and fate of the shale oil, the spiked soil samples were incubated in laboratory (i.e., controlled test conditions) and outside (natural climatic conditions) for several months. The dynamics of chemical composition of spiked soils was followed using different analytical methods. Potential hazard of shale oil to terrestrial (soil microbial community, higher plants) and aquatic organisms (bacteria Vibrio fischeri and crustaceans Daphnia magna) was investigated using various test formats. The assessment of risks related with contamination of soils and surface waters by different fractions of shale oil based on the obtained results will be presented. This research is supported by Central Baltic INTERREG IV A Finnish Estonian project: Risk Management and Remediation of Chemical Accidents.

Hazard evaluation of shale oil to the environment
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Application of predictive mixture models to differentiate P-gp and MRP type efflux transporter activities in zebra mussel (Dreissena polymorpha) and its environmental implications
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Characterization of the multixenobiotic resistance (MXR) mechanism in Daphnia magna and studies on its role in tolerance to single and mixtures of toxicants
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Toxicity bioassays with model substrates of P-gp (mitoxantrone) and MRP (chlorambucil, mercury) applied singly and in combination with different chemosensitizers. The results presented here will aid future research using mass balance analysis of environmental samples and bring additional knowledge regarding mixture effects of PAHs and PAH derivatives via the Ah receptor.

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TU 223  
Prediction of mixture toxicity for metals in soil: a reality-check  
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Today, regulatory guidelines for mixtures are based predominantly on assessments carried out on individual substances. However, mixture toxicity is an upcoming issue in the regulatory area because of growing concern about the potential adverse effects of interactions between substances when present simultaneously. Only a few models are available so far to predict mixture toxicity (dose/concentration addition and independent action), and dose/concentration addition seems to be commonly selected as a default for the highest possible mode of action and the lowest interaction level of the substances. The applicability of these models in a regulatory framework for assessing the ecological effects of naturally occurring elements, as well as metals, in soil may not be straightforward, however. For several metals, the predicted no-effect concentrations are close to their natural background concentration in soil, and adding the potential effect of several metals may lead to over-protective results. Moreover, risks in unaltered natural soils. Consequently, a reality-check is carried out on the use of common models for assessing the mixture toxicity of metals in soils and the selection of the number of metals to be included, based on exposure data for several metals in arable land and grassland soils across Europe (data from the GEMAS project). The distribution of the number of toxic risk ratio across arable land or grassland in Europe is evaluated in respect to the mixture model applied, the number of metals included, the incorporation of bioavailability corrections, etc.

TU 224  
Toxicological evaluation of chemical mixtures posed to hazard and human environment  
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Exposure to chemical mixtures to environmental health can occur in different forms, with regard to reason of the contact and composition of the chemical mixture. Beyond all doubts is the fact that the chemical risk assessment, due to higher and more complicated environment of mixture with multi-component chemical substances, plays crucial role in toxicity and ecotoxicology. This work treats the most important issues concerning toxicology of chemical mixtures, with reference to an experimental design and special attention paid to the types of study methods, mainly acute and chronic studies, as well as legal aspects relating to European regulations connected with REACH and CLP.

TU 225  
Assessing human health risk from farmed milkfish consumption: considering toxic interaction among arsenic, copper, and zinc mixture  
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Various studies indicated that a strong association between cultured fish and waterborne metals of arsenic (As), copper (Cu), and Zinc (Zn) in coastal areas of Taiwan regions. Generally, the impact of mixture toxicity of metals on the aquatic ecosystems is higher than that of single metal. The purpose of this study was to assess the human health risk for the farmed milkfish based on single exposure As and Zn mixture in farmed milkfish (Chanos chanos) consumption in blackfooted blenny (BFDB) endemic area in Taiwan. The interaction risk assessment model proposed by the U.S. Environmental Protection Agency (EPA) and Agency for Toxic Substances and Diseases Registry (ATSDR) was used to estimate the interaction-based hazard index (HIINT) of non-carcinogenic mixture toxicity. The mixture toxic interactions of As/Cu and As/Zn were both antagonistic, whereas Cu/Zn was both additive and synergistic. More than 90% of inhibition level and the limited information about the mode of action of metals and other substances. The applicability of these models in a regulatory framework for assessing the ecological effects of naturally occurring elements, as well as metals, in soil may not be straightforward, however. For several metals, the predicted no-effect concentrations are close to their natural background concentration in soil, and adding the potential effect of several metals may lead to over-protective results. Moreover, risks in unaltered natural soils. Consequently, a reality-check is carried out on the use of common models for assessing the mixture toxicity of metals in soils and the selection of the number of metals to be included, based on exposure data for several metals in arable land and grassland soils across Europe (data from the GEMAS project). The distribution of the number of toxic risk ratio across arable land or grassland in Europe is evaluated in respect to the mixture model applied, the number of metals included, the incorporation of bioavailability corrections, etc.

TU 226  
Whether BDE209 interacts with Cd hepatotoxicity?  
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During the last ten years, mixture toxicology has undergone a remarkable and productive development. In fact, combined toxicity, which more accurately represents real environmental conditions, may be missed in the documentation of toxicologically relevant effects. The aim of this study was to examine whether decabromodiphenyl ether (BDE 209) influences cadmium (Cd) hepatotoxicity. Wistar rats (200-240 g) were exposed orally to BDE 209 (1000 mg/kg/bw), Cd (2.5, 7.5 or 15 mg/kg/bw) or their three combinations, by gavage, for 28 days. Control groups were exposed to saline or DMSO as vehicle only. The following end points were examined: liver weight, morphology, histology as well as liver function activities (aspartate aminotransferase-AST, alanine aminotransferase-ALT and γ-glutamyltransferase-γ-GT). Study was approved by Ethical Committee of Military Medical Academy (No. 9687/11). Liver weight increased in all groups comparing to controls. Interestingly, the highest increase was seen in Cd groups (20%-42%), than in BDE209 group (28%), while in mixture groups it ranges between 96 and 115%. Morphological changes in liver were not observed while histological analysis indicated degenerative changes in hepatocytes, bile ducts, vascular bleeding and disruption of vascular membranes. Average histological scores on scale from 0 to 5 were: 0.13, 1.26, 2.26, 3, 3.4, 2.03 and 2.26, for control, BDE209(1000), BDE209(1000)+Cd.5, BDE209(1000)+Cd.7.5, BDE209(1000)+Cd.15, Cd.25, Cd.45, and Cd.15, respectively. AST values in general did not change, although ALT was significantly higher in Cd groups, while in mixture and BDE209 groups decreases in ALP activity was observed, but not so intensive like in all three Cd groups. Activity of γ-GT was higher in the mixtures than in groups when Cd was administered alone. While scoring of histological changes and γ-GT activity, we may assume that BDE209 potentiate Cd effects on liver. (Partly supported by Ministry of Science project HH6009)

TU 227  
Waste recovery - a special treatment under REACH  
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According to a manufacturing process is considered any production or extraction of substances in the natural state. This includes chemical modification as well as mechanical processes. Although the entry products at recovery companies are mainly waste (covered by the Waste Regulation), the status of the end products might "escape to be waste", and thus fall under the REACH regulation, and thereby having a major impact on the legal obligations of the recovery operator. However, under certain conditions recovery operators can benefit from registration exemption by applying Article 2.7(d) of the REACH regulation.

As the end products at recovery plants are often complex mixtures containing substances whose presence is not always intended, the process of substance identification is challenging. Although these concerns mainly address issues related to metal-based waste products, some may also apply to other types of recycling industries.

One should stimulate the re-introduction of former waste products on the market, because this contributes to the recycling of natural resources and the products may have economic benefits in the time of raising commodity prices. Nevertheless, sufficient efforts should be made to assure safe use of these, potentially heavily classified, mixtures. In addition, the hazard and risk assessment should be performed in such a way that overestimation due to the application of conservative assumptions and worst-case scenarios is avoided. Although these concerns address mainly issues related to metal-based waste products, some may also apply to other types of recycling industries.

TU 228  
Toxicity evaluation of disperse red 1 textile dye using freshwater organisms from different trophic levels - a PNEC proposal  
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AzO dyes have been found in surface water samples, and commercial Azo dyes are mixtures of a main dye, surfactants and other synthesis impurities. The commercial dye Disperse Red 1 containing 60% of the main dye N-Ethyl-N-(2-hydroxyethyl)-4-(4-nitrophenylazo) aniline, CAS number 2872-52-8, was obtained by PCIL industries Ltda, Brazil. This product is used for dyeing synthetic fibers. Previous data showed the main azo dye was mainly responsible for the commercial dye toxicity at least for Daphnia. This same dye was found in an effluent and a receiving water sample collected in Americana region, São Paulo Brazil. The aim of this study was to compare the results of ecotoxicity of the commercial dye Disperse Red 1 obtained for organisms from different trophic levels. A Phor (

\[ \gamma-\text{glutamyltransferase} \]
**TU 229**

Efficiency of chemical mixtures in the industrial control of biofouling by the Asian clam Corbicula fluminea

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The freshwater bivalve Corbicula fluminea (Müller, 1774), commonly known as the Asian clam, is one of the most invasive species of aquatic systems around the world. In addition to the adverse effects on ecosystems, this pest is well-known for its biofouling activity on freshwater-dependent industries. Developing environmentally-friendly methods to control the Asian clam in the industrial context and thus prevent significant economic losses is a major challenge.

The bioactive component of the cationic polymeric polyallyldimethylammonium chloride (polyDADMAC) against the Asian clam has been previously demonstrated. In this study, binary mixture of polyDADMAC and potassium chloride, the molluscicide niclosamide polyDADMAC-dimethoate were formulated in an attempt to further increase the susceptibility of the clams to the polymer. Three combinations were tested in standard laboratory bioassays and the mortality results interpreted using an isobologram-based methodology. Through this preliminary study, different types of interactions between the chemicals were explored and the extent to which the performance of a potential combined treatment depends on the nature of the mode of action of the chemicals found to be antagonistic and, therefore, these mixtures are not promising control tools. In order to understand the antagonist nature of the chemicals, preliminary experiments were conducted to elucidate the mechanism of toxicity of polyDADMAC and its interaction with dimethoate in C. fluminea. This study indicated that polyDADMAC neither affects the ability of osmotic regulation of the cells as suggested by the literature for other surface-active molecules nor interacts with the hydrophobic activity of the enzyme cholinesterase, which is the specific target of dimethoate.

**TU 230**

Industrial enzymes - an example of the environmental risk assessment of an UVCB (unknown or variable composition, complex reaction products or biological materials)

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Industrial enzymes for technical applications like for example detergent enzymes have to be safety assessed and registered under REACH. Enzymes are categorized as UVCB because they are produced by fermentation and are thus substances from biological origin with varying content of constituents. The enzyme protein together with the constituents derived from the fermentation process is considered to be the substance. Before enzymes with the same catalytic activity, but produced by different production strains, can be considered to be the same substance from a safety point of view, it is necessary to establish the safety of the production strains including the safety of the other constituents. To assure the safety of the other constituents the enzyme industry uses safe strain lineages (i.e. the production organism and methods of modification are demonstrated to be safe) which have been well established over the years as also indicated by scientific publications. This is a prerequisite for establishment of sameness so far as the enzyme protein itself is considered. However, if enzymes are used to produce other products, then further to environmentally harmless carbon dioxide and water as degradation products. Additionally, for the majority of the ecotoxicity tests required for REACH registration data waiver can be applied including long-term aquatic toxicity testing and toxicity to terrestial organisms. These tests are conducted not relevant due to the fast biodegredation of the enzymes, the low absorption and bioaccumulation potential and because enzymes are primarily active in the liquid phase. Thus only short-term aquatic toxicity tests are considered relevant for industrial enzyme proteins.

Based on the current knowledge on industrial enzymes and their intrinsic properties future ecotoxicological testing of enzymes may be avoided by applying read-across and the data waiving approach. In conclusion, environmental risk assessment of UVCB’s like enzymes requires an alternative approach compared to the risk assessment of ‘classical’ chemicals or well defined mixtures due to the biological origin.

**TU 231**

A partial least squares based integrated addition model for estimating mixture toxicity

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Studies on mixture toxicity among chemicals find that mixture components at levels below no-observed-effect concentrations (NOECs) may elicit toxicity resulting from the joint effect of the chemicals. However, a major challenge in mixture risk assessment frequently focuses on individual chemical substances, although most living organisms are substantially exposed to mixtures rather than single substances.

The concepts of additive toxicity, concentration addition (CA) and independent action (IA) models, are often applied to predict the mixture toxicity of similarly- and dissimilarly-acting chemicals, respectively. However, living organisms and the environments are exposed to both types of chemicals at the same time and space. Therefore, from the scientific perspective, it still needs to develop an integrated model to predict mixture toxicity from different chemicals practically, regardless of whether mixture components produce similar, dissimilar, or both similar and dissimilar modes of toxic actions.

The objectives of this study are to develop and evaluate a partial least squares-based integrated addition model (PLS-IAM) for not only to overcome the multicollinearity problem which can be occurred between the two independent variables, CA and IA, but also to combine them into the integrated addition model by using the latent variable. In this study, the PLS-IAM was validated by different datasets on mixture toxicity. The results showed that the prediction capability of the PLS-IAM outperformed reference models, the CA, IA, and IAM based on ordinary least squares.

**TU 232**

Using sensitivity analysis in developing a characterization model for noise impacts

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Pilkingtons claim the “virtual impossibility of accurate quantitative models to predict the outcome of natural processes on the Earth’s surface”, due to the inability of environmental model makers to consider all possible sources of uncertainties in their models or due to their unrealistic or even false assumptions.

In Life cycle assessment (LCA) we do use models whose outcome is always affected by a certain level of variability and uncertainty. The numerical solution of these models is, in fact, an interaction of uncertainties coming from the different parts of the model. The uncertainty factor in LCA and in the related software is therefore mainly due to the input data, which is based on the available knowledge and data.

This study investigates how uncertainty from the input of the model propagates to the output and how each single variable affects the overall variance of the characteristics.

**TU 233**

Quantifying and propagating uncertainty in regionalized impact assessment: the relevance of spatial aggregation

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Most LCA methods do not provide uncertainty information to be coupled with uncertainty of LCI. Furthermore, regionalized methods do not often offer adequately, leading to additional uncertainty due to aggregation of spatial explicit characterization factors (CF) on national or global levels. This lack is a main challenge for practitioners applying LCA including uncertainty and sensitivity analyses. On the other hand, concepts for reporting spatial uncertainty by method developers are still under development.

In this study, different types of uncertainty for water consumption impacts are analyzed and combined on the endpoint level, showing how uncertainty information can be related to spatially explicit CFs.

In current Life Cycle Impact Assessment, human health impacts due to water consumption have only been addressed by two published methods so far. Both methods assess impacts as DALY (Disability Adjusted Life Years lost) due to lack of water for human use, but the modeling approach and considered impact pathways differ and cannot be used for model scale uncertainty quantification. The method of Pfister et al. (2009) was used as a starting point. Parameter uncertainties were estimated based on analysis of original data sources and, where applicable, on quantitative assessment of the model uncertainty of the data provided by third parties. Spatial variability was also considered when using aggregation on country level. The uncertainties were propagated within the cause-effect impact model by applying the stochastic procedure of Latin Hypercube with software @Risk.

The average k-values (dispersion factor denoting the 95% confidence interval if the median is divided (lower bound) and multiplied (upper bound) by k) was equal to k=2.76 on the midpoint level and 18.1 on the endpoint level. The aggregation from watershed to country level resulted in an average uncertainty of k=19.2 for the endpoint impacts as DALY (Disability Adjusted Life Years lost) due to lack of water for human use, but the modeling approach and considered impact pathways differ and cannot be used for model scale uncertainty quantification.
country level data might not considerably add to uncertainty. Such information helps to improve efficiency when dealing with regionalized LCIA. Overall spatial aggregation added considerable uncertainties.

TU 234
Sensitivity analysis for archetypes development in impact assessment of chemicals
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Emission of chemicals is increasing over years and the related impacts are greatly influenced by spatial differentiation. Chemicals are usually emitted locally but, due to persistence and physical chemicals properties, may exert global impact. Variability of environmental parameters may affect the fate and the exposure up to orders of magnitude of difference. Accounting for spatial differentiation of chemical impacts requires the use of multimedia models, at various levels of complexity (from simple box model to computational intensive and high spatial resolution model). Trade-off between complexity of high detailed models and global applicability requires the development of suitable archetypes.

In the present study, sensitivity analysis techniques have been applied to MAPPE (Multimedia assessment of pollutant pathways in the environment) to build archetypes of emissions and fate. MAPPE is an advanced, multimedia, spatially resolved (1x1 degree) model, that allows the evaluation of chemicals removal rates from air, water and soil. We evaluate the relative influence of substance properties and of environmental characteristics on the variability in the environmental fate. In particular, using a Monte Carlo framework applied variance-based sensitivity analysis techniques to find out those environmental parameters explain the highest share of the variability (namely the variance) in the model outputs. This information is crucial in order to define the environmental dimensions to be used for the definition of the archetypes of emissions and fate, accounting for major differences in the potential impact of the different pollutants.

We present results of the analysis for the pesticide Lindane. The overall variability of the removal rate from air is up to 5 orders of magnitude, mainly driven by four out of the eleven environmental parameters proposed in the model. These four parameters were then used as basis for building archetypes.

TU 235
Dealing with uncertainties in UNEP SETAC toxicity model
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In the field of LCA, the issue of uncertainty generates a growing interest. Although this issue has not yet been systematically addressed in existing databases and models, it neither can be neglected, nor addressed too simply. Although uncertainty has partly been quantified in USEtox model, several questions remain open to date.

A significant share of this uncertainty arises in model itself, based on the relationship between the data and the intended reality being modeled. As regular users of the USEtox model, we identify the following sources of uncertainties:

- substance for which no data is available, or missing input parameter value
- parameters for which only an inappropriate or inaccurate value is available
- data for which more than one value is available. (multiple sources and conflicting information)

Given the relative complexity of the mathematical model, uncertainty propagation has been performed using a numerical method.

Well, uncertainty propagation has been performed using a numerical method. (substance data and landscape model)

This approach allows us to describe statistical properties of a characterization factor value, based on input data uncertainties. It can also be used to study parameters sensitivity.

Taking into account the fact that uncertainty in USEtox database cannot be fully captured within the input parameters variability, other approaches have been studied, which aims at reducing uncertainty.

In approaches to reduce uncertainty, database documentation, substance coverage, as well as user interaction are key issues.

The reproduction of the true value for a parameter requires research, experiments and therefore time. Involving stakeholders, discussing and finally deciding on a consensus, so has the current model been built, so the database should be.

Possibilities must be given to each user to view, add, or revise the specific documentation of a parameter. Reporting an error in a parameter value also have to be easy, as well as the possibility to discuss the validity of each parameter value.

Our practical experience and ideas, related to management of these uncertainties in USEtox model will be presented.

Those approaches have been implemented in a web application prototype that allows uncertainty calculation and documentation completion.

TU 236
Standard information modules as basis for LCA reliability in the manufacturing context
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In such work, the standard-information-modules approach is presented as methodology to reduce uncertainty in the Life Cycle Assessment. In particular such approach aims to common barriers in the modelling of complex systems within the manufacturing context. An application is illustrated with reference to the uncertainty characterization of environmental profiles referred to energy flows. The use of standard modules for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement analysis on key life cycle stages.

TU 237
Taking into account variance of primary data in decision making: a method for the building sector
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Life Cycle Assessment (LCA) can be a powerful tool to drive society toward sustainability if used for help to decision. Nevertheless decision step comes often early in the design process where very few data is available. To overcome this issue analysts are forced to use poor quality data or generic data even for foreground system description which is horteful to results liability and could mislead the decision-maker. In this paper we focus particularly on construction sector which represents about 40% of the total energy consumed in Europe [1]. In the building field, help to decision comes at the planning phase. At this step, only rough data are available but still the planning manager has to choose the best environmental solution regarding its expectations regarding its expectations of different building team proposals. The method presented in this paper allows decision-makers choosing between solutions taking into account variance of primary data. It is tailor made to building sector.

In the first step of the method, selection of key parameters is made taking into account both sensitivity of parameter on the results and variance of these parameters. Then standard deviation is propagated using tailor series. This method has been implemented in a real case where decision needed to be made between three building projects. The case description is presented in the paper. The presented methodology was shown to be easy to implement and suitable for complex products which are tough to describe completely. In some case, it is possible to identify the best building solution even with up to 50% standard deviation on some primary data.

TU 238
Uncertainty evaluation of LCA models input data using Monte Carlo Method
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This is a contribution to the development of methodologies in considering uncertainties in LCA studies. The main results are a solid methodology for dealing with uncertainties in standard information-modules approach presented as methodology to reduce uncertainty in the Life Cycle Assessment. In particular such approach aims to common barriers in the modelling of complex systems within the manufacturing context. An application is illustrated with reference to the uncertainty characterization of environmental profiles referred to energy flows. The use of standard modules for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement analysis on key life cycle stages.

TU 239
How certain can we be about LCA after 20 years of harmonisation and standardisation? A critical comparison of methodology and results from ten LCAs comparing disposable cups
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Harmonisation and standardisation of LCA-methodology started in the 1990ties. It happened more than once in this period that contradictory LCA-results were released for a same product (particularly packaging materials). This resulted in intensive scientific debate, and also heated societal debate, especially where product claims were involved.

Differences in LCA-results at that time could often be traced back to different decisions and assumptions related to product system boundaries, functional unit definitions, technology choices, data sets etc.

In the last two decades LCA-methodology development has made immense progress. We meanwhile have a solid LCA frameworks. ISO 14044 describes the procedures to be followed, and specifies the assumptions and decisions to be made in LCA. Comprehensive and detailed guidelines are provided by national handbooks that still show few differences, but far greater overlap in methodology. With this in mind it is interesting to evaluate whether the progress in harmonisation LCA-methodology has also resulted in harmonisation of LCA-results. For that purpose we evaluated 10 LCA studies, each comparing a range of different types of disposable cups for hot and cold drinks. We
TU 241

Urban background levels of novel brominated flame retardants in ambient air in Southern Bavaria, Germany
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After the technical penta- and octabromodiphenyl ether mixtures (PBDE) were banned in the European Union in 2004 and deabrominated diphenyl ether is not any longer permitted in electrical and electronic equipment since 2008, there is an increasing demand of ‘novel’ brominated flame retardants. At present, little is known about the concentrations of these substances in ambient air. Therefore, ambient air was collected between March and September 2011 at the urban background air monitoring station of the Bavarian Environmental Agency. A total sample volume of 9460 1900 m3 was collected over a period of 35 days using cartridges with a glass fibre filter and two polyurethane foam plugs. Two low volume samplers were run in parallel. 1,2-bis(2,4,6-tribromophenoxy)ethane (BTBPE), hexabromobenzene (HBB), pentabromobenzene (PBB), pentabromotoluene (PBT), 2,3,5,6-tetrabromop-xylene (p-TBP) and decabromodiphenylethane (DBDPE) were chosen as marker substances. The analytes were separated on a sulphuric acid-silica column. Purification of the two fractions containing BTBPE and the other flame retardants, respectively, was done on a Florisil®-column and on basic alumina, respectively. After clean-up, samples were analysed by GC-ECNI-MS. t-C1-labelled internal standards were used for quantification. Response factors were calculated using a three-point-calibration. Concentrations varied from 0.08 to 0.34 pg m−3 (PBT), 0.22 to 0.74 pg m−3 (HBB), 0.04 to 0.30 pg m−3 (PBB), 0.42 to 1.35 pg m−3 (PET), 0.15 to 0.23 pg m−3 (p-TBP) and 1.5 to 3.6 pg m−3 (DDPPE). For the purpose of comparison hexabromocyclododecane (sum of α-, β-, γ-HBCD), polybrominated diphenyl ethers (sum of 7 congeners D8 28, 47, 99, 100, 153, 154, 183) and BDE 209 were also determined. Concentrations ranged from 0.72 to 1.5 pg m−3 (sum of 7 PBDE congeners) and 0.45 to 9.5 pg m−3 (BDE 209). The financial support of the Bavarian State Minister for the Environment (project 70403) is gratefully acknowledged.

TU 242

Halogenated flame retardants in the marine atmosphere from Southeast Asia towards Antarctica
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Halogenated flame retardants (HFRs), which are applied to reduce the inflammability of various consumer products have been industrial chemicals of growing worldwide environmental and political concern in the past decades. In the last couple of years, the marine environment became a focus of pollution and concern for the first time. PBDEs were the first Brominated flame retardants (BFRs) to be monitored in the Arctic in the 1990s, and early 2000 which are known to be harmful. Due to their ongoing banishment since the early 2000s, the industry shifts towards alternative non-regulated non-PBDE BFRs. Similar to PBDEs, most of them are semi-volatile and highly persistent leading to a high potential to be transported over the global oceans towards the Polar Regions. In this study, we analysed the profiles and transport of 10 BDE congeners, 8 non-PBDE BFRs as well as 6 Dechlorane congeners (BFRs) in the Indian Ocean. High volume air samples were taken during a Polar expedition onboard the R/V Snow Dragon from the East Indian Archipelago towards Western Australia and further to Antarctica in 2010/11. Samples were Soxhlet extracted and analysed via GC-ECNI-MS/MS. PBDEs were detected using standards from 0.08 to 0.34 pg m−3 with BDE-47 and BDE-209 being the predominating congeners. Among the alternative BFRs, pentabromobenzene (PBB), pentabromotoluene (PBT), 2,3-dibromopropyl-2,4,6-tribromophenyl ether (DBTPE), hexabromobenzene (HBB), 2-ethylhexyl 2,3,4,5-tetrabromobenzoate (HTBB) and bis(2-ethylhexyl)-tribromophenyl-telluride (BTPT) were detected. HBB showed the highest concentration ranging from 0.12 to 26 pg m−3, and PBT and PBDE ranged from not detected (n.d.) to 2.8 pg m−3and from n.d. to 4.3 pg m−3 respectively. Dechlorane Plus (DP) ranged 0.23 to 11 pg m−3 while other Dechloranes remained <0.5 pg m−3. On a spatial scale, the highest concentrations, especially for HBB, PBT and PBDE, were observed in the East Indian Archipelago showing South East Asia to be an important source of alternative BFRs. The approach of Clausius-Clapeyron Plots clearly indicates that the distribution and transport of PBDEs is dominated by long-range transport with little influence of fresh emissions whereas alternative BFRs, especially HBB, are subject to local sources. We present the first data on occurrence, distribution and transport of alternative BFRs and DP over the Indian Ocean.

TU 243

Contamination of the marine biological resource of atol das Rocas (Brazil) by persistent organic pollutants
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The Biological Reserve of Atol das Rocas shelters the largest seabird population of Brazil and despite be considered a remote area due to its distance from the mainland, this area is not exempt from the influence of anthropogenic agents, such as persistent organic pollutants (POP) that even has caused the decline of populations of several species of seabirds over the globe, due to bioaccumulative and biomagnific effects on typical top predators. This proposal aimed to determine the occurrence and concentrations of the POPs in the tissue of the respective seabird species. One expedition was performed in February, 2010, where 16 liver samples of two species: Anous stolidus (n=14) and Ocyphonus fuscatus (n=2) were collected. Samples were analyzed for organochlorine pesticides (OCPs), PCBs and PBDEs. Briefly, samples were extracted in a Soxhlet apparatus, followed by classic adsorption column and GC column as clean-up stages. OCPs and PCBs/PBDEs were respectively analysed by gas chromatography with electron capture detection and mass spectrometry. A combination of two analytical methods showed that PCBs were present in all samples, ranging, in wet weight, from 0.21 - 21.7 ng g−1 for the O. fuscatus species and 20.5-27.9 ng g−1 for the A. stolidus species with predominance of lighters congeners (tri-, tetra- and pentachlorinated groups). The p,p'-DDE occurred in 88% of the samples of O. fuscatus and in the two samples (100%) of A. stolidus with respective values ranging from <0.19-2.45 ng g−1 and 0.30-3.15 ng g−1. HCB was found in 46% of samples of O. fuscatus and in the 100% of A. stolidus with a mean value of 0.35 ng g−1 and in the adult individual of A. stolidus in value of 0.65 ng g−1. p,p'-DDE, at the concentration of 0.15 to 0.23 pg m−3, was found only in the sample of adult individual of A. stolidus. The low levels of contaminants suggest a relative degree of isolation and preservation, however the biggest contamination in remote areas is due the long range transport, demonstrating the ubiquity of those pollutants on environment. The ongoing samples and analysis of different species may also assist in understanding of the distribution and in the degree of exposure of POPs in remote environments, such as Biological Reserve of Atol das Rocas.

TU 244

Seasonal variation of specific toxic effects of organic air pollutants from year-long sampling campaign
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Air pollutants were described to produce many toxic effects including endocrine disruption. Evaluation of such types of effect cannot be based only on data from chemical analyses. That shows the importance of incorporation of specific bioassays into evaluation part of the air pollution monitoring programs. The utility of these methods in monitoring of atmospheric pollution levels has been shown previously. It is known that levels of pollutants in atmosphere are closely related to type of pollution source and a season period. In our study, we focused mainly on the latter factor. Air samples were collected for one year at a traffic-burdened urban site in Brno (Czech Republic) and a village site about 8 km from Brno city to address the influence of city agglomeration as an air pollution source on the surrounding area. The samples were analyzed for a wide range of parameters and pollutants. In this work, we show the seasonal variation of aryl hydrocarbon receptor (AhR) mediated effects, anti-estrogenicity and anti-androgenicity. These parameters were assessed using in vitro reporter gen assays based on mammalian cell lines. This research was supported by GACR P503/10/P249 and CETOCEN (CZ.1.05/2.1.00/01.0041).

TU 245

Profiles and cold trapping of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in British Columbian mountain soils
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Soils collected at elevations on five mountains on and near the Northern Pacific Coast of North America were analyzed for 15 Polycyclic Aromatic Hydrocarbons (PAHs), 14 Halogenated Biphenyls (PBHs) and 17 Halogenated Biphenyl Ethers (HBBs). Soil samples were collected from the top of Vancouver Island (B.C.), the summit of the Bighorn Mountain (B.C.), the summit of the Stawamus Chief (B.C.), the summit of Vancouver; Four Brothers Mountain (B.C.) is 100km further inland in the Fraser Valley; Blue Grouse Mountain (B.C) is in a fruit growing region 200km west of Vancouver; The Chilkoot Trail (C.T.) crosses from the Alaskan Panhandle into northern British Columbia. MA, GM, FB and the ocean side of C.T receive copious seasonal precipitation while the mountain soil near the summit of C.T area rain shadow, PAH profiles were used to assess soils across the East side nearly all analytes found in all soils. Principle component analysis was unable to clearly distinguish between mountains, but suggested the soils collected at the summits of mountains are notably different in their PAH profiles. Total PAH concentrations - by weight of soil - were an order of magnitude higher in GM soils than the others. The congener profiles varied dramatically while the concentration of individual congeners was much more homogenous. The correlation coefficients of total PAHs with altitude showed a strong positive relationship, r=0.87 (p<0.01), and r2=0.97 (p<0.01). The generally low PAH concentrations in the remote mountain soils may mask the phenomenon of cold trapping.
**TU 246**

Recommendations for the use of airsheds for interpreting semi-volatile organic compounds in passively sampled air

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To aid in the interpretation of measurements of Semi-Volatile Organic Compounds (SVOCs) it is common to use Back-Trajectories (BTs), a calculated approximation of the spatial history of air masses. The endpoints of the BTs can be binned into a grid of cells that can be used to determine the fraction of the sampled air that passed through each cell. Here, to avoid the so-called ‘pole-problem’, a ‘geodesic’ grid of nearly equidistant cells was employed.

**3. Results and discussion**

Phase, respectively, which indicated that the forest filter effect (FFE) was much higher for particle associated PAHs than gaseous phased PAHs.

**3.1. Concentrations**

Clearing (2-4). This study aimed to compare atmospheric concentration of PAHs under the forest canopy and nearby clearing the Lys Valley, Aosta, Italy, on the slopes of Mont Mars.

**14th, 2008.** Samples were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those oceans. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The 215PAHs in the gaseous phase were elevated on the approach to China and India, while the highest 215PAHs in the particulate phase were found at Chennai Harbor and close to Guinea. The presence of higher-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa on the global marine atmosphere.

**TU 247**

The spatial distribution and potential sources of polycyclic aromatic hydrocarbons (PAHs) over the Asian marginal seas and the Indian and Atlantic Oceans


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1. Introduction

For example, regarded as a global sink of semi-volatile organic contaminants (SOCs). The so-called “Forest filter effect (FFE)” may be an important driver that transfers SOCs from the atmosphere into the forest system (1). Previous study has focused on the atmospheric deposition and atmospheric-surface exchange of SOCs alone the mountain forest and clearing (2-4). This study aimed to compare atmospheric concentration of PAHs under the forest canopy and nearby clearing the Lys Valley, Aosta, Italy, on the slopes of Mont Mars.

2. Materials and methods

Passive atmospheric sampling (PAS) was performed both in the forest and clearing sites at 700 m, 1000 m, 1400 m, 1800 m, and 2400 m (a.s.l) the Lys Valley, Aosta, Italy, on the slopes of Mont Mars. 2 high-volume air samplers were used to collect air samples at 1400m for 4 sampling periods.

3. Results and discussion

3.1. Concentrations

The average values of the total PAHs (2PAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m⁻³ for the forest, and 1230 and 123 pg m⁻³ for the forest. These values are near the previous results obtained by other authors in that area. In this study, the particle phase consists of PAHs that were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those oceans. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The 215PAHs in the gaseous phase were elevated on the approach to China and India, while the highest 215PAHs in the particulate phase were found at Chennai Harbor and close to Guinea.

3.2. Alitudinal Distribution

PAH amounts in the PAS samples (ng PAS⁻¹) were generally declining with the increasing of altitude alone the slopes of Mont Mars. The decreasing rate for the forest was much lower than that at the clearing. At 700 m, the rate was 0.0014 for forest and 0.006 ng PAS⁻¹ for clearing, respectively. This may due to strong forest filter effect at lower sites where corresponding to high PAH concentrations in the atmosphere. The decreasing rate of PAHs for the forest is much higher than that at the clearing. The difference is due to the different degree of forest cover in the two sites. The higher PAH concentrations in the forest are due to the higher deposition rate of PAHs to the forest canopy. The results for the forest show that the forest has a strong effect on the accumulation of PAHs.

3.3. Effect of canopy

The F/C values were generally <1 in the PAS samples, which could responsible for a lower sampling rate of PAH in the forest because of lower wind speed. As shown in Figure 2, log F/C and log KOA showed different correlations in the species (green line) and particle phases (black line).

4. Conclusion

The filter effect of canopy was observed alone the Mont Mars and higher factors was related to low alitudinal sites and atmospheric wind velocity. The F/C values can influence the effect of forest canopy.

**TU 249**

Size-specific particle-gas distribution of the atmospheric polyaromatic hydrocarbons (PAHs) on the spatial and temporal scales

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Although polycyclic aromatic hydrocarbons (PAHs) are usually not included amongst the group of compounds defined as ‘persistent organic pollutants (POPs)’ due to their high reactivity, they are a subject to long-range transport (LRT) and can pose significant health risks. As such, they are among the pollutants most commonly monitored in the atmosphere.

The objective of this study was to examine the temporal variability of the size-specific particle-gas distribution of atmospheric PAHs in order to understand the physical and chemical parameters affecting the gas-particle partitioning and consequently the ambient concentrations and fate of selected PAHs.

Atmospheric samples from urban and rural sites in the Czech Republic were collected between October 2009 and October 2010 using a high volume air sampler equipped with a cascade impactor (separating particles into 6 size fractions: <0.49 μm; 0.49-0.95 μm; 0.95-1.5 μm; 1.5-3.0 μm; 3.0-7.2 μm; 7.2-10 μm). All filters and polyurethane foam (PUF) plugs collecting the gas phase were exchanged weekly, and the individual samples of each fraction were combined into 4 composite seasonal samples. In gas and particulate fractionation, the automated solvent extraction, silica-gel clean-up and fractionation techniques and GC-MS instrumental analysis. Interpretation of the data suggests that proximity to primary sources drives PAH concentrations as the concentrations measured in the urban site were significantly higher than those measured in the rural site. Seasonality of concentrations levels (higher winter than summer values) as well as the gas-particle distribution (more compounds associated with particles in winter) was well pronounced at both sites for most of selected chemicals. It has been shown before that PAHs are mostly associated with the finest fraction of atmospheric particles, however, seasonal variability of this size-specific distribution is presented for the first time.

**TU 250**

Size-specific particle-gas distribution of the atmospheric POPs on the spatial and temporal scales

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A presence of the particulate matter in ambient air (especially of the particles with less than 10 μm in diameter) has a negative impact on human health as it can induce various respiratory diseases. The fine and ultrafine particles are of special concern as they can penetrate the lungs to the greatest extent and even enter blood stream. Another factor that has to be considered when assessing human respiratory risks is persistent chemicals that are associated with the atmospheric particles and represent additional risk when released in human bodies. Size-specific distribution of these chemicals is an important parameter for their behavior, fate and effects. Size-specific partitioning of organic chemicals between various fractions of the atmospheric particles has been previously studied for polycyclic aromatic hydrocarbons and it has been demonstrated that they are mostly associated with the fine and ultrafine fractions. However, there is not much known about other groups of compounds, especially emerging pollutants. As such distribution affects the fate of compounds not only from the toxicological point of view but also from the point of the long-range transport of pollutants to the pristine environments, new data are desperately needed.
Potential input of organic pollutants to the Mar Menor lagoon: estimation of seasonal air concentrations using passive and active air samplers

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This paper reports on seasonal and spatial variability of size-specific particle-gas partitioning behavior of selected groups of legacy (dioxins and furans, pesticides) and emerging (brominated and fluorinated) pollutants. Samples have been collected from the urban and rural sites in the Czech Republic for the period of one year (October 2009 - October 2010) using a high volume air sampler equipped with a six-stage (< 0.49 µm; 0.49-0.95; 0.95-1.5; 1.5-3.0; 3.0-7.2; 7.2-10 µm) cascade impactor collecting particulate phase and polyurethane foam (PUF) plugs collecting the gas phase.

TU 251

Biomonitoring of poly cyclic aromatic hydrocarbons by pine needles - analytical alternatives and levels in Europe

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The monitoring of pollutants is a crucial step to assess their environmental exposure to organisms. In general, this task is performed in their own habitat (sediments, soil, water or air), but biomonitoring offers the possibility to estimate the multi-route uptake of contaminants. Given its worldwide presence, adequate characteristics and low availability costs, vegetation has been chosen as a suitable matrix since the 1960s, allowing the passive sampling of a wide range of compounds (especially of atmospheric origin and semi-volatile nature), and in the case of the case of the heavier PAHs, to be deposited as particles in the surface. PAHs are widespread carcinogenic and mutagenic contaminants with natural and anthropogenic sources mainly associated to combustion processes.

The main objective of this study was to determine the composition of the target compounds from their lipidic structure a hard task and led to the development of multisite extraction methods in the last 20 years. This means that biomonitoring studies using these matrices demand for reliable extraction and clean-up procedures, which have been suffering continuous development to reach increasingly lower limits of detection associated with sharper chromatographic resolution.

The study has been made in the framework of a number of projects, such as: nearshore and oceanic sampling of selected organics in the Antarctic, sub-ice samples of Euphausia Superba (krill) and 19th international conference on emerging pollutants (brominated and fluorinated).

TU 252

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TU 255

TU 256
The environmental health decline and the loss of organism diversity of South Florida (USA) ecosystems have been attributed to nutrient inputs from nearby urban and agricultural activities. Intensive agricultural pesticide use may also challenge the ecosystems. One possible agricultural pesticide release to the atmosphere after application which can be enhanced in this region due to the calcareous soils, frequent rainfall, and high humidity and temperatures. A study was conducted to examine the atmospheric fate of the widely-used insecticide endosulfan. Air samples were collected over a five-year period (2001 to 2006) at a site within the agricultural community of Homestead, Florida. This site was located in and near the agricultural lands of Everglades National Parks (NPs). Endosulfan emissions from agricultural areas around Homestead appeared to influence air concentration observations at the NP sites. During an intensive sampling campaign, the highest total endosulfan concentrations at the NP sites were observed on days when air parcels were predicted to move from Homestead towards the sampling locations. The α-endosulfan fraction (α/(α+β)) was used to examine the contribution of pesticides to regional air pollution to the overall endosulfan deposition. The fraction was found to have an α fraction of approximately 0.7, whereas volatilization is predicted to have an α fraction of 0.9. The median fraction observed at Homestead during periods of high and low agricultural activity was 0.84 and 0.86, respectively, indicating that drift contributes to the atmospheric concentrations. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.00 indicating air concentrations are primarily influenced by regional volatilization. The near-inversial isomerization after application of β-endosulfan to α-endosulfan also influences the value of the α fraction.

TU 257

Raman microscopy as a tool to examine agricultural sources of PM10
L.L. McConnell1, H. Huang1, E. Razote1, W.F. Schmidt1, B.T. Vineyard1, A. Torrents1, C.J. Hapeman2, R. Maghirang2, S. Trabuc1

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A number of studies have been focused on indoor sources and proximal environmental sources including outdoor sources, such as soil dust, outdoor air, and building materials. However, indoor sources and proximal environmental sources may also be significant contributors to outdoor PM10 concentrations. Characterization of PM10 from these sources is complex and often difficult. Raman microscopy has been demonstrated as a useful technique for characterizing PAHs in PM10, but the potential of Raman microscopy to characterize PM10 has not been investigated. In this study, we conducted a Raman microscopy analysis of PM10 to assess the potential for Raman microscopy to characterize PM10 from indoor and outdoor sources. Both indoor and outdoor PM10 samples were obtained from two buildings located in a suburban area of Gainesville, Florida. The Raman microscopy analysis was performed using a Renishaw inVia Raman microscope, and the chemical characterization was performed using a家中 CASA software. The results of the Raman microscopy analysis indicated that the PM10 from indoor and outdoor sources was chemically different. Indoor sources were characterized by the presence of PAHs, while outdoor sources were characterized by the presence of more complex organic compounds. These results suggest that Raman microscopy can be used to characterize PM10 from indoor and outdoor sources, but further studies are necessary to fully understand the potential of Raman microscopy to characterize PM10.

TU 258

A langmuir-hinshelwood fit of atmospheric reactions of OH radicals with semivolatile, aerosol-borne compounds in chamber experiments
L. Han1, W.U. Palm2, H.U. Krüger1, S. Bielicher1, C. Zetzsch1

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Semivolatile, aerosol-borne compounds are an important source of atmospheric organic compounds. They can be emitted from various sources, including traffic, industry, and agriculture. In this study, we used a chamber experiment to study the atmospheric reactions of OH radicals with semivolatile, aerosol-borne compounds. The compounds studied included polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ethers (PBDEs), and perfluorooctanoic acid (PFOA). OH radicals were generated in the chamber by photolysis of H2O2. The reactions were monitored using gas chromatography-mass spectrometry (GC-MS) and time-of-flight mass spectrometry (TOF-MS). The results showed that OH radicals react with the semivolatile compounds to produce volatile products, which are then detected by the GC-MS. The rate constants for the reactions of OH radicals with the semivolatile compounds were determined and compared to those in the literature. The results suggest that the atmospheric reactions of OH radicals with semivolatile, aerosol-borne compounds are an important source of atmospheric organic compounds.

TU 259

Analysing PBDE in house dust samples with the TSQ Quantum Ultra XLS GC-MSMS in EI-SRM mode and GC-MS negative chemical ionization in SIM; a comparison of two analyzing techniques
M.S. de Dobbeleer1, A.G. Mayer2, J. Gummensbach2, H.J. Huebschmann2, P. Siolek2

1ThermoFisher, Breda, Netherlands
2Thermofisher, Dreische, Germany

Polybrominated diphenyl ethers (PBDEs) are a class of compounds used as flame retardants in a wide variety of household apparatus and furniture. Certain congeners have been banned completely and are currently on the list of the Stockholm convention on the persistent organic pollutants. There is an ever growing concern about the health risks being exposed to these class of compounds and one of the sources of human intake is next to nutrition, inhalation of indoor air and house dust. In this study, a comparison is made between two analytical techniques; GC-MS-MS and GC-NCI-SIM, evaluating detection limits, repeatability and selectivity in matrix.

TU 260

Human exposure to flame retardants in different occupational settings from Pakistan
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Flame retardants (FRs) are widely used in a variety of consumer’s products, such as plastics, textile coatings, electrical appliances and printed circuit boards to inhibit the development of fire. Studies have shown that these chemicals can leach out into the environment. In order to investigate the presence of FRs in the specific occupational setting, human exposure to FRs, we collected dust, serum, urine, and ambient air samples from individuals working in electronics and textile market in Pakistan. Polychlorinated dibenzo-p-dioxins (PCDDs), polybrominated diphenyl ethers (PBDEs), novel brominated FRs (NFRs), hexabromocyclododecane (HBCD) and organophosphate FRs (OPFRs) were quantified in dust, serum, and urine samples. FRs were fractionated according to their ease of extraction. DRCPs were extracted from dust, serum, and urine using solid phase extraction (SPE). In dust and serum extracts, PBDEs and NFRs were analysed by gas chromatography (GC) coupled to mass spectrometry (MS). In urine samples, DRCPs were extracted by liquid chromatograph (LC) to couple to high-performance liquid chromatography (HPLC) to couple to mass spectrometry (MS). OPFRs were analysed by gas chromatography coupled to mass spectrometry (GC-MS). OPFRs were quantified using standard addition methods. These results suggest that the FRs are occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan. The occupational exposure to FRs is high in electronics and textile market in Pakistan.

TU 261

Use of volatile organic compounds (VOC) in consumer products and comparison between the European and US reactivity models for assessment
J. Kauamann

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Use of Volatile Organic Compounds in consumer products and comparison between the European and US reactivity model for assessment:

The environmental impact of Volatile Organic Compounds (VOC)’s is their ability to react with NOx in the lower atmosphere in the presence of sunlight and heat to produce ground-level ozone, also called summer-smog. Summer conditions favour the formation of ground-level ozone primarily because of increased ultraviolet radiation, temperature and low wind speeds. The reactivity potential of VOC in Europe is defined as Photochemical Ozone Creation Potential (POCP); developed by Derwent et al (1995). By USA / Canada, the concept described the reactivity potential of VOC is the Maximum Incremental Reactivity (MIR); developed by Carter et al. (2006). MIR’s and POCP’s both measure the reactivity towards ozone production of a given VOC. The MIR scale is reported as the mass of additional ozone produced per mass of VOC reacted. POCP report the additional ppb of ozone produced by an additional emission of that VOC, expressed relative to that produced by the same emission of ethane as reference.

International consumer companies with global brands have the challenge to meet all aspects of regulatory requirements to reduce their impact of VOC’s. Some examples
The dominant PBDE congeners were BDEs 47, 99, 100, 153, 154 and 183 in both M and F, which are the same dominant congeners present in the penta technical mixtures. However, bats have a lower proportion of PBDE 47 than the technical mixtures, suggesting degradation of this compound. Total BDEs were dominated by penta-BDEs (65% of the total), followed by hexa-BDEs (with just over 20%) for both males and F.

The sum of the PBDE analyses showed an average width (10.4 - 8191 ng g⁻¹ wet weight (ww)) of concentrations, with a mean of 916 ng g⁻¹ ww. Males had on average twice the concentration of PBDEs than F (M: 1182 ng g⁻¹ ww, F: 673 ng g⁻¹ ww), although this difference was not statistically significant, possibly a result of the small sample size.

The highest significance concentrations were found in batrooms; in particular, D5 represented the principal compound probably due to its dominant presence in most of hair-care products, skin lotions, cosmetics, household products and cleaning agents. Personal lifestyles and everyday-life behaviours (e.g., selection of products, frequency of application, amount applied) had a determining factor in the amount of total significance found in both Italian and UK adult and living rooms. No significantly different concentrations were found in different indoor environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.

The study was intended to investigate the occurrence and distribution in indoor environments, including domestic (i.e., batrooms, living rooms, boy/girls rooms) and public (i.e., offices, schools, hospitals, hotels) environments, respectively. An extensive air-sampling campaign was performed contemporaneously in the UK and Italy, between May and August 2011. Indoor air samples (n = 100) were collected on adsorption Tenax GR cartridges (60/80 mesh, Markes) using conventional portable air sampling pumps (i.e. GilAir3, Gilian- Sensydine), operating at a flow of about 120 mL min⁻¹. Sampling cartridges were desorbed using the Automatic Thermal Desorber UNITY2 coupled to a GC-MS, with samples injected in splitless mode. The analysis was conducted in order to determine the concentration of total volatile methyl silicone (in particular D3 and D5) accounted for ~90% of total volatile methyl silicone in both M and F.

The highest significance concentrations were found in batrooms; in particular, D5 represented the principal compound probably due to its dominant presence in most of hair-care products, skin lotions, cosmetics, household products and cleaning agents. Personal lifestyles and everyday-life behaviours (e.g., selection of products, frequency of application, amount applied) had a determining factor in the amount of total significance found in both Italian and UK adult and living rooms. No significantly different concentrations were found in different indoor environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.
The study case involves the Contemporary Political History Archives sites in Ca’ Tron, Treviso (Italy) in the Veneto countryside. A specific seasonal aerobiological protocol were applied in a concentration range of 0.001 - 1.0 mg/mL. Particle sizes (5-10 µm) in these suspensions were measured by dynamic light scattering. The control contained particulate matter gained electrostatically from different furnaces in the flue gas channel. Suspended in water, vortexted for 1 min, and ultrasonificated for 15 min samples.

In fact, one of the major causes of paper degradation is the biodeterioration, which develops with specific environmental conditions. Therefore, it is necessary to conduct (summer 2010 and 2011, respectively) versus 60 and 61 cfu/m3 (winter 2010 and 2011, respectively). The concentration of the remaining microbiological agents (gram-negative bacteria) near a MBT plant (Ecoparc-2) in Montcada i Reixac, (Barcelona, Catalonia, Spain) was presented. The aim of this study was to evaluate the potential changes in the environmental levels of metals and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) in the vicinity of a cement plant before and after using sewage sludge as alternative fuel. The concentrations of PCDD/Fs and metals were determined in soil, herbage and air samples around this facility before and after the partial fuel substitution. The potential changes on the health risks for the population living around the facility were also assessed.

In general, no statistically significant differences in the pollutant values were found between the 2 scenarios (before and after the partial fuel replacement), with the exception of a few significant decreases in some metals. Besides, the carcinogenic and non-carcinogenic risks due to the exposure to metals and PCDD/Fs were below the national and international safety limits.

Environmental impact of chemical- and microbiological-treatment systems. Human health risks of chemical and microbiological pollution L. Vilvert, M. Nadal, M. Schuhmacher, J.L. Domingo

TU 268

Environmental risk management in confined spaces. A study case of an archive like a model of indoor environment involved with biodeterioration A. Micheluz, S. Manente, R. Ganziera, G. Ravagnan

Ca’ Foscari University of Venice, Venice, Italy

Propagate specific indoor environments, such as those that preserve Cultural Heritage, cannot fail to take into account the interactions they may have on human health. The Historical Archives, where cellulosic microfungi and bacteria find a comfortable environment for their development, are of particular interest in this sense.

In fact, one of the major causes of paper degradation is the biodeterioration, which develops with specific environmental conditions. Therefore, it is necessary to conduct research linking aerobiological with environmental Archives, to understand the conservation state of the documents and, also, the possible risks for the Archive’s operators and for people who work within these environments.

The study case involves the Contemporary Political History Archives sites in Ca’ Tron, Treviso (Italy) in the Veneto countryside. A specific seasonal aerobiological protocol was developed to monitor the presence of microorganisms both in the air and on the documents stored, the temperature, humidity and light conditions, and the detection of dust (PM10 and PM2.5).

For the aerobiology analysis, active and passive samplings were performed. Volumetric samplers were used to measure the concentration of microbes in air (expressed by CFU/m3), while Petri dishes with different culture media (Nutrient Agar, Malt Extract Agar and Malt Extract Agar plus Chloramphenicol) were used for qualitative microbiological sampling (expressed by CFU/m2).

In addition, two parameters were considered for the surface contamination, using nitrocellulose membranes: the Microbial Buildup (MB, the total number of microorganisms collected on a surface in 30 second) and the Hourly Microbial Fallout (HMF, the number of microorganisms collected during 1 hour). In this way, it was possible to:
- Define the conservative situation of the archive.
- Identify microbial species present both in the air and on the documents and then identify those potentially cellulytic and those dangerous for human health.
- To propose measures to improve archivists' conservation and thus prevent degenerative risk situations, like the Sick Building Syndrome.

TU 270 Persistent organic pollutants (POPs) in ambient air, human breast milk and edible fish - a potential for health risk in Ghana S.O. Adekumi1, J.K. Klamo2, K.A. Asante3

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2, Center for Marine Environmental Studies (CMES), Ehime, Japan

Persistent organic pollutants (POPs) in rural and urban background air of southern Ghana were measured in 2008 using polyurethane foam (PUF) disks passive air samplers (PUF). The objective of this study was to quantify the levels of POPs in air and to establish their baseline information for future monitoring and trend studies. This is the first comprehensive study reporting on levels of POPs in background or ambient air in Ghana covering the coastal zone and the middle belt. POPs in pooled and individual human breast milk samples collected from lactating mothers countrywide were also determined using a high-resolution gas chromatography interfaced with a high-resolution mass spectrometer (HRGC-HRMS). This constitutes the first comprehensive nationwide human breast milk study of assessing risks of HCHs for the general population of Ghana. The results of the study showed that the general population of Ghana is widely exposed to POPs although the current levels are generally low. POPs measured included organochlorine compounds, namely Lake Volta, Lake Bosumtwi and Weija Lake in Ghana shows that there is a potential health risk from POPs for the general population of Ghana because fish is one of their important protein sources.

TU 271 Toxicity screening of fine particles by a novel microbial test battery I.R. Gutierrez1, D. Dietrich, W. Abel1

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Burden management of fine particles has become more important to the increasing costs of fossil fuels. Claimed as renewable energy source, wood has often been ignored as a source for fine particles causing toxic effects. Rapid reproducible and validated biotests for toxicological characterisation of such particles exist neither for fine nor for microorganisms. Thus there is a need for established microscale toxicity screening of unknown combustion born particles.

Hence, the aim of the current study was to monitor the presence of microorganisms both in the air and on the documents stored, the temperature, humidity and light conditions, and the detection of dust (PM10 and PM2.5). For the aerobiology analysis, active and passive samplings were performed. Volumetric samplers were used to measure the concentration of microbes in air (expressed by CFU/m3), while Petri dishes with different culture media (Nutrient Agar, Malt Extract Agar and Malt Extract Agar plus Chloramphenicol) were used for qualitative microbiological sampling (expressed by CFU/m2). In addition, two parameters were considered for the surface contamination, using nitrocellulose membranes: the Microbial Buildup (MB, the total number of microorganisms collected on a surface in 30 second) and the Hourly Microbial Fallout (HMF, the number of microorganisms collected during 1 hour). In this way, it was possible to:
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- Identify microbial species present both in the air and on the documents and then identify those potentially cellulytic and those dangerous for human health.
- To propose measures to improve archivists' conservation and thus prevent degenerative risk situations, like the Sick Building Syndrome.

Airborne particulate matter induced pro-inflammatory effects and oxidative stress in A549 cells S. Michael, M. Montag, W. Dott

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 343
Institute of Hygiene and Environmental Medicine, Aachen, Germany

Clean air is a basic requirement for human health and well-being. An average daily inhalation of 20 m³ of air is characterized by an exposure to many different pollutants. Apart from the classic gaseous pollutants airborne particulates continue to pose a significant threat to human health worldwide.

The objective of this study was to compare the atmospheric particle load for different investigated sites in regard to their relations to the chemical composition. In this context we investigate airborne PM from different sites in the Region of Aachen. A549 cells were exposed to increasing PM concentrations followed by analyses of cell viability, pro-inflammatory and oxidative stress response.

The results showed a seasonal and location dependant variability of the PM concentration for both particle fractions. Chemical analysis of these particles indicated the presence of 21 elements, water-soluble ions and a multitude of different PAH. The major inorganic components are the crustal elements (Ca, K, Mg, Na) and the (transition) metals Al, Fe, Zn. In contrast to metals and PAH, the concentration of ionic species is only approx. 50% higher at the rural site, compared to the urban site. Water-soluble particles of the urban traffic, which had induced a significant decrease in cell viability and an increase in pro-inflammatory and oxidative stress markers. The samples of the urban traffic location, characterized by a high concentration of elementaric/green carbon and metals, induced the highest pro-inflammatory and oxidative activity.

Due to the combination of chemical-analytical and toxicological methods a characterization of PM induced cause and effects are possible. The obtained information about the ambient PM quality may be used for various complimentary analyses of source regions in the region of Aachen. Our results support other investigations regarding the importance of the chemical compositions and there PM induced toxicity in vitro.

The study is embedded in the project City2020+ which is part of the interdisciplinary Project House HumTec (Human Technology Center) at RWTH Aachen University funded by the Excellence Initiative of the German federal and state governments through the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG).

TU 273 Selectivity of PCIs at low level with high precision using GC-MS/MS Triple Quadrupole

W. Phillips, D. Steinger, T. Roharge, A. Mayer, M. Godula

THERMO Fisher Scientific, Austin, Texas, United States of America

As it is known from aqueous sorption-desorption experiments, here also char coal significantly

Apart from the classic gaseous pollutants airborne particulates continue to pose a significant threat to human health worldwide.

metals Al, Fe, Zn. In contrast to metals and PAH, the concentration of ionic species is only approx. 50 % higher at the urban site, compared to the rural site. Water-soluble

samples of the urban traffic location, characterized by a high concentration of elemental/organic carbon and metals, induced the highest pro-inflammatory and oxidative stress markers. The samples of the urban traffic location, characterized by a high concentration of elementaric/green carbon and metals, induced the highest pro-inflammatory and oxidative activity.

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The present results indicate that the weight of accessibility data obtained with single-substance spiked soils may have to be re-evaluated.

Soil bioaccessibility extraction techniques are generally simple dissolution experiments, where the fraction of compounds that are transferred to the medium is measured and considered to be bioaccessible. However, such techniques can lead to an underestimation of bioaccessibility, since they do not account for the consumption of contaminants by either chemical reactions or biological degradation. It is therefore necessary to develop approaches that combine both mobilisation and consumption processes.

The mobilisation medium can be chosen to either maximize desorption without attacking the matrix or even to simulate the relevant organism conditions. A sorbent can act as an infinite diffusion sink for continuously removing the mobilized contaminants from the medium. Initial tests with spiked cyclodextrin and digestive fluids confirmed an efficient absorption of PAHs by the silicone rod. Finally, determination of the readily desorbing PAH fraction from a wood extract was applied to determine the free fraction and partitioning of PAHs in cyclodextrin and digestive fluids, which in turn was used for sink dimensioning. Validation experiments by the enrichment of soils with highly sorbing constituents (e.g., soot, cf. MGP soils) showed that a sink is needed and makes a substantial difference. In the present study, weak binding of PAH in spiked soils (aged and freshly contaminated) was assessed by the enrichment of soils with highly sorbing constituents (e.g., soot, cf. MGP soils). In the present study, weak binding of PAH in spiked soils (aged and freshly contaminated) was assessed by the enrichment of soils with highly sorbing constituents (e.g., soot, cf. MGP soils).

PAH desorption behavior from freshly contaminated and aged soils was monitored and compared with PAH desorption from three historically contaminated soils. The complete configuration of the CEPBET system is required as the COL significantly increases pollutant desorption. A configuration of CEPBET is now required that combines the ‘trap’ with the ability to actually measure the desorption resistant contaminants in soils, its main limitation being that it is not possible to extract the complete PAH fraction from the silicone rod. This contaminant trap is a practical and simple approach for the isolation and quantification of the desorption resistant contaminants in soils, its main limitation being that it is not possible to extract the complete PAH fraction from the silicone rod. This contaminant trap is a practical and simple approach for the isolation and quantification of the desorption resistant contaminants in soils, its main limitation being that it is not possible to extract the complete PAH fraction from the silicone rod.

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous environmental organic pollutants, a number of which are known carcinogens. Soils are the major environmental sink for PAHs and it has been estimated that over 90% of the U.K. PAH burden resides in soil. Total pollutant concentration is frequently used in the assessment of risk posed by contaminated land to human health. However, it has been widely established that such an approach significantly overestimates the amount of pollutant absorbed by humans resulting in an overestimation of risk. One of the main pathways for human exposure to contaminated soils is direct ingestion as a result of hand-to-mouth activity. To address this number several in vitro physiologically-based extraction tests have been proposed for metal and organic pollutants. In recent work we developed a colon extended physiologically-based extraction test (CPEBT), this enhanced the bioaccessibility of PAH compared to a two compartment, i.e. stomach and small intestine, model. The current work was to combine the CPEBT bioaccessibility test with a charcoal contaminated trap in order to maintain a full diffusion gradient for the complete sink process, thereby enhancing the bioaccessibility extraction. This was believed to be necessary because the gastrointestinal tract (GIT) provides a considerable sorptive sink for PAH due to its large surface area and lipophilic nature. The present study was concerned with the development of an enhanced PAH sorption from incubated soils, reducing gut medium concentrations to <5% of the no trap values within the appropriate physiological timescales. This clearly identifies the need for a sink in bioaccessibility extractions. The complete configuration of the CEPBET system is required as the COL significantly increases pollutant desorption. A configuration of CEPBET is now required that combines the ‘trap’ with the ability to actually measure the desorption resistant contaminants. This seems possible with the present contaminant trap, since quantitative back extraction from the carbon silicon composite is difficult if not impossible. Once an appropriate extractable ‘trap’ has been found there is the requirement for validation of CEPBET with animals studies.

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efficiency in increasing biodegradation performance, and its dependence on environmental conditions, has hitherto not been conducted. Using a microbial simulation model, we therefore investigate bacterial degradation performance in response to networks that either act as bacterial dispersal vectors ('highways') or as contaminant translocation vectors ('pipelines') or as a combination of both. We analyse biodegradation improvements compared to the situation without networks, and systematically test a variety of spatially homogeneous and heterogeneous environmental scenarios. Our results suggest that each mechanism can improve biodegradation performance. The degree of improvement, however, may vary distinctly depending on the environmental conditions, and may also be negligible under certain conditions. Particularly, networks acting as 'highways' allow bacteria to overcome motility restrictions and reach remote areas, whereas networks acting as 'pipelines' may initiate degradation by bringing remote contaminants to bacteria. As a consequence, highest biodegradation improvements often emerge from the combination of both mechanisms. We therefore conclude that 'functional highways' as well as 'functional pipelines' should be considered for developing novel bioremediation strategies based on fungus-mediated transport. Future experimental studies should focus on detection and appropriate stimulation of the two mechanisms in typical bacteria-fungus associations in contaminated soils.

TU 286

Influence of rhizosphere oomycete mycelia on bacterial biodegradation of phenanthrene present in nonaqueous-phase liquids (NAPLs)

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Two rhizosphere oomycete species (Pythium aphanidermatum and Pythium oligandrum) were tested for their influence on biodegradation of phenanthrene present in NAPLs by the soil bacterium Mycobacterium gilvum. All strains showed antagonistic effects on the bacterium in co-culture assays. An optimized production protocol was established for oomycete mycelia using a direct scrap-cake-out method with solid agar, which prevented the contamination by carbon-rich medium components. Mineralization of 14C-phenanthrene present in hexadecane-fuel-NAPL mixtures with M. gilvum VM552 was increased in the presence of P. oligandrum mycelia. The fungus showed to have a stimulating effect for mineralization and delayed the isotope plateau. However, there was no stimulation of mineralization when the NAPL was composed of a heptamethyleneanenine/fuel mixture. We suggest that fungal growth on biodegradable NAPL mixtures may promote the bacterial colonization of the NAPL/water interface, possibly by promoting cell adhesion and/or causing surface interaction, thus increasing the biodegradability of PAHs for bacteria.

TU 287

Sunflowers in rhizoremediation: a possible alternative for improving the bioavailability of PAHs in soils

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The stimulating effect of plant root exudates on biodegradation depends largely on the ability of degraders of contaminants in soil and plant growth that drive organisms to colonize roots efficiently. In our work, we present the effect of sunflower rhizosphere on the biodegradation of PAHs in soil with creosote (217.5 mg kg⁻¹ containing 6 HAPs). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and on the other hand a decrease in the amount of contaminant when compared to the control. Results indicated that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

TU 288

Combining synchronous fluorescence, liquid scintillation and passive dosing for studying the bioavailability of pyrene in the presence of dissolved humic substances

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Degradation of HAPs in soil and sediments is a critical limiting factor that controls biodegradation rates of hydrophobic pollutants such as PAHs, resulting in a long-term persistence of these compounds in the environment. The use of biosurfactants is a promising alternative for enhancing desorption of soil-buried PAHs and their bioavailability to microorganisms. It is already known that biosurfactants can promote dissolution of solid PAHs and also enhance desorption when they are present at rapidly-desorbing fractions (> 0.1%). However, not much is known about the effect of biosurfactants on bioavailability of slowly-desorbing hydrophobic compounds, as PAHs. In this study, we focus on the capacity of rhizomolipid biosurfactants, produced by Pseudomonas aeruginosa 195J, to enhance the bioavailability of different soil-buried GC-labeled PAHs in soil-aqueous systems. In a well-controlled batch system, we studied the effect of biosurfactants, at concentrations above the critical micellar concentration (CMC), on the bioavailability of fast and slow desorbing fractions of GC-labeled PAHs present in soil. Desorption kinetics of GC-labeled PAHs from soil were performed by Tenax solid-phase extraction and compared to mineralization kinetics with a PAH-degrading soil bacterium (Mycobacterium gilvum VM552) in the presence of biosurfactants. Results indicated that the promoting effects of biosurfactants on biodegradation were accentuated in soils exhibiting a slow-desorption profile. Given the biodegradable and non-toxic nature of biosurfactants, their use constitutes a promising alternative for promoting bioavailability of this 'resistant' fraction in a sustainable way.

TU 290

Bacterial taxis and sustainable remediation: effects on bacterial dispersal

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We investigated the degrading potential of microorganisms in porous media as a bioavailability-promoting strategy. The positive effects of - often energy-consuming - mobilization approaches in bioremediation depend on the efficiency of bacterial movement in porous media, which is often restricted by high deposition rates and adhesion to soil surfaces. Besides, adhesion to surfaces may be sometimes beneficial in promoting biodegradation of slowly-desorbing chemicals. In well-controlled column systems, we observed the capacity of Pseudomonas putida to reach and degrade the hydrophobic contaminant, naphthalene, as a mechanism for bacterial mobilization in porous media. We characterized the motility behavior by capillary assays and by analyzing the movement of individual cells through computer-assisted motion analysis, determining parameters like linear speed and rate of change of direction. The cell interaction with the column packing material, and subsequently deposition, depended on the motility behavior (hypermotility, attraction or repellence). For example, positive chemotaxis caused smooth trajectories and reduced the affinity of the cells for surfaces, thus promoting transport due to a decreased deposition, whereas repellence caused the opposite effect. We propose that, by promoting the right motility transport, we could establish cell deposition to a given bioremediation scenario, thus achieving an enhanced and sustainable remediation performance.

TU 291

Behavioral responses of Tetrahymena pyriformis exposed to microgradients of hydrophobic organic chemicals

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University of Gothenburg, Gooteborg, Sweden

Behavioral changes of microorganisms may reveal subtlethadverse effects of hydrophobic organic chemicals. Using them as an endpoint requires, however, that the organisms can be observed microscopically during exposure. We therefore applied passive dosing on microscope slides as a new experimental platform to study the effect of selected polycyclic aromatic hydrocarbons (PAHs) on the behaviour of the ciliate Tetrahymena pyriformis. Motile cells and organisms that are able to sense chemical signals may directly use this information to orient along concentration gradients of a chemical, a behaviour known as chemotaxis. T. pyriformis was therefore exposed to various PAH-gradients and the swimming behaviour of the cells was then recorded under infra-red light illumination. Trajectories of the cells were obtained using an automated cell tracking software and were subsequently analyzed for chemotaxis by statistical measures. The Taylor model, which mathematically describes the scale-dependent transition from ballistic to diffusive movement of certain colloids, was applied to obtain first motility parameters such as the tumbling frequency and effective swimming velocity to evaluate changes in the swimming behaviour of the cells. The results did not reveal chemotactic behaviour of T. pyriformis in the concentrations gradients of the compounds tested. However, motility behaviour was affected at levels that were about two orders of magnitude below the reported effective chemical activity causing 50% lethality, emphasizing that behavioural responses are a sensitive endpoint in toxicity testing.

TU 292

Sorption of ionized and polar contaminants to natural dissolved organic matter

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Concentrations of dissolved organic matter (DOM) have been rising in the environment over the past decades due to climate change and decreases in acid rain. The transport potential of organic contaminants can be affected by increased DOM concentrations in surface water. It is therefore relevant to gain more insight into the mechanism of organic contaminant sorption to DOM. In this study, the interactions between polar organic contaminants (neutral and ionized forms) and DOM were studied to assess the
Passive dosing method is used to determine the HOCs, whereas E can be determined at or below the saturation, and for defined levels of each mixture component.

In the current work, we studied the above examples using "enhanced capacity" as a new measurement endpoint. Enhanced capacity (E) has some similarities to the well-established concept of "solubility enhancement" but should not be confused with it. Solubility enhancement is determined at, and applies only to, the saturation level of the HOCs.

The binding of hydrophobic organic compounds (HOCs) is usually considered to be a risk reduction process. However, if the bound form becomes mobile then it can in fact enhance uptake and risk. This phenomenon can be seen in 1) colloid facilitated transport 2) the use of chemical agents to enhance soil remediation and 3) in biology, where body fluids help solubilize and transport HOCs into cells. Nevertheless, the extent of solubilization in the environment can be highly variable.

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solutions were irradiated by sun light in quartz tubes for up to 3 days. Photo-degradation of TCDD studied by in vitro assay (based on the HIEIE-luc transgenic cell line) was observed, but both TCDD alone and TCDD in mixtures with low concentrations of NOM (up to 10 mg/L) were photo-degraded in almost the same half-lives. High NOM concentrations (25–150 mg/L) significantly decreased the half-lives of TCDD photo-degradation, probably due to filter effect of more coloured solutions. Supported by project CETOCDEN (European Regional Development Fund no. CZ.1.05/2.1.00/01.0001).

**TU 299**

Influence of sorption on bioavailability and biodegradation of secondary alkane sulfonates (SAS) in marine sediments

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Contaminants of environmental concern are often influenced by wastewater discharges from surrounding populations. Surfactants, with a worldwide production over 10 million tons per year, are among the organic contaminants showing highest concentrations in water. Many studies on this topic deal with the distribution and fate of alkylphenol polyethoxylates (APEO) in aquatic systems, as some of their degradation intermediates are endocrine disruptor compounds (EDC). Linear alkylbenzene sulfonates (LAS) have also been studied as they show the highest worldwide production volumes. Environmental data on many other surfactants, however, are still scarce. This is the case of secondary alkane sulfonates (SAS), one of the major anionic surfactants used in the market of dishwashing, laundry and cleaning products. Although this compound is easily removed during wastewater treatment, previous studies have shown that SAS and other anionic surfactants such as LAS accumulate in sludge as they are hardly biodegradable by aerobic digestion. Recently, anaerobic degradation of SAS was confirmed in marine sediments due to the presence of sulfate reducing bacteria. This research has focused on determining whether SAS are biodegradable or not in absence of oxygen in the marine environment, and, if that happens, on the role of sorption on the speed of the biodegradation. First sorption experiments were performed using several amounts of sediments (0.5-5 g) and SAS concentrations (1-10 mg/L). Distribution coefficients (Kd) were determined. It was observed that the sorption capacity increases with higher for those homologues having longer alkyl chains (e.g., C17-SAS) rather than for more polar homologues such as C14-SAS. Later, biodegradation experiments using anoxic marine sediments and seawater were conducted. SAS anaerobic biodegradation was observed for the first time, reaching overall values up to 98% in 166 days. Half-life values ranged from 20 days (C14-SAS) to 37 days (C17-SAS), showing that the speed of this process significantly depends on the sorption capacity and, therefore, bioavailability, of each SAS homologue.

**TU 298**

Removal of PCB- and PAH-contaminated soil with modified clays

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Bentonite, a clay mineral known for its great potential in the remediation of contaminated soils and sediments, is often used in combination with other clays or chemicals. The present study deals with the removal of polychlorinated biphenyls (PCBs) and aromatic hydrocarbons (PAHs) using modified clays. In this research, sodium dodecyl sulphate (SDS) and humic acid were used to modify bentonite. Kaolinite was modified by papaya seed. Different percentages of the modified clays were mixed with the contaminated soil and suspended in 0.01M CaCl2 in the dark for 20 days. After equilibrium analysis of the modified clays in solution was conducted using SPE coupled with GC/MS.

Presented are the sorption capacities of the modified clays and results of remediation. The results of this study indicate a promising potential of the modified clays to immobilize PCBs and PAHs in soils.

**TU 300**

Fate of iodinated X-ray contrast media in a soil column percolation experiment simulating elevated dissolved organic carbon (DOC) by amendment of saccharose

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Regarding the removal of X-RCM, moderate pollution of surface waters with low molecular organic compounds can thus be compensated by natural water treatment like river bank filtration or artificial groundwater recharge (AGR) are used, but some X-RCM like amidotrizoic acid are known to be persistent. Due to the slow sorption tendency of X-RCM, their fate is rather related to biodegradation, as proved by the detection of metabolites reported in literature [2].

To simulate the process of AGR, the fate of six iodinated X-ray contrast media tosylhexamic acid, iohexol, iomepr, iopamidol, amidotrizoic acid and iodipamide was studied during percolation of a sandy gravelly substrate in a column percolation experiment using filtrated surface water from the Rhine. The question of interest was, whether elevated DOC would improve or impair the removal of X-RCM during the column passage. Thereafter, filtrated Rhine water used for column percolation was spiked with concentrated aqueous saccharose solution to achieve elevated DOC and to simulate the pollution of the Rhine with low molecular organic compounds, e.g. from food industry or accidental spills. Weighted complete composite samples of column influent and effluent were analysed for X-RCM and DOC and treatments with and without saccharose were compared.

Moderately elevated DOC (1,3-fold of background) stimulated iohexol removal, but for most X-RCM there was no effect. In contrast, twenty-fold elevated background DOC impaired the removal of most X-RCM, while there was a tendency towards elevated iopamidol removal. The latter implication is supposed to be related to the observed changes in redox settings in the column induced by the high DOC load, as the fate of iopamidol is reported to depend on site-specific redox conditions at several field sites in literature [1].

Regarding the removal of X-RCM, moderate pollution of surface waters with low molecular organic compounds can thus be compensated by natural water treatment like AGR, but excess pollution would reduce the cleaning capacity of these systems and must be avoided.

Literature:


Acknowledgement: We thank TZW Basel for funding and support.

**TU 301**

Effect of pH and electrolyte concentration on soil adsorption of pesticides

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2Food and Agricultural Materials Inspection Center, Kodaira, Japan

The Japanese Positive List System for Agricultural Chemicals was implemented in 2006. Under this system, the uniform limit was set at 0.01 mg/kg for agricultural chemicals for which maximum residue limits (MRLs) have not been established. Since then, there have been some vegetable crops at levels above the uniform limit, and the distribution of these crops has been prohibited. One of the reasons why the limit has been exceeded is that succeeding crops are contaminated by pesticides remaining in the soil. Assuming that these pesticides in the soil are taken up by plants via the soil solution, an understanding of the soil-water distribution of the pesticide would be very important. Here, we report the sorption capacities of nonionic pesticides is strongly influenced by soil organic content. However, there is little information available on the influence of soil pH and electrolyte concentrations, changed by chemical fertilizer treatment, on pesticide adsorption. We therefore used batch experiments to investigate the effects of these factors on the distribution coefficient for adsorption (Kd) of about 30 pesticides. We used buffer solutions (pH 3, 5, 7.5, and 9) and two electrolyte concentrations (0.1 M, and 1 M) and correlated with different organic matter contents. Each soil was shaken with an aqueous solution containing 0.1 mg/L of pesticide at a soil-to-solution ratio of 1 to 5, with a 24-h equilibration period for all experiments. Increasing the CaCl2 concentration from 0.01 to 0.1 M had a significant effect on soil pH and electrolyte concentrations. In a soil-water partition coefficient (log Kow). The results suggest that the hydrophobic interactions between pesticides and soil organic matter are influenced by pH levels. Further, it is implicated that crops can take up the pesticide from soil at high pH compared with at low pH.

**TU 302**

Relationships between soil adsorption of pesticides and pesticide/soil properties

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The positive list system for pesticide residue in food, such as crops, was applied in Japan in 2006. For pesticides for which maximum residue levels were not set, the residue levels in food must not exceed 0.01 mg/kg (uniform limit). Pesticides, which are applied to foliage and soil at the crop cultivation, remain in soil after harvest, and pesticides remaining in soil may contaminate the succeeding crop. Crops, for which growing cycle is short, are rotated in Japan. Therefore, the residue levels of some pesticides in succeeding crops have exceeded 0.01 mg/kg in Japan. To prevent excess of the residue level 0.01 mg/kg in the succeeding crop, the succeeding crop must be cultivated in consideration of the physicochemical properties of the pesticide applied to the preceding crop, the soil properties affecting the pesticide residue in soil, and the pesticide's uptake into the succeeding crop.

The succeeding crop may take up the pesticide in soil solution from the root or the stem as a kind of a pesticide's uptake into the crop. Data on the distribution of a pesticide in soil/solution (pesticide sorption) is important for assessing the risk of pesticide contamination of the succeeding crop. Soil adsorption of nonionic pesticides
is influenced by organic carbon content in soil; however, there are few investigations on influence of pesticide and soil properties except organic carbon content on the adsorption of pesticide in soil.

The present study conducted batch experiments with approximately 30 pesticides and 7 soils in Japan to determine their soil adsorption coefficients ($K_d$ values). The results of relationships between $K_d$ values and pesticide/soil properties will be present.

TU 303

Leaching of aged DDTs and current use pesticide residues in undisturbed soil columns: non-ionic surfactant and carboxylic acids effects

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Soil pollution by Persistent Organic Pollutants such as DDTs ($p'$-$p''$-DDT) and its metabolites $p'$-$p''$-DDE and $p'$-$p''$-DDD represents a continuous source to the environment. As a consequence of their high persistence DDTs occur up to 60 cm on agricultural soils. The Current Use Pesticide (CUP) endosulfan is characterized by its high lipivxination potential, and excessive use of low Kow value, leading to soil contamination by leaching or riverine water events as well as plant growing may modify pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agriculturals uses that will account for a variety of compounds of sand, surfactants and dissolved organic carbon. This work studies the vertical distribution and movement of aged DDTs and endosulfan in undisturbed soil columns irrigated with riverine or tap water, Tw-80 and Acids. Experiments were carried out with 13 cm x 30 cm soil columns taken from Aridisol soils from a fruit field in Patagonia, Argentina. Columns were saturated with distilled water and solutions (4L) were added under saturated condition. One L leachates (n=4) were collected for pesticide residues analysis. After elution, columns were dried (24 h), opened and extracted by batch techniques and resolved by GC-ECD. $p'$-$p''$-DDE and $p'$-$p''$-DDD endosulfan-$p$-$p'$-endosulfan pattern was found in all soil sections. $p'$-$p''$-DDE levels ranged between 7,250-8,70 and 13,200 ng g$^{-1}$ dry weight in control, Tw-80 and Acids, respectively. Under all conditions pesticide levels decreased concomitantly with depth and sand increase. In control and Acids, $p'$-$p''$-DDT and $p'$-$p''$-DDD desorption from soil was correlated to soil sand ($r$=0.85), $p'$-$p''$-DDT showed the order control <$p'$-$p''$-DDT <$p'$-$p''$-DDD. Under Tw-80 and Acids, $p'$-$p''$-DDT and $p'$-$p''$-DDD were the main compound on the first elution volume and $p'$-$p''$-DDD started to lixiviate after 2 L while for Tw-80, DDE represents the main residue in all elution waters. Lixiviation of aged $p'$-$p''$-DDT residues or endosulfan effectively occurs under irrigation with riverine water and is increased by adding non-ionic surfactant or carboxylic acids. Tw-80 had a washing effect of pesticides leading to lower levels on soil while carboxylic acids enhance pesticides availability.

TU 304

Sorption of cationic organic compounds to soil as the sum of soil components

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Many emerging contaminants are strong bases that under environmental conditions mostly occur as cationic species. The environmental fate of these compounds depends on the competitive binding to specific sites on soil matter, soil, sediment and dissolved colloids. Since both natural organic matter and clay minerals are negatively charged substrates, both sorbent types are well known to bind organic cations, but it is not clear to what extent each type contributes in natural soils. Using a customized dynamic HPLC column retention method, we studied the sorption of a set of organic cations to individual soil components, such as natural organic matter (NOM, Palohoe peat) and pure clay minerals (kaolinite, illite, bentonite). In addition, sorption affinity to five different Eurosoils was tested, which ranged in organic carbon content (fOC) from 1.3 - 9.2%, and in clay content from 6 - 75%. We examined to what extent sorption of cationic compounds to soil can be predicted based on sorption to individual soil components alone. In general, sorption of primary amines to clay minerals was weak relative to quaternary ammonium compounds (quats), whereas sorption of primary amines to NOM was strong relative to quats. Such relative sorption affinity differences between test compounds between NOM and clay minerals were used to evaluate soil sorption.

TU 305

Degradation of UV filters in sewage sludge by the linydolactic fungus Trametes versicolor and study of the 4MBC degradation process in liquid medium

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UV filters, agents also used in UV filters, have become very popular chemicals since they have shown to have a protective role against photoaging, photocarcinogenesis and other harmful effects of UV-B radiation. UVA filters are used in personal care products but are also present in a wide variety of industrial goods such as paints, plastics or to prevent photodegradation of polymers and pigments. UV filters can enter the environment through the liquid effluent of wastewater treatment plants (WWTPs) but also adsorbed in the sludge due to their high hydrophobic character, and later spread on agricultural fields. A solid-state treatment of sludge from a sewage treatment plant with the fungus Trametes versicolor is reported in the present work as feasible to degrade them in a range from 87 to 100%. This experiment is the first step of any future fungal treatment, essential to prove that the elimination is only due to the action of the fungus and not of other microorganisms as the sludge was pre-treated and sterilized.

Degradation studies of 3-(4′-methylbenzyldiene) camphor (4MBC) in liquid media were also done in particular and complete removal was achieved in less than 24 h. The main metabolites were identified and the first steps of the transformation pathway were elucidated: a mono- or di-hydroxylation by cytochrome P450 and the subsequent conjugation with a pentose. These results support the extended hypothesis that conjugation processes constitute one of the defensive mechanisms that fungi against toxic hydroxylated compounds.

TU 306

Concentration levels of phthalates in water and sediment samples from Nadela river basin, Vojvodina region

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Concentration levels of phthalates in water and sediment samples from Nadela river basin, Vojvodina region were determined. The work was supported by Ministry of Education and Science, Republic of Serbia (III46009 and TR43014).

TU 307

Increasing levels of PBDEs, PCBs and organochlorine pesticides in fish following a mega-flooding episode in the Negro River basin, Argentinian Patagonia

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A mega-flooding event in the Negro River basin, Argentine Patagonia, caused a significant outflow of contaminants from the surrounding soils. Agriculture, hydroelectric vegetation, and industrial-urban contaminators are the most important activities in the basin. This study evaluates the effects of flooding events on polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), polybrominated diphenyl ethers (PBDEs), endosulfan, DDTs and polychlorinated biphenyls (PCBs) levels in females of silverside (Odontesthes hatcheri) tissues. Muscle, liver, gills, gonads and stomach content were analyzed by GC-MS. Levels in water, suspended particulate matter (SMP) and sediments (SS) were also measured. Post- and pre-flood fish showed the following patterns for PBDEs, PCDDs, PCDFs, PCBs and organochlorine pesticides (OCPs): PBDEs levels in post-flood fish increase until 23 times (from 63.2 to 1,478.6 ng lipid in liver), which were dominated by penta- (PCB-110, 118) and hexa- (PCB-138, 139) congeners. These results could have stemmed from historical usage of Aroclor 1254 and 1260 in Argentina. Post- and pre-flood fish, endosulfan sulfate presented the highest levels suggesting metabolic activity in addition to direct metabolite uptake, while an a/h ratio >1 similar to the technical mixture which is widely used in the region. In post-flood muscle, DDTs levels increased 5-fold than pre-flood. The metabolite p,p'-DDE represented about 10% of the total DDTs. This could be a result of the intensive use of this insecticide during long time on agricultural practices. Contaminant profiles observed in pre- and post-flood silverside were according to water, SPM and SS, showing that this species is a good biomonitor of aquatic pollution of Negro River. The presence of pollutants in this river was modified and enhanced by the flooding, increasing their bioavailability to fish. Additionally, pollutant occurrence deserves more attention, and monitoring programs are recommended in order to diminish their incorporation to aquatic ecosystem.

The present study conducted batch experiments with approximately 30 pesticides and 7 soils in Japan to determine their soil adsorption coefficients ($K_d$ values). The results of relationships between $K_d$ values and pesticide/si...
TU 308
Polychlorodioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX
B. Subedi
United States of America
Fish, crabs, and clams were collected from the San Jacinto River waste pits, a superfund site in Houston, TX, and analyzed for polychlorodibenzo-p-dioxins, polychlorodibenzofurans (PCDD/Fs) and dioxin like polychlorobiphenyls (dl-PCBs). Sample preparations comprised of tissue homogenization, enhanced pressurized liquid extraction (HS-PLE) at high temperatures, sample clean-up, and GC-MS analyses. Concentrations were determined using the slope of the calibration curve and the peak area of the response signal. The method detection limits ranged from 2.0 to 10 pg/g ww in tissues. Ten out of twelve priority dl-PCBs (Identified by World Health Organization, 2005) were measured with concentrations ranged from 2.0 to 948 pg/g ww. All measured concentrations were at least an order of magnitude higher than that of PCDD/Fs. Average PCDD/Fs fish tissue concentrations were at least an order of magnitude higher than that of dl-PCBs. Biomagnifications and Bioi and Sedmentation Accumulation Factors were also calculated.

TU 309
Effect of humic substances on remediation of soil: phosphogypsum mixtures
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Phosphogypsum (PG) is a by-product of traditional production of phosphoric acid. Due to high content of nutrients (calcium, phosphorus and sulfur) it is sometimes used as a fertilizer for poor unfertilized soils. But besides nutrients, PG also contains toxic impurities, such as fluorine, strontium and some others. One of contemporary approaches to reduce the ecotoxicity of polluted soils and soil- PG applications is the use of humic substances (HS). Among these substances, humates offer the best possibilities for application due to their relatively low cost and ability to be generated from different sources, such as peat, coal or lignosulfonate. They are used as dispersing agents, builders, in agricultural production and in remediation of phosphogypsum (PG) contaminated soils. For P. subcapitata and H. attenuata tests were prepared an elutriate solution mixing the sample with distilled water in the concentration 3.3 and 7.5 wt. %.

Humates from peat - Pe-FlexK, Pe-EcoK, coal - BC-EnK, BC-HumNa and lignosulphonate - OW-LhK introduced into the MS in the form of 5% of PG (3.3 wt. %) some humates decreased the toxicity (Table 1). The results for S. Quadricauda indicate the predominance of acute affects, or lethal stages (tulip and D). Analyses of average detoxification indexes DAV (averaged over three test-organisms) showed that influence of humates depended both on PG concentration and humates' nature. Thus, application of PG at concentration 7.5 wt. % was toxic for all the test-organisms and humates were not able to decrease the toxicity. At lower rate of PG (3.3 wt. %) some humates decreased the toxicity (DAV is 0.5–0.8), whether other did not. Among all humates tested the highest detoxifying ability was observed for two organo-humic preparations from peat and BC from coal.

For these humates EC50 and NOEL values increased in 1.3–1.8 times for S. Quadricauda, in 1.31–1.4 times for D. Magna, in 1.6–2 times for S. alba for 0.005 wt. %, humates content.

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ETOP 1 - A Systems Biology approach to predictive Ecotoxicology

TU 312
Birds versus crops: a GIS-based procedure to identify specific combinations
A.C. Caffi, E.G. Galimberti, F.M. Marchetto, G.A. Azimonti, A.M. Moretto
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Regulation (EC) No 1107/2009, applied from 14 June 2011, requires new data protection rules for both active substance and product data and, for the first time, includes data protection for extension of authorisations to minor uses. Moreover, rules for either avoiding duplication or sharing tests and studies involving vertebrate data have been included. A new GIS-based approach, introduced to vertebrate data sharing provisions which allows Member States to use vertebrate studies on behalf of prospective applicants if an agreement of the holder(s) of the authorisation cannot be reached.

Considering birds, the species currently used in risk assessment are the ones considered the most sensitive to all pesticides. This approach, which can be considered a good worst case scenario at broad scale, could fail at detail scale where sensitive species living on specific crops could be exposed to pesticides.

In this work a realistic approach has been developed to correlate the avian population at local level, derived from a monitoring survey, with the land-use (Corine land-cover) and the relative pesticide treatments. A GIS analysis was performed to identify peculiar combinations crop/bird specific in order to determine which species is most likely to be exposed to a specific active substance.

The area considered was the North of Italy characterised by an intensive agriculture and a consequently high load of pesticides. These results could be used as a useful tool to address the uncertainty associated to the bird risk assessment.

TU 313
Toxicity of sludge water treatment station for aquatic invertebrates
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TU Bergakademie Freiberg, Freiberg, Germany
The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process, which contains suspended solids, bacteria, heavy metals and others toxic substances present in the untreated water. The amount of sludge generated in treatment is directly proportional to the amount of treated water, a WTP that treat 1500 L/s of water generates approximately one ton of sludge/day, which returns to the river origin. The aim of the present study was to evaluation the toxicity processes involved in P. subcapitata and H. attenuata tests were prepared an elutriate solution mixing the sample with distilled water (1:4 ratio). The elutriate samples were used as 100% and diluted to 75, 50, 25, 12.5 and 6.25% with specific culture medium. The samples collected in October 2009 were slightly more toxic for P. subcapitata and H. attenuata, both samples were high toxicity for P. subcapitata, showed IC50 of 11%. However for H. attenuata showed IC50 of 15.5, 19.1% and LC50 of 17.7 and 64.6% (hockulation and decanter, respectively) which correlated with the highest electrical conductivity determinations (460 and 404 ms/cm) and DO (0.79 and 3.87 mg L-1). The proximity of the EC50 and LC50 results for H. attenuata indicate the predominance of acute affects, or lethal stages (tulip and crumbled), showing the effective power of the toxic sludge, mainly the one collected in the flocculation tank. It’s possible to conclude that both species tested were adequate to characterize the toxicity of the sludge generated by WTP. It’s possible to conclude that both species tested were adequate to characterize the toxicity of the sludge generated by WTP.

TU 314
Toxicity of copper on the freshwater snail Physa acuta: reproduction output and biomarkers of effect
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Copper constantly enters aquatic environments through several paths such as industrial effluents, agriculture runoffs and domestic wastewaters. Trace amounts of copper are needed for metabolic and biochemical processes in several organisms but, like for every chemical compound, in excess it becomes toxic. This study aimed to assess effects on reproduction and direct stress responses using living freshwater pulmonate snail Physa acuta exposed to copper sulfate in laboratory conditions. A 1428 days chronic test was conducted using adult snails in 5 different copper concentrations showing that reproduction was impaired as the concentrations increased. Biomarkers activity (e.g. AChE, GST and CAT) and energy reserves were determined and correlated with reproduction. As expected the energy cost allocated to the detoxification process was one of the reproduction impairment causes.

Aqueous snails, like Physa acuta, have proved to be good test organisms to assess the presence of chemicals in the environment as they have proven to be very sensitive to exposure.

TU 315
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolomics approach
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Triclosan is an antimicrobial substance which is used in many pharmaceutical and personal care products such as soaps, toothpaste and mouthwash. Because of this broad application it has been detected in streams, seawater and sediments in concentrations up to 0.007 µmol L-1 [Singer et al., Environ. Sci. Technol., 2002; In a prior study Franz et al. (2008) observed that chlorophytes are one of the most sensitive organisms affected by triclosan in the range of environmental concentrations. This raises the question of metabolic pathways affected by triclosan in chlorophytes. We used an established metabolic approach to analyse exposed green algae Scenedesmus volumatus [Klindworth et al., Metabolomics, 2009]. Therefore we exposed a synchronised culture of S. vacuolatus with different concentrations of triclosan (range from 0.002 to 0.071 µmol L-1) for 14 hours to derive concentration-dependent metabolic changes to assess them to phenotypic changes (inhibition of cell growth and photosynthetic activity). After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed by GC-MS and evaluated by multivariate analysis.

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Critical toxicants are likely to be present at levels that may induce oxidative stress or alter the mechanisms of defense in the fatty acid elongation pathway. The inhibition of the Enoyl-ACP-reductase during the fatty acid elongation [McMurry et al., Nature, 1998].

Identification of lipophilic metabolites with the NIST and Golm library for GC-MS data revealed many fatty acids (e.g. hexadecanoic acid, oleic acid, octadecanoic acid) characteristic for fish physiology. These findings demonstrate the potential of response methods to the known mode-of-action of the toxicant in bacteria, the inhibition of the Enoyl-ACP reductase during the fatty acid elongation [McMurry et al., Nature, 1998].

Statistics (PCA) . Two concentration dependent response patterns could be identified. Metabolites from the hydrophilic phase showed comparable sensitivity as phenotypic statistics (PCA) . Two concentration dependent response patterns could be identified. Metabolites from the hydrophilic phase showed comparable sensitivity as phenotypic

The catarina scallop constitutes an important fishing resource in B.C.S., Mexico state, due to their production to decreased 86%, in this paper, an evaluation of 5 biomarkers: respiration rate, feeding rate, O: N index, oxidative stress and AchE inhibition being the pearl oyster collected in Pichilingue and the organisms exposed to toxic metals. It is evident that these biomarkers are a good tool in environmental biomonitoring studies.

Species richness and population density of freshwater mussels Unionidae have declined substantively throughout North America. Surveys have revealed that environmental pollution is one of the prime causes for the decline in mussel population. In this study, we evaluated the effects of copper on gill morphology and biochemical parameters of freshwater mussels in order to detect the presence of compounds with toxic and genotoxic effects and evaluate the use these biomarkers as reliable tool in environmental biomonitoring studies. Adult clams were collected in 5 locations on the coast of the state (450 organisms in total). The biomarker data were integrated for calculating the biological response index (BRI) for each location. The previous results are consistent with the levels of pollutants recorded in areas where clams were collected. It is clear that the battery of biomarkers used is a useful tool for environmental biomonitoring studies.

1 Morphometric and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, deterrents and pharmaceuticals)
2 S.R. Rodrigues1, S.C. Antunes1, P.B. Brandão2, B.C. Castro1, P.G. Gonçalves1, A.C. Correia1, B.N. Nunes1, 1Universidade de Aveiro, Departamento de Biologia, Aveiro, Portugal
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In this study, we evaluated the effects of copper on gill morphology and biochemical parameters of freshwater mussels in order to detect the presence of compounds with toxic and genotoxic effects and evaluate the use these biomarkers as reliable tool in environmental biomonitoring studies. Adult clams were collected in 5 locations on the coast of the state (450 organisms in total). The biomarker data were integrated for calculating the biological response index (BRI) for each location. The previous results are consistent with the levels of pollutants recorded in areas where clams were collected. It is clear that the battery of biomarkers used is a useful tool for environmental biomonitoring studies.
Accordingly, the present study investigated two cryptic Gammarus fossarum lineages - namely type A and type B - for differences in their sensitivity towards chemical stress. Two size classes of each cryptic lineage type were exposed to seven different concentrations of the fungicide tebuconazole or the insecticide thiacloprid in six independent experiments. The two rating level on face plate was determined after seven days of exposure as a measure of sensitivity.

The subsequent computational analysis revealed that the meta-analysis of the highly statistically significant expression changes of the cryptic lineage type A compared to type B (n=16; p<0.0001), using combined results of all bioassays, Discrete meta-analyses for each of the exposure levels, showed a similar tendency, however, results were statistically significant only for tebuconazole (n=8; p<0.0001). This deviation in sensitivity between lineages is new due to the minor consideration of the cryptic lineages concept in the field of ecotoxicology, however, mechanistically yet not explainable. Hence, further studies should address the sensitivity to other stressors, by also conducting morphological analyses such as the physiological fitness, of a broader range of cryptic complexes. Nonetheless, genetically distinct lineages may confound the results of ecotoxicological tests, as indicated in the present study, and should thus be interpreted with caution.

TU 322
Status of PAHs in greater Johannesburg area and possible sources
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The presentation gives an overview of the status of the presence and levels of PAHs in greater Johannesburg area. Although many studies of persistent organic pollutants such as polycyclic aromatic hydrocarbons (PAHs) in South Africa and the world in general, the study on PAHs is still having a lot of gaps. The presentation gives an overview of the status of PAHs in water and sediments in rivers and dams in greater Johannesburg area. The common PAHs found and their concentration levels are presented. The levels of PAHs in water and sediments in dams is higher than in sediments. Detailed information on the possible sources of PAHs is given and how these sources impact aquatic ecosystems in the studied area. Finally, the overview of PAH status in South Africa urban environment is given.

TU 323
Linking transcriptome to phenotype: response of a mouse liver cell line to Benzo(a)pyrene
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The aim of the systems biology initiative, “From contaminant molecules to cellular response: system quantification and predictive model development”, is to build a model of interactions between cells and the toxic chemical Benzo(a)-Pyrene (BaP). As part of this initiative, we aim to identify the regulation of genes by BaP in a time and concentration dependent manner, in relation to the physiological response of the cellular distribution of BaP and the physiologic response. Exposure to BaP has been linked to carcinogenic, immunosuppressive and pro-inflammatory effects but there is still limited knowledge on BaP interactions with cells at systems levels. The well characterized Hepa1C1c7 was chosen as a cellular model to identify cellular BaP interactions and advance mechanistic understanding and predictability of the multiple toxic responses. In a first step, two concentrations (50 nM and 5 μM) and four time points (2, 4, 12 and 24 h) were used for comprehensive transcriptome analysis. The results show a small number of genes being regulated at the early time points for both concentrations and a high number of genes being regulated at later time points for the high concentration.

Genes like Cyto 1A1, Tiparp and Nqo1 are regulated early for both concentrations whereas Aldh3a1, well known to act against oxidative stress, is only regulated at the high concentration. Chemical toxicity, chemical viability, detection of ROS formation and lipid droplets were also regulated. There was a significant reduction of the cell viability but only a weak reduction of the ROS production after 12 hours of BaP exposure. Using H2DCFDA staining, ROS production is already observed after 4 hours of exposure to high BaP whereas no response is observed for the low BaP concentration. However, at 24 hours, ROS appears to be produced even for the low BaP concentration. Gene response after 12 hours of 5 μM BaP exposure moreover shows genes related to lipid metabolism. Indeed, lipid body staining using nile red revealed significant changes in lipid droplet morphology already after 4 hours. We conclude that the low BaP concentration induces a small gene expression change, that, together with biochimical defense mechanisms, helps the cell to return to its initial state. However, the high concentration causes strong pathway regulation and cellular dysfunction accompanied by early ROS production and lipid droplet modification.

TU 324
Insights into the effects of silver by transcriptomics and proteomics in Chlamydomonas reinhardtii
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3EPFL, Lausanne, Switzerland

Ecotoxicology aims to identify effects that elicit an impact upon the environment. A major challenge is to understand the toxic mechanisms at a molecular level and how these relate to the organism and population level. Integrating across various levels of biological organization, molecular, cellular and organismal, is required to draw conclusions on impacts in populations, communities and ecosystems.[1]

Our research deals with the analysis of silver induced alterations in gene and protein expression in the algae Chlamydomonas reinhardtii and anchoring of these changes to known biological pathways. This involves collecting and integrating transcriptional data analysis, transcriptions, proteomics, metabolomics and bioinformatics. The transcriptome of silver exposed algae were analysed using C. reinhardtii whole genome microarray. The global protein profile of silver exposed C. reinhardtii (5h exposure time) was done by Multiplexed Protein Identification Technology (MudPIT) which consists of 2D- LC and mass spectroscopy. The transcriptome analysis determined which significantly regulated transcripts are those of molecular pathways of photosynthesis, tetrapyrrole synthesis, mitochondriar electron transport, protein transport and oxidative stress response. Similarly, the proteome profile showed these biological processes being significantly regulated indicating that silver affects key functional pathways in C. reinhardtii. The regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be correlated with inhibition of photosynthesis and ATP synthesis. This study could help towards understand of physiological level. Also, the results could be linked to the physiological endpoint of lipid membranes. Hence, this research will help to understand the effects of silver and lead to active clues for the future in this research field. The results also show the advantages of using our system which allows the comparison of the results obtained from the two techniques, effective tools for the visual inspection of data and exhaustive overview of the real cellular response and of changes in gene expression. Indeed they do not consider the relation between mRNA level, protein concentration and metabolic level which are known to be related to cellular response to BaP exposure. The subsequently conducted meta-analysis revealed a statistically significant higher overall sensitivity of the cryptic lineage type A compared to type B (n=16; p<0.0001), that may be produced even for the low BaP concentration. Gene response after 12 hours of 5 μM BaP exposure moreover shows genes related to lipid metabolism. Indeed, lipid body staining using nile red revealed significant changes in lipid droplet morphology already after 4 hours. We conclude that the low BaP concentration induces a small gene expression change, that, together with biochimical defense mechanisms, helps the cell to return to its initial state. However, the high concentration causes strong pathway regulation and cellular dysfunction accompanied by early ROS production and lipid droplet modification.

TU 325
An integrative approach to understanding the response of Caenorhabditis elegans to valproate exposure
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University of Birmingham, Birmingham, United Kingdom

C. elegans has been extensively used to study the effects of chemical exposure, aging, pathogenicity and reproductive development. With a well annotated genome, well characterized cell lineages maps, ease of making knock-outs, availability of mutants and short life span, it is a good model system to study the effect of chemical exposure to humans. In this work, wild type, wild type C. elegans were treated with sodium valproate, a known teratogen and a histone deacetylase inhibitor used as a first line drug in epilepsy, manic depression, bipolar disorder and schizophrenia. Computational biology and omics technology was utilized to develop gene signatures associated with valproate exposure. We employed a systems biology approach by mapping transcriptomic data to known biological pathways to identify possible pathways affected by valproate treatment. The network models generated with the genes significantly associated with valproate indicates an overall downregulation of nuclear proteins. Metabolite signatures associated with valproate treatment were identified by Nuclear Magnetic Resonance (NMR) spectroscopy on formalin fixed worms. Functional analysis was done from the DAVID gene ontology web tool. Genes were mapped to known pathways using Ingenuity Pathway Analysis software (Ingenium® Systems, www.ingenuity.com). Networks derived from the genes highly correlated to valproate exposure were analysed by the same software. Metabolomic analysis was performed on the aqueous fraction of methanol/chloroform extracted samples on Bruker Avance 500MHz spectrometer at FWHB-NMR Center, University of Birmingham. C. elegans were fixed prior to extraction, by adding 37% formalin directly on to plates. Treatment with valproate resulted in an increase in lipid level and a decrease in egg laying in a dose dependent manner. The genes with positively correlated expression to valproate were enriched with functional terms such as structural molecule activity (cuticle/collagen), detoxification, phosphorylation and lipid metabolism. Genes related to embryonic/larval development/reproductive development, cell cycle/growth, transcription and chromosome organization are negatively correlated correlated to valproate levels. This could be due to the down regulation of the components of the histone deacetylase complex, DNA replication initiation complex, splicingosome and some translation initiation factors by valproate.

TU 326
Development of a resource for the collection, analysis and integration of ecotoxicologically-related high throughput data
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2University of Piemonte Orientale, Alessandria, Italy

In environment, the presence of chemical pollutants or climate changes can induce organism responses at the cellular and molecular level. Beside more traditional analysis systems like mRNA of biomarkers, researchers can nowadays benefit of high throughput technologies (i.e microarray, deep sequencing, 2-DIE) that allow very large scale investigations. Data deriving from these technologies offer snapshots of the changes induced by the presence of environmental variations. Management, analysis and interpretation of the massive data obtained from high throughput technologies can be quite challenging and requires bioinformatics skills still beyond the reach of many laboratories and researchers. Here we present a comprehensive overview of the real cellular response and of changes in gene expression. Indeed they do not consider the relation between mRNA level, protein concentration and metabolite levels which are known to be poorly correlated. Finally it would be very useful to compare the biological effects induced by the same environmental stress on different organisms in a comparative studies. Here we propose a web based system that works as a centralized resource for the collection, analysis and integration of ecotoxicology related high throughput data.

3Aggregated information is accessible by means of simple web based data mining tools and is supported by effective and simple graphic representations to facilitate the understanding of biological response mechanisms.

We have benchmarked our platform with data obtained by high throughput analysis techniques - microarray and 2-DIE - applied on the social amoeba Dictostelium discoideum after treatment with several doses of mercuric.

We show the advantages of using our system which allows the comparison of the results obtained from the two techniques, effective tools for the visual inspection of data and integrates data from external resources such as specialized databases (i.e. genomic databases, metabolic pathways, Gene Ontology).
TU 329
On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
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Environmental mixtures usually consist of several substances and not only of mixtures. Therefore it is of great importance to assess the ecological risk not only substance by substance but also for mixture-related endpoints. Two models are generally used to predict mixture toxicity: the concentration addition (CA) (or dose addition) and the response addition (RA) (or independent action) models. Their adequacy to predict mixture toxicity of similarly acting compounds (CA) and dissimilarly acting compounds (RA) for single species was already shown during the last decades. To assess the risk of chemical mixtures to ecosystems, these two models have also been proposed to be applied on species sensitivity distribution (SSD) curves to derive a multi substances potentially affected fraction of species (msPAF). Usually, this is done in two steps: (i) the CA model is applied on individual SSDs of similarly acting compounds and then (ii) the RA model is applied on the predicted SSDs by CA between groups of similarly acting compounds. However, it was mentioned above that mixture models were already used for single species when applied on single dose-response curves and not on multi substance SSDS. For a validation of this approach, one should therefore apply the mixture models for each species, then construct the mixture SSD to calculate the msPAF and compare it with a msPAF derived by applying the mixture models directly on the SSDS. This approach is however rarely done because the information on the whole dose-response curves of each single species for all substances is needed and this information is poorly available.

In this study, we highlight the difference between the two methodologies (SSD combination with CA/RA models or single species mixture assessment followed by SSD construction) to derive a msPAF. To compare the two methods we calculate msPAF with different cases, varying the EC50s and the slopes of the individual dose-response curves.

The results show that the predictions with CA are quite similar between the two methods and small differences can be explained by the goodness of fit of SSDs and the species tolerance correlation among substances. However, the application of RA may result in differing msPAF between the two methods. Finally, we define cases in which the two methodologies give similar results and for which the use of CA and RA directly on SSDs to predict the risk of mixture compounds is appropriate.

TU 330
Estimating inter-individual sensitivity from survival data using a mechanistic model
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In the literature, there are two main alternatives to model mechanistically dose-survival relationship in ecotoxicology. Effects are related to a concentration of concern, for instance body concentration, and either individuals have different concentration threshold for death, or individuals have equal probability to show an effect, with dying organisms just being the "unlucky" ones. A general framework to unify both approaches has recently been proposed but only special cases could be confronted to actual data. We used such a unified model to analyse four datasets. We showed the possibility to estimate properly the toxicity parameters together with inter-organism differences of sensitivity and the probability of death to any dose (or the threshold for effect). For all datasets, the model we propose outperformed the standard approach without accounting for differences of sensitivity. More accurate parameters' estimations would be obtained through the incorporation of prior knowledge, in particular relative to background mortality. We also pointed that the standard threshold estimate is close to the medium value of the distribution (which would induce the death of half of the organisms), and that more relevant parameters, such as the concentration protecting 85% of the population would be 2 to 4 times inferior to this standard threshold. We believe that our approach can be of great help to ecotoxicologists when doing experiments and to applying models. Moreover it permits to relate two fundamental concepts in understanding the response in ecotoxicity tests: the link between internal concentration and effects and the inter-individual variability regarding sensitivity.

TU 331
Incorporating data quality scores and acute-to-chronic ratios in the construction of SSDs
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The species sensitivity distribution (SSD) approach is in principle an alternative to the assessment factor approach for PNEC calculation, However, due to requirements on data quality scores and acute to chronic extrapolation to the entire data sets of complex heterogeneous ecotoxicological information (data of different data quality, acute and chronic values, EC50, EC10, and NOEC values). More precisely, we aimed to provide a method which provides reliable and robust PNEC assessment, which is applicable to wider area of compounds.

For this purpose, we replaced the dichotomic classification of data as either valid or not valid by a system of quality scores which integrate on the inherent experimental and statistical reliability of data and on their biological relevance (organism and endpoint). This system serves as weighting factors of individual data in the SSD analysis. Furthermore, we studied different options of how to incorporate acute values. Different options (of probabilistic Acute-to-Chronic ratios and weighting) for data treatment were integrated in a tool, which allows a generation of SSD functions and estimate uncertainties.

As a result, we calculated the standard SSD function (based on chronic NOECs only) for several real ecotoxicological data sets on compounds fulfilling the strict TGD/REACH requirements for SSD application. Subsequently, we applied the developed method using weighting scores and acute to chronic extrapolation to the entire data set and bootstrap subsamples. SSD function obtained for subsamples of the entire data set using different options for data treatment were compared to the SSD based on chronic NOECs. Influences of different options for data treatment and sample size will be discussed with respect to the robustness and reliability of the SSD function and the associated HC value.

TU 332
Investigating the replacement of NOEC and LOEC values with regression-based ECx values
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Data from chronic toxicity tests have traditionally been analysed by hypothesis test based statistical analysis to obtain a No Observed Effect Concentration (NOEC) and a Lowest Observed Effect Concentration (LOEC). Although a firmly entrenched paradigm, much recent debate has questioned whether these methods are the most appropriate way to analyse data from eco-toxicology studies. As part of this debate the use of ECx values and associated confidence intervals, determined by regression analysis and other modelling techniques, have been investigated by the OECD and others as possible replacement or complementary endpoints and are now included as a requirement in some test guidelines.

For the purpose of a number of data sets, the work described has shown that it is possible to apply a number of different static regression models to results arising from ecotoxicity tests, and to derive ECx values. The work indicates that, although not consistent for all datasets examined, it is possible to derive ECx values broadly similar to the respective NOEC and LOEC values.

However, a number of issues remain which will be of importance when considering the possible replacement of NOEC and LOEC values with ECx values, including experimental design. It is thought that current test designs may not necessarily be suitable for data analysis using regression based methods, and that modifications to current protocols may be required to ensure that regression analysis of test data yields reliable and significant results.

The work described has applied regression analysis to a number of simulated data sets which were developed according to differing test methods. This has shown that the experimental ecotoxicity study can have significant implications for the results obtained by statistical analysis using regression techniques. In particular, both the estimated ECx values and the associated confidence intervals have been shown to be impacted by experimental design. This could have implications for both the ethical and practical aspects of ecotoxicological testing, when seeking an optimum test design.

TU 333
Statistical approach to select bioindicators for soil monitoring, risk assessment and soil characterization. Results from the French national programme 'Bioindicators'
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The validation of statistical approach (Breiman, 2001), is used to classify, predict and select the best set of explanatory variables in large fields of research. Yet, only few applications were made in environmental research, especially in soil ecotoxicology.

The analytical strategy of the French "Bioindicators Programme" (2006-2012) is to (i) measure a large number of bioindicators in contrasted pedo-geo-climatic contexts covering the French territory and to compare two similar sampling protocols, (ii) compare high numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a database mining of collected data during two years, with the help of a biostatistician team. The main objective is to develop a generalised method for selecting relevant bioindicators with regard to the targets (characterisation, monitoring, risks) (IDOTS), that may assess risks of soil contamination to ecosystems. Most bioindicators are similar variables are screened, including microorganisms (e.g. biomasses of fungi and bacterial communities, bacterial diversity, enzymatic activities), mesofauna (e.g. nematodes and collemboles), macrofauna (e.g. earthworm at community levels and metal accumulation in snails). Such bioindicator variables were measured in soil surface horizons, at 13 sites, selecting 47 different contexts in terms of land use and origin of contamination (PAH, ETM, pesticides).

As a first step of statistical analyses, our results showed the importance of correlations between biological variables in intra and inter-groups. Then discriminated analyses using Random Forest revealed sets of relevant indicators for land use (crops, pastures, woods and forests), levels of metal contamination (high, medium and low) as well as ...
We illustrated two structural problems linked to the model itself or to the likelihood function. (1) We cannot simplify the model by fixing the natural mortality to 0 even for a set of 7 biomarkers in the bivalve Dreissena polymorpha, resulting in a matrix of 720 IBR values. It evidenced the variability of the IBR, that is not our main concern. Moreover, we are currently developing a new and open source tool enabling the comparison of several distributions and also the use of both pointwise and interval-censored data (or a mix of both).

A probabilistic model for species sensitivity distributions taking into account inherent uncertainty and variability of effects to estimate environmental risk P. Gottschalk, E. Kost, B. Nowack Empa, St. Gallen, Switzerland

TU 336

An interfaced R-package to fit SSDs E. Bilisiot, D.R. Fox, C. Charles, M.L. Delignette-Muller1 1Plateforme de Recherche de ROVALTAIN, Valence, France

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Species Sensitivity Distributions (SSDs) rely on the assumption that aquatic species of a community or assemblage differ in their sensitivity to a hazardous chemical. Toxicity values are used as indicators of the sensitivity and are assumed to follow a theoretical distribution accounting for the inter-species variability. A Hazardous Concentration (HC) is then derived using a low-order percent of the SSD fitted to a limited (and often small) set of toxicity values, the latter being assumed to be a representative sample of species sensitivity among the community to be protected.

The SSD approach is an element of most regulatory guidance documents for environmental risk assessment (e.g. ANZECC, ECHA, USEPA). Yet, the approach to be used is still debated, including: (1) whether parametric or non-parametric methods should be preferred - the applicability of the latter being limited by the small size of toxicity data sets available and (2) in the parametric cases (3a) the choice of the distribution shape - this is often decided on the basis of mathematical properties, especially on the existence of analytical results, and (2b) the choice of the method for estimating HCs and their confidence interval.

Several softwares have been provided through environmental protection agencies for estimating HCs and their companion uncertainty, such as Burrflso in Australia and New Zealand, ERTRAC in The Netherlands or Web-ICE in the U.S. Those softwares have been developed as turn on key tools for the application of regulatory recommendations and rely on different choices regarding the three points aforementioned. Besides, it appears that none of these programs allows censored data to be accounted for. For users interested in examining the impact of the methodological choices made in existing softwares (and in the corresponding regional guidance documents), we offer, therefore, a new and open source tool enabling the comparison of several distributions and also the use of both pointwise and interval-censored data (or a mix of both).

The IBR revisited: optimization to avoid misuse S. Devin1, C. Cossu-Leguille2, A. Geffard1, L. Giamberini1, L. Minguez1, E. Rodius1, T. Burgeot2, S. Pain-Devin1 1LIBE - CNRS UMR 7146, Metz, France

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Multibiomarker approaches are widely used for in situ assessment of ecotoxicological effects of contaminants and to understand the relationships (1) between biomarkers and (2) between biomarkers and contamination. Several tools have been proposed to integrate these responses in a single and simple measure. Among them, the Integrated Biomarker Response (IBR) is a promising method that provides both a graphical synthesis of the different biomarker responses and a numeric value that works only when 4 biomarkers are used. The attractiveness for simplicity led to frequent misuse of the IBR (40% of the 38 publications using it). Moreover, the final end-users of the calculation process highly depends on the sequential organisation of the biomarkers. We aim to propose a new procedure to resolve these main problems in the IBR application.

We first go back to trigonomy basics to propose a new formula for the IBR, that is far more simple than the original one. Then we wrote a procedure that creates all the possible circular permutations of k biomarkers. It results on a (k-1)! matrix of IBR values that allows to calculate the mean IBR for a site and to prioritize IBR values among sites in a more confident way. A case study using this method is presented, based on the results of a survey of 8 sites presenting contrasted levels of sediment contamination. The permutation is performed for each study site, providing a specific IBR value to each biomarker. The IBR value is then calculated by summing these values. It evidences the variability of the IBR, that is not our main concern. Indeed, the consequence is a different prioritization of contaminants effects depending on the biomarker sequence, that could lead to misunderstanding of contamination consequences on biota. Considering the need of multibiomarker approaches to understand the complexity and the variability of biological responses, our study provides an efficient and robust tool to integrate these data and avoid subjectivity in the final outcome of the method.

TU 339

Statistics Service - a new tool for efficient data analysis A. Wedemeyer1, T. Bier2, N.A. Hernandez Vargas3, B. Erzgraeber3 1BASF, Limburgerhof, Germany

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3Heidelberg University, Heidelberg, Germany

In this talk we present a newly built statistics tool which allows a highly convenient and efficient data analysis. The tool combines Excel (a Microsoft Office product) and R (a cost-free available statistics programming language) via a specific server. This Excel-R connection significantly broadens the spectrum of available statistical methods in Excel. Moreover, the user (e.g. lab technician) can easily conduct complex statistical analyses:

The user selects the desired statistical method in Excel after highlighting the input data for the computational analysis. The data is then transferred to the server, the computation starts and the results are automatically transferred back to Excel. Besides the results (e.g. graphical plots) the user can also receive an interpretation help (text file) of the result output.

In addition to a short introduction of the Statistics Service technical background, we will demonstrate its functionality using examples from the environmental fate modeling for plant protection products, e.g. the analysis of environmental fate data and selection of relevant input parameters to exposure models, in order to provide a general overview of how this tool works.
Long term effects of an early exposure to PAHs on zebrafish behavioural responses

C. Vignet, K. Le Melech, S. F. Lévy, L. Lépy, D. Leguay, H. Budzinski, M. L. Bégout, X. Cousin

The data from the present studies support the earlier risk assessment conclusions. The data also provide further support for a narcosis-related aqueous toxicity evaluation because observed differences in the tolerance between a contaminated and an uncontaminated site are rarely connected to the ecological risk that burdens the population.

EXPERIMENTAL DESIGN

1. M. Mckee

The acute toxicity of triclosan (TCS) toward aquatic organisms has been well studied but information on long-term, low level exposures at environmentally relevant concentrations is lacking. The objective of the present study was to evaluate the toxicity of triclosan in a multi-generational test with Daphnia magna in laboratory exposures. 24-hr old D. magna neonates were exposed to TCS (0.5 to 150 µg/L) in six successive 21-d life cycle tests. Brood randomly collected from 5 replicate beakers per treatment on day 21 were used to seed the next generation. Survival across the 6 generations exceeded 80% in all treatments across all generations. A slight increase in mortality was observed in the 150 µg/L treatment in the first generation but not thereafter. Total offspring produced over 21 d and fecundity (average offspring/adult) decreased significantly at concentrations >50 µg/L (NOEC = 10 µg/L) in the first 3 generations but this difference disappeared in the last 3 generations indicating increased tolerance to TCS. Reproductive data from these studies were used to estimate the intrinsic population growth rate of the population-level effect that corresponded to a 1/4 reduction of the intrinsic population growth rate. The indicated level of the population-level effect may have considerably reduced the probability of persistence of the population.

TU 344

Triclosan toxicity: a multi-generational and demographic assessment using Daphnia magna

K. Sibboly, M. Mckee, J. Lucass

A previously published risk assessment for C1 to C4 phthalate esters concluded no risks to aquatic organisms due to aqueous solubility constraints, low expected surface water concentrations, and metabolic biotransformation capabilities of aquatic organisms. Important chronic aquatic toxicity studies that have included transgenerational exposure have been conducted since those assessments and are presented here. The data from the present studies support the earlier risk assessment conclusions. The data also provide further support for a narcosis-related aqueous solubility cut-off at approximately C6 and higher phthalate esters. Finally, for the C1 to C4 phthalate esters, the present study shows that secondary endpoints (e.g., molecular, biochemical, and/or histopathology) to date, provide limited benefit in practical ecological risk assessment of phthalate esters to aquatic species.

TU 345

Assessing the chronic aquatic toxicity of phthalate ester plasticizers

A. Staples, R. Gunn, K. Kramarz, M. Lampert, N. Scholar

Phthalate esters are a class of chemicals varying greatly in terms of uses, properties and toxicity. C1 to C4 phthalate esters are used in non-vinyl commercial products and pharmaceuticals. C8 to C10 phthalate esters are of primary concern to primary endpoints of survival, growth and development, or reproductive fitness. A previously published risk assessment for C1 to C4 phthalate esters demonstrated low risks in North American and Western European surface waters. Risk assessments conducted by authorities in Europe with DEHP, DINP, and DIDP have concluded no risks to aquatic organisms due to aqueous solubility constraints, low expected surface water concentrations, and metabolic biotransformation capabilities of aquatic organisms.
Evolutionary consequences of the loss of genetic diversity in C. riparius populations - Introducing the MIDGE project

P. A. Venâncio1,2, C. Nowak1, A. C. Reinecke1, L. Pestana1, M. A. C. De Schamphelaere1,2, S. Navis3, A. Waterkeyn4, T. Voet3, L. Brendonck4

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4Department of Environmental Sciences, Northwestern University, Potchefstroom, South Africa

Evolutionary studies need to consider not only short term effects of pollution, such as changes in life history traits of organisms, but also its long term effects, such as genetic erosion. This genetic erosion can lead to the loss of evolutionary potential and thus it is also of crucial importance to assess the evolutionary consequences of changes in genetic variability.

In the MIDGE project aims to study the Microevolutionary Dynamics and Genetic Erosion in pollution-affected Chironomus populations. More specifically we are investigating the genetic variability of C. riparius populations from unpolluted and contaminated sites using mitochondrial sequence variation and nuclear microsatellite analyses and we intend to address three main questions:

- Does chronic pollution affect genetic variability of C. riparius populations in the field?
- Are C. riparius populations in contaminated areas adapted to pollution exposure?
- What are the consequences of this altered genetic variability due to pollution in terms of fitness costs?

Measure of genetic erosion have recently been proposed as the ultimate biomarker of effect and by focusing on effects of contaminants on genetic variability in natural populations we aim to aid in developing new bio-monitoring approaches and provide advanced scientific basis for integrative ecological risk assessment methodologies which are essential for effective environmental conservation strategies. The SETAC meeting is an excellent opportunity to share ideas, approaches, methodologies and preliminary results with other researchers working in the field of evolutionary toxicology.

Metal tolerance in the earthworm Eisenia fetida: Is it a case of adaptation or mere physiological acclimation?

O. J. Oworo1, P. Voua-Otomo1, S. A. Remecke2, A. J. Remecke2

1ICTO Ökoktoxologie GmbH, Florschheim, Germany
2Department of Environmental Sciences, Northwestern University, Porchettouf, South Africa

Aim: In this study we investigated whether the earthworm species Eisenia fetida inhabiting an extremely high metal polluted compost heap on a wine farm, did not have elevated body loads of the metals but exhibited genotoxic tolerance when exposed to Cd in the laboratory (Voua Otomo and Remecke, 2010). To unravel the mechanism behind the surprisingly low body metal burdens on one hand and genotoxic tolerance on the other hand of the metals but exhibited genotoxic tolerance when exposed to Cd in the laboratory (Voua Otomo and Remecke, 2010). To unravel the mechanism behind the surprisingly low body metal burdens on one hand and genotoxic tolerance on the other hand, we investigated the estimated bioavailability of these metals (Cu, Zn, Pb and Cd) using sequential extraction methods with CaCl2 and diethylene-triamine-pentaacetic acid (DTPA) and alkaline pyromorphite in this field population, a laboratory control as well as a long-term Cd exposed population. The amounts of mobile (extracted with CaCl2) and mobilisable (extracted with DTPA) metals in relation to the total (extracted with nitric acid) metals were all below 0.05% for all four metals, suggesting low availability for uptake. The low availability of these metals could not be explained by physico-chemical properties of soil but by the phenomenon of aging of the metals. There was no difference in alkaline mobility between metal tolerant and non-metal tolerant populations of E. fetida. This suggested that the tolerance found in earlier studies could be a mere physiological adaptation.

Potential role of biotransformation and antioxidant enzymes during maternal transfer of microcystin resistance in Daphnia

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Due to eutrophication and other factors, the frequency of cyanobacterial blooms in freshwater has increased worldwide. They are an important problem to the ecosystem, particularly affecting zooplankton populations which feed on phytoplankton. Among other toxins, some cyanobacteria produce microcystin (MC), MCLR, the most studied variant. MCs inhibit serine/threonine protein phosphatases type 1 and 2A and provoke oxidative stress. The planktonic genus Daphnia plays a central position in pelagic food
Is there a functional role of DNA methylation in the stress response?  

LT. Trent1, M.V. Vandegeachute1, J. Asselman1,2, J.C. Colin1, T.D. de Meyer1, K.A.C. De Schamphelaere1,2,3,4, S. Wiater5, W. Gheysen1,6, G. Van Immerseel7,8,9

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2 INIA, Madrid, Spain  
3 Bioinformatics analysis (i.e. mapping with the most recent D. magna genome assembly) was performed in order to generate the methylome map. Ongoing bioinformatics analyses is now focused on determining structural, functional or evolutionary relationships among the methylated sequences and to determine if methylated sequences occur in genomic or pathways that may be relevant for dealing with chemical and ecological stress.

TU 353  
Effects of benzo[a]pyrene and vinclozolin on freshwater snails: I) epigenetic and genetic responses of adults and II) offspring embryo toxicity  

N. Aparicio, M.T. Cervera, M.A. Guevara, L. Díaz, L. San Segundo, P. Sanchez-Arguello

INIA, Madrid, Spain  
Vinclozolin causes transgenerational effects upon inducing DNA methylation changes in exposed rats. Benzo[a]pyrene is a clastogen used as a reference chemical for the in vitro mammalian cell micronucleus test. Taking into account that epigenetic and genetic profiles could be altered by these pollutants we studied molecular and cellular responses after adult exposure to freshwater snails (Physa acuta). Additionally, the embryo toxicity in the following generation (F1) after parental exposure was evaluated. Mature snails exposed for 46 days and deposited egg masses were used for determining parental endpoints (F0) and transgenerational effects, respectively. DNA extracted from mature snails were analysed to evaluate differences in DNA methylation patterns In order to analyze methylation-sensitive sites we used PCR technique with arbitrary primers (AP-PCR) using HpaII and MspI digested samples. HpaII and MspI are isoschizomers that recognize the tetranucleotide sequence 5'-CCGG-3' but that show differential cleavage of methylated DNA. HpaII cannot cleave it one or both cytosines are fully methylated in both strands, whereas MspI cleaves CCGG but not 5mCCGG sequences. Gel electrophoresis of PCR products and comparative analysis between HpaII and MspI patterns allowed the study of CCGG regions in the genome that are sensitive to methylation and the effect of these on pollutants on these sites. Genotoxicity was measured by the micronucleus test in cells isolated from whole adults after homogenization of soft tissues. The development of offspring was measured when egg masses were recovered and the teratogenic effects of both non-exposed and exposed single egg capsules were measured in multiwell plates. Parental responses at cellular and molecular levels were compared with F1 responses using an ecological relevant endpoint (embryo toxicity). The aim of this work was to establish potential linkages between mechanisms of action and long-term responses at higher levels of biological organisation, which could ultimately have consequences on population dynamics. This study was supported by the Spanish research project CTM2008-03492.

TU 354  
Late-life effects of early-life mitochondrial DNA damage  

J.N. Meyer  

Duke University, Durham, United States of America  

I suggest that mitochondrial DNA is a potentially important and understudied target of environmental toxicants, and one that when impacted is likely to have long-term effects. Mitochondrial DNA (mtDNA) is more sensitive than nuclear DNA to many common genotoxins, and lacks some repair pathways that are present in the nucleus. In particular, helicase-distorting adducts formed after exposure to environmentally important genotoxins such as ultraviolet C (UVC) radiation and some polycyclic aromatic hydrocarbons and mycotoxins are repaired in the nuclear genome by nucleotide excision repair. However, nucleotide excision repair proteins are not present in the mitochondria, so that the fate of such DNA damage in the mitochondrial genome is unknown. The effects of such persistent damage are also unknown; we hypothesized that the effects of such damage would be particularly important after early life stage exposure since mtDNA copy number is lowest at that time. Using the nematode model (C. elegans), we found that exposure to benzo[a]pyrene and vinclozolin, PAHs, and metals) of sediment and organisms to gain information about potential cause-effect relationships. The integrated analysis of the data showed that the nature of effects of benzo[a]pyrene and vinclozolin on freshwater snails: I) epigenetic and genetic responses of adults and II) offspring embryo toxicity are varied across the contaminants. These results prove transgenerational or maternal effects provoked by a natural toxin in a very important freshwater herbivore which may explain the observed acquisition of enhanced tolerance over generations through a biochemical perspective.

TU 355  
Is trans-generational PCB transfer a key process for parental detoxification and adaptation in amphipods?  

K. R. Ruelle1, J. Smith-Sheila1,2, S. Shinn1, M. Loef2, J. Asselman1,2,3,4, S. Wiater5, W. Gheysen1,6, G. Van Immerseel7,8,9

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2 Stockholm University, Stockholm, Sweden  
3 To explore the effects of reproductive disorders and pesticides have been studied in several marine organisms like fish and amphipods to address the question of the impact of contaminant exposure on wild populations. This focus is on the characterisation of the progress of toxic effects from subcellular damage at the individual level of the parental generation to deterioration of the offspring in the amphipod species Monoporeia affinis. Monoporeia affinis have been sampled at differentially polluted and reference areas in the Baltic Sea. Reproductive success, spermatid and ovocytogenesis, sex ratio and larval survival were evaluated in exposed and non-exposed populations. The seven day exposure of the parental generation to MC-LR induces higher activity of glutathione S transferase and malate dehydrogenase in the offspring and enables it to cope with the exposure to the toxin. Seven day exposure of the parental generation to MC-LR induces higher activity of glutathione S transferase and malate dehydrogenase in the offspring and enables it to cope with the exposure to the toxin. In offspring from the 1 day exposed parental generation those effects were less pronounced or not visible. Offspring from 1 day exposed mothers showed a significant decrease in daily growth and higher daily survival. Higher survival of the offspring is correlated with the elevated activity of glutathione S transferase, malate dehydrogenase and catalase, suggesting maternal transfer of activation factors. These parent transgenerational or maternal effects provoked by a natural toxin in a very important freshwater herbivore which may explain the observed acquisition of enhanced tolerance over generations through a biochemical perspective.
The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total 111 distinct genetic profiles, being Peniche the location with lower variability while Figueira da Foz had the highest variability. Selected isolates were used to bioremediate waters contaminated with TBT.

We have isolated 157 TBT-resistant isolates from Portuguese ports and harbours. Bacteria resistant to 3mM TBT were characterised by rep-PCR. Relationships between the isolates were assessed by DGGE.

TU 359
Evaluating effects of pollution on Caenorhabditis elegans population dynamic through a bio-energetic approach
B. Goussen1, A. Péry1, R. Beaudout1, M. Dutilleul1, C. Lecomte1, J.M. Bonzom1
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TU 360
Bacterial diversity on Portuguese ports: TBT degrading bacteria
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TU 361
Biotechnological potential of impacted scenarios for the restoration of TBT contaminated environments
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TU 362
Biological effects of pollution on Caenorhabditis elegans
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TU 363
Are TBT sources migrating from harbors to marinas in Latin America?
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TU 364
Characterization of water and sediment contamination in historic mine sites
R. Monteiro1, L. Fonseca2, A. Correia3, C. Ana4, F.L. Lemos4
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TU 365
Bioremediation of contaminated waters from TBT polluted environments
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TU 366
Assessment of toxic effects at biologically and ecologically relevant scales is an important issue in ecosystem protection. Mathematical models exist to predict effects of pollution on population dynamics from individual data. Nevertheless there are only a few datasets and models that account for adaptive phenomena which may appear in a stressed population. The selection pressure exerted by a pollutant is known to amplify the phenomenon of natural selection. It is thus essential to understand and quantify the adaptive dynamics governing populations under stress in order to assess ecological risk.

Regarding this background, we adapted a bioenergetic model to study adaptive phenomena in Caenorhabditis elegans population dynamic exposed to a heavy radiotoxic metal (uranium). The Dynamic Energy Budget (DEB) (Kooijman, 2010) bioenergetic approach highlights the distribution of energy fluxes between processes such as growth, reproduction, maturation and maintenance. It is a relevant basis to understand and model the links between assimilation disruptions, growth and reproduction fluctuations in organisms exposed to anthropogenic stress (e.g. pollutant, global change) and to assess potential consequences on population over many generations.

We therefore studied the responses of C. elegans exposed to six experimental concentration of uranium over several generations. The individual traits followed were growth curve, egg laying curve, survival until end of egg laying. We showed that uranium impacted C. elegans growth curve and egg laying over several generations, with, consequently, adverse effects on the population dynamic and variations on DEB parameters. Nevertheless, results also tend to show an evolutionary response throughout the generations.

TU 367
ETP1 - Marine environmental chemistry and ecotoxicology

TU 368
Bioenergetic potential of impacted scenarios for the restoration of TBT contaminated environments

TU 369
Characterization of water and sediment contamination in historic mine sites

TU 370
Bioremediation of contaminated waters from TBT polluted environments

TU 371
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TU 372
Bacterial diversity on Portuguese ports: TBT degrading bacteria

TU 373
Biological effects of pollution on Caenorhabditis elegans

TU 374
Characterization of water and sediment contamination in historic mine sites

TU 375
Assessment of toxic effects at biologically and ecologically relevant scales is an important issue in ecosystem protection. Mathematical models exist to predict effects of pollution on population dynamics from individual data. Nevertheless there are only a few datasets and models that account for adaptive phenomena which may appear in a stressed population. The selection pressure exerted by a pollutant is known to amplify the phenomenon of natural selection. It is thus essential to understand and quantify the adaptive dynamics governing populations under stress in order to assess ecological risk.

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TU 376
Biotic community analysis of impacted and reference sites: TBT resistant bacteria

TU 377
Tributyltin (TBT) is a very toxic compound that was used as antifouling paints biocide during four decades. Due its environmental toxicity the International Maritime Organization banned TBT based antifouling paints in September 2008. Thereafter, TBT environmental concentrations as well as imposex levels (the most widely used TBT biomarker) declined in several coastal areas worldwide. However, in Latin America some recent observations have shown high TBT levels and imposex levels in areas close to harbors, despite the general reducing pattern in many areas. The present study reported imposex parameters (imposex %, VDI and RPL) in gastropods from Venezuela and Brazil in harbor areas and marinas. In Venezuela, samples with 30 adults of Purpura patula were collected in 23 sites (2 located inside marinas). In Brazil, the sampling
collection has been performed for some years at Angra dos Reis (10 out of 33 stations were close to marinas) and Arraial do Cabo (2 out of 10 stations were close to marinas) in Rio de Janeiro state. These studies used 30 adults of Stramonita haemastoma per site (whenever found). The results for Venezuela showed that the VDSI ranged from 0.22 to 0.50% in 2010 and from 0.25 to 0.50% in 2011, respectively. The chemical analysis results showed that TBT and TPT were the main OTs in tissues of both the west coast and the east coast of Sweden. The use of tin-organic substances were prohibited in 1989 for all boats less than 25 m and in the marinas. The main sources of organotins pollution are the marinas and sediments, which can account for the occurrence of imposex. Furthermore, the genomic DNA that was amplified with 8 pairs of fluorescence-labeled primer showed a variety of exposure approaches, a better understanding of the mechanisms of organism stress responses to metals in ecological systems was gained and the predictive capability of ecological risk assessment improved.

T163 Imposex occupancy and the genetic changes in Veined Rapa Whelk (Rapana venosa) from Bohai Bay, China

M. Taylor, W.A. Maher
University of Canberra, Act, Australia

Establishing relationships between metal exposure, internal dose and associated biological effects for organisms is necessary to understand the fate and effects of metals in the environment. The accumulation and sequestration of biologically available metals by aquatic organisms, particularly bivalve molluscs, has led to the use as biomonitoring of metal contamination in the ecosystem. Biomonitoring has enabled the measurement of metal bioavailability. This study aimed to establish the relationships between metal exposure, internal dose, and biological responses of Veined Rapa Whelk (Rapana venosa) from Bohai Bay, China. The samples were collected in September 2008 and April 2009 and were selected from 33 stations in Bohai Bay. The concentration of total metals was measured by FAAS, and the total metal accumulation was measured by atomic absorption spectrophotometry. The total metal accumulation was then compared with the metal concentration in the sediment to determine the metal bioavailability. The results showed that the metal accumulation was significantly higher in the stations with higher metal concentration in the sediment. This suggests that the metal bioavailability is affected by the concentration in the sediment. The results of this study provide valuable information for the management of metal pollution in Bohai Bay, China.
immune system activities. Indeed, all of the immune system biomarkers studied, except the number of circulating haemocytes which decreased in both experiments, were increased by zinc treatment. A relevant strategy is to use early stages of development. Even if the exposure time is limited compared to the life-span of the organism, if exposure starts at the very beginning, it covers the whole lifetime up to the end of the experiment, which is relevant in terms of chronicity. In addition, early stages of development are often more sensitive to pollution than adults, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but it becomes toxic at high concentration. In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (*Crassostrea gigas*) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl₂ up to 2 mg L⁻¹, as 1 day post-metaplanul and for 10 weeks. They were fed with micro algae at the same cells concentrations. Zinc was measured in seawater and in oysters throughout the experiment. Survival and growth were monitored on large sample populations to deal with individual variability. A dose-response curve analysis allowed deriving the EC₅₀ for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxification machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was affected as early as a few days of exposure to relatively low dose and turned out to be an earlier and more sensitive marker of the effect of zinc on oyster spat.

TU 371

Assessment of sacrificial anode impact by zinc accumulation in oyster Crassostrea gigas: comparison between a long- and short-term laboratory tests


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In marine environments, sacrificial anodes made of zinc are currently used to mitigate marine corrosion as part of cathodic protection systems of immerged metallic structures. Zinc is an essential metal for living organisms but can alter their physiological processes at toxic levels when present in excess. The aim of this study was to assess the bioaccumulation and the effects of zinc released using an electrochemical device providing controlled zinc concentrations from sacrificial anode degradation to mimic the in situ conditions. The work was carried out on oysters Crassostrea gigas by comparing two in vivo tests. The first test was conducted over a period of 10 weeks at a concentration of 0.33 mg Zn L⁻¹ as ZnCl₂, an exposure time of 2 months and, a second one for 168 hours at a concentration of 2 mg L⁻¹ as ZnCl₂, an exposure time of 2 weeks. During exposures, zinc concentrations were measured in oyster gills, digestive gland and soft tissues and, endpoints such as mortality, immune parameters and mRNA expression of genes associated with oxidative stress and cell death were analysed. The results obtained from the laboratory experiment showed significant differences in mortality rates (81.4% mortality rate was recorded, and the bioconcentration factor (BCF) exhibited values up to 405 in the digestive gland. In contrast, the results obtained though chronic exposure showed a higher BCF (13,397), whereas no mortality was detected. Moreover, zinc was able to modulate immune system activities. Indeed, all of the immune system biomarkers studied, except the number of circulating haemocytes which decreased in both experiments, were increased by zinc treatment. A relevant strategy is to use early stages of development. Even if the exposure time is limited compared to the life-span of the organism, if exposure starts at the very beginning, it covers the whole lifetime up to the end of the experiment, which is relevant in terms of chronicity. In addition, early stages of development are often more sensitive to pollution than adults, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but it becomes toxic at high concentration. In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (*Crassostrea gigas*) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl₂ up to 2 mg L⁻¹, as 1 day post-metaplanul and for 10 weeks. They were fed with micro algae at the same cells concentrations. Zinc was measured in seawater and in oysters throughout the experiment. Survival and growth were monitored on large sample populations to deal with individual variability. A dose-response curve analysis allowed deriving the EC₅₀ for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxification machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was affected as early as a few days of exposure to relatively low dose and turned out to be an earlier and more sensitive marker of the effect of zinc on oyster spat.

TU 372

Effect of herbicides on embryo-larval development and metamorphosis in the Pacific oyster, Crassostrea gigas

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The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors including physiological stress and embryotoxicity related to xenobiotic stress. In this context, terrestrially inputs including pesticides could be involved in oyster mortality events, not as a single causative agent but as additional stressors. The study was carried out in the frame of the European Project Chronexpo. The aim of this project was to evaluate the impact of different contaminants (including pesticides) used in the surrounding region of the English Channel on the early stages of Crassostrea gigas. Experiments were conducted on oocytes, fertilized eggs, and larval stages after 48hpf (post-hatch). Fertilized oysters and larvae were exposed to 2 concentrations of 0.1 mg L⁻¹ and 1 mg L⁻¹ of each herbicide (Mecoprop, Mecoprop-P, 2-methyl-4-chloro phenol; 2M4C) for 48hpf. Mecoprop, Mecoprop-P and their main metabolite (2-methyl-4-chloro phenol; 2M4C) were also tested. The effects of these substances and copper sulphate (used as a positive control) were studied in D-hinged larvae in order to assess their potential embryotoxicity by comparing to a normal larval growth (control) of the kind of abnormalities (multi-varied analyses). The effects were also researched in pediveliger larvae ready to metamorphosis (calculations of metamorphosis rates). For metamorphosis test, we optimized Coon & Bonar’s protocol because of the difficulty to count moving larvae. For each endpoint (embryo-larval development and metamorphosis rates), results of 4 experiments allowed us to determine the EC₅₀ values. As regards embryotoxicity, 2 kinds of Roundup exposed about 10-fold more toxic than glyphosate and AMPA and the toxicity of 2M4C reached 3-5-fold of those active substances. In the metamorphosis assay, a similar result was recorded and, glyphosate, AMPA and mecoprop appeared little toxic (EC50 >100 µg L⁻¹). Finally, the comparison between the 2 larval stages generally showed a greater sensitivity of D larvae (embryotoxicity) compared to pediveliger larvae. For most of the molecules, results showed that embryotoxicity assay is more sensitive than the classic standardized acute toxicity Daphnia magna test. This work is the first part of a study which will be continued by long time exposures and will allow us to provide guidance on pesticide regulation in the frame of the European Directive “Marine Strategy” (2008/56/CE).

TU 373

Ecotoxicity of nitrarnineS, important transformation products of amines used in carbon capture

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Due to the imminent use of amines in the CO₂ capturing process from gas power stations in Norway, it is anticipated that the inputs of amine transformations products into the environment will increase. The two major types of transformation products that have the potential to cause environmental harm have been identified as nitramines and nitroamines, both of which are considered to be carcinogenic. For this reason, two metabolites were used for this study (CAS: 74386-82-6) and dimethylnitramine (CAS: 4164-28-7) to be present. However, despite the likelihood of these compounds increasing in the environment, information on their toxicological properties is currently lacking. For this reason, the ecotoxicity of nitramines and nitroamines was tested using a suite of standardised bioassays for the measure of acute and chronic toxicity, which found the EC/LC₅₀ concentration of the selected nitramine concentrations to be in the low to mid µg l⁻¹ range for all aquatic toxicity tests. In addition, the sub-lethal effects of these compounds was also investigated, using in a 3 tiered approach to assess the potential endocrine disrupting effects of these compounds. Overall, data to develop the environmental risk assessment for these future environmental pollutants will be presented.

TU 374

Effects of arsenic on physiological parameters of mussels (Mytilus edulis) from the Scheldt Estuary (Belgium)

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Marine species are exposed to these low doses during their entire life. Because biological mechanisms to respond to acute and chronic exposure may be different, the concentration sensitivity is also different. It is thus a challenge that stakeholders in charge with the environment protection regulation can lean on robust scientific basis when addressing the consequences of chronic exposure of species to low doses of pollutants. For long life-span species, investigating chronic exposure means long term experiments with larvae. A relevant strategy is to use early stages of development. Even if the exposure time is limited compared to the life-span of the organism, if exposure starts at the very beginning, it covers the whole lifetime up to the end of the experiment, which is relevant in terms of chronicity. In addition, early stages of development are often more sensitive to pollution than adults, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but it becomes toxic at high concentration. In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (*Crassostrea gigas*) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl₂ up to 2 mg L⁻¹, as 1 day post-metaplanul and for 10 weeks. They were fed with micro algae at the same cells concentrations. Zinc was measured in seawater and in oysters throughout the experiment. Survival and growth were monitored on large sample populations to deal with individual variability. A dose-response curve analysis allowed deriving the EC₅₀ for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxification machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was affected as early as a few days of exposure to relatively low dose and turned out to be an earlier and more sensitive marker of the effect of zinc on oyster spat.

TU 375

Setac 6th World Congress/SETAC Europe 22nd Annual Meeting
Metal exposure and associated effects in mussels: an integrated approach - hyphenated analytical techniques and biomarkers

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Aim of the study was to assess the metal exposure in coastal areas under indirect or direct influence of maritime activities and national tourism (port and marinas) using integrated metal biomarker approach to indicator species. Mytilus galloprovincialis is a common bivalve across the Mediterranean and near-shore continental areas and is frequently used for monitoring purposes and as a bioindicator species.

Next to the natural sources, a large number of metals are present in the environment as a result of human activities. Since the ban of organo-tin compounds, Cu is the main metal studied in coastal areas. Cu concentrations in bivalves are often used as a potential marker of pollution.

In this study, the levels of 14 metals were determined in bivalves from marinas and ports along the Adriatic and Ionian coasts of Croatia. The analytical approach was based on the integration of metal concentrations with the activity of metal-dependent enzymes, such as metallothioneins and glutathione-S-transferases (GSTs). The activities of these enzymes were used as indicators of metal stress and as a way to assess the potential toxicity of metals to marine organisms.

The results showed that Cu concentrations were significantly elevated in samples collected from marinas and ports compared to control sites. The integration of metal concentrations with enzyme activities indicated that Cu exposure had a significant impact on the biology of M. galloprovincialis, as evidenced by changes in the activities of metallothioneins and GSTs.

The study highlights the importance of combining chemical and biological data to assess the ecological impact of metal pollution in coastal environments. It also underscores the need for further research to understand the mechanisms by which metals affect marine bivalves and to develop effective strategies for mitigating metal pollution in coastal areas.
TU 381
Impact of suspended particles on bioavailability of petrogenic PAH in cod (Gadus morhua), mussels (Mytilus edulis) and passive samplers exposed to produced water M. Pampanni1, C. Bjørklund2, C. Harman3, S. Vingen3, B.F. Godal1, R.C. Sundt1
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Caged organisms and passive samplers are routinely used to monitor environmental impact of operational discharges from offshore oil and gas production. Comparison of caged organisms and passive samplers may be required if time may be restricted. In a previous study, particles to the sea water may influence the bioavailability of these compounds. Temporal variations of microalgae density may therefore affect exposure measurements in caged organisms and passive samplers. In order to investigate the consequences of differences in biological particle density on bioavailability of petrogenic polycyclic aromatic hydrocarbons (PAHs), a laboratory study was conducted in blue mussel (Mytilus edulis) and cod (Gadus morhua) and produced water (PWW) from a petroleum production area in the Norwegian Sea. The PAHs were spiked on mussels and passive samplers (SPMDs) exposed to PW. Organisms and SPMDs were exposed for 17 days to diluted PW in a continuous flow-through system. The dilution was set at 0.1%, from day 6 until day 10 the flow was set to 0.2% to mimic real field conditions with varying PW concentration over time. The exposure set up included: a negative control with sea water only, a positive control with diluted PW only and three tanks containing diluted PW 1:1, 1:2, and 1:4. Alternative exposure to contaminated and clean seawater respectively was performed in order to record the different metal concentration trends in shell and soft tissues. In fact it is demonstrated that once the metal is incorporated in the crystalline carbonate lattice, its loss from the shell during mussel lifetime may be considered of no concern; on the other hand it is known that soft tissues are able to release contaminants in response to changes in environmental conditions.

The aim was to establish a set of experimental conditions able to optimize metal accumulation in mussel hard parts and to calculate the specific MATC (Maximum Acceptable Toxic Concentration) value. So it was possible to test physical, chemical and physiological parameters in order to maximize the shell metal content and set the basis for implementation of biomonitorization strategies exploiting mussel metal activity and detoxification mechanisms.

TU 382
Estimation of environmental conditions to maximize mussels shell capability in trace metal accumulations A. Zorri, S. Manente, G. Ravagnan
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The observation of mussels shell capability of concentrate heavy metals was performed by means of a set of laboratory experiments conducted with mussels collected from unpolluted sites exposed to sublethal concentrations of a known toxic metal. Multiple cycles of accumulation and depuration were carried out all along the experimental period; the constant monitoring of experimental conditions and periodical metal detection in shell and tissue samples allowed the individuation of the accumulation and depuration patterns in both Bivalve materials in the selected species. Alternative exposure to contaminated and clean seawater respectively was performed in order to record the different metal concentration trends in shell and soft tissues. In fact it is demonstrated that once the metal is incorporated in the crystalline carbonate lattice, its loss from the shell during mussel lifetime may be considered of no concern; on the other hand it is known that soft tissues are able to release contaminants in response to changes in environmental conditions.

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stronger responses.

Studying both types of stressors and its interaction with contaminants can be crucial to provide improved interpretation of ecological effects of relevant scenarios for environmental risk assessment.

TU 387

Effects of mercury contamination on acute and chronic parameters of exposed sea snail Gibbula bulimaculis

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In the field of risk assessment of chemicals entering the marine environment, tools are needed as the pressure of several pollutants impacts marine and estuarine ecosystems. Relevant sources may be the chemicals from gas/oil production platforms and sea-side refineries. The discharge of compounds to the marine environment will be receiving additional attention in the EU Marine Strategy and rapid assessment tools are needed. In the field of marine toxicology the effects of contaminants in marine waters cannot be underestimated. The field of marine toxicology is an area of increasing interest as the International Convention for the Control and Management of Ships’ Ballast Water and Sediments will introduce worldwide requirements for treatment systems. Most of the treatment systems use chemicals; and therefore risks need to be identified before market (certification) and after (monitoring and control).

The use of xenobiotics is a very common practice in many studies. Xenobiotics are substances that are not naturally present in the environment and are introduced by humans. They can have a variety of effects on marine organisms, including changes in physiology and behavior.

In this study, we investigate the effects of mercury contamination on acute and chronic parameters of exposed sea snail Gibbula bulimaculis. The experiments were conducted in the laboratory under nearly natural conditions with running ambient seawater and addition of detergent. The results were analyzed using the QwikLite(R) toxicity system, which is a rapid, cost-effective, portable bioassay based on inhibition of bioluminescence from marine dinoflagellates, and can serve as a quick and easy to use test to screen for effects in marine waters. The test is ASTM Standard E1924 “Standard Guide for Conducting Toxicity Tests with Bioluminescent Dinoflagellates”.

The QwikLite(R) test uses bioluminescent dinoflagellates to determine the effects of contaminants in marine waters. The test is based on the principle that bioluminescent dinoflagellates produce light as a result of a chemical reaction. The amount of light produced can be used to determine the concentration of a contaminant present in the sample. This test is rapid, cost-effective, and portable, making it ideal for use in the field or in laboratories.

The results of this study show that mercury contamination can have significant effects on the behavior and physiology of Gibbula bulimaculis. These effects include changes in the animals' swimming behavior and in the expression of enzymes involved in detoxification processes. The study highlights the importance of understanding the effects of contaminants on marine organisms, as these effects can have far-reaching consequences for the health and survival of marine ecosystems.
contaminants. Since they represent a very large biomass, they can act as an important sink for contaminants becoming a gateway for higher trophic levels. Moreover, it is known that macroalgae, especially estuarian, are very important in the aquatic system due to several aspects: easy to find and to identify, vast biomass percentage and great bioindicator, making them potential sentinels of to monitor xenobiotics in aquatic environments. Macroalgae presence or absence, as well as their look-like may reflect the current state of the marine ecosystem, thus it is mandatory to develop new tools and methodologies to quickly and cost-effectively assess their status. The green macroalga Ulva lactuca was used as a model species, when exposed to xenobiotics, can show signs of decay by losing their colour and their texture. But these signs only are assessed by visual inspection. To be sure the algae are in decay and correctly quantify it, a new method was developed by measuring the texture across a colour scale. For this a colorimeter (Chroma Meter CR 400/410- Konica Minolta) was used and color variations calculated when exposed to contaminants. Also its validation by measuring photosystem electron transfer in exposed macroalgae was performed. The methodology revealed to be sensitive and an effective measure of xenobiotic toxicity and a prospective tool for environmental risk assessment.

TU 393

Analytical and environmental distribution of organic micropolutants in urban protected salt marsh areas

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Coastal ecosystems concentrate most of the marine organisms and species compared to open ocean areas. However, they are often heavily affected by human activities that can jeopardize their populations. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple disciplines. Our first objective in this work was to develop a fast, easy and low-cost consumption multispecies method for the simultaneous identification and quantification of a wide variety of classic and emerging pollutants that often impact coastal systems. This method is coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) for determining polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphorous pesticides, triazines, plasticizers and some personal care products (triclosan, UV filters and fragrances). Briefly, 10 mm stir bars coated with polydimethylsiloxane (PDMS) were placed in a flask containing water samples (100 mL) and stirred for 24 hours at room temperature. Then, bars were sonicated during 30 min using a reduced amount of ethyl acetate (0.2 mL) to release the analytes. This extract was analyzed by GC-MS/MS, so sub-ppb levels could be detected. Several parameters were optimized: extraction and desorption time, ion strength, presence of organic modifiers, pH and MS/MS transitions. The second objective was applying this method to characterize the presence and distribution of micropolutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cadiz and Huelva, respectively). 20 water samples were collected at each area during summer 2011. Concentrations were often below 1 µg/L for most analytes; nevertheless some of them such as triclosan (up to 0.3 µg/L) can act as endocrine disruptors and affect marine organism populations after chronic exposure. Overall, results from this study provide an overview on the state of the two sampled marine environments with respect to chemical pollution, being useful for carrying out future toxicological assays with native species.

TU 394

Mixing toxicity of anthropogenic and natural metalloids in marine micro-algae

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Coastal ecosystems concentrate most of the marine organisms and species compared to open ocean areas. However, they are often heavily affected by human activities that can jeopardize their populations. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple disciplines. Our first objective in this work was to develop a fast, easy and low-cost consumption multispecies method for the simultaneous identification and quantification of a wide variety of classic and emerging pollutants that often impact coastal systems. This method is coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) for determining polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphorous pesticides, triazines, plasticizers and some personal care products (triclosan, UV filters and fragrances). Briefly, 10 mm stir bars coated with polydimethylsiloxane (PDMS) were placed in a flask containing water samples (100 mL) and stirred for 24 hours at room temperature. Then, bars were sonicated during 30 min using a reduced amount of ethyl acetate (0.2 mL) to release the analytes. This extract was analyzed by GC-MS/MS, so sub-ppb levels could be detected. Several parameters were optimized: extraction and desorption time, ion strength, presence of organic modifiers, pH and MS/MS transitions. The second objective was applying this method to characterize the presence and distribution of micropolutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cadiz and Huelva, respectively). 20 water samples were collected at each area during summer 2011. Concentrations were often below 1 µg/L for most analytes; nevertheless some of them such as triclosan (up to 0.3 µg/L) can act as endocrine disruptors and affect marine organism populations after chronic exposure. Overall, results from this study provide an overview on the state of the two sampled marine environments with respect to chemical pollution, being useful for carrying out future toxicological assays with native species.

TU 396

Analysis of toxicity in eutrophic coastal environments: from biological model to environmental biomonitoring application

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Nowadays, anthropogenic activities have resulted in accumulations of inorganic and organic pollutants in the environment as well as in the food chain, hence leading to serious ecological and human health problems. This may pose a risk to benthic and epibenthic organisms and it is crucial to discover tools that will identify adverse effects of stressors on benthic organisms as well as to assess toxicity mechanisms to biological effects. Due to their nature as a eukaryotic cell/organism and their position in the food web, ciliates proved to be suitable models for evaluating the biological effects of chemicals in living organisms as well as in estimating pollution levels in aquatic environments. Lethal and sub-lethal effects of exposure to inorganic and organic pollutants were tested on the cell mortality, replication rate, lysosomal membrane permeability, endocytosis rate of the ciliate E. crassus. Increasing concentrations of mercury, copper, and benzo[a]pyrene, individually and as mixtures, were investigated in our study as they might be bioavailable in naturally occurring polluted sites. Exposures to binary mixtures of all studied pollutants were performed showing both inorganic-organic and inorganic-inorganic additive and/or antagonist effects. Moreover, medium salinity was also varied to mimic estuarine-like environmental conditions. Copper was responsible for the toxicity response to toxicant treatments. Results indicated that the toxic potency of the proposed mixture was clearly additive and that the mixture toxicity of these compounds. A species, compound and mixture specific response was observed for Octanol and TBT, while a large more than additive mixture effect was found for Decadecanol and TBT. These results suggest that single compound toxicity data can not be used to predict the mixture toxicity of these compounds. A species, compound and mixture specific response was observed for determining the toxic potency of mixture on coastal waters on the primary producers.

TU 397

Can foraminifera be reliably used as environmental indicators?

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sediment samples around the Robben Island were collected along a pipeline and a fish factory pipeline in St Helena Bay were examined for foraminifera as well as for a suite of environmental factors. X-ray analysis was conducted on “live” foraminiferal tests to determine correlations with trace metals within the sediments. The species diversity, richness and abundance were negatively correlated with trace metals. The percentage nitrogen was negatively correlated with diversity while the percentage carbon was positively correlated with richness and abundance. The percentage nitrogen was negatively correlated with richness. The most important factor was nitrogen, which in both sites was lower than 0.5%. The percentage carbon, percentage nitrogen, and the mean grain size most influenced community structure. The dominant genera in St Helena Bay were negatively correlated with trace metals and percentage nitrogen. The dominant genera from around Robben Island were most strongly correlated with the mean grain size. Both Elphidi um, Elphidium and Quinqueloculina appeared to be most strongly affected by environmental factors than the other genera and may be regarded as good bio-indicators. Amphistegina, although dominant was less correlated with environmental factors and because it is considered an opportunist. No significant correlations could be found between the metal concentrations of the tests and the sediments. It appears that foraminifera can regulate the concentration of toxic metals within their test, evident in the low concentrations of trace metals in tests despite high concentrations in the sediments. Sediment samples also displayed a higher concentration of trace metals but a lower Ca:Mg ratio than those of Robben Island. Trace metal concentrations appear to interfere with the laying down of calcium carbonate within foraminiferal tests. Decomposition normally found in benthic meiofauna, trends found in foraminiferal assemblages could be related to environmental conditions, particularly the trace metal concentrations within the sediments. Despite the trace metal tests not being significantly correlated with the trace metals in the sediments, trace metal tests do appear to have an effect on Ca:Mg ratios within the tests.

TU 398

The effect of a Copper and Zinc mixtures on Dunaliella tertiolecta

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Toxicity experiments were performed under conditions where metal concentrations in the test water were equitoxic. The mixtures comprised Cu and Zn, in a 1:1 ratio, with concentration levels of 10, 25, 50, 100, 250 and 500 µM. Toxicity experiments were performed with one compound, but contamination in the field generally consists of mixtures of toxicants. The aim of this study was therefore to determine the effect of a Cu:Zn mixture on the marine alga Dunaliella tertiolecta. Growth rate (cell count) and photosystem II efficiency (Pulse Amplitude Modulation fluorometry) of D. tertiolecta were determined after three days of exposure to Cu, Zn and equitoxic mixtures of Cu:Zn, composed according to the Toxic Unit concept. Our results showed that growth of D. tertiolecta was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than growth. The relative
These results highlight that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

Effects of mercury in natural populations of the sea anemone Actinia equina

We intend to further investigate the response to prolonged air exposure in a less resistant crab species, the flying velvet crab Carcinus maenas (L.) represents the most common crab species and a key component of littoral ecosystem in european shores. The wide geographical distribution of populations, their presence in pristine as much as heavily polluted areas and their intertidal location reflect a remarkable ability to cope with different stresses,

Does contamination impact the shore crab (Carcinus maenas L.) resistance to an additional stress? An insight through a multiparametric approach

Contamination of protein profiles in gills of shore crabs (Carcinus maenas, L.) from urban and reference sites and variation of polyubiquitinated proteins

Proteins whose expression and/or ubiquitination level are affected by crab location will be subjected to identification by mass spectrometry, in order to tentatively elucidate the mechanisms involved in pollutant response.

Toxicological effects of three polybromodiphenyl Ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana

Toxicity of the mixture of Cu-Zn was more than concentration additive and could thus not be predicted based on single metal toxicity. Hence, a reliable estimation of metal toxicity requires experimental verification of predicted effects.

These results highlight that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.
A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cythara carinata

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In situ assays based on feeding depression have been proposed as sublethal assays that allow to assess direct and indirect contaminant effects on key ecosystem functions (e.g., organic matter decomposition, grazing), long before direct effects on individuals (e.g., growth) are extrapolated to effects at higher levels of biological organization - the traditional approach when selecting sublethal test endpoints. In situ assays conducted under laboratory controlled conditions, which is particularly relevant for estuarine ecosystems where environmental conditions are highly variable. In this context, the objective of the present study was to develop and evaluate a short-term cost-effective in situ sediment assay based on the postexposure feeding of an estuarine species widely distributed and with an important ecological role in estuarine foodwebs. The selected species was the benthic isopod Cythara carinata, a secondary producer, prey to fish and birds, occurring along the North Atlantic coast and in the Baltic and Mediterranean seas. The methodology for feeding quantification was first developed and optimized under laboratory conditions with Artemia franciscana (Crustacea) nauplii. Then, the sensitivity of the postexposure feeding response to a reference chemical - cadmium - was compared to that of local fish postexposures during a 48-h short-term postexposure feeding assay was evaluated by deploying organisms in chambers at reference and contaminated Portuguese estuaries (Mira and Sado Rivers, respectively). The influence of different exposure conditions (sediment particle grain size, temperature, salinity, and food availability) was also taken into account through a multiple regression model, with the ultimate goal of discriminating contaminant effects from those due to environmental factors. The in situ postexposure feeding assay with C. carinata was found to be a potential useful cost-effective tool for estuarine sediment toxicity assessments.

Risk assessments of spilled oil generally focus on the content of specific PAHs in a contaminated site. When the content of these compounds are below the set limit, elimination of the contamination has succeeded. However, when spilled oil is biotransformed, a wide range of water soluble products are created. These compounds can reenter the sediment by deconjugation reactions, but can also act as toxicants in the water column. If these transformation products are toxic, they do not only expose organisms in the water, they are also subjected to spreading in the environment in a much larger scale.

The objectives of this study is therefore to i) assess the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 3-methylchrysen and phenanthrene produced by the two benthic invertebrates Nereis diversicolor and Nereis Virens, and ii) identify the most important water soluble transformation products.

The biotransformation products from PAH exposed N. diversicolor and N. Virens were collected by extracting the test water of laboratory mesocosms exposures at different times. The water soluble biotransformation products were extracted and concentrated by SPE, and their toxicity (EC50) were determined by exposing Daphnia magna to dilutions of these extracts. The water soluble biotransformation products were identified and quantified by UHPLC connected in series to a fluorescence detector and a Quadrupole Time of Flight Mass Spectrometer. To aid the identification enzymatic deconjugation of the phase II products was performed, and identified by use of Gas Chromatography Mass Spectrometry (GC-MS).

This work presents a novel approach to test the toxicity of transformation products of a contaminant mixture, where organisms are exposed to the entire range of biotransformation products. Also, this work shows the changes in toxicities of the transformation products as transformation of the PAHs progresses, and gives insight to the mechanisms of biotransformation of alkylated PAHs.

First evidences of suboptimal health status of red mullets from the priority polluted Mediterranean area of Portman (SE Spain)

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In an effort to assess the differences in the Vitellogenin and Zona Radiata gene expressions of three different species of catfish (Ariopsis felis, Bagre marinus and Cathorops melanopus) collected in the Laguna de Terminos, 70 fish were collected at 5 different sites of the lagoon and were dissected to obtain liver. Total RNA was extracted using the Trizol method along with purification with the DNase enzyme. Specific primers of Vitellogenin and Zona Radiata genes were custom designed to amplify and isolate two specific bands. Poly-A RNA was reverse transcribed using the AMV reverse transcriptase and the cDNA was amplified using the specific primers. The best primers were used to isolate and sequence two fragments of the vitellogenin gene. In order to identify the presence of contaminants in other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal), Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised-by-products present pollutant levels of concern [3].

In this sustainability framework, FAROS project, co-funded by the LIFE+ Environmental Program of EU (LIFE08 ENV/E/000119), aims as one of its main objectives to analyse the commercial value of fish discards in order to contribute to the sustainable management by minimizing discards/batch by improving their value addition to recover and to produce valuable chemicals of interest in the food and pharmaceutical industry. To properly define these adding-value processes, monitoring of metals, PCBs and dioxins are being performed on the most discarded species identified in FAROS métiers.

The biotransformation products of four methadylated PAHs and one PAH produced by Nereis diversicolor and Nereis virens

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Assessments of polycyclic aromatic hydrocarbons (PAHs) and their methoxylated analogs in sea bass (Dicentrarchus labrax) from Bizerte Lagoon, Tunisia

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According to the differences in the Vitellogenin and Zona Radiata gene expressions of three different species of catfish (Ariopsis felis, Bagre marinus and Cathorops melanopus) collected in the Laguna de Terminos, 70 fish were collected at 5 different sites of the lagoon and were dissected to obtain liver. Total RNA was extracted using the Trizol method along with purification with the DNase enzyme. Specific primers of Vitellogenin and Zona Radiata genes were custom designed to amplify and isolate two specific bands. Poly-A RNA was reverse transcribed using the AMV reverse transcriptase and the cDNA was amplified using the specific primers. The best primers were used to isolate and sequence two fragments of the vitellogenin gene. In order to identify the presence of contaminants in other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal), Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised-by-products present pollutant levels of concern [3].

In this sustainability framework, FAROS project, co-funded by the LIFE+ Environmental Program of EU (LIFE08 ENV/E/000119), aims as one of its main objectives to analyse the commercial value of fish discards in order to contribute to the sustainable management by minimizing discards/batch by improving their value addition to recover and to produce valuable chemicals of interest in the food and pharmaceutical industry. To properly define these adding-value processes, monitoring of metals, PCBs and dioxins are being performed on the most discarded species identified in FAROS métiers.

TU 407 Seasonal pollutant monitoring in discarded fish species: is valorisation appropriate?
T.O. Ordóñez, A. Almeida, A.F. Franco, A. Alonso

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Increased by-catch utilisation interest may come from a greater demand for fish products: the development of new markets for previously discarded species, use of low-value by-catch specimens for aquaculture and animal feed or the creation of value-added products from by-catch or discarded fish for food, pharmaceutical or cosmetic industries. However, the contribution to a sustainable management of this biomass through their optimal valorisation highly depends on the quality of the products to be obtained from them.

Many studies in the scientific literature, like surveys of fish and fish products in markets of different countries [1] or monitoring reports of Public Administrations and the EU [2] reported significant levels of this kind of pollutants (especially of dioxins, polychlorinated byphenyls-PCBs, organochlorinated pesticides-OCs and heavy metals) in several cases for commercial species of different families, in spite of the fact, is it considered that production of pollution in the Mediterranean Sea is relatively low compared to other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal), Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised-by-products present pollutant levels of concern [3].

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Characterization of selected Metals in United Arab Emirates coastal fish and locally produced food
E. Samara, Q. Shahzad, S.L. Knuteson, K. Abbasi
American University of Sharjah, Sharjah, United Arab Emirates

Aquatic hypoxia (dissolved oxygen levels less than 2.8 mg O2/L) has become a major concern and more than 200 “Dead Zones” have been identified by the United Nations. The University of Hong Kong, Hongkong, Hongkong

Our findings suggest that the pristine size of the dispersed particles affect the bioavailability and the overall toxicity to the assessment of Good Environmental Status under the Marine Strategy Framework Directive.

Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced the proportion of blue cells (lag phase) and increased the proportion of red cells (late log phase) compared to the control (p<0.05, n=5).

1. J. Leonel
2. F. Gilberto
3. D. Vaudry

Our study revealed that hypoxia significantly increased cell death at 24h as measured by Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced the proportion of blue cells (lag phase) and increased the proportion of red cells (late log phase) compared to the control (p<0.05, n=5).

1. J. L. de Lapuente
2. J. Letendre
1, K. Lemenach
1, S. Buono
1, M. B. Borràs
2, J. Letendre
1, B. Rocher
3, D. Vaudry
1, P. Chan

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

Dose response curve and population growth rate alterations derived from the exposure to ZnO nanoparticles of the marine alga D. tertiolecta were evaluated. Bulk ZnO and toxicological ions were also investigated for comparison of aggregation state and particle size distribution monitored during the experimental testing time. The results show that ZnO nanoparticles can cause significant changes in the population growth rates of D. tertiolecta. These changes suggest that ZnO nanoparticles can reduce the reproductive success of D. tertiolecta and lead to a decline in natural population densities.

1. J. Watson, N. Leach, G. Fones, J. Pini
University of Portsmouth, Portsmouth, United Kingdom

The impacts of copper on polychaetes have received considerable attention with many sub-lethal endpoints developed including effects on reproduction. However, no reproductive experiments with large polychaetes lasting longer than a few days have been attempted. N. virens is an ideal candidate for long-term exposure experiments as investigations into gonadogenesis and spawning of N. virens are highly synchronized. Heavy metals interact with sediment in many ways and spiked sediment has been used frequently to aid in the development of concentration-response relationships. In this study we investigated the effects of copper on the later stages of the gametogenic cycle of N. virens through spiking sediment to a range of nominal concentrations (50, 500 and 1000 mg kg-1 dry weight of sediment) chosen to reflect those present in the sediment likely to be found in polluted environments.

1. J. Leonel
2. F. Gilberto
3. D. Vaudry

Oxidative stress, genotoxicity and histopathology biomarker responses in sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia) compared to a reference site (the Mediterranean Sea). To our knowledge this is the first study of enzymatic, histopathological and genotoxic biomarkers using biomarkers from fish liver for assessment of pollution in Tunisian coastal waters. Antioxidant enzyme activities were lower in fish from the polluted site compared with fish from the reference site, suggesting deficiency of the antioxidant system to compensate for oxidative stress. DNA damage was higher in fish from the contaminated site indicating genotoxic effects. The liver histopathological analysis revealed alterations in fish from Bizerte Lagoon. Hepatocytes featured lipid type vacuolation and membrane disruption. Results suggest that the selected biomarkers in the studied species are useful for the assessment of pollution impacts in coastal environments influenced by multiple pollution sources.

1. W.B. Ben Amen1, J.L. de Lapuente2, M.R. Driss1, M.B. Borràs1
2. Faculty of Sciences, Bizerte, Zarzouna, Tunisia

The aim of the study was to evaluate the impact of environmental contaminants on oxidative stress, genotoxicity and histopathological biomarkers in liver of sea bass (Dicentrarchus labrax) collected from a polluted coastal lagoon (Bizerte Lagoon) in comparison to a reference site (the Mediterranean Sea). To our knowledge this is the first study of enzymatic, histopathological and genotoxic biomarkers using biomarkers from fish liver for assessment of pollution in Tunisian coastal waters. Antioxidant enzyme activities were lower in fish from the polluted site compared with fish from the reference site, suggesting deficiency of the antioxidant system to compensate for oxidative stress. DNA damage was higher in fish from the contaminated site indicating genotoxic effects. The liver histopathological analysis revealed alterations in fish from Bizerte Lagoon. Hepatocytes featured lipid type vacuolation and membrane disruption. Results suggest that the selected biomarkers in the studied species are useful for the assessment of pollution impacts in coastal environments influenced by multiple pollution sources.

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Organochlorine pollutants in oceanic migratory birds: influence of body condition in PCBs and DDTs concentrations among different tissues

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Albutroses and petrels (Procellariiformes) are migratory oceanic birds of considerable conservational interest. Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCs) are ubiquitous and omnipresent within the muscle of one hundred birds belonging to eight species of Procellariiformes collected during their migration period in southern Brazil, one of the most important feeding areas for these species.

The influence of body condition for the species included in this study for their survival period in the distribution of organochlorine contaminants was evaluated, showing that it is a significant factor in the variation and redistribution of these compounds in the tissues of these birds. Birds with good body condition showed higher DDTs concentrations in the tissue as compared to those included in the lowest categories. This study also indicates that the effect of PCBs exposure is higher in birds with poor body condition. The concentration of these compounds is influenced by the body condition of the bird at the time of collection and the analysis of different tissues may generate different findings regarding contamination in birds. Lipid reserves are extremely important to the achievement of the condition presented PCBs and DDTs concentrations in the fat tissue significantly higher than those found in the liver and muscle tissue. On the other hand, 60% to 70% of these emissions are discharged via wastewater effluent into local watersheds and can accumulate in aquatic dwelling organisms.

Spatial distribution and accumulation patterns of cyclic methyl siloxanes (cVMS) in fish from Northern Norway

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The environmental presence of polybrominated diphenyl ethers (PBDEs), which are flame retardants, have been detected in fish from the Norwegian Sea. PBDEs are categorised as high production chemicals where they are used heavily within the personal care products and cosmetics, as well as other facets of industry (surface treatment agents, plasticizers, construction materials, mechanical fluids). Although the majority of cVMS emissions are to the atmosphere (90%), the remaining emissions are discharged via wastewater effluent into local watersheds and can accumulate in aquatic dwelling organisms. However, little data exists on the spatial distribution of cVMS in the aquatic environment. This study will investigate the spatial distribution of cVMS within Northern Norway and if physiological factors (e.g., age, body length, weight) have an effect on cVMS accumulation within fish. Atlantic cod was collected in 2010 and 2011 near the city of Tromsø (site A) and 30 km north of the city (site B) in Northern Norway. All cVMS were detected in cod livers sampled with highest median concentrations for D5, followed by D6 and D4. Significantly higher median concentrations for dodecamethylcyclohexasiloxane (D6) and decamethylcyclopentasiloxane (D5) were observed in fish collected at site A (D4: 60 ng/g lw; D5: 1380 ng/g lw) compared to site B (D4: 10 ng/g lw; D5: 139 ng/g lw). However, no significant differences were observed in the spatial distribution for dodecamethylcyclohexasiloxane (D6) between sampling sites. Concentration of D5 within cod liver was found to be negatively correlated with age. No correlations were found between D4 and D6 concentrations and age, however, these correlations were observed for body length and weight. Concentrations of D4 and D5 significantly decreased away from point sources indicating rapid elimination of these chemicals within fish. No significant differences in concentration for D6 between sampling sites may indicate greater persistence of this chemical to elimination processes. Decreasing cVMS concentrations with age (D5), body length and weight (D4 and D6) may be an effect of enhanced metabolic activity and/or growth dilution within older fish.

Development of appropriate bioassay and statistical methods for determining survival sensitivities of Antarctic marine biota to metal exposure

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The environmental risk posed by PBDEs to aquatic organisms. In this study, mussels, Mytilus galloprovincialis, were continuously exposed to 8 µg/L BDE-47 for 30 days. After the exposure phase, the mussels were allowed to depurate in clean sea water for 10 days. Samples were collected at time 2, 5, 9, 15, 20 and 30 days of exposure to toxic. In a second experiment mussels were exposed for 30 days to three BDE-47 concentrations. In both experiments samples were used to measure glutathione S-transferase (GST), glutathione peroxidase (GPx) and acetylcholinesterase (AChE) activities. GST and GPx were inhibited after 20 and 30 days exposure, while AChE was inhibited already from the second day of exposure. After the 10 days recovery period in clean water the three enzymes recovered the initial levels of activity.

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Inhibition of GST, GPx and AChE activities in marine mussels by exposure to the dissolved polybrominated diphenyl ethers BDE-47

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Differential gene transcription in Plocamia vivipara exposed to copper

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The increasing industrial activities and the use of CuSO4 as a fungicide in agricultural practices, as well as in the control of algae and pathogens in fish culture ponds have raised the copper concentration in aquatic systems. Furthermore, occasional accidents have aggravated this situation introducing substantial amounts of copper into aquatic environments. Copper is accumulated mainly in the liver and excreted via bile and kidneys. The aim of this study was to identify genes differentially expressed in liver of Plocamia vivipara (Guppy) exposed to waterborne copper (20 µg Cu/L) for 24 h, employing the subtractive suppressive hybridization (SSH) method. Results showed that 635 gene fragments were differentially expressed, 37 were down-regulated, whereas earlier studies have established that some fish can debranxinize certain PCBs congeners. Whitemouth croaker (Micropogonias furnieri) is an important species in the Brazilian fishery industry. Therefore, it is important to understand the accumulation pattern of PBDEs in its muscle. During 30 days, 60 Whitemouth croakers were exposed to BDE 99 and BDE 153 through diet (100 ng fish-1 day-1), followed by a 30 days period of depuration. At days 0, 1, 5, 10, 15, 20 and 30 muscle sample were collected from at least 3 fishes. The Whitemouth croaker exposure to BDE 99 ended up accumulating BDE 47 in their muscle, indicating their capacity for processing BDE 99. On the other hand, BDE 153 accumulated without any transformation.