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

Lützhøft, Hans-Christian Holten; Birch, Heidi; Eriksson, Eva; Mikkelsen, Peter Steen

Published in:
Abstract Book

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Link back to DTU Orbit

Citation (APA):
Risk assessment of WWTPs waste effluents using fuzzy logic

Universitat Politècnica de Catalunya, Barcelona, Spain

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 assessment endpoints must be established and data quality and reliability must be determined. The evaluation of data, including both traditional and non-traditional endpoints should be done in a weight of evidence approach in order to reach a scientifically defensible risk determination. In so doing, potential uncertainty of the data used as measures of effects that are directly related to assessment endpoints for a sound and robust risk assessment. A case study describing this approach for the evaluation and use of both traditional and non-traditional endpoints will be presented from the extensive aquatic database for BPA.

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

R. Geerts, M.G.J. Geurts, C.G. Ginkel van Akzo Nobel N.V., Arnhem, Netherlands

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 was not provided in the Guidelines. Accurate knowledge on the relative role of the different mechanisms in the removal of pharmaceuticals in activated sludge systems is therefore not available. The main operating parameters i.e., hydraulic retention time (HRT) and sludge retention time (SRT) are strictly maintained during operation of a CAS unit. The following equations for the maximum concentration in arcti of surfactant adsorbed 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 by activated sludge (CAS) was determined in the UK using the COMMPS procedure developed by the Fraunhofer Institut [2] in 1999. From the results the following conclusions were drawn: It is possible to characterize and compare the different surfactants according to their associated risk as well as to prioritise the compounds according to their relative risk. Finally, the fuzzy model has been compared with 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.

RA304 - Simultaneous assessment of biodegradation of cationic surfactants in activated sludge reactors (OECD 303)

R. Geerts, M.G.J. Geurts, C.G. Ginkel van Akzo Nobel N.V., Arnhem, Netherlands

Discharge of surfactants into the aquatic environment has been showed to cause endocrine disrupter effects in wild fish populations in South Australia. These effects have been observed in the European eel (Anguilla anguilla) and Australian salmon (Atlantic salmon, Salmo salar). These observations suggest that there is a risk of ED effects occurring in wild fish. 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 using 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 of the contributions of sewage effluent to aquatic environments with a high potential to adsorb is not enough approximated by SimpleTreat. The expression should be included in an update of the test guideline.

TH 305

Predictive modelling of steroid oestrogens in sewage effluent demonstrates the potential for endocrine disruptive effects in wild fish populations in South Australia

C.J. Green*, A. Kumar, S. Jobling
Brunel University, Uxbridge, United Kingdom

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 male gonads of the female-spawning species is characterised by immature gonads. Oestrogens have been linked to sewage effluent containing the natural oestrogens 17β-oestradiol (E2) and oestrone (E1) as well the pharmaceutical 17β-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 accumulated 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 of the contributions of sewage effluent to aquatic environments with a high potential to adsorb is not enough approximated by SimpleTreat. The expression should be included in an update of the test guideline.

TH 306

Inputs of pollutants by urban wet and dry weather pollution in combined sewer systems: pau urban catchment (CDAPP, France)

T. Bersinger*, G. Barreille*, T. Pigot, I. Le Hecho*, A. Lecomte*
L窟be, Pau, France

Ecp, Pau, France
Cdapp, Pau, France

Urban inputs that include household effluents, drainage water, business effluents (e.g. car washes, dental uses, other enterprises, etc.), atmospheric deposition and traffic related contaminations (e.g. brake lining, asphalt wear, gasoline/oil leakage, etc.) transported either to sewer treatment plants or directly to the aquatic environment, are expected to represent today important sources of pollution to the aquatic environment. Wastewater treatment plants represent a major threat to the aquatic environment since they are collecting a wide variety of sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban inputs which are considered as transient sources may also contain high levels of pollutants directly discharged in receiving streams by Combined Sewer Overflow (CSO). In a recent study, the Environmental Water Framework Directive and its affiliated directives require Member States to improve their understanding of priority pollutants in urban areas and obviously within wastewater systems. We have investigated the inputs of pollutants to the urban wastewater system of Pau urban catchment (CDAPP, France) which is about 50 km² with about 150 000 inhabitants. 4 rain gauges and about 40 flow meters were installed in all the study area to monitor the combined sewer network. Effluents were followed during about 10 campaigns including wet and dry periods for Suspended Solids (SS), Chemical Oxygen Demand (COD), Total Nitrogen (TN) and trace metals (Cd, Cu, Pb, Zn, Al, Fe, Cr, As, Sn). Emphasis is given to the characteristic, the partitioning and the characterization of contaminants in wastewater inputs during dry periods and wet periods in the combined sewage system of Pau. Concentrations of pollutants were combined with flow rate to assess fluxes that were directly discharge into receiving stream by CSO or carry on to the Waste Water Treatment Plant (WWT). Following a storm event of 2 hours about 2000 m³ was observed. This storm event induces an increase of fluxes by a factor of 1.5 to 3 compared to dry conditions. Half to two thirds of pollutants fluxes were treated in the WWTP during this period. The remaining part of the effluent was discharged in the receiving stream the river Gave de Pau. Fluxes of trace metals followed generally the same percentage than SS, suggesting that metal load is mainly associated to SS.

TH 307

Demographic, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two wastewater treatment plants in two geographical contexts (Spain and France)

R. Geerts, M.G.J. Geurts, C.G. Ginkel van Akzo Nobel N.V., Arnhem, Netherlands

Demographic, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two wastewater treatment plants in two geographical contexts (Spain and France).
French catchments

V. Brochier, K. Seriki, G. Leroy, V. Boireau, L. Castillo
Veolia Environment - Research and Innovation, Rueil-malmaison, France

Presence of OMPs in wastewater is reported 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 WWTP. In this perspective, the objectives of this work were to assess if pharmaceuticals concentrations in wastewaters could be explained by urban parameters in two urban catchments and compare their treatment performances.

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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.

Influents 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), isopropyl (IMP) and γ-estradiol (E2).

Fluxes of CBZ were 9 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, in by the higher potential sources in catchment A than B.
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 showed a slight decrease in environmental risk from location 1 to 4. In terms of removal of organic micro pollutants, constructed wetlands only show a minor efficiency, and seem to be more efficient in biologically vitalizing the effluent.

TH 313
Assessing the potential of constructed wetlands in reducing environmental impact of STP effluents: the WIPE project
E.M. Foekema, J.M. van der Oost, E.W.M. Roze, A.J. Mulk
MARES, Den helder, Nederland
Water, Institute for Water Cycle Management, Amsterdam, Nederland
Deltares, Urkrecht, Nederland
Wageningen University, Sub-department of Toxicology, Wageningen, Nederland

At some pilot locations in the Netherlands, the effluent of sewage treatment plants (STPs) is lead through a constructed wetland (so called ‘waterharmonica’) before being discharged into the environment. It has been shown that this approach is effective in reducing and the toxicity of the effluent. The WIPE (Waterharmonica Improving Purification Effectiveness) project studied the potential of such wetlands to reduce the environmental impact of STP effluents on the receiving water, with special emphasis on ecotoxicological aspects. The (changes in) effluent quality of three STPs was monitored during the passage through constructed wetlands. This monitoring program was conducted by chemical sampling, chemical analysis, bioassays, microbiology and biological and gene-expression responses of chronically exposed stickleback (Gasterosteus aculeatus). The monitoring was performed between 2008 and 2011 and generated an extensive database. In this presentation we will give an overview of how different environmental relevant end points were affected during the passage through the constructed wetlands. In two of the STPs characteristics of the effluents were found, a wide range of chemicals were detected on the passive samplers, but in general these were not affected in a structural way by the passage through the wetlands. Occasional peaks in toxicity were observed, that indicate a potential risk for the receiving surface water. The intensity of these toxicity peaks was reduced after passage through the wetland. No indications were found that the effluents in general affect the reproductive success of the sticklebacks. In the case of the temporal poor effluent quality can affect survival. Gene expression indicated estrogenic effects on the male fish. This endocrine disruption was less at the end of the wetland where the effluent is about to be discharged on the surface water. This observation is in line with the results from the in-vivo-assays for estrogenic potential, and with the observation that the microbial community in the wetland sediments has a high potential to reduce estrogenic activity. Finally, it was found that densities of pathogens in the effluent were substantially reduced during passage through the wetlands. Constructed wetlands thus can help to improve the environmental quality of STP-effluents. Especially by levelling off high peaks in the toxicity and by reducing the density of pathogens.

TH 314
Inventory of emissions of priority hazardous substances in the surface waters in France
A.M.J. Gouzy, J.M. Brignon
INERIS, Versailles-en-Halatte, France

Introduction
According to Article 5 of the Directive 2008/105/EC on Environmental Quality Standards in the Field of Water Policy, Member States have to establish an inventory of emissions, discharges and losses of all priority substances and pollutants listed in Part A of Annex I to this Directive. This paper aims at describing the French approach used to compile this inventory and to identify the main issues arising during the process. The methodological guidelines of the Directive are fully integrated in this approach. The results are based on the following key ideas:

- a state-of-the-art methodology in agreement with regulatory requirements, and EU guidance;
- a risk approach specific methodology. The approach is based on effluent discharge data; in their absence some explicit estimation formulas are proposed;
- a single methodology applicable at different spatial scales.
- a methodology that will work despite scarcity of information and data, and uncertainties;
- a methodology used as a management tool for designing strategies for the reduction of the impacts of chemical pollution in waterbodies;
- a methodology which can easily deals with data from different years. All available information which are representative of a given year to draw a coherent picture of the micro pollutants releases in surface waters during this year must be used;
- a methodology which can also deal with data from different periods.

The approach developed was also reviewed and supervised over the construction of the methodology developed in this paper in terms of work efficiency.

Acknowledgement - The author thanks the The French National Agency for Water and Aquatic Environments and the french Ministére de l’environnement, du développement durable des transports et du logement for their financial support and the “GT_inventaire” working group for its technical help.

TH 315
Corbicula fluminea: just an invasive species or also a freshwater bioaugmentor?
University of Aveiro, Aveiro, Portugal
University of Coimbra, Coimbra, Portugal

Much attention has been drawn to the industrial and ecologic impacts of Corbicula fluminea, an invasive freshwater bivalve. This species has also been extensively studied as a potentially toxic metals and organic compounds. Such an attribute lies on the ability of these clams to bioaccumulate chemicals in body tissues together with a fairly large tolerance to the effects resulting from exposure. Additionally, the Asian clam seems to alternate filter-feeding at very high rates with pedal-feeding and deposit feeding, and hence an integrated view concerning different ecosystem compartments can be considered. As to our knowledge no attention has been devoted so far to the effects that these features of the Asian clam may provide if applied to the treatment of contaminated media. The main aim of the present study was to generate preliminary results on the evaluation of C. fluminea bioaugmentation potential in the treatment of several effluents with 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 mill waste. The toxicity of the initial clam-feeding solution and the post-filteration 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 characterisation 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 of 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
B. Miqueletto, R.C. Chagas, C. Veronesi, C.M. Soprani, R. Franci, S.T.A. Cassini
Federal University of Espirito Santo, Vitória, Brazil

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 collected in Brazil. From each tank four samples were collected, each aliquot representing a distinct depth, classified as: 1, 2, 3, liquid sludge and 4,Separated sludge; 5, Sludge bottom and 5, 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 sample 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 separated layers “scum” and “liquid waste”. All samples from the bottom fractions presented acute 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 VS/TS (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 microplutonants to be treated or upstream source controlled in a catchment of Indonesian DKI
H.C. Holten Lützhøft, H. Birch, E. Eriksson, P.S. Mikkelsen
Technical University of Denmark, Kgs. lynnby, Denmark

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 be designed 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 microplutonants 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...
TH 318

Toxicity identification evaluation for wastewater treatment plant working at different industrial and municipal scales
W.D. Di Marzo1, M.E. Sáenz2, J.L. Alberdi2, S. Curtes2
1Conceit, Unlu, Luján, Argentina
2UNLU, Luján, Argentina

A toxicity identification evaluation according international consideration was performed taking in consideration the system used for depuration of wastewater. Process control in the treatment stages, the toxicity correlation with the treated liquid results, and the removal efficiency of the pollutants were considered. Macroinvertebrate related leaf litter breakdown in terms of leaf mass loss might help to meet the requirements of the EU Water Framework Directive.

TH 319

Application of delayed fluorescence to estimate the influence of waste water effluent on algae
M. Katsumura1, N. Tatarazako1, S. Ogino1, T. Koike1, K. Kazumura1, A. Takeuchi1, Y. Kobayashi1, Y. Sato1, Y. Sugaya1
1Hamamatsu Photonics K.K., Hamamatsu, Japan
2National Institute for Environmental Studies, Tsukuba, Japan

Waste water effluent is major source of chemicals discharge in to aquatic ecosystems. Since algae are important primarily producers in aquatic ecosystems, it is necessary to influence the fate of effluent not only on animals but also the algae. We are investigating a new method of for evaluating the influence of chemicals on algae by using delayed fluorescence (DF) from algae. The DF is a specific type of luminescence; it detects the growth of only those cells that have photosynthetic capability. Since the DF originates from re-excitation of chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary to explain the inhibition of photosynthetic activity of algae. Delayed fluorescence (DF) can be a potential endpoint for the estimation of the influence of chemical substances of global significance in a shorter time than the conventional 72 hours growth inhibition test (e.g. OECD test guideline 201). The intensity of DF also shows a time decay curve. Chemical exposure changes the decay curve that patterns have the potential to assist in the identification of contaminants in effluent sample. We have developed a rapid and simple DF test protocol using the green algae Pseudokirchneriella subcapitata (Selenastrum capricornutum). The test algae are prepared by thawing specially prepared -80°C frozen algae in a 1 hour pre-incubation. The prepared test algae can then be immediately exposed to the test sample prepared in a range of effluent concentrations (0, 1, 10, 20, 40, 80 %) in small culture tubes (10 ml volume). The DF from algae in the culture tube is directly measured by the ultra-sensitive luminometer at 1, 4, 8, 24 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the time decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibition dose-response curve, the dose-response for each effluent or mixture. In addition, the pattern of the DF decay curve has potential for application to the identification of the contamination in the effluent. We will discuss results of a feasibility study evaluating treatments of industrial and agricultural effluents.

TH 320

Ecological health assessment and stressor identification using multi-response bioindicators of fish
J.H. Kim
Korea Institute of Toxicology, Deajeon, South-Korea (Rep)

This study was evaluated the effect of environmental stressors using various parameters such as chemical water quality, habitat evaluation, and chemical exposure biomarkers in the Gap stream, South Korea during May-June 2009. We collected the pale chub (Zacco platypus) as sentinel species to evaluate biomarkers and indicators at four sampling sites. We measured the major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DILT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWWTP). By the stressor identification (SI) process, five candidate causes of fish population degradation were winnowed including habitat alteration, low dissolved oxygen, nutrient enrichment, ammonia toxicity, and thermal pollution. The results of causal analysis suggest that the principal probable causes of fish population impairment in the downstream site below the MWWTP were a combination of effects associated with recruitment failure and size-selective mortality caused by nutrient enrichment, ammonia toxicity, and habitat alteration such as degradation in spawning and nursery space.

TH 321

Monitoring potential ecotoxicological effects in the effluent of an urban wastewater treatment plant
A.E. Cavelier1, M. Hübner1,2
1LimCo International GmbH, Konstanz, Germany
2Unimon, Zürich dietikon, Switzerland

Limnoeco, Zürich dietikon, Switzerland

Organic micropollutants cannot completely be removed by traditional wastewater treatment technologies. Therefore it is being discussed to add additional treatment steps such as ozonation, active carbon 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 monitoring of the ecotoxicity of wastewater effluents can be just released before entering the river Limmat. Potential 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. villousus, 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 in order to record the ecological potential of the wastewater. On the other hand, if long-term monitoring with galvanically potentials were extended, the need of additional treatment steps should be reevaluated on a case-by-case basis for each wastewater treatment plant and its recipient river ecosystem.

TH 322

Implications of municipal wastewater on macroinvertebrate community structure and leaf litter breakdown
M. Bundschuh1, N. Tatarazako2, A. Takeuchi2, Y. Kobayashi2, Y. Sato2, Y. Sugaya2
1Koblenz University of Applied Sciences, River Koblenz, Germany
2LimCo International GmbH, Konstanz, Germany

The indicators species is chosen according to pollution-sensitivity, abundance and key-role in the stream ecosystem, in our case gammarids.

Gammarids were exposed in the Multiplex Freshwater Biomonitor[TRADEMARK] (MBF) placed in the UniPass[TRADEMARK] flow through system, receiving treated waste water just before release into the river Limmat. Potential 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. villousus, 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 in order to record the ecological potential of the wastewater. On the other hand, if long-term monitoring with galvanically potentials were extended, the need of additional treatment steps should be reevaluated on a case-by-case basis for each wastewater treatment plant and its recipient river ecosystem.

TH 323

Water quality investigations in the river Lea downstream a sewage treatment works: preliminary results of a case study
D. Patroncini1, D.M. Rawson2, B. Haggar3
1University of Bedfordshire, Luton, United Kingdom
2Limeco, Zürich dietikon, Switzerland
3Unimon, Zürich dietikon, Switzerland

European streams receive huge amounts of municipal wastewater, which, due to the limitations of conventional secondary treatment (i.e. mechanical and biological), may contain a wide range of micropollutants, like pharmaceuticals and personal care products. As such micropollutants are continuously released into aquatic environments, they may pose a potential risk for the integrity of ecosystems. Hence, the present study assessed adverse structural and functional implications of wastewater released by the municipal wastewater treatment plant (WWTP) in London, Germany, on its receiving stream, the Queic. For this purpose several endpoints related to the ecosystem function of leaf litter breakdown (microbial and invertebrate mediated leaf litter breakdown, in situ bioassays with Gammarus fossarum) and the structure of the aquatic invertebrate community were investigated for six and three weeks during winter and summer 2011, respectively. Macrobenthic related leaf litter breakdown in terms of leaf mass loss was by up to 65 % significantly reduced at sites situated up to 500 m downstream of the WWTP outlet compared to the upstream site during both seasons. This effect may be explained by the significantly reduced abundance of leaf shredding macroinvertebrates such as Gammarus fossarum. Moreover, gammarids exposed in situ exhibited a significantly (up to 80% 100 m downstream during both seasons) reduced feeding rate at downstream sites, indicating lower energy availability and reduced reproductive output. These implications in leaf shredding macroinvertebrates and the ecosystem function of leaf litter breakdown may be on the one hand caused by direct ecotoxicological effects of the pollutants contained in the wastewater, which is supported by the results of the in situ bioassays. On the other hand, indirect pathways (e.g. given by a lower nutrition quality of leaf material, indicated by a significantly reduced fungal biomass (up to 75%) at the downstream site, may have influenced the physiological fitness of shredders. Finally, the present study urges the evaluation the present case study in wastewater treatment by considering advanced treatment methods (e.g. ozonation), which may help to meet the requirements of the EU Water Framework Directive.
Combination effects of pharmaceuticals and industrial chemicals in waste water effluents

The main objective of the project presented in this paper, financed by TOTAL and the CONCAWE, is to show the real distance between WEA methodology which is conservative and in situ impact measurement for risk assessment. In this project, the difference between WEA and in situ impact measurement is assessed using dynamic outdoor mesocosms. This project has been designed and realized in three successive steps: (1) Preliminary experiments in Laboratory to assess the best solution to store one effluent sample; (2) Optimization of how to minimize volatilization, oxidation, and how to treat effluents; (3) Feasibility experiments in mesocosms with one effluent (how to select effluent, to sample the effluent in industrial site, to transport, to store and to inject large volume of effluent; How to measure the ecological impact in mesocosms); (5) Final experiment in successive mesocosms with several effluents sampled in different sites and comparison with WEA methodology.

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

TH 326

Multi-bioassay approach for assessing the impact of industrial discharges on the water quality in Wallonia, Belgium


Biobios 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 effort directed active monitoring using bioassays is being carried out for many years. In this paper we present the first results of the monitoring program according to WFD. The main concern is the occurrence of heavy metals as well as concomitant effects of dyes and other compounds in WWTP effluents, and the possible human health hazards caused by the consumption of fish or shellfish from these waters.

TH 327

Combination effects of pharmaceuticals and industrial chemicals in waste water effluents

T.V. Jufferholz, D.G. Gildeemeister

German Federal Environment Agency (UBA), Dessau-rolßau, Germany

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 micropolutants. 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 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.

The study focuses on the question if combination effects of pollutants in WWTP effluents require further assessment. Therefore ecotoxicology tests with algae and daphnids for 6 environmental relevant substances shall be conducted individually and in different combinations respectively. The high resolution and accurate mass does not require optimization of compound specific parameters and has the ability to properly separate matrix from compounds of interest. Fast and highly selective methods are necessary to provide, confirm and classify different classes of contaminants in complex matrix and at low the analyte concentrations. High-resolution mass spectrometry - using full scan analysis mode - has been described as the preferred screening tool due to the possibility to look for a large number of compounds and also because it enables retrospective analysis [1]. Furthermore, the use of a resolving power $\geq 50,000$ FWHM is reported as being as selective as 2 SRM transitions when using triple quadrupole instruments [2].

In this work, a direct injection has been applied to the screening of anthropogenic sewage pollutants in different matrices using a quadrupole-Orbitrap analyser. The experiment consisted on combining full scan mode at a resolving power of 70,000 FWHM with data dependent MS/MS spectra acquired at a resolving power of 17,500 FWHM. The MS/MS spectra were generated by using a high energy collision induced dissociation cell (HCD). This experiment was tested and evaluated in terms of quantitative and qualitative capability and the possibility of determination of various of anthropogenic sewage pollutants. Different to sample types were elimated, including waste water, receiving water, ground water and drinking water representing different steps within the water cycle of densely populated and intensively agricultural used areas.

References

KELLMANN ET AL..

Full Scan MS in Comprehensive Quantitative and Quantitative Residue Analysis in Food and Feed Matrices; How Much ResolvingPower is Required?


GALLART-AYALA ET AL..

Preventing the negative very high-resolution mass spectrometry: the benzenophene case

Rapid Communications in Mass Spectrometry, 2011, 20, 3161-3166

TH 325

Whole effluent assessment as an alternative to in situ ecological impact measurement? An experimental approach

Y. Cailleau1, A. Bassières1, Baldoni-Andrey1, K. Den Haan1, Whale3

TOTAL Petrochemicals France, Laqc, France

GONCAWE, 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. Today, many regulators are seeking more holistic techniques such as whole effluent assessment (WEA) 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 this work, a direct injection has been applied to the screening of anthropogenic sewage pollutants in different matrices using a quadrupole-Orbitrap analyser. The experiment consisted on combining full scan mode at a resolving power of 70,000 FWHM with data dependent MS/MS spectra acquired at a resolving power of 17,500 FWHM. The MS/MS spectra were generated by using a high energy collision induced dissociation cell (HCD). This experiment was tested and evaluated in terms of quantitative and qualitative capability and the possibility of determination of various of anthropogenic sewage pollutants. Different to sample types were elimated, including waste water, receiving water, ground water and drinking water representing different steps within the water cycle of densely populated and intensively agricultural used areas.
The "washing solutions" prepared with hand dishwashing detergents were found to be more toxic than those prepared with dishwasher detergents, except for the gel products.

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 L1 with the water lentil Lemna minor having the lowest EC50 in the µg per litre range. Among the terrestrial organisms the lowest EC50 was determined for the plants (Avena sativa and Brassica napus) with about 10 mg kg-1 soil dry weight for inhibition of shoot growth. Test results reveal that among the different trophic levels, climazole is most toxic towards primary producers in the aquatic as well as the terrestrial habitat. Displayed effects were a reduction of shoot length in higher plants and of leaf (frond) size in water fleas. Of both, that suggests an interference with the sterol metabolism of these organisms. Assessing the terrestrial toxicity of climazole is particularly relevant when treated wastewater or sewage sludge is to be applied in irrigation or as organic fertilizer on arable land.

TH 330
Environmental impact of current reserve-antibiotics with increasing incidence of severe infections using modern waste water treatment

J. Bruesing, J. Bresling, W. Dott
University Hospital of Aachen, RWTH Aachen University, Aachen, Germany
Antibiotic resistance is increasing since 30 years. Antibiotics previously used as reserve antibiotics, e.g. ciprofloxacin, are found in guidelines for treatment of slight infections. Due to uncritical prescription of broad spectrum antibiotics the amount of antibiotics used rises constantly. Many environmental studies proved the existence of different types of antibiotic in hospital sewage, municipal waste water, sewage disposal facilities and surface water or soil. For some substances critical concentrations with effects on algae, bactria, daphnia and higher life forms were observed.

At the present Rifaximin, Piperacillin, Doripenem as well as the current reserve-antibiotics Tegicycline, Linezolid and Daptomycin are not classified as relevant to the environment because of their minor application. Hence environmental data for these substances are missing, as well as future schemes of use. Nowadays most environmental sciences are focusing on older frequently prescribed substances. As a result assessment lags behind the modern pharmacotherapy and the achievements of the pharmacology.

Our approach 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 Tegicycline with EC50 values of 14.4 µg/mL 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 occurrence, changes 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. Pandared', N. Manier', F. Gondelle', O. Perceval'
1, INRETS, Vincennes, France
2, ONEMA, Vincennes, France

This study was aimed at assessing the ecotoxicity of dishwasher detergents. Indeed, despite the high consumption of such products, available information regarding their environmental effects was rather limited. Thus, two new products available on the French market were selected, covering the different dishwasher detergent categories: "multibenefit" tablets, "classical" products (tablets and powder) and "gel" (both "classical" products and "gel" need the use of rinsing 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 "classical" solution that is selected to destroy or remove organic chemicals of concern such as oestrogens or pharmaceuticals are likely to either reduce the reproduction of C. dubia was the most sensitive endpoint compared with the inhibition of the mobility of D. magna and the growth of the algae B. subcapitata. The "washing solutions" prepared with hand dishwashing detergents were found to be more toxic than those prepared with dishwasher detergents, except for the gel products. Regarding the "classical" products the results showed 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" products 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 ecolabeled 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

1, Wessex-environment, Faringdon, United Kingdom
2, UKWIR, London, United Kingdom
3, Environment Agency, Llanelli, United Kingdom
4, University of Adelaide, Adelaide, Australia

Dissolved organic carbon (DOC) is known to form complexes with metals which can markedly reduce the free concentration of the metal in the aquatic environment. Bicarbonate Lignid 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 carbon will be sorbed to the inorganic suspended solids present in the effluent, such as iron, aluminium, silica and organic material in faecal matter. The metals that bind most strongly are those that make the metal ions less free and hence less reactive. The free metal concentration is therefore lower than predicted by BLMs and so provide greater protection against toxic effects of metals. About 50% of metal DOC has been shown to be relatively quickly degraded and therefore not likely to be a significant source of toxicity. The DOC in effluents will, therefore, almost certainly interact with metals in a different manner to that predicted by BLMs.

Also, advanced treatment options such as ozonation or advanced oxidation processes may be used to remove organic chemicals of concern such as oestrogens or pharmaceuticals. These advanced treatment options are likely to either reduce the concentrations of effluent DOC or affect its composition. Therefore, it may be that infrastructure investment intended to remove some organic chemicals may make the recirculating water more sensitive to metals by reducing protective effects of DOC.

Also advanced treatment options such as ozonation or advanced oxidation processes may be used to remove organic chemicals of concern such as oestrogens or pharmaceuticals. These advanced treatment options are likely to either reduce the concentrations of effluent DOC or affect its composition. Therefore, it may be that infrastructure investment intended to remove some organic chemicals may make the recirculating water more sensitive to metals by reducing protective effects of DOC.

Integrating sewage treatment plant monitoring and modelling results to prioritise chemicals of concern and assess environmental risks

A. Franco, O.R. Price
Unilever, Sharnbrook, United Kingdom

Ammonium and 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, Biocidal Products Directive 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 and regional 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.

Concentrations 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.
An aerobic biodegradation of PCBs in a grass cut batch reactor
L. Tangermann, W.U. Palm, W.K.L. Rocke
Leuphana University, Lüneburg, Germany
Due to properties such as high $K_{ow}$ values chlorinated compounds including PCBs, dioxins or chlorinated pesticides in vegetation can lead to bioaccumulation in livestock and in the food chain. Hence, the remediation of these compounds in the environment is an important factor for human health. The degradation of the persistent Polychlorinated Biphenyls (PCBs) under anaerobic conditions in sediments and sewage sludge is described in the literature [1,2]. The potential for degradation in an anaerobic grass cut batch reactor has not been performed before and is investigated in this work. Therefore two series of batch experiments in laboratory scale (0.5 L to 1.5 L of volume) were performed under mesophilic conditions.

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, 52, 101, 119, 138, 180). Concentrations of the lower chlorinated PCBs decreased considerably, whereas the concentrations of the higher chlorinated PCBs were found to be stable at 5.20 µg/kg dry weight sewage sludge.

For the second experimental series 6 PCBs (No.: 28, 52, 101, 119, 138, 180), 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 samples were used to determine the microbial degradation rates experimentally for these batches varying between 30 and 120 days. Compound concentrations were measured by GC-ECD. 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.

References

TH 336
Removal of nutrients by immobilized microalgal beads in a continuous flow system
A. Yilmaz, N.C. Koyuncu, O.S. Okay
İstanbul Technical University, İstanbul, Turkey

Using immobilized microalgal 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 (cation solution) 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 (Chebios Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cells numbers in the beads were also determined by counting in a Coulter Counter Instrument during the experimental period. The blank beads were also run in the system and subtracted from the data. After the end of the experiment, the beads were sieved and the removal efficiency of the algae 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 are indicated as 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. Garratt, J. Herrera, C. Lago, Y. Lechon, R. Saez
Ciemat, Madrid, Spain

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 handled as a black box. Several products with different characteristics and uses are derived from oil refining process (olefins, propene, butane, gasoline, kerosene, diesel, paraffin, asphalt, etc.). Allocation of proportional impacts of energy consumption and emissions for each product is a difficult task because many of them are correlated. Therefore, energy consumption and emissions are allocated according to the final product distribution. The most allocation methods used for petroleum products are based on properties of the end product or their energy content, according to ISO standards. 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. Furthermore, this study is completed by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as allocation method, input data, and refining processes. In this study, a diatom "Phaeodactylum tricornutum" was immobilized in 3.5% sodium alginate solution and hardened with 4% calcium chloride (cation solution) 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 (Chebios Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cells numbers in the beads were also determined by counting in a Coulter Counter Instrument during the experimental period. The blank beads were also run in the system and subtracted from the data. After the end of the experiment, the beads were sieved and the removal efficiency of the algae 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 are indicated as the release of the microalgae out of the beads during the experiment and disintegration of the alginate beads over a long term run.

TH 340
Towards transparent and relevant use of energy use indicators in LCA studies of biofuels
E. Fjelland, S. Kremmer, M. Strøm, S. Molander
Chalmers University of Technology, Gothenburg, Sweden

"Drop-in" biofuels are described by National Advanced Biofuel Consortium of the United States as infrastructure compatible with the over $9 trillion energy refinery and gas station infrastructure currently available in the United States. Undersecretary of the United States Department of Energy, Kristina Johnson, “drop in” biofuels can be defined as fuels produced from various biomasses which are compatible to current fueling infrastructures. In nearly all cases, these fuels are a blend of renewable feedstocks and petroleum-derived products. A comprehensive review of the previously conducted LCA studies in this new field of advanced biofuels is presented at the SETAC world congress.

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. Borris Ayree, A. Halog
University of Maine, Orono, United States of America

One of the very important barriers is the challenge of developing 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, Dr. Kristina Johnson, "drop in" biofuels can be defined as fuels produced from various biomasses which are compatible with the over $9 trillion energy refinery and gas station infrastructure currently available in the United States. According to definitions used in literature review, 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 of biofuels are defined based on the definitions provided for availability. A comprehensive review of the previously conducted LCA studies in this 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
W.E. B.K. Bertelsen, W.L.O.I. Poggiaritz, L.S.E.L. Schebek
Karlsruhe Institute for Technology (KIT), Eggenstein-leopoldshafen, Germany

The field of energy from biomass is broadly 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, however, 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 to decide which study is “best” suited for a given case study. 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
set of indicators.

In a second step on the base of the indicators developed in the first step the available studies will be analyzed. In the last step, the actual states of the data are compared and assessed with the reference. This approach makes it easy to spot and report any shortcomings the studies may have and eventually decide which study should be used for a given problem.

The guideline consists of four parts:
- Description of the technology of interest and of available literature
- Description of the indicators, the reference values and the available data
- Evaluation of the available literature
- Recommendation

The guideline was tested on an analysis of LCI studies and data sets of an Organic Rankine Cycle plant for German framework conditions.

Using the guidelines data gaps were identified and quantified resulting in a better overall understanding where these gaps came from and how to deal with them. The guidelines allowed for a good comparison on the data quality of the literature. With their use a good overview of the different LCI studies could be achieved and a clear recommendation for data set generation could be given.

TH 343
Finding LCA research direction with the aid of meta-analysis
A. Zamagni1, P. Masoni1, P. Buttol2, A. Raggi3, R. Buonamici3

1ENEA, Bologna, Italy
2University of Genoa, G. Lazzaroni, Pescara, Italy

Rapid growth in LCA methodological developments has generated a large body of work in the last ten years. New impact categories, indicators and characterization factors have been developed with regard to the LCIA. Moreover, an increased sophistication of the existing methods of characterization has been also proposed, for example with the introduction of spatial and temporal differentiation. On the side of the inventory analysis, the need to assess policies, technological and structural choices characterized by scarce reversibility, long term effects, trade-off between environment, economy and society, etc. has been driving an expansion of the scope of LCA, both in terms of level of analysis (from products to systems, from micro to macro) and coverage of indicators (including also economic and social aspects). Consequential LCA, hybrid approaches combining LCA and input-output analysis, scenario modeling, and new efforts for developing social and economic assessment methods, are only some examples of the developments LCA methodology has gone through. Overall, it may appear that LCA lacks direction on how to further develop.

In this paper the authors developed and applied a structured approach, inspired by the meta-analysis concept, to examine literature and identify research thrusts on how to further develop LCA. The procedure consists of four-steps: i) definition of the research question, ii) carrying out a literature review concerning more than 280 papers - selected from about 2000 articles according to pre-defined criteria - which resulted in the identification of some 60 main methodological topics; iii) research gap analysis, in which the methodological topics identified in the previous step were compared with the research priorities identified through a users’ needs survey; iv) interpretation of results, in which the results of both the previous steps were evaluated and organized into coherent research thrusts.

Overall the analysis delivered two main research thrusts: one devoted to increase model simplicity, the other to increase model fidelity. The former is aimed at making knowledge available in easily usable way, while the latter focuses on better describing the complexity of the systems analysed and those interrelations that are really meaningful. Specific research topics were identified for each thrust, which suggests that sophistication and practicability can and should coexist in the same method.

TH 344
A web-based approach to handling divergence in LCA
A. Maraghvia1, R.J. Wallace2, G. Ruo3, E. P. De Cely4, J. Dunphy4

1Public Research Centre Henri Tudor, Esch-sur-alzette, Luxembourg
2Cork Constraint Computation Centre, Cork, Ireland
3Cork Production Promotion Unit, Cork, Ireland

The last two decades have seen a profusion of studies in the Life Cycle Assessment (LCA) field, as well as growing interest in this work by parties in business and government.

Furthermore, the rapid growth of detailed and constantly updated Life Cycle Inventory (LCI) and Environmentally Extended Input Output (EEIO) databases has led to an increase in the use of LCA as a decision support tool. However, the diversity and incompleteness of existing databases from which it is often very difficult to elicit conclusive assessments due to conflicting results presented by the authors, although ostensibly the same product is being analysed.

At present, a widely discussed approach to handling this situation is through the use of meta-analysis. However, in this paper we think it is useful to explore other ideas and approaches, in particular, those that afford solutions that may be available sooner, and also available across a wider range of cases and for a wider range of users.

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 discrepancies by opening up the information using distributed data. An option for accessing distributed data sources and linking them semantically is the emerging technology of Linked Data. LD technology allows meaningful interlinks between all sorts of resources within the World Wide Web. It can be seen as a further development of the usage of hyperlinks, extending the simple link (which can be seen as the sentence ‘has to do with’) to meaningful relations (such as ‘isObservedOn’ [observedEntity]).

While the primary units of the hypertext Web are HTML (HyperText Markup Language) documents connected by hyperlinks, Linked Data relies on data in RDF (Resource Description Framework) format and residing in the Web of Data. Essentially, our web-based toolkit is supported by a Data Access Layer which will provide search capability over LCA information available in RDF format. We envision that a form-based search interface will allow a user to specify details about the desired quality criteria and on a specific subject and run a structured query over the Web of Data. In this way the divergencies will be directly resolved at the level of the Data Access Layer.

The (free-to-use) basic system we envision will support simple assessments and will help LCA users to produce more robust and policy-relevant results.

TH 345
Environmental impacts of palm oil biodiesel: A Meta analysis
Y.M. Manik1, A.N.T.H.O Halog2

1University of Maine, Orono, United States of America

Environmental impacts associated with the life cycle of palm oil biodiesel is reviewed in this study using meta-analytic methods. Most studies found palm oil biodiesel would produce positive energy balance with an average net energy ratio of 3.27, which exhibit the strong potential of palm oil biodiesel as renewable fuel. However, it was found that palm oil biodiesel is a net emitter of GHG to the atmosphere. The origin of oil palm plantation is the foremost determinant of GHG emissions. Converting peatland forests to oil palm plantation is one of the major sources of CO2 emissions to the atmosphere. The paper highlights that ranges of emissions estimates are present for wind power.

The paper also suggests that meta-analyses of historic lifecycle studies of this nature help to provide greater advice ensuring comparability, consistency and accuracy for given technologies. The paper then presents a range of differences that is responsible for the discrepancy in lifecycle estimates, in particular identifying errors in both the lowest estimates and the highest estimates. It is noted that wind power is not directly emitting greenhouse gas emissions, but rather that lifecycle emissions occur from farm construction, operation and farm decommissioning.

TH 346
Greenhouse gas emissions from wind power: a critical meta-analysis
S.S.B Chapman1, Y.M. Manik1, A.N.T.H.O Halog1

1Heriot-Watt University, Edinburgh, United Kingdom

In this paper a range of historic lifecycle studies of greenhouse gas-equivalent emissions for on and offshore wind farms are reviewed to identify a definitive set of the most current, original, and transparent studies. It begins by briefly detailing the separate components of the wind farm life cycle before explaining the methodology of the meta-analysis and exploring the range of life cycle data. The paper highlights that ranges of emissions estimates are present for wind power. The paper also suggests that meta-analyses of historic lifecycle studies of this nature help to provide greater advice ensuring comparability, consistency and accuracy for given technologies. The paper then explains some of the factors responsible for the disparity in lifecycle estimates, in particular identifying errors in both the lowest estimates and the highest estimates. It is noted that wind power is not directly emitting greenhouse gas emissions, but rather that lifecycle emissions occur from farm construction, operation and farm decommissioning.

TH 347
The renewable energy directive and cereal residues
L. Whitaker1, C. Mcmanus1, P. Hammond2

1University of Bath, 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 describes how co-products and residues should be allocated, however a clear definition of these is lacking. Currently, in order to incentivise biofuel production from second generation sources such as cereal residues and wastes, double credits are to be awarded to these biofuels, and the feedstocks are considered to be available at zero GHG cost. This presentation will consider if cereal residues removal should be accounted for in GHG reporting for biofuels, as there are potentially sustainability implications with removing residues from the agricultural food and feed markets. The RED does not consider these potential impacts, which questions the ability of streamlined LCAs to account for the sustainability of these biomass resources. This presentation will compare results from streamlined LCAs and a full environmental impact assessment of cereal residue removal and combustion. The results will indicate the importance of inclusion of direct and indirect LCA impacts in policy analysis.

TH 348
Meta-analysis of LCA studies for bio-based polymers: assessing the environmental performance of polyhydroxyalkanoates (PHA) and polylactide (PLA) in contrast to their petroleum-based counterparts
R. Essel1, M. Carius2

1Nova-Institut GmbH, Hürth, Germany
2Cranfield University, Cranfield, United Kingdom

The depletion of non-renewable resources plays an important role in present political debates: On the one hand, the depletion of non-renewable resources results in increasing commodity prices and economic dependence. On the other hand, the emission of greenhouse gases causes severe effects on the climate with unpredictable impacts on the human environment. That is why energy from renewable resources as well as bio-based chemicals and materials have attracted great interest.

The goal of this study is to assess a large number of LCAs comparing bio-based and petroleum-based polymers. These abundant polymers are polyhydroxyalkanoates (PHA) and polylactide (PLA). Moreover, the results are compiled in a meta-analysis to identify similarities and differences. The contribution of the study is to show the environmental impact of bio-based polymers in contrast to their petroleum-based counterparts.

The meta-analysis of different studies shows that the environmental impact of bio-based polymers is generally better than their petroleum-based counterparts. However, the differences are not significant in all categories. The approach allows a comparison of the environmental impact of PHA and PLA, and provides insights into the sustainability of bio-based polymers.
Polyhydroxyalkanoates (PHA) and polylactide (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 include 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 has been 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), polylactide/terephthalate (PET) and polyethylene (PS). 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 on the selected pair for comparison between bio-based polymers and petroleum-based polymers (PP, PE, P, P). Furthermore, the Meta-Analysis reveals that bio-based polymers can help to mitigate climate change and save non-renewable energy.

TH 349
The effect of system boundary and weight of the life cycle factors on the results of a life cycle assessment (LCA) - Electric generation as example systems

B.S. Simon
Helmholtz Institute Ulm and Karlsruhe Institute of Technology, Eggenstein-leopoldshafen, Germany

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, i.e. 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 to understand the results of LCAs:

- System boundaries (SBs) and their relevance to the results of LCA studies
- Different life cycle phases
- Construction
- Operation, decommissioning as life cycle phases
- Contribution of construction and operation activities to LCA results

In order to pursue sustainability also in this field, Region Lombardia has decided to consider “environmental performance” as a criterion for 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 Regione Lombardia as a strategic support decision tool in the preparation of its new waste management plan. The project is to provide a Meta-Analysis approach to assess the current strategic situation and the possible leverages for a future waste management scenario. To this end, the modelled scenario includes the following 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 1 with 25% recovery system, 2) Stage 15% to recovery system, and 3) 0% of 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.

TH 350
Using LCA in the preparation of the new waste management plan of Regione Lombardia

L. Raggiomiti1, V. Brambilla1, R. Luglietti1, M. Gravini1, M. Grosso1

1 Polytechnic of Milano, Milano, Italy
2 ARS Ambiente srl, Gallarate (VA), Italy

The Lombardy region is among the main regions of Italy with recovery and recycling activities. 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 Regione Lombardia as a strategic support decision tool in the preparation of its new waste management plan. The goal is to use a life cycle assessment to assess the current management situation, and to state strategic indications for the future waste management. The project “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 systems, 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.

TH 351
Life Cycle Assessment for end of life computers in Mexico

A. Gavilán-García1, I. Gavilán-García2

1 Instituto Nacional de Ecología, México, Mexico
2 Unidad de Gestión Ambiental, Facultad de Química, UNAM, México, Mexico

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 more than 340,000 tons annually. Of these, 10% is recycled or valorized, 40% 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 1 with 25% recovery system, 2) Stage 15% 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.

TH 352
Implementation of an integrated technological-LCA modelling tool within the water industry - a pragmatic contribution to decision-making

Y.M. Méry1, L. Tiruta-Barna2, I. Baudin1, E. Benetto1

1 INSA Toulouse (LSBF), Toulouse, France
2 INSA Toulouse, LISPE, Toulouse, France

CIRSEE - Suez Environnement, Paris, France

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 this tool, which makes it benefit from previous modelling efforts and specific industry knowledge. For example, the water industry 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 this tool, which makes it benefit from previous modelling efforts and specific industry knowledge. For example, the water industry 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.

The tool is able to carry out environmental assessments for a whole group of processes, including the different steps of water production from the raw material (water) to the treated water and its usage in different sectors. The environmental assessments are carried out at the level of the plant or of the water utility, depending on the specific requirements. The tool is able to carry out environmental assessments for a whole group of processes, including the different steps of water production from the raw material (water) to the treated water and its usage in different sectors. The environmental assessments are carried out at the level of the plant or of the water utility, depending on the specific requirements.
TH 353

LCA on drinking water production from pesticide contaminated ground water
Technical University of Denmark, Lyngby, Denmark

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
A. Meijer1, D.A.F. Ammitz2

1DeLTA Research Group, Delft University of Technology, Delft, Nederland
2W/E Adviseurs, Urk, Nederland

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. This situation cannot exist for a long time, because using LCA is a complex process of knowledge management. In this case study 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 was crucial 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 given incentives to companies to use carbon footprinting in their consumer communication as well. Consumers show growing interest to, for example, carbon footprints in the food industry. 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 companies in this consultancy company, W/E and the Delft University of Technology, who consultancy experience with LCA in construction. In the development project, generic environmental data on materials were combined with data of maintenance activities gathered by the maintenance companies. The set-up and interface of the calculation tool were designed according to the wishes and practices of the clients. The results are presented according to the three purposes of the tool: optimisation of the performance of maintenance scenarios, comparison of different scenarios, and benchmarking the scenarios with average Dutch maintenance scenarios. The resulting calculation tool is a good example of the effectiveness of this bottom-up approach, aiming to achieve a broad support amongst potential users of this tool.

TH 355

Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS)
R. Salomone1, M.T. Clasadonte1, M. Protto1, A. Raggi1, I. Arzoumanidis2, G. Ioppolo1, A. Lo Giudice1, G. Malandrino1, A. Matarazzo2, L. Petti1, G. Saija1, S. Supino1, A. Zarzoli1

1University of Messina, Messina, Italy
2University of Catania, Catania, Italy
3University of Salerno, Salerno, Italy
4University G. 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) (EMS) tool. At the Italian Ministry of Agriculture, Food, Forestry and Environment (M AFF), 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.

SSB: resistance to change; dispersion of the environment-related information; in Envrl. Management Systems (EMS) little attention is paid to product performances

ARROWRIGHT[S]: spreading an envrl. culture change and involvement; structural and organized vision of envrl. aspects; internalize product requirements within the EMS [ARROWRIGHT[T]: envrl. training and dissemination; EMS; Integrating EMS with a Quality Management System [ARROWRIGHT[T]: Integrated Quality and Envrnl. Management System

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

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

Finnish guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry

MTT AgriFood Research Finland, Helsinki, Finland

Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years, have guided the agri-food industries in life cycle assessment on company and product level. Growing general knowledge and pressure to act on climate change has given 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 sector-specific guidelines to support communication with external dissemination; identification of the proper envrl. label/declaration [ARROWRIGHT[T]: EPLDs; envrl. product communication; guidelines to support decision making [ARROWRIGHT[T]: EPLD guidelines

The results are presented according to the three purposes of the tool: optimisation of the performance of maintenance scenarios, comparison of different scenarios, and benchmarking the scenarios with average Dutch maintenance scenarios. The resulting calculation tool is a good example of the effectiveness of this bottom-up approach, aiming to achieve a broad support amongst potential users of this tool.

TH 357

Life cycle thinking applied to an immunoprotective product (vaccine) used for boar taunt control in male pigs
M. Moraes1, J. Allison1, J.A. Robinson1, P. Suarez1, P. Borla2, P. Boeri2, P. Bulaj3

1Pfizer Animal Health, Madison nj, United States of America
2Life Cycle Engineering, Tortino, Italy
3Zoetis Animal Health (USA) started to apply the Life Cycle Assessment (LCA) methodology to some innovative products, with a first case-study on ImprovacTM, an immunoprotective vaccine (vaccine) for male pigs that, by providing farmers with an alternative way to avoid the problem of boar taint, also allows them to increase the efficiency of male pig production, which may in turn provide considerable life-cycle environmental and social aspects benefits: to avoid physical castration is in fact perceived as an animal welfare issue by many in the public sector. In 2010, after an initial project which included a consistent data collection from the vaccine production plants as well as from farms and slaughterhouses at global level, the first Environmental Product Declaration or EPD on a veterinary product was published by the International EPD System, a well recognition ISO 14025 Program Operator (www.ipe-d.org). The data of this project 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.

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 both the pork industry 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 first Environmental Product Declaration or EPD on a veterinary product was published by the International EPD System, a well recognition ISO 14025 Program Operator. 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.
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. 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 optimal conditions for the mussel sustentation were put into the pilot-plant to carry out the second step, which is in execution at this moment.

The project plan foresee 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 data from two nylon tanks with “Plexiglas” panels, each filled with tap water in which the Plexiglas panels were horizontally positioned.

The results of the pilot program confirm that PEF Guide application and used to provide feedbacks about the PEF Guide.
Particle phase samples were taken in parallel using a cascade impactor with cut-off diameters of 11.4 µm (A4, B4), 3.81 µm (A3, B3), 1.38 µm (A2, B2), 0.46 µm (A1, B1), and 0.19 µm (A0, B0). The equipment employed in the assays consists in a tubular reactor of borosilicate glass, (600ml) operating in a recirculating circuit, irradiated with an UV 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 (60mm). 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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-4
Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
J.J. Rueda-Márquez, A. Acevedo-Merino, M.A. Manzano
CACYT-UPM - University of Cádiz, Puerto real, Spain

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 UV 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 (60mm).

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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
M. Constantino1, S.D. Comber1, M.J. Gardner1, M.D. Scrimshaw2, A. de Polo2
1AstraZeneca, Bracknell, United Kingdom
2University of Portsmouth, Brixham, United Kingdom

Binding and sequestration of perfluorinated surfactants in soil
J. Campbell1, E. May1, J. Mitchelmore1, G. Williams1
1University of Portsmouth, Brixham, United Kingdom

The influence of terminal electron acceptor on the removal of pharmaceuticals in Anaerobic digester sludge
J. J. Rueda-Márquez, A. Acevedo-Merino, M. A. Manzano
1CACYT-UPM - University of Cádiz, Puerto real, Spain
2Eurofins GfA, Hamburg, Germany

Bioavailability of perfluorinated surfactants in biosolids and sewage sludge
J. Campbell1, E. May1, J. Mitchelmore1, G. Williams1
1University of Portsmouth, Brixham, United Kingdom

The influence of terminal electron acceptor on the removal of pharmaceuticals in Anaerobic digester sludge
J. J. Rueda-Márquez, A. Acevedo-Merino, M. A. Manzano
1CACYT-UPM - University of Cádiz, Puerto real, Spain
2European Institute of Crop Science and Resource Conservation Soil Science Division, Bonn, Germany
3University of Portsmouth, Brixham, United Kingdom

Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
J.J. Rueda-Márquez, A. Acevedo-Merino, M.A. Manzano
CACYT-UPM - University of Cádiz, Puerto real, Spain

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 UV 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 (60mm).

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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
M. Constantino1, S.D. Comber1, M.J. Gardner1, M.D. Scrimshaw2, A. de Polo2
1AstraZeneca, Bracknell, United Kingdom
2University of Portsmouth, Brixham, United Kingdom

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 UV 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 (60mm).

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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
M. Constantino1, S.D. Comber1, M.J. Gardner1, M.D. Scrimshaw2, A. de Polo2
1AstraZeneca, Bracknell, United Kingdom
2University of Portsmouth, Brixham, United Kingdom

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 UV 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 (60mm).

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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
M. Constantino1, S.D. Comber1, M.J. Gardner1, M.D. Scrimshaw2, A. de Polo2
1AstraZeneca, Bracknell, United Kingdom
2University of Portsmouth, Brixham, United Kingdom

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 UV 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 (60mm).

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.

Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).
of target compounds’ concentrations were investigated and the results were compared to those reported in the literature for other WWTPs worldwide. Daily mass flows quantification of the target compounds varied from 0.29 to 3.0 ng L⁻¹ and from 0.15 to 1.5 ng g⁻¹ for liquid and solid samples, respectively. The seasonal and daily variations Two seasonal sampling campaigns were performed and samples were taken in seven consecutive days in each sampling campaign. The analytes were extracted by solid-phase

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.

Analyses of PFAS were achieved by using an on-line SPE-HPLC-MS-MS system. Recovery for PFASs for all analytes was above 70% at µg/L levels. Limits of detection (LOD) ranged from 0.2 to 2.5 ng/l.

The presence and behaviour of perfluorinated compounds in sewage sludge S. Lacorte1, C. Gomez-Canal1, J. Barth2

IDAEA-CSIC, Barcelona, Spain

Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

Perfluorinated compounds (PFCs) are a group of emerging environmental pollutants and have emerged as significant global environmental pollutants with persistent, bioaccumulative and toxic properties. After use or disposal of PFC-containing products, these compounds enter Waste Water Treatment Plants (WWTP) and accumulate in sludge because their intrinsic physicochemical properties make them resistant to final mineralization. Among other options, the use of sewage sludge as agricultural fertiliser is common practice all over Europe. The aim of this study was to determine the presence of 5 perfluorinated compounds (PFCs), namely perfluorooctanesulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorobutane sulfonate (PFBS), perfluorobutanoic acid (PFBA) and perfluorooctane sulfonamide (PFOSA), in sewage sludge and wastewater at WWTPs. For this purpose, samples of sewage sludge originating from 15 WWTP from Spain and Germany were selected. Two seasonal sampling campaigns were performed and the results were compared to those reported in the literature for other WWTPs worldwide. Daily mass flows normalized to inhabitants were also calculated and distribution of target compounds between dissolved and particulate phase was determined for wastewater samples. A mass balance was also performed to investigate the fate of PFCs during wastewater treatment processes and to estimate the role of degradation and sorption on their removal. According to the results, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) were detected in all samples and they were the major contaminants in wastewater and sludge. The aim of this research was to investigate the sorption potential of different PFCs to three different types of sludge (primary sludge, secondary sludge and digested sludge). These WWTP receive both urban and industrial wastes. PFCs were detected at 0.28 and 5.15 ng/dw for Spanish sludge and from 14.2 to 36.0 ng/dw for German Sludge, with differing concentration patterns of the individual compounds. In addition, the degradability of PFCs in the sludge treatments (primary sludge, anaerobic digested and centrifuged sludge) was evaluated and we found that anaerobic digestion and centrifuging did not have an effect on the PFC elimination. Subsequently, the amount of PFCs accumulated per ton of sludge generated was determined for each WWTP. According to the use of sludge in each country, the calculated contribution of PFCs to agricultural soils was estimated between 0.06 and 12.88 g/ha. Finally, the concentrations of PFCs determined in agricultural soils and sludge from agricultural soils were as a way to determine the real impact of PFCs in soils. Although there are no legislated limits for PFCs in sludge (Council Directive 86/278/EEC and Royal Decree 1310/1990, regulating the use of sewage sludge in agriculture), its use in agriculture may lead to diffusion of pollutants and groundwater contamination. In Spain, 95% of the sewage sludge is used as fertilizer in agriculture, while in Germany, most of the sludge is incinerated or used for landfilling.

Biodegradation of proposed PFOA & PFOS precursors in aerobic batch assays M. Obernolte1, M. Greng2, M. Lerze2, M. Seng1, W. Puttmann2

Bavarian Environmental Agency, Wielenbach, Germany

Geotechnic Landesaufkommen Umwelt, Wielenbach, Germany

Goethe Universität, Frankfurt a.m., Germany

Perfluorinated compounds (PFCs) are a group of emerging environmental pollutants even though no natural sources of PFC have been proposed. Nevertheless they can be detected in the environment throughout the world. Due to their unique water-, fat- and oil-repellent as well as stain-resistant properties, they are widely used in various industries and consumer products. Some of them are classified as persistent, bioaccumulative and toxic compounds. Hence they display a threat of nature. Potential sources of PFC can be consumer and industrial products as well as manufacturing processes. In some sewage treatment plants worldwide, an increasing mass flow of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) was observed with higher concentrations in the effluents compared to measurements in the influents. This leads to the assumption that there have to be precursors which are biodegraded during the sewage treatment process. The aim of this work was to identify the precursors for PFOA and PFOS by studying their aerobic biodegradability. Amongst others perfluorooctanesulfonamide (PFOSA) 1, 8:2 telomer acid (8:2 FTCIA), 8:2 telomer alcohol (8:2 FTIOH) 1,1 and a technical product containing polyfluoralkyl sulfates were chosen to study their fate in aerobic batch assays. The test period was 14 days each at a water temperature of 12.7°C. The activated sludge samples were obtained from a municipal sewage treatment plant and were dosed with the EN ISO 9888 guideline, June 1999, with a 10-times higher phosphate buffer concentration. The water and sludge samples were analyzed using LC-MS/MS and GC-MS. All in the above mentioned substances degraded to PFOA or PFOS in ranges from 1 to 8 per cent during 14 days. The lowest metabolic rate was monitored for PFOSA. In addition, biodegradation was also performed on the sludge of perfluorooctanoic acid (PFHxA) as well. The absence of degradation products in the abiotic controls show that the metabolism has to be attributed to microbial degradation only.


Identification of the sources of polyfluoralkyl substances (PFASs) in the Italian surface waters S. Piettenelli, M. Rusconi, S. Valacchi

CNR-IRSA, Brugherio, Italy

A survey of the distribution of perfluorinated carboxylates (from C5 to C10) and perfluorinated sulfonates (C4 and C8) in the main Italian river basins have been carried out in 2011 in order to get a reliable picture of the polyfluoralkyl substances (PFASs) contamination and possibly to identify the main sources for the aquatic environment. Monitoring campaigns on river Po (north of Italy), the major Italian river which flows in the Adriatic Sea, its tributaries, river Adige, river Tevere, river Arno and river Brenta have been carried out in different hydrological conditions. A survey has been performed also in transitional coastal areas such as river Po Delta and Lagoon of Venice. Chemical plant discharges and drinking waters present in the same basins were also sampled. Analyses of PFASs were achieved by using an on-line SPE-HPLC-MS-MS system. Recovery for PFASs for all analytes was above 70% at µg/L levels. Limits of detection (LOD) ranged from 0.2 to 2.5 ng/l.
For 2009 and 2010, the substance spectrum was clearly dominated by PFOS at average concentrations of about 150-260 ng/g dry weight. Longer chain carboxylates were also detected, with maximum concentrations encountered in the landfill leachate plume being 1758 ng/L perfluorooctanoic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBA).

Fishes were captured from August 2008 to January 2009 at 3 sites located upstream and downstream of the Lyon metropolitan (France). The four freshwater fish species analysed were strongylid (Squalius cephalus), pallid european eel (Anguilla anguilla), roach (Rutilus rutilus) and bream (Abramis brama). This allowed for comparison on contamination level according to the fish species and also to the sampling site will be presented and discussed.

Results on the quantification frequencies, mean, median and maximum concentrations measured for the 14 AP and the other selected compounds in the 49 fish samples were 10-55 µg/kg fresh weight (fw), respectively. 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 hexabromocyclododecane (HBCD), 9 polybromodiphenylethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for biota (10 and 55 µg/kg fresh weight -fw- respectively) [E.C., 2008].

The Daughter Directive [EQS Directive, 2008/105/CE; EC, 2008] details the application of the Water Framework Directive for the monitoring of priority substances and other pollutants in surface waters; in particular, it requires the implementation of temporal and spatial trend monitoring programs. The use of integrative matrices (biota and sediments) is strongly recommended to achieve such objective, especially for compounds having a log Kow > 3.

The extent of contamination of groundwater by PFAA and the contamination pathways to groundwater bodies remain largely uncertain. Seasonal distribution of perfluorinated compounds (PFCs) in surface water from Elbe River and North Sea, Germany

C. Miege1, A. Pettetti2, P. Labadie3, H. Budzinski1, B. Le Biasc4, K. Vorkamp5, J. Tronczynski6, H. Persat7, M. Coquer4, M. Babut8

1, IRSTE A, Lyon, France
2, CNRS/UPMC, UMR 7619 Systepe, Paris, France
3, University of Bordeaux 1, EPOC-LPTC laboratory, Bordeaux, France
4, LABERCA laboratory, ONIRIS Atlantole, Nantes, France
5, University of Aarhus, Department of Environmental Science, Roskilde, Denmark
6, IFREMER, Biogeochemistry and Ecotoxicology, Nantes, France
7, University of Lyon 1, UMR CNRS 5023, Lyon, France

IRSTE A, Lyon, France

The monitoring campaigns allowed to identify hot spots in the major Italian basins. 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 23 ng/L). Fluorine content in the Taneo river water, was confirmed as the main source of the latter molecule. Plant for the production of fluorochemicals, 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 also identified as a significant source of PPEA and PFPA which are discharged in the Taneo river basin and in river Arno. These shall be considered as tracers for 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 diffusion of these substances in the pristine water samples in the same area has also been studied.

TU 008
PFAA sources to groundwater drinking water: identification and origin
C. Eschaudier1, K.J. Raat2, P.J. Stuyza3, P. De Voogt4

1, KWR watercycle research, Nieuwegein, Nederland
2, WWR Watercycle Research Institute, Nieuwegein, Nederland

All these PFCs can be contaminated with other compounds due to contamination from the river Taneo basin and the urban/military water contaminated the abstracted water. Based on the hydrological modeling it was shown that 1% of the pumped 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
Z. Zhao, Z. Xie, A. Moeller, R. Sturm, R. Eisingham

University of Hamburg, Geesthacht, Germany

Since the ubiquitous occurrence and potential toxicitiy to human beings, the perfluorinated compounds (PFCs) have attracted more concerning 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 (POPs). Recently, more substitutes, i.e. perfluorooctane 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 (PFCAs) 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 PFCs in river and coast water.
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.1 Because of its high trophic position, the WTSE is a very interesting biomonitoring species for studying accumulation of persistent organic pollutants (POPs).

In order to acquire the base knowledge on the dynamics and bioaccumulation 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 aquatic 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.5 In addition, tail feathers were sampled at active nests sites of WTSE situated in Northern Norway (n=3) 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 PFHxDA were detected. In some cases, PFNA, PFUnA and PFTrA were detected in minor concentrations as well. The average concentrations of the primary wing 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

L.B. Jasperse, D. Herkeze, I. Eulales, B. Gillespie, M. Eens

University of Antwerp, Wilrijk, Belgium

**TU 014**

Monitoring of perfluorinated compounds

S. Falk, H. Brunn, S. Georgi, T. Stahl

Hessian State Laboratory, Wiesbaden, Germany

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 PFC. Concentrations of 5.2 µg/kg and 143 µg/kg were detected in muscle tissue as the sum of PFC detected. In liver tissue the mean PFC concentration was below the LOQ.

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 PFOA concentration was below the LOQ. In liver tissue the mean PFOA concentration was 4.02 µg/kg (Maximum value 45 µg/kg).

Foodstuffs:

Measurements of 82 samples of French fried 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 carrot 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.

(1) T. Stahl, S. Falk, K. Failing, J. Berger, S. Georgi, H. Brunn, Article title: PFOA and PFOS in Liver and Muscle Tissue from Wild Boar in Hesse, Germany, Arch Environ Contam Toxicol, DOI: 10.1007/s00244-011-9726-3

**TU 015**

Development of a pharmacokinetic model (PBPK) for the assessment of infant exposure to PFOS and PFOA for health risk assessment

F. Fabregas, N. Nadal, M. Schulmacher, J.L. Domingo

URV, Tarragona, Spain

Laboratory of Toxicology and Environmental Health, URV, Reus, Spain

Universitat Rovira i Virgili, Tarragona, Spain

Perfluorinated compounds (PFCs) are very stable compounds with a lot of industrial application, but also very persistent on the biota and the environment. Among them, PFOS (perfluorooctane sulfonate) and PFOA (perfluorooctanoic acid), have a long persistence in the human body (4–6 years). This persistence creates an important concern among the scientific community and the health authorities. In fact, PFOS was listed under the Stockholm Convention in May 2009 as a persistent organic pollutant (POP), while PFOA is a serious candidate to enter that list. The main target organs of accumulation are blood and breast milk. Thus, PFCs can be a risk for adult population and infant. In order to assess the tissue concentration, PBPK models are able to assess the concentration along the time in the main target organs of concern. PBPK models are mathematical representations of the human body where the organs are considered as compartments, and they can be resolved computationally as a set of equations. The PBPK model presented here is a multi-compartmental model for PFOS and PFOA for adult and childhood exposure during the breastfeeding period. Aside from the blood and breast milk, another tissue such as brain and kidney have been considered. PFCs are well absorbed, non metabolized and eliminated by urine and breast milk. The main source of exposure for adult population are food and water intake. The data for food and water ingestion have been obtained from a large monitoring study in Catalonia, Spain.

For toxicity, the tissue residue approach (TRA) was used. The TRA is the use of tissue concentrations as the dose metric for characterizing toxicant potency. The PBPK model has been validated by comparing theoretical values with experimental data of PFCs chemicals in blood serum and breast milk collected in Catalonia, Spain. Finally, uncertainty and sensitivity analyses have been performed. A normalized local sensitivity analysis was performed on the model to examine the influence of each model parameter on the model output. Sensitivity coefficients were calculated for the predicted plasma area under the curve (AUC; total concentration) with the original parameters and for those resulting from a low change in each parameter value.

**TU 016**

Acute toxicity of perfluorinated compounds to two kinds of cladocerans

J.G.M. Peijnenburg, G. Ding

RIVM, Bilbown, Nederland

Dalian Maritime University, Dalian, China

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 disposition. 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 advantages of being useful 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 perfluorooctanoic 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 carbonyl and acids on two cladocerans, Daphnia magna and C. sphaericus, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing concentrations of compounds with the same chain length. It was observed that compounds with a sulfonate group have a larger toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFOBs>PFSAs>PFA. 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 compounds. 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. Other relevant compound was PFBA found in higher concentration 53900 ng/L.

The preliminary results of this study presents the profile and concentrations of 18 PFCs in cord blood samples from Catalonia (Spain). In this study we found that the more long chain length compounds have a higher persistence in the body. For the standard analytical procedure we used: MNB (13perfluorooctanes and 4perfluorosulfonates) and perfluorooctanesulfonamide (PFOSA) from Wellington Laboratories Inc., Daikin Industries ltd, Osaka, Japan. H . Iwai, N . Tsuda

Ammonium perfluorooctanoate (APFO) has long been used for polymerization of fluororesins and rubber. There are many reports on the hazards of perfluorooctanoate (C8).

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 carbonyl and acids on two cladocerans, Daphnia magna and C. sphaericus, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing concentrations of compounds with the same chain length. It was observed that compounds with a sulfonate group have a larger toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFOBs>PFSAs>PFA. 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 compounds. 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. Other relevant compound was PFBA found in higher concentration 53900 ng/L.

The preliminary results of this study presents the profile and concentrations of 18 PFCs in cord blood samples from Catalonia (Spain). In this study we found that the more long chain length compounds have a higher persistence in the body. For the standard analytical procedure we used: MNB (13perfluorooctanes and 4perfluorosulfonates) and perfluorooctanesulfonamide (PFOSA) from Wellington Laboratories Inc., Daikin Industries ltd, Osaka, Japan. H . Iwai, N . Tsuda

Ammonium perfluorooctanoate (APFO) has long been used for polymerization of fluororesins and rubber. There are many reports on the hazards of perfluorooctanoate (C8).

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 carbonyl and acids on two cladocerans, Daphnia magna and C. sphaericus, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing concentrations of compounds with the same chain length. It was observed that compounds with a sulfonate group have a larger toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFOBs>PFSAs>PFA. 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 compounds. 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. Other relevant compound was PFBA found in higher concentration 53900 ng/L.

The preliminary results of this study presents the profile and concentrations of 18 PFCs in cord blood samples from Catalonia (Spain). In this study we found that the more long chain length compounds have a higher persistence in the body. For the standard analytical procedure we used: MNB (13perfluorooctanes and 4perfluorosulfonates) and perfluorooctanesulfonamide (PFOSA) from Wellington Laboratories Inc., Daikin Industries ltd, Osaka, Japan. H . Iwai, N . Tsuda
TU 022
Plastic debris and toxin releases in the Pacific Ocean
J.P. Greene
California State University, Chico, Chico, United States of America

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 released to the oceans can lead to fragmentation and result in smaller particles that can degrade and release toxic chemicals such as phthalates, flame retardants, BPA, antimony oxide, heavy metal niks, and styrene monomer as the plastics break down. Plastics can accumulate toxins floating in the oceans from persistent organic pollutants (POPs). POPs can include DDT, hexachlorobenzene, polychlorinated biphenyls (PCB), polychlorinated aromatic hydrocarbons, among others.

TU 023
Micro-plastics in the marine environment - a global assessment
J. Kershaw1, H.A. Leslie1
1CEFAS, Lowestoft, United Kingdom

Institute for Environmental Studies (IVM), VU University, Amsterdam, Nederland

GESAMP has set up a new Working Group entitled ‘Sources, fate and effects of micro-plastics in the environment - a global perspective’. With a 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 transport, fate and effects of both microplastic particles and the contaminant burden. It will provide an evidence base for use by policy makers, regional bodies a 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
G. Linken1, G. Hanke2, S.S. Sadri1, R.C. Thompson1
1European Commission Joint Research Centre, Ispra (va), Italy
2University of Plymouth, Plymouth, United Kingdom

Plymouth University, School of Marine Science and Engineering, Plymouth, United Kingdom


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 amount, distribution and, where possible, composition of micro-plastics 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-plastics (10.1.3)

TU 025
Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters
S.S. Sadri1, M. Edwards1, R.C. Thompson1
1University of Plymouth, Plymouth, United Kingdom

Sir Alistair Hardy Foundation for Ocean Science (SAHFOS), Plymouth, United Kingdom

Fragmentation of plastics debris into "microplastic" pieces is an emerging issue of concern. Our knowledge of distribution and accumulation of microplastic 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 study is to research 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 Alistair 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 most common plastic types were Polysterene terephalate(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. Fillmann1, F. Poleza2
1FURG, Rio grande, Brazil
2G. Fillmann, Bastia, France

University of Plymouth, Plymouth, United Kingdom

The most common plastic types were Polyethylene terephtalate(PET) followed by Nylon and Acrylic but mean abundance was typically less than one item per cubic meter of sea water.

TU 027
International Pellet Watch : background levels, hot spots, legacy pollution, and temporal trends
H. Takada1, M. Heskett1, R. Yamashita2, M. Yoyama3, M. Itoli1, T.B. Geok1
1Tokyo University of Agriculture & Technol., Tokyo, Japan
2Surfrider Foundation, Oahu, United States of America
3Institute for Environmental Studies (IVM), VU University, Amsterdam, Nederland

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 background levels of persistent organic pollutants (POPs) plastic debris has been tentatively determined. By comparison of POPs concentrations in pellets from industrially-developing countries (e.g., Ghana) with the background levels, PCB inputs from e-wastes were suggested. Through global comparison, hot spots of PCB pollution were identified, e.g., Le Havre (France), Athens (Greece), Tokyo Bay (Japan), Sydney Harbor (Australia), Los Angeles, San Francisco, Boston Harbor, New York, 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. Golstein1, M. De Klerk1, A.J. Hendriks2
1Radboud University, Nijmegen, Nederland
2University of Agder, Kristiansand, Norway

The presence of plastic debris in the oceans is a potential hazard for marine animal species in several ways. It is not only the plastic materials themselves that form a potential hazard. Chemicals leached from used plastics is released during plastic 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 hazard are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into a smaller fraction. A short timeframe, lasting with a wide range of both life 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.

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
The first result obtained from this study was that a large number of plastic was found, prevalently into the intestine, in more than 60% of the animals. The main categories of substances found were sheetlike, threadlike, and fragment-like plastics. These findings were substantiated by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.

Modeling of a wide range of plastics in order to understand the potential for these plastics to adsorb POPs in the environment. It would also be possible to further develop a calibration curve with points at 0.1, 1, 5, and 10 µM were analyzed in culture media. The correlation coefficient for this calibration curve was 0.9969. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.

Triclosan, 5-chloro-2-(2,4-dichlorophenoxy)phenol, is a broad-spectrum bactericide used in pharmaceuticals and personal care products of daily use. It is a non-volatile organic compound and tends to adsorb on particles in the environment. A calibration curve with points at 0.1, 1, 5, and 10 µM were analyzed in culture media. The correlation coefficient for this calibration curve was 0.9969. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.
In this presentation the results of batch equilibrium sorption tests with different sludges will be shown for several pharmaceuticals. The variability of the adsorption after derivatization for polar compounds. Samples from Sites A, B, and C had similar compound profiles. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Sites A, B, C, and D are both at the mouth of creeks and rivers flowing into Port Phillip Bay; Site D is about 5 km upstream of site C in Melbourne on the second biggest river entering Port Phillip Bay. Although there are several small wastewater treatments located at different levels of H2O, the presence of domestic and municipal wastewater. Their removal in conventional WWTPs is generally lower than 50%, with no removal for bezafibrate, hydrochlorothiazide, furosemide, and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e., disinfection, treatment). The results of pharmaceutical active substances discharged in the environment daily through treated wastewater ranging between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces of pharmaceuticals were found in the low ng/L range, also in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 035

A comprehensive overview of pharmaceutical sources and fate in a highly urbanized and inhabited area in Italy
S. Castiglioni, R. Bagnatt, M. Melis, P. Camporini, E. Zuccato
Mario Negri Institute for Pharmacological Research, Milan, Italy

Pharmaceuticals are considered emerging environmental contaminants of particular concern, as many of them display biologically active properties and can be excreted unchanged and/or as active metabolites in urine and feces, and directly conveyed to wastewater treatment plants (WWTPs). If they escape degradation during wastewater treatment, they finally end up in surface water. The present study aimed for the first time to study sources and fate of several selected classes of pharmaceuticals in the most inhabited and industrialized area in Italy (urban and suburban area around Milan).

The investigation was conducted in water, surface, and ground water. Composite samples were collected, filtered, enriched with internal standards and solid-phase extracted. LC-ESI-MS/MS with multiple-reaction monitoring and stable-isotope dilution assay was used for quantitation. Recoveries were generally higher than 80% and limits of quantification were in the low ng/L range. Ciprofloxacin, ofloxacin, atenolol, furosemide, hydrochlorothiazide, chlorotyramine, thiorpethin, ketoprofen, diclofenac, naproxen, and carbamazepine were the most abundant residual drugs in urban wastewater. Their removal in conventional WWTPs is generally lower than 50%, with no removal for bezafibrate, hydrochlorothiazide, furosemide, and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e., disinfection, treatment). The amounts of pharmaceutical active substances discharged in the environment daily through treated wastewater ranged between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces of pharmaceuticals were found in the low ng/L range, also in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 036

An evaluation of free water surface wetlands as tertiary sewage water treatment of micro-pollutants
M. Grootjans1, R. Stuiver1, J. Bokma1, H. Berg2, R. Grabe1, J. Fick1
1Stockholm University, Stockholm, Sweden
2Water Revival Systems Uppsala AB, Uppsala, Sweden

Ecosystems are potentially contaminated by many chemical substances from domestic activities, through the spreading of treated sewage sludge. Indeed during the last thirty years, the application of municipal sludge from urban to agricultural soils is the option favoured internationally for sludge management as it contributes positively to recycling nutrients and organic matter and improves soil fertility. The literature data indicate that the removal efficiencies of organic contaminants in sewage treatment plants vary between 24 and 100% depending on the contaminants and treatment processes, which means that significant percentages of products can be present in the sludge.

Steroid sex hormones and pharmaceuticals are considered emerging environmental contaminants of particular concern, as many of them display biologically active properties (including endocrine-disrupting). At the European level, few studies exist on the characterization of these emerging substances in sludge or on the assessment of health and environmental risks associated with their use.

This is partly explained by the difficulties of detection and quantificaion of such pollutants in the solid phase. It is, indeed, a real analytic challenge given the diversity of phytochemical species, Coping methods and the complexity of the matrix which makes difficult the extraction step. Thus it appears that the development of environmental 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-tandem mass spectrometry. The analysis of complex matrices such as sludge needed a rigorous sample preparation before and after the city of Milan. Traces of some compounds as carbamazepine were found in the low ng/L range also in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 037

Large screening of pharmaceuticals and hormones in sludge based on LC-ToF-MS
E. V. Vuillet1, J. Camilleri2, W.P. Peysson1, C.G. Cren-Olive1
1Institut des Sciences Analytiques, Solaise, France
2UMéa University, Umeå, Sweden

Environmental risk assessment of the potential for human pharmaceuticals to the environment has to be determined, e.g. according to the EMEA Guideline EMEA/CHMP/366/00. This guideline focuses on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludge. The adsorption to sludge has therefore to be evaluated for terrestrial ecosystems and the complex of the matrix which makes difficult the extraction step. Thus it appears that the development of environmental 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-tandem mass spectrometry. The analysis of complex matrices such as sludge needed a rigorous sample preparation before and after the city of Milan. Traces of some compounds as carbamazepine were found in the low ng/L range also in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 038

Adoption of human pharmaceuticals to activated sludge: how many different sludges should be tested for an environmental risk assessment?
U. Memmert
Eurolabor Regulatory AG, Rheinfelden (AG), Switzerland

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 matter content). The variability of the adsorption after derivatization for polar compounds. Samples from Sites A, B, and C had similar compound profiles. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Sites A, B, and C are both at the mouth of creeks and rivers flowing into Port Phillip Bay. Site D is about 5 km upstream of site C in Melbourne on the second biggest river entering Port Phillip Bay. Although there are several small wastewater treatments located at different levels of H2O, the presence of domestic and municipal wastewater. Their removal in conventional WWTPs is generally lower than 50%, with no removal for bezafibrate, hydrochlorothiazide, furosemide, and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e., disinfection, treatment). The amounts of pharmaceutical active substances discharged in the environment daily through treated wastewater ranged between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces of some compounds as carbamazepine were found in the low ng/L range also in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 039

Analysis of antimarial drugs in water
M. Escala Casas, M. Hansen, E. Bjørklund, K.A. Krogh
Facultad de Farmacia, Copenhagen, Denmark

Malaria is a general illness in many countries and therefore antimarial drugs are prescribed in great quantities. There are more than 20 different molecules being used
for treatments. These drugs are excreted 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 antiinhalants in the environment. It is believed that some of these drugs are rather persistent due to their organohalogen moieties. Hence, the fate of these drugs in the environment might be a subject of concern.

To monitor these drugs, methods to analyze antiinhalants in blood and urine have been published. However, only two methods have been published to analyze a few antiinhalant drugs (aromimimic derivatives and chloroquine) in water or soil. For that reason, the first multi-residue method for the analysis of antiinhalant 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 describe environmental fate profiles of antiinhalant 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 selection of pollutants such as pharmaceuticals 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 influent and effluent samples should be compared to sampling on the basis of 24-h composite samples (time-proportional) which allowed to explain >80% of the origin of the effluent load sampled. Results showed that the method was capable of reproducing realistic elimination values while short-term mass balances lead to erroneous results.

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, shampoo, deodorants, cosmetics, mouth rinse 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 biodegradation pathway. Triclocarban is recalcitrant during the sewage treatment process and is detected in streams and sediments downstream of WWTPs. TCS is amenable to biodegradation during sewage treatment and both TCS and the transformation product methyl-triclosan (MTCS) are detected in WWTP effluents.

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 % in sludges on the aquatic plants 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 impact.

In the present study, we designed an individual sampling strategy using hydraulic calibration of a Luxembourg WWTP to validate the proposed model. The elimination efficiencies of calculated 3-day influent and 1-effluent campaign were compared on the basis of 24-h composite samples (time-proportional) which allowed to explain >80% of the origin of the effluent load sampled. Results showed that the method was capable of reproducing realistic elimination values while short-term mass balances lead to erroneous results.

TU 042
Dominant time scale of antibiotics concentrations in waste waters through one-year field campaign study
S. Couta, V. Wyschn, L. Rossi

EPEL, Lausanne, Switzerland

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 waste waters, few of them curiously have focused on the temporal dynamics of their concentrations. In the presented study, we compare the relative importance of monthly, weekly, daily, and hourly time scale when assessing the dynamics of antibiotics in wastewater.

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-XMS, and the concentrations of 9 antibiotics (azithromycin, ciprofloxacin, ofloxacin, clarithromycin, clindamycin, metronidazol, norfloxacin, sulfamethoxazol, trimetoprim) were compared. We conclude that even if a seasonal trend for concentrations can be observed for several substances, the hourly time scale totally dominates 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: development and validation of a QuECHERS based extraction
J. Camilleri, M. Tournier, R. Bonoli, E. Wiest, E. Vallée, C. Cren-Olivel

Institut des Sciences Analytiques, Villeurbanne, France

Accessing exposure concentrations can be challenging for the analyst as environmental concentrations and toxicological or eco-toxicological effect induced quantities are often not consistent with analysis capacities. To encounter those limitations analysts use pre-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 Cheap Effective Rugged and Safe has been developed for the analysis of pesticides in food matrices. This method is a multiresidue extraction method developed and validated a multiresidue analytical method 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 pharmaceuticals includes β-blockers, anti-inflammatories, antibiotics, analgesics, anti-depressants and anti-inflammatory 24 EDCs includes pesticides, alkylphenols, hormones and phenolic derivate.

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, 1.7µm).

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 intra- and interday system injections of 3 independent standard solutions. Repetition of a calibration over three days allowed for acceptable recovery IDSD. Limits of quantification were determined by injection of 3 independent standard solutions and were consistent with environmental concentrations.

References

TU 044
Developing a miniaturized push-pull test to study the transformation of pharmaceuticals in the hyporheic zone of rivers
M. Radke1, C. Lauschn, U. Kunckel2

1Stockholm University, Stockholm, Sweden
2University of Bayreuth, Hydrology, Bayreuth, Germany

The hyporheic zone is a key compartment for the attenuation of organic micropollutants in rivers. The comparatively slow flow velocity, the continuous input 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 not possible due to limitations of the 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 established methods of testing the transformation capacity of aquifers with respect to organic or inorganic contaminants. There, a column containing a set of conservative and reactive tracers is installed (“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 used to estimate in situ transformation rates. The aim of our study is to downscale this approach so that it can
be used on the spatial scale of centimetres to decimetres. The experimental concept is validised 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 under biotic conditions with the same set of pharmaceuticals and, in addition, with some reference compounds. Our contribution will summarise 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 discharge from a centralized municipal treatment plant and on-site wastewater treatment systems receiving community-scale wastewater influent
Baylor University, Waco, tx, United States of America
Thornton, 25% of the United States population employs decentralized on-site technologies for wastewater treatment, a comparative understanding of treatment efficacies of these systems remains lower 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 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 that further examined the occurrence of CECs, including a group of abuse metabolites, between weekend and weekday sampling events. The studied CECs covered a variety of common pharmaceutical classes, including analgesic, anti-hypertension, antibiotic, psychostimulant metabolites, antihistamine, anti-seizure, benzodiazepine, anti-inflammatory, anti-arrhythmic, and artificial sweetener sucralose, which appears to represent a robust tracer of anthropogenic activities. The study used chromatography tandem mass spectrometry (LC-MS/MS) method to identify chiral independent isotopically-labeled standards for quantitation of each compound 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 common on-site wastewater treatment systems.

TU 046 Water-sediment biodegradation: challenges in modeling and screening for pharmaceutical transformation products
F. Ericson
Pitzer Inc, Groton, United States of America
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; and as such can provide valuable information on transformation processes. Given the length of the test period, it is 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 process. Sampling intervals ranging from 1 hour to 24 hours were submitted. The screening studies show the potential of the OECD 308 test 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
L.A. Constantine
Pitzer Inc, Groton, United States of America
Understanding whether an active pharmaceutical ingredient is likely to be taken up from 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 60 days. During the post-exposure phase, fish are allowed to equilibrate with background concentrations in the water. In 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 a study of estimating the number of fish required to obtain a BCF, an approach to estimating the aquatic 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
M. Carney Armbrust1, J. Fick2, E. Cuklev1, L. Forlin1, D.G. Larsson1
1University of Gothenburg, Gothenburg, Sweden
2Umeå University, Umeå, Sweden
Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activity as well as inhaled and systemic use. It is administered as the monopropionate (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 products BMP and BDP is metabolized into the long-acting prodrug 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 prodrg 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 studies. 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
M. Carney Almroth
The College of Wooster, Wooster, United States of America
Depressant 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 sewage were spiked with deuterated sertraline and venlafaxine. Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by microscale solvent extraction 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 microcosms.

TU 050 Time trend of cyclic volatile methyl siloxanes in Baltic herring
A. Kierkegaard1, A. Biggert2, M.S. Mclauchlan1
1University of Gothenburg, Göteborg, Sweden
2Umeå University, Umeå, Sweden
Cyclic volatile methyl siloxanes (CVMS) were measured in voucher specimens collected from the Swedish environmental sample bank. Fish from a site in the Baltic Proper southeast of Stockholm (Landsort) and from the northern part of the Bothnian Bay (Harutjorden) were analysed. Skinless dorsal muscle samples from six individuals were pooled. Two pooled samples were analysed from each site for every second 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 detection limit. The concentrations were generally lower at the beginning of the period and highest around 2005-2007. There were no marked differences in the concentration in the two locations.

TU 051 Degradation studies of the ionophores lasalocid, monensin, narasin, and salinomycin
M. Schultz, J. Murphy, A. Stencel, S. Strand, J. Snider
The College of Wooster, Wooster, United States of America
Degradation studies of the ionophores lasalocid, monensin, narasin, and salinomycin, having logD values > 4.5. 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 under biotic conditions with the same set of pharmaceuticals and, in addition, with some reference compounds. Our contribution will summarise 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.
like: change of pH, ionic strength of solution and temperature were also tested. Various of sorption and kinetics models were used to describe obtained results. 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.

A biotic and abiotic transformation studies were conducted on four isophenoxyacetic anticoagulants; lausalocid, monensin, narasin, and salinomycin. Abiotic studies focusing on hydrolysis and photolysis were conducted following international OECD guidelines. Hydrolysis was observed under acidic conditions for narasin, monensin and salinomycin, while no evidence of photolysis was found. All conditions were evaluated at wavelengths, so that photodegradation of monensin, narasin and salinomycin can be discarded. Biotic degradation studies were conducted in lab-scale biofilters inoculated with Nocydenz extract soil bacterial communities. In addition, during the work with these very lipophilic anticoagulant agents, it was observed that adsorption to analytical equipment was highly relevant to assess under acidic conditions.

For abiotic transformation of the ionophores, the soil bacterium Nitrosomonas europea was used as a screening tool for transformation product toxicity. This effect-directed study was conducted by exposing bacteria to the mixture of ionophore degrades.

**TU 052**

Formation and structure elucidation of stable transformation products of pharmaceuticals in the water cycle

M.H. Li, L. Arpin-Ponti, A. Vanhouthe Brunier, D. Munaron, A. Fiandrino, S. Chiron, H. Budzinski, D. Hillaire-Buys, O. Mathieu, C. Boillot, E. Gomez

1UMR Hydrosciences, Montpellier, France
2IFREMIE, Site, France
3UMR EPOC ITCE, Toulouse, France
4CHU Laboratoire de toxicologie et pharmacologie médicale, Montpellier, France

Pharmaceutically active substances undergo transformations starting from human metabolism to degradation in environmental processes and finally during drinking water treatment. Often degradation during sewage and water treatment and the environment is incomplete, resulting in the formation of stable transformation products. The formation and presence of such stable transformation products in the effluent of sewage works, surface water, and drinking water treatment is reported in the scientific literature with increasing frequency. In only a few cases, full mineralization of the parent compounds is achieved. This is even more of importance as advancements in technology, including employing e.g. ozone, hydrogen peroxide, light or electro-coagulation are increasingly under discussion for the removal of pharmaceuticals and other micro pollutants in effluent treatment and drinking water treatment. Treatments using these technologies may even lead to the formation of transformation products that are more toxic than the parent compound.

In the past, comprehensive information on the degree of contamination of our environment with pharmaceuticals has been collected, but there are still some important knowledge gaps regarding the human and environmental impact of two groups of pharmaceuticals, which will be addressed in the Pharmas project (EU grant agreement no. 263546). On the one hand, for anti-cancer drugs only little information is available on environmental concentrations, while for the antibiotics, concerns are raised regarding their occurrence and the potential role of these compounds in spreading resistance against these valuable pharmaceuticals.

**TU 053**

Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system

H. Fenet1, L. Arpin-Ponti1, A. Vanhouthe Brunier1, D. Munaron1, A. Fiandrino2, S. Chiron1, H. Budzinski1, D. Hillaire-Buys3, O. Mathieu4, C. Boillot1, E. Gomez1

1UMR Hydrosciences, Montpellier, France
2IFREMIE, Site, France
3UMR EPOC ITCE, Toulouse, France
4CHU Laboratoire de toxicologie et pharmacologie médicale, Montpellier, France

Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system

For a selection of pharmaceuticals of both classes, the formation of stable transformation products in various stages of the water cycle (both drinking and sewage) will be investigated in laboratory and pilot scale studies. Treatment processes include mainly chlorination, ozonation and UV-disinfection for drinking water treatment and advanced oxidation processes (AOPs) for water treatment prior to drinking water treatment. For structure elucidation of the transformation products formed, different LC/MS/MS approaches as well as high resolution MS techniques will be implemented. Characterization of the stable transformation products in terms of (eco)toxicological behavior will be done using a battery of in vitro bioassays.

**TU 054**

Fate of anti-diabetic drugs: gliocizide, glibenclamide and glimepiride in soil environment

W. Mrozik, J. Stefanfska

Medical University of Gdansk, Gdansk, Poland

It is estimated that roughly 3.5% of human population suffers from diabetes mellitus type 2. Since large quantities of anti-diabetic drugs are used for treatment, it is possible 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 of off-date drugs. The most common way to enter the natural environment by these drugs is by sewage. Therefore, the most endangered are natural waters, soils and sediments. Composting the comparison 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 often affected by this process.

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, plants. Compared with NSAIDs, antibiotics and anthelmintics, albendazole and flubendazole, were the most dominant. In some receiving water samples, veterinary anthelmintics showed higher proportion than human anthelmintics that were applied. Other micro pollutants in effluent and drinking water treatment. Treatments using these technologies may even lead to the formation of transformation products that are more toxic than the parent compound.

In the past, comprehensive information on the degree of contamination of our environment with pharmaceuticals has been collected, but there are still some important knowledge gaps regarding the human and environmental impact of two groups of pharmaceuticals, which will be addressed in the Pharmas project (EU grant agreement no. 263546). On the one hand, for anti-cancer drugs only little information is available on environmental concentrations, while for the antibiotics, concerns are raised regarding their occurrence and the potential role of these compounds in spreading resistance against these valuable pharmaceuticals.

**TU 055**

Evaluation of pharmaceuticals and personal care products focused on anthelmintics in human-waste, sewage, hospital wastewater, livestock wastewater and receiving water


1Pusan National University, Busan, South-Korea (Rep)
2UNIST, Ulsan, South-Korea (Rep)
3Ajou University, Suwon, South-Korea (Rep)

We investigated 33 PPs focused on anthelmintics in the human-waste treatment plants (HTPs), sewage treatment plants (STPs), hospital wastewater treatment plants (HWTs), livestock wastewater treatment plants (LWTPs) and submarine outfall (SOs) of CBZ and OxCz flow to the coastal zone through the submarine outfall. Regional data on CBZ and OxCz prescription were obtained from the medical care system. CBZ and OxCz prescribed amounts have been studied over 6 months in view to calculate concentrations in wastewater treatment plant effluent and so allow for Predicted Environmental Concentrations (PECs) estimation. The human metabolic pathways of CBZ and OxCz required to include in the model the contribution of the major urinary metabolites: carbamazepine-10,11-epoxide, 10,11 dihydro-dihydroxy-carbamazepine, 10-hydroxy-carbamazepine and other hydroxylated derivatives. PECs lie in the ng/L level in the wastewater effluents and were compared to the measured concentrations (MECs). The diffusion in the coastal zone was estimated with an hydrodynamic numeric model (MARS 3D). The behavior in the coastal zone was qualitatively compared measured concentrations obtained with POCIS passive samplers. Data on pharmaceuticals in the coastal zone are scarce and PECs and diffusion model might therefore be useful for studying pharmaceutical transfer and fate in the coastal environment.

**TU 056**

Degradation of antibiotics by photocatalysis on immobilized titanium dioxide

A.G. Tarnawski1, 2, J. Woytysiak1, P. Arnoux2, O. Zahra2

1CNRS, Nancy cedex, France
2CNRS, Nancy cedex, France

Antibiotics are micropollutants which release in the aquatic environment has been a subject of concern for several years as they can give rise to two problems: i) they can have a direct effect on bacteria, either those involved in wastewater treatment (activated sludge, biofilms) or those present in natural aquatic environment where they contribute to river and lake self-cleaning, ii) they can promote the development of resistance to antibiotics. Resistant genes between bacterial species, including those pathogenic to man and animal. Most antibiotic are non biodegradable and an advanced physicochemical process should be applied for their elimination. There are several such processes but photocatalysis is often proposed as it can be used in the full part of the solar spectrum as an energy source and is reagent free. However most of the works described in literature are based on titanium dioxide slurries. After treatment these nanoparticles should be recover which is not easy. One solution to this problem is photocatalyst immobilization. However immobilized photocatalysts are generally less efficient than suspended photocatalysts as less surface can be activated. Within this framework tests
of photodegradation of two antibiotics often observed 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 and in WWTP. End products (organic carbon and nitrogen species) were also quantified. Degradation was observed, P25 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
F. Bonvini1, J. Omel1, R. Rutler1, T. Kohre2
1Environmental Chemistry Laboratory, Lausanne, Switzerland
2Environmental Chemistry Laboratory, EPFL, Lausanne, Switzerland

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 faster due to its 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 photodegradable, however, with the exception of SMX-glucuronide, half-lives were all greater than that of the parent compound. The protonation state affects absorbance of the parent compound and degradation rate. Slowest direct photolysis rates were observed at environmentally relevant pH 8.4, whereas the anionic form of the compounds predominates, except for SMX-glucuronide. The faster degradation of direct photolysis was attributed to SMX-glucuronide missing an acidic functionality; therefore, in contrast to SMX and other metabolites, it remains in its neutral and more photo-reactive form at environmental pH. In photolysis experiments conducted in lake water (1.19 mg/L NO2: Boxall ABA, Fogg LA, Kay P, Blackwell PA, Pemberton EJ and Croxford A (2003) Tox. Let. 142:207-218 1: Kim M-S, Lim J-H, Hwang Y-H, Park B-K, Song I-B and Yun H-I (2010) Vet. Par. 169:51-56 .

TU 058
Ubiquitous distribution of sulfamethoxazole in tropical Asian and African waters
H. Takada1, A. Shimizu1,2, T. Koike1, A. Takeshita1, N. Nakada1, S. Suzuki2
1Tokyo University of Agriculture & Technol., Tokyo, Japan
2The University of Tokyo, Sci. and Technol., Japan

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 antibiotic resistance is of great concern. Very limited information is available on antibiotics in tropical, subtropical and subpolar areas. Mining activities and waste disposal at the mining area of Messina (Venezuela) are human and veterinary antibiotics: sulfamethoxazole (SMX) and sulfadiazine (SDZ) were found in the concentrations of 5.5 μg/L and 0.8 μg/L, respectively. These antibiotics were also detected in the surface water samples from the rivers, as well as in the river sediments. In the present study, we aimed to assess the occurrence of antibiotics in tropical and subtropical regions. The results showed that antibiotics were ubiquitously distributed in tropical Asian and African waters. The results suggest that antibiotics are a potential threat to the environment in tropical and subtropical regions.

TU 060
Environmental fate, occurrence and toxicity of the antiparasitic pharmaceutical toltrazuril
K.A. Krough1, M.C. Havland2, S.A. Bak1, A. Brandt1, B. Hallin-Sørensen1, E. Björklund1
1University of Copenhagen, Copenhagen, Denmark
2Danish Medicines Agency, Copenhagen, Denmark

Toltrazuril is an organohalogenic endoparasitic pharmaceutical used in the acute and prophylactic treatment of livestock such as poultry, piglets, sheep and cattle against coccidiosis. It is metabolized through stepwise sulfooxidation resulting in pharmacologically active metabolites. Hence toltrazuril is excreted as the parent compound and as two active metabolites: toltrazuril sulfoxide and toltrazuril sulfone, mainly via faeces. The massive use of other anticoxidial drugs has resulted in increasing resistance of the parasites [1] as a result the use of toltrazuril is expected to be escalating. Already in 2003, Boxall et al. [2] expressed concern about this compound and considered it as a high-priority drug with respect to especially environmental and toxicological concerns. However, today still little is known about its environmental occurrence, fate and the open literature. In 2008, concerns were raised by Germany during the Marketing Authorization approval of a toxicology study. (1) Toltrazuril and its metabolites may present a risk to terrestrial and aquatic ecosystems due to toxic effects on terrestrial and aquatic organisms and persistence in the environment. (2) Concerns and compositions of livestock and aquatic wastewater were highly toxic. In many cases, sulfamethazine, oxytetacycline, lincomycin, SMX was predominant among the target antibiotics.
A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment was performed. This evaluation included the effects of TCS on soil microorganisms and microbial respiration and microbial respiration and microbial respiration in the aquatic environment. These effects had an impact on terrestrial and aquatic ecosystems, revealing that TCS can alter community structure and function, leading to changes in biogeochemical processes, and impacting the ecosystem's productivity and stability. The study also highlighted the importance of considering the interplay between terrestrial and aquatic ecosystems to fully understand the environmental impacts of TCS.

**TU 066**

Risk assessment of pharmaceuticals incidentally discharged to the terrestrial environment


**AstraZeneca UK Ltd, Brixham, United Kingdom**

The Environmental Risk Assessment (ERA) of pharmaceuticals mainly considers the aquatic compartment, since the majority of active pharmaceutical ingredients (APIs) are hydrophilic and have a high bioavailability. However, APIs are also found in the terrestrial environment through various emission routes, such as effluents from wastewater treatment plants, leaching from landfills, and atmospheric deposition. This study assessed the risk of pharmaceuticals to terrestrial ecosystems, focusing on their potential for bioaccumulation and effects on soil biota.

**TU 067**

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


**University of Milano Bicocca, Milan, Italy**

Waterborne Environmental Inc, Leesburg, United States of America

The ScanAT exposure model is a novel spatial method designed to inform environmental risk assessments of personal care products, particularly focusing on their potential exposure to aquatic and terrestrial ecosystems. This study applied the ScanAT model to assess the environmental impact of personal care products in China, providing insights into their distribution and potential risks to both aquatic and terrestrial habitats.

**TU 068**

A cross-country assessment of Predicted-No-Effect-Concentration (PNEC) aquatic toxicity data for pharmaceuticals

T. Verschyle, F. Mastrocco, J. C. Lema

**Gradient, Cambridge, United States of America**

The aim of this study was to conduct a cross-country assessment of Predicted-No-Effect-Concentration (PNEC) values for aquatic toxicity data of pharmaceuticals across multiple countries. The study analyzed data from various sources and highlighted inconsistencies and gaps in the available data, emphasizing the need for standardized and robust methodologies to ensure accurate risk assessments.

**TU 069**

Environmental risk assessment for the polycyclic musk AHTN and HHCB in the Molgora river (Lombardia region, Italy)

V. La Rosa

University of Milano Bicocca, Milan, Italy

Polycyclic synthetic musk (PCMs) compounds are used as fragrances in a wide array of personal care products. This study evaluated the environmental risk assessment of two PCMs, AHTN and HHCB, in the Molgora river (Lombardia region, Italy). The assessment included the analysis of concentration levels, toxicity, and potential ecological impacts, revealing that both compounds can pose risks to aquatic life and affect the ecosystem's biodiversity.

**TU 070**

Does price pressure on medicines result in more pollution?

L. Gunnarsson, D. J. Larson

Gothenburg University, Sweden

Pharmaceutical industries are major consumers of raw materials, affecting the production of active pharmaceutical ingredients (APIs) and impacting the environment. This study investigated the relationship between the price pressure on medicines and the environmental impact, focusing on two selected APIs, AHTN and HHCB. The results suggested that increased price pressure might lead to increased environmental impact, highlighting the need for more sustainable production practices in the pharmaceutical industry.
production sites. Furthermore, we will analyze if there are general differences between the country of origin of the APIs in generic and original products. To accomplish this, we are analyzing sales statistics (price) and information on the production site for APIs for roughly 60% of all products (7836) that were sold on the Swedish market in 2010. To date, all data has successfully been compiled into a workable database. We believe our analyses will highlight some of the international aspects of the environmental challenges linked to pharmaceutical production.

TU 071
Do pharmaceuticals with evolutionary preserved drug-targets pose a greater environmental risk? S.M. Furuhagen, A. Fuchs, E. Lundström, E. Gorokhova, M. Breitholtz
Stockholm University, Stockholm, Sweden
Hormone-like drugs are designed to target specific molecules involved in a particular metabolic or signaling pathway in humans to obtain desirable effects at low doses. Although not all of these drug targets are present within the diversity of biological life found in nature, some are evolutionary well-conserved. It has therefore been hypothesized that non-target organisms with highly conserved human drug targets may be at a greater risk to be affected by pharmaceutical residues in the environment. In this study, we herein provide evidence that pharmacological effects with well-conserved drug-targets in the cladoceran Daphnia magna have greater effects on gene expression and RNA content. Three different pharmaceuticals were tested: the anti-fungal drug miconazole, the anti-histamine promethazine (both with highly conserved drug targets in D. magna), and the progestogen levonorgestrel (with a low drug-target homology). For each pharmaceutical, juvenile daphnids were exposed to sublethal concentrations and raised for 21 days and the effects were assayed at the level of (1) gene expression (vitellogenin and cuticle protein mRNA using β-actin as a housekeeping gene), (2) relationship between total RNA and DNA (as a proxy for protein synthesis rate), and (3) body size. The exposure to miconazole resulted in a two- and three-fold decreased gene expression of vitellogenin and cuticle protein genes, respectively, as well as a significant increase in RNA content in relation to DNA. The down-regulated expressions of vitellogenin and cuticle protein genes are indicative of endocrine disruption while increased RNA can be a result of enhanced protein synthesis as a response to stress. By contrast, promethazine and levonorgestrel did not alter RNA-DNA relationship. No effects on the body size were observed for either test substances. Thus, our preliminary results indicate that for miconazole, the drug with well-conserved drug-targets, the endocrine and protein synthesis disrupting effects were indeed observed at sublethal concentrations. To fully test the hypothesis, complementary analyses on the other two pharmaceuticals are also planned.

TU 072
Androgenic activity of levonorgestrel in three-spined stickleback (Gasterosteus aculeatus) U.F. Svensson, I. Brandt, B. Brunstrom
Uppsala university, Uppsala, Sweden
Synthetic androgens are used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair reproduction in fish at concentrations in the low ng-L⁻¹ range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic progestins, such as levonorgestrel (LNG), exert androgenic effects in humans and other mammals by binding to the androgen receptor (AR). Studies in fish indicate that AR activation by progestins may partly mediate their reprotoxic effects, and cause female fish to develop male secondary sex characteristics. In order to acquire a quantitative determination of the androgenic potency of progestins in fish, we exposed three-spined stickleback (Gasterosteus aculeatus) to LNG. Male sticklebacks synthesize a unique glue-like glycoprotein called spiggin, which is used in nest building. Spiggin is produced in the kidney under the influence of androgens binding to the AR. Spiggin production is absent in females but can be induced by exogenous AR agonists, and serves as the best known biomarker for androgens in fish. Adult stickleback females in duplicate groups were exposed to 300 ng LNG or to 2x10⁻⁴ molar solution of LNG at 5 x 3 and 358 ng L⁻¹ for 24 days. The effects of LNG on the mRNA expression of spiggin and vitellogenin, kidney epithelium height and organosomatic indices were studied. Spiggin and vitellogenin transcripts were measured using real-time quantitative PCR. Kidney epithelium height was determined in histological sections. The results show a clear androgenic effect of LNG at concentrations ≥40 ng L⁻¹. Spiggin expression, nephrosomatic index, organosomatic index and vitellogenin and spiggin mRNA expression were significantly reduced at 358 ng L⁻¹. Our in vitro and in vivo quantitative data show that LNG acts as a potent androgen in fish, giving support to the contention that androgenic effects of certain progestins may contribute to their reproductive toxicity.

Supported by Mistra, the Swedish Foundation for Strategic Environmental Research, through the MistraPharma research programme.

TU 073
Transcriptome analysis of the brain of the gilthead sea bream (Sparus aurata) after exposure to environmental concentrations of human pharmaceuticals V. Zlabek, V. Burkina, H. Kroupova, C. Steinbach, R. Grabic, G. Fedorova, J. Velisek, T. Randak
University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic
V. Zlabek, V. Burkina, H. Kroupova, C. Steinbach, R. Grabic, R. Grabic, J. Velisek, T. Randak
TU 074
Pharmacokinetics, genotoxicity, and functional activity of atenolol in juvenile rainbow trout (Oncorhynchus mykiss) M. Hampe1, M. Milan2, J. Blasco3, S. Ferraresi2, L. Bargelloni2
1Institute for Marine Sciences of Andalusia, Puerto real, Spain
2University of Padova, Legnaro, Italy
3University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic
Pharmaceuticals are being released into the environment in extremely large quantities on a regular basis. Ingested drugs are eventually excreted from individuals, as well as they are released from manufacturing and disposal of unused or expired drugs ultimately winding up in the effluent of wastewater treatment plants and aquatic environments. In order to determine the long term effects of exposure to environmental contaminant concentrations relevant to the production sites, the gilthead sea bream (Sparus aurata) to representative drugs found at ng-µg-L⁻¹ levels in surface- ground and coastal waters. Acetaminophen (APAP), Carbamazepine (CBZ) and Atenolol (AT) were used as model compounds to assess the treatments with the greatest number of differentially expressed genes was CBZ with 467 features, compared with 226 for APAP and 4 for AT. The selected vehicle, DMSO, didn't show any significant expression changes in comparison with the SW control. Out of all these features, only one was common between all the three treatments. This feature was identified by homology search as Sparus aurata cytochrome c oxidase subunit I mRNA. No other feature was common both between APAP and AT or CBZ and AT. However, there were 130 common features between the APAP and CBZ treatment.

Functional annotation clustering and enrichment analysis of APAP and CBZ candidate genes in DAVID revealed treatment specific activation of different pathways and processes, with energy-related features present in all the applied treatments.

TU 075
Molecular and genetic mechanisms of physiological responses in fish to atenolol concentrations V. Zlabek, V. Burkina, H. Kroupova, C. Steinbach, R. Grabic, G. Fedorova, J. Velisek, T. Randak
University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic
V. Zlabek, V. Burkina, H. Kroupova, C. Steinbach, R. Grabic, G. Fedorova, J. Velisek, T. Randak
TU 076
Investigating the genotoxicity effects of pharmaceutical photo-transformation products M.I. Vasquez1, M.I. García-Käfer2, E. Hapeshi3, K. Kümmerer1, D. Fatta-Kassinos1
1University of Cyprus, Nicosia, Cyprus
2University Medical Center Freiburg, Freiburg, Germany
3Institute of Sustainable Chemistry and Material Resources, Lubeck, Germany
A renaturational and genetic analysis of the effects of atenolol were carried out on juvenile rainbow trout, Oncorhynchus mykiss, by chronic semi-static bioassay. Fish were exposed to sublethal concentrations of atenolol (1, 10 and 1000 µg/L) for 42 days. Multiple biomarkers were measured, including morphological parameters, haematological parameters, antioxidant responses and CYP450 activities. Parameters measured in this study displayed various dependent patterns to atenolol concentrations and exposure time. In short, the multiple responses in fish indicated that atenolol induced physiological stress and could be used as potential biomarkers for monitoring residual atenolol in aquatic environments.

Molecular and genetic mechanisms of these physiological responses in fish are not clear and need to be further studied.

Acknowledgement - This study was supported by the project CENAKVA CZ.1.05/2.1.0001.0024, Grant agency of USB GAJU 0472010Z and Grant agency of the Czech Republic P503/11/1130.

TU 077
Economical and ecological aspects of pharmaceutical photo-transformation products E. Farcy1, R. Bureau2, A. Serpentini3, J.M. Lebel1, M.P. Halm4
1CERMIN, UPRES EA4258, FR CNRS 3038 INCM, University of Caen, Caen, France
2Cnam, 3 Université de Caen Basse-Normandie, Caen, France
3CNRS INEE, FRE3484 BioMCA, Caen University, Caen, France
4University of Padova, Legnaro, Italy
The serotonon, also named 5-hydroxytryptamine (5-HT), acts both as a neurotransmitter or an as hormone, depending on its localization. The presented work investigated the ecotoxicological consequences of pharmaceutical photo-transformation products, as well as enhancing the effects mediated by serotonin in the central nervous system. The tested
molecules are mainly antidepressant (fluoxetine, sertraline, paroxetine, fluvoxamine, clozapine, citalopram, clobazam, mirtazapine, mianserin, milnacipran, duloxetine, venlafaxine) but also antipsychotic drug (clozapine), cough suppressant/halucinogen drug (dextromethorphan) or beta-blocker (propanolol). 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 tests on the microcrustacean Daphnia magna. Additionally to these conventional bioassays, a novel bioassay was developed using primary cell culture of hemocytes from the marine gastropod abalone (Halosthais tuberculata). This assay was used in order to address the question of pharmacological effects of these substances in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to 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 anticholinesterasic therapeutic drugs on a crustacean species, Daphnia magna
R.J. Rocha1, C.P. Marques2, F.J. Gonçalves2, B.A. Nunes3
1University of Aveiro, Aveiro, Portugal
2Universidade do Porto, Porto, Portugal
3Protein Analysis Facility, University of Aveiro, Aveiro, Portugal

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 anticholinesterasic therapeutic drugs, neostigmine and pyridostigmine in Daphnia magna. This evaluation included acute (24 h) toxicity and reproduction experiments and compared the sub-lethal toxicity of psychiatric drugs with their metabolites on aquatic ecosystems. In the reproduction assay, we found that the most affected parameter was the somatic growth rate (LOECs of 41.9 μg L−1 for neostigmine and 11.4 μg L−1 for pyridostigmine, respectively). We also determined a 48 h-EC50 for cholinesterase activity of 1.7 and 45.5 μg L−1 for neostigmine and pyridostigmine, respectively. These results indicate that both compounds are extremely toxic for D. magna at concentrations of 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 alter 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 080

Calmodulin inhibition as a mode-of-action of antifungal imidazole pharmaceuticals in non-target organisms: implications for mixture toxicity assessment
M.C. Breinholtz, S. Furuhagen, K. Ek, P. Ivanov, E. Gorokhova
1Stockholm University, Stockholm, Sweden

Calmodulin (CaM) is a calcium binding protein expressed in all eukaryotic cells, where it participates in many signaling pathways (e.g. nitric oxide signaling), thereby affecting many different cellular functions, particularly neurosecretory and muscular behavior. Since arthropods are unable to synthesize sterols relying on dietary sources, the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothetized 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.

TU 081

Behavioural and physiological responses to pharmaceutical presence in Gammarus spp. and Fucus vesiculosus
A.K.E. Wiklund, H. Oscarson, G. Thorsen, L. Kumbold
1Stockholm University, Stockholm, Sweden

Gammarus spp. and Fucus vesiculosus are two foundation species of the Baltic Sea. These species inhabit the littoral community and are thereby exposed to substances released in coastal areas. In this study both species were exposed to three concentrations of two pharmaceuticals, ibuprofen and propranolol. Both physiological and behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Freshwater Biomonitor (MFB|TRADEMARK) were estimated for Gammarus spp. and gross production to respiration ratio (GPR) and chlorophyll a fluorescence for F. vesiculosus. Ibuprofen did not affect any of the measured parameters of Gammarus spp. significantly and only slightly affected the algae. The strongest effect was related to activity of Gammarus spp measured by the MFB|TRADEMARK, and results showed that propranolol decreased the activity. The addition of predator cues into the exposure lowered the activity in all treatments, but the gammarids could not compensate for the reduced activity caused by the pharmaceutical. The feeding rates of Gammarus spp. exposed to propranolol were more than two times higher in all concentrations compared to the control. Also the alga was more affected by propranolol measured as lower GPR in all exposure concentrations. These data indicate that both compounds affect the alga and Gammarus spp. in combination with the stress responses in the algae, might cause unexpected indirect and cascade-effects which have implications on the littoral communities.

TU 082

Acute effects of psychiatric drugs on D. magna under insecticide exposure
L.T. Pestana1, M.E.L. Leomos2, V. Calisto1, C. Barata1, V. Esteves3, A.M.V.M. Soares4
1University of Aveiro, Aveiro, Portugal
2ESTM&GIRM, Polytechnic Institute of Leiria, Peniche, Portugal
3IDAEA-CSIC, Barcelona, Spain
4Instituto de Aviação Civil e CESAM, Aveiro, Portugal

The environmental presence of psychiatric 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 anticholinesterasic therapeutic drugs, neostigmine and pyridostigmine in Daphnia magna. This evaluation included acute (24 h) toxicity and reproduction experiments and compared the sub-lethal toxicity of psychiatric drugs with their metabolites on aquatic ecosystems. In the reproduction assay, we found that the most affected parameter was the somatic growth rate (LOECs of 41.9 μg L−1 for neostigmine and 11.4 μg L−1 for pyridostigmine, respectively). We also determined a 48 h-EC50 for cholinesterase activity of 1.7 and 45.5 μg L−1 for neostigmine and pyridostigmine, respectively. These results indicate that both compounds are extremely toxic for D. magna at concentrations of 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 alter 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.
Despite the fact that pharmaceuticals have been detected in the environment at the ng L-1 to ng L-1 range, it has been demonstrated they can cause adverse effects at environmentally relevant concentrations. To detect possible adverse effects of a contaminant in the environment, standardized short-term, sensitive and low-cost methods are usually applied to estimate chronic toxicity against organisms. Lysosomal membrane stability (LMS), has been successfully applied as a screening tool to determine the health status of a wide range of organisms. The feeding style and habitat of the manila clam (Ruditapes philippinarum) make this species vulnerable to organic contaminants bound to water and has been widely used in ecotoxicological studies. LMS was evaluated in clams’ haemolymph by the neutral red retention assay (NRRA). Clams were exposed in the laboratory to concentrations of caffeine (a psychostimulant), carbamazepine (anticonvulsive and mood stabilizing), ibuprofen (non-steroidal anti-inflammatory drug) and novobiocin (antibiotic) during 35 days in a semi-static 48 h renewal assay. Filtered sea water was spiked every 2 days with caffeine (0.1, 5, 15, 50 μg L-1), ibuprofen (0.1, 5, 10, 50 μg L-1), carbamazepine and novobiocin (0.1, 1, 10, 50 μg L-1). Stock solutions of pharmaceuticals were prepared in DMSO (0.001%) to ensure solubility. The experiment was run to test no significant effect on LMS. Results showed that neutral red retention time (NRRT) measured at the end of the bioassay was significantly (p < 0.001) reduced when exposed to caffeine (0.1 μg L-1) when compared to control (p > 0.05) and carbamazepine (0.1 μg L-1) and novobiocin (10 μg L-1). Results showed dose-dependent effect of pharmaceuticals (p < 0.05); Clams analyzed after exposure to 10, 15 and 50 μg L-1 were considered to present a diminished health status (NRRT ≥ 45 min) (p < 0.05). LMS appears to be a sensitive tool that enables evaluation of the health status of clams after exposure to concentrations of selected pharmaceuticals under laboratory conditions and could thus be used as a biomarker for pharmaceutical contamination in aquatic environments.

TU 084

Assessing health status of ruditapes philippinarum exposed to caffeine, carbamazepine, ibuprofen and novobiocin using the neutral red retention assay

G.V. Aguirre-Martínez1, S. Buratti1, E. Fabbri1, A.T. del Valli2, M.L. Martín-Díaz2

1University of Cadiz, Cadiz, Spain
2University of Bologna, Bologna, Italy

Pharmaceutical and personal care products (PPCPs) are considered new environmental pollutants, since hundreds of these molecules are commonly revealed in the aquatic environment in the high ng/L to low μg/L range worldwide. Among them, the occurrence of the antibacterial triclosan (TCS), the antibiotic trimethoprim (TMP) and the non-steroidal anti-inflammatory drugs (NSAIDs) ibuprofen (IBU), diclofenac (DCF) and paracetamol (PCM) is well documented both in surface and sewage waters. Notwithstanding the presence of their target organisms, in order to enlarge this topic, sub-lethal effects induced by these therapeutic substances were investigated by using a multi-biomarker approach: the neutral red retention assay on the freshwater bivalve Dreissena polymorpha. According to a semi-static in vivo approach, zebrafish were exposed for 96 h to an environmentally relevant concentration (1 μM) similar for each drug, corresponding to the level measured in surface waters. This choice allowed us to estimate their impact towards both primary and intermediary targets. 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 investigate inter- and intra-chromosomal damages, respectively, were used to evaluate secondary DNA lesions. The induction of lysosomal damages was evaluated by the Neutral Red Retention Assay (NRRA), by evaluating the lysosomal membrane stability, was used to assess cocaine cytotoxicity. 96 h exposures to three increasing nominal concentrations of cocaine (40 ng/L, 200 ng/L and 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) increase in both primary and secondary DNA damages and a decrease dose-dependently (p < 0.05) of the Neutral Red Retention Assay in lysosomes, measured in our data, may further specify the cytotoxicity and the possible implications of oxidative stress for the observed genotoxic effects.
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 these two substances was investigated on natural marine biofilm communities (periphyton) mainly composed by microalgae and bacteria.

TU 090

Effects of chronic exposure to pharmaceuticals on aquatic biota: an experimental study

J.D. Braasch, L. Wegener, V. Weijers, A. Oosterheert, A. Piersma, E. van der Dennen, R. Wageningen, Netherlands

The use of personal care products is a common practice in developed countries. This brings as consequence a frequent exposition to chemicals likely to be damaging for human health, particularly in the case of babies and children. Fragrances are a group of chemicals incorporated in most cosmetic and other personal care products including baby care ones. The Scientific Committee on Consumer Products (SCCP) has identified 26 of these ingredients as likely to cause contact allergies. Among products for baby care, soaps are one of the most product with high potential to cause allergic reactions. Here we test the ability of maternal and young cutaneous keratinocytes to respond to a panel of common fragrance allergens.

TU 091

Toxicity of Ciprofloxacin and Sulfamethoxazole on marine biofilm communities

C.J. Coutinho, A.C. Backhaus, A. Barra Caracciolo, P. Grenni, M. di Lenola, L. Patrolecco

The activated sludge respiration inhibition test (OECD Procedure 209) is used to assess the inhibitory effects of a substance on the respiration of the heterotrophic population of sewage microorganisms found in the activated sludge treatment process. The original OECD guideline for the test was first issued in 1984 and remained unchanged until a revised and expanded following the STP Effluent is available. The test design has been updated to improve the statistical basis of the test. Changes introduced in the new guideline included an increase in the level of replication of test and control mixtures to allow the determination of the No Observed Effect Concentration (NOEC) of a substance, a requirement of Guideline EMEA/CHMP/SWP/4447/00 for the risk assessment of human pharmaceuticals, together with methods for assessing inhibition of nitrification. Work was done to be conducted by one operator with relatively simple equipment, the new requirements for replication call for more complex equipment and higher levels of effort to set up the study. To satisfy these requirements we have introduced and validated a computer-controlled respirometer system comprising 30 incubation chambers each containing an oxygen probe, aeraton and headspace nitrogen purge systems and a stirrer to provide mixing and flow of media across the probe membrane.

TU 092

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

W.R. Jenkins, C.A. Jenkins, R.A. Dickinson, G.L. Podd

Huntingdon Life Sciences, Eye, United Kingdom

The activated sludge respiration inhibition test (OECD Procedure 209) is used to assess the inhibitory effects of a substance on the respiration of the heterotrophic population of sewage microorganisms found in the activated sludge treatment process. The original OECD guideline for the test was first issued in 1984 and remained unchanged until a revised and expanded following the STP Effluent is available. The test design has been updated to improve the statistical basis of the test. Changes introduced in the new guideline included an increase in the level of replication of test and control mixtures to allow the determination of the No Observed Effect Concentration (NOEC) of a substance, a requirement of Guideline EMEA/CHMP/SWP/4447/00 for the risk assessment of human pharmaceuticals, together with methods for assessing inhibition of nitrification. Work was done to be conducted by one operator with relatively simple equipment, the new requirements for replication call for more complex equipment and higher levels of effort to set up the study. To satisfy these requirements we have introduced and validated a computer-controlled respirometer system comprising 30 incubation chambers each containing an oxygen probe, aeraton and headspace nitrogen purge systems and a stirrer to provide mixing and flow of media across the probe membrane. This method was validated against the protocol described by the International Organization for Standardization (ISO). The new system allowed us to test the respiration inhibition of several compounds, including pharmaceuticals, dyes, and heavy metals at different concentrations. The results provided a more accurate and reproducible measurement of the respiration inhibition, allowing us to better understand the effects of these compounds on the microbial community.

TU 093

Pharmaceuticals in River Water: Biochemical Markers and Ecological Impact

J.A. Nogueira, A.M. Soares, I. Domingues

University de Aveiro & CESAM, Aveiro, Portugal

In this study, we examined the presence of pharmaceuticals in river water from the area of Aveiro, Portugal. The aim was to determine the potential risk of exposure for aquatic organisms and to assess the ecological impact of these compounds. To achieve this, we used a sensitive and specific analytical method based on high-performance liquid chromatography coupled with mass spectrometry (HPLC-MS/MS). The compounds of interest included antibiotics, non-steroidal anti-inflammatory drugs, and cardiovascular drugs. In addition, we analyzed the concentration of some biochemical markers, such as catalase (CAT), lactate dehydrogenase (LDH), and glutathione-S-transferase (GST), which are commonly used as indicators of stress and toxicity in aquatic organisms.

TU 094

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

R. Oliveira1, J.C.L. Jessica2, S. Mcdonough1, A.M.V.M. Soares1, A.J.A. Nogueira1, I. Domingues1

University de Aveiro, Aveiro, Portugal

Oxytetracycline (OTC) and amoxicillin (AMX) are antibiotics that are extensively used worldwide. Both compounds are applied in fish and shrimp farming practices, and are also used in veterinary medicine. Their use as growth promoters in aquaculture systems has been a target for environmental health. Considering this scenario, our study aims at assessing the sub-lethal effects of the exposure of zebrafish (Danio rerio) to oxytetracycline and amoxicillin. We exposed zebrafish larvae to different concentrations of these antibiotics and determined the effects on several physiological and biochemical parameters, such as growth and survival, hepatosomatic index, and stress biomarkers. The obtained data showed that oxytetracycline and amoxicillin have different effects on zebrafish larvae, with oxytetracycline being more toxic at lower concentrations. Our results highlight the importance of monitoring the exposure of aquatic organisms to these antibiotics and the need for developing more effective methods to control their use.
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 were exposed for 96 hours using a flow-through system to 100 and 500 µgL⁻¹ ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µgL⁻¹, respectively) of mass loadings. Another 4.3% was predicted to discharge and run off from rice paddies. Urban runoff accounted for less than 1 percent. 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 and spatial resolution comparable to that of the processes of interest. With the availability of databases of compound properties and environmental fate and transport models, it is possible to develop more sophisticated models that include multiple pathways of transport and transformation and their interactions. These models can be used to predict the fate and effects of pesticides in aquatic systems and to identify areas of concern for risk management. The work was supported by Ministry of Education and Science, Republic of Serbia (II46009) and NATO Science for Peace Project ‘Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia’ (JEPESA/SIP 984087).

EM022P - Fate and exposure modelling

TU 097
The effects of ibuprofen exposure on fathead minnows (Pimephales promelas)
A. Patel1, H.T. Trollope1, Y.C. Glennon1, G.H. Panter1, J.P. Sumpter1, M. Rand-Wheater1
1Brunei University, Uxbridge, Middlesex, United Kingdom
2National Centre for Environmental Laboratories, Brixham, Devon, United Kingdom
3Institute for the Environment, Brunel University, Uxbridge, Middlesex, United Kingdom
4Biosciences, Brunel University, Uxbridge, Middlesex, United Kingdom
5Occurrence of the non-steroidal anti-inflammatory drug, ibuprofen, has been reported in aquatic waters in the UK at concentrations ranging between 3.7-1 µgL⁻¹. Ibuprofen is a widely prescribed usage and over-the-counter medication, 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 a risk 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 level in non-target organisms similar to human therapeutic levels.

TU 096
Determination of emerging substance as human indicator in the Danube River samples
N.N. Gruje1, N.B. Mile1, M.M. Turk Sekulic2, M.B. Vojvonic Miloradović2, M.L.J. Milanovic2, J.R. Radonic3
1Faculty of Medicine, Novi sad, Serbia
2Faculty of Sciences, Novi Sad, Serbia
3Caffeine, methylxantine derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heartbeat rate, dilates blood vessels and works as a weak diuretic. It is present in many natural and non-human sources. The objectives of this study were to determine the presence of caffeine in the Danube River samples and to evaluate its stability during two months storage of samples on 4°C. Analysis was performed by solid-phase extraction (SPE) followed by new developed reverse phase high performance liquid chromatography (RP HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (150 x 4.6 mm i.d., 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 from 0.84 ng/L on the 1st day and 0.52 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 ostrov’, Novi Sad. Obtained results due to caffeine shows significantly decreased during two months storage of samples on 4°C most likely due to its degradation.

The work was supported by Ministry of Education and Science, Republic of Serbia (II46009) and NATO Science for Peace Project ‘Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia’ (JEPESA/SIP 984087).
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, two metabolites 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 consistent with the studies where only M1 was identified. Kinetic optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed.

The kinetic evaluation demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolism studies were found 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
R. Saur1, V. Gourlay2, W. Schmidt1, W. Gurlitz1, B. CropScience, Monheim, Germany
RPL AgroScience GmbH, Neustadt/Weinstr., Germany
RLP Agroscience, Neustadt/Weinstr., Germany

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 the plant uptake factor. The PUF is strongly dependent on the plant species and pesticide concentration. 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 hydrodynamic experimental setup 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 PUF default of 0.5 is a very conservative approach in terms of leaching assessment. For the test compounds exhibiting ionic to lipophilic properties, the PUF was determined 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 PUF 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 national French tool for pesticide risk assessment in the context of the water framework directive
S. Reichenberger1, J. Dubus2, R. Talva3, S. Teller4, J. Pres5, E. Escalant6
FOOTWAYS S.A.S., Orléans, France

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 clear that this goal cannot be achieved by 2015 for a number of applications. In that context, the French Government has implemented a powerful exposure assessment tool which are able to i) 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 ii) explore the effect of risk mitigation measures a priori in order to determine the most effective and cost-efficient measures for risk management 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) edge of field 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 conducted. 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
M. Bach1, M. Trapp2, D. Guerniche2, D. Groβmann1, J. Gourlay1, W. Gurlitz1, B. CropScience, Monheim, Germany
Institute for Environmental Research, RWTH Aachen University, Aachen, Germany
University of Giessen, Giessen, Germany

Pesticide risk evaluation for surface waters in the EU is based on well established standardised scenarios and risk criteria. The Qualitative Risk Assessment (QRA) approach is still the main tool to assess the potential risk of pesticides and the potential risk to the ecological status of surface water bodies. In the QRA approach basic parameters such as: concentration (RAC) and stream flow are being used to calculate the Predicted Environmental Concentration (PEC) which is then compared to the regulatory acceptable concentration (RAC). For this purpose the GeoRisk project introduced the quantity PECMO in order to take into account the temporal and spatial pattern of the pesticide input in the aquatic environment. For the registration procedure these concentration oscillations have to be transformed into an operational exposure indicator, comparable to a regulatory acceptable concentration.

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 assessment procedures with the procedure used at the EU level and in various other member states.

Institute for Agroecology, RLP Agroscience, Neustadt/Weinstr., Germany

Institute of Agroecology, RLP Agroscience, Neustadt/Weinstr., Germany

Institute of Agroecology, RLP Agroscience, Neustadt/Weinstr., Germany

The pesticide concentration in flowing waters observed at a point of a river stretch fluctuates irregular, 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. For this purpose the GeoRisk project introduced the quantity PECMO in order to take into account 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.

The timing of the spray drift depositions along the water course was randomized for each MC realization 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
F. Guriolay1, R. Kahub1, RPL AgroScience, Neustadt/w., Germany

Plant uptake of environmentally relevant chemicals like pesticides is an important process limiting their availability for leaching, run-off and volatilisation. Chemical hydrophobicity (log Kow) and for ionisable compounds the pKa value are the most important properties determining the ratio between a compound's concentration in the hydrodynamic pore water and the concentration in the root system. The Plant uptake factor (PUF) can be used as input parameter in simulations models (e.g. FOCUS, PELMO) to determine the leaching behaviour of the substance more precisely. The PUF was measured in soilless hydroponic test systems with intact plant root system in an artificial pore water system (1-L of 0.01 M CaCl2) containing a given concentration of the substances. By determining the volume uptake and concentration of the test item at a fixed time interval PUFs can be calculated. If 14C-labeled compounds are used, the distribution of test item in the root plant system can be simply determined by sampling combustion followed by liquid scintillation counting (LSC). The test setup used in this study are 1-L brown glass vessels in which the plants without soil (pre-grown in soil for 3-6 weeks) are inserted into the test solution and cultivated for 8 days under controlled greenhouse conditions. For each substance, the experiment is conducted with three different species (species: tomato, wheat and maize) and under three different conditions using biological buffers (5.5, 6.5 and 7.5). The PUF of 8 test substances, chosen on a relevant range of lipophilicity and pKa value, will be determined on several sampling dates (0, 2, 5 and 8 days after treatment), as well as in the test plants at the end of cultivation. The PUFs determined will be presented crop specific as a function of the chemical hydrophobicity of the substances, and of the pH-level of the test solution.

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
S. Reichenberger1, M. Bach1, D. Groβmann1, D. Guerniche1, U. Hommen2, M. Kaiser3, M. Klein4, R. Kubiaκ4, A. Müller4, T.G. Preuss5, M. Trapp6
FOOTWAYS S.A.S., Orléans, France
University of Giessen, Giessen, Germany

German Federal Environment Agency (UBA), Dessau, Germany
Institute for Agroecology, RLP AgroScience, Neustadt/Weinstr., Germany
Fraunhofer Institute of Molecular Biology and Applied Ecology, Schmallenberg, Germany
Institute for Environmental Research, RWTH Aachen University, Aachen, Germany

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 reproducibility 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

L.P. Pontal1, E. Beltran2, M. Darriet1, P. Adrian1

1CECITRA Europe SPRL, Waterloo, Belgium
2CECITRA, Saint-Etienne, France

Registration of agrochemicals under the EU Regulation 1107/2009 requires a lot of challenges and numerous guidance documents have been recently issued, thanks to EFSA for facilitating the registration systems. The majority of the cases, the methodology of the derivation of kinetic parameters linked to the degradation potential and the exposure assessment is the most advanced in the Regulation arena worldwide. This poster is dealing with the estimation 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 duration of calculating degradation half-life is well known but the assumptions made during this process can appreciably affect the results. Usually a minimum of four laboratory studies are required to estimate the dissipation pattern in soils. If the degradation half-life (DegT50) in top soil at 20°C at pH 7 exceeds 60 days additional field dissipation studies need to be conducted. In the past years, 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 pH 7.

However, according to EFSA panel, this decline is expected to show a random initial phase in the period when surface processes play an important role followed by a slower phase that is dominated by degradation rates within the soil matrix.

In the proposed poster, we will show for an existing substance how the methodology is being used (according to the new EFSA (2010) guidance) to derive DegT50 and we will discuss the impact of this new guidance on the results and on exposure estimation.

How reliable is the predicted leaching of pesticides into Groundwater? - Validation of the FOCUS groundwater model PELMO 4 for use in the German national registration procedures

W. König1, G. Holde1, P. Klaas2, M. Klein2

1Federal Environment Agency (UBA), Dessau, Germany
2Fraunhofer IME, Schmallenberg, Germany

In the registration procedure in Germany the risk assessment for the leaching potential of plant protection products into groundwater is based on modelling results using simulated leaching concentrations of the FOCUS Hamburg scenario from the latest version of the FOCUS PELMO model (tier 1, 2). Dependencies of pesticide sorption and degradation data from different soil properties as well as the parameter variability are considered in the endpoint selection for modelling, which is in line with the FOCUS recommendations. The measured leachate concentrations for active substances and/or metabolites from outdoor lysimeter studies are accepted as higher tier endpoints in the risk assessment and overwrite predicted concentrations from simulation runs (tier 3). This is generally justified by comparable soil and climate conditions in the Hamburg scenario and the comparison of measured and modelled concentrations for active substances and their metabolites. Preliminary results are presented and lead to discussions about the reliability of the predicted potential leaching behaviour of pesticides into groundwater in Germany.

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 potential and the methodology of tiering. An alternative approach named with PELMO POCUS was chosen to derive degradation and sorption values for selected substances and allow a model based extrapolation of the lysimeter results to different conditions, e.g. longer investigation period, multiple application, different application rates and crops. The outcome of the analysis shall indicate under which conditions lysimeter studies can be evaluated as endpoint or as process studies. A proposal, how inverse modelling of lysimeter results can be adequately considered for future regulatory decision making, is thought to be useful with respect to further harmonisation between member states in the EU.

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

N. Settler-Winn, G. Wiedemann, M. Wang

Rifcon GmbH, Heidelberg, Germany

In the new EFSA guidelines for soil persistence (EFSA, 2010) it is intended to exclude loss processes on the soil surface (photolysis, volatilisation) for the derivation of field half-lives of pesticides. As a pragmatic approach, it is stated that only sampling points after 10 mm cumulative rainfall should be used to derive DT50. While this rainfall criterion is meant to ensure that processes on the surface are not taken into account for kinetic evaluation of field studies, there is no clear scientific basis for the selected 10 mm cumulative rain criterion. We therefore evaluated which impact the selection of this criterion has on the kinetic analysis based on field studies from different locations across Europe and for different substances. Of those studies which could be evaluated according to the new guidance, a substantial fraction showed different results (DT50) depending on the selected rainfall criterion (e.g. 5 mm, 10 mm, 15 mm, etc). While in some cases only the resulting DT50 varied according to the applied rainfall criterion, in other cases a complete data set could be evaluated according to the rainfall criterion. We also show that the impact of the rainfall criterion can be assessed over a longer period, translation of the lysimeter results to a different situation with respect to the environmental conditions (e.g. different climate), parameters of the lysimeter result to a different situation with respect to the application pattern of the substance (e.g. change of the rate), parameters of optimal treatment settings for a refined standard tier 1 simulation.

InversePELMO a specific software to perform inverse modelling simulations with FOCUSPELMO 4 for use in the German national registration procedures

P. Gallien1, R. Herr1, M. Klein1

1Federal Environment Agency (UBA), Dessau, Germany
2Fraunhofer IME, Schmallenberg, Germany

In the assessment for authorisation of plant protection products its leaching beha-viour is an important factor to protect the groundwater. In this context the sorption to soil (Parameter: Koc) and the degradation (Parameter: DT50) are processes that must be taken into account. Recently, the new FOCUS groundwater group suggested a third method for the parameter setting of FOCUS 2006. The idea is to analyse outdoor studies, especially lysimeters, using the inverse modelling method that allows the estimation of Koc and DT50 parameters within a single step. For this procedure an optimisation tool, the program PEST (Model Independent Parameter Estimation), has to be combined with a leaning model (here: FOCUSPELMO 4). The aim of inverse modelling simulations is to find those Koc and DT50 values that could describe the outdoor study data recorded during experiments (e.g. rainfall, temperatures, percolation, and substance fluxes). Therefore all data of a lysimeter study are used to vary the input parameters Koc and DT50 until the leaching model shows the same results as the experiment. Generally, 2 steps have to be conducted when performing inverse modelling simulations. Firstly, the hydrology in soil is optimised, followed by the optimisation of pesticide fate. The software InversePELMO is able to provide both processes in a single simulation and the simulation module with the necessary input files in the correct format. InversePELMO has also a built-in module to perform standard statistical tests to check the quality of the optimisation such as the determination of the ‘FOCUS error’ at which the chi² error passes as described in FOCUS (2006). It was also tested that PEST works under all relevant windows systems (XP, VISTA and 7) in a 32 bit as well as 64 bit version. The results of InversePELMO can be used to make predictions about the likely behaviour of substances that have been optimised over a longer time period, translation of the lysimeter results to a different situation with respect to the environmental conditions (e.g. different climate), translation of the lysimeter result to a different situation with respect to the application pattern of the substance (e.g. change of the rate), parameters of optimal treatment settings for a refined standard tier 1 simulation.
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
A.D. Duboisse1, A.B. Boivin2, P.C. Carpenter3, M.V. Volte4, P.C. Cattan5, A.C. Conrad6, D.A. Ahebhemou7, V. Poulsen1

ANSES, Maisons-alfort, France

INRA, Montpellier, France

CIRAD, Montpellier, France

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 of these tropical regions would require to use specific methods concerning each region. The aims of this communication are to (1) clarify how deriving some pesticide’s properties appropriate for tropical soils from EU endpoints with the aid of a statistical analysis performed on degradation and adsorption parameters obtained from temperate and tropical soils, (2) summarize the main specificities of agro-pedoclimatic conditions and transport of pesticide in these regions to account in modelling and (3) provide a brief overview of the principles of the model currently under development and the framework planned to adapt it for regulation.

The statistical analysis shows that EU endpoints seem to be provisional acceptable entries for the risk assessment in these tropical regions but should not supersede any experimental evidence supplied with tropical soils. The knowledge about agro-pedoclimatic conditions and transport of pesticide in these territories underlines that (1) a minimum of four scenarios (2 soils: arable and nitosol and 2 crops: banana and sugar cane) would be necessary for the risk assessment of the main uses of the French overseas territories (2) and 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 be to 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 fluafenacet and metalachor in a lowland catchment with the model SWAT - A sensitivity analysis
A. Dietrich1, U. Ulrich2, O. Kolyachalo1, N. Fohrer1

1University of Kiel / Institute for Natural Resource Conservation, Kiel, Germany

2University of Kiel, Inst. for Natural Resource Conservation, Kiel, Germany

Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Assessment (LCA). A key issue to be addressed in the impact assessment of complex chemical mixtures, such as industrial effluents, is the list of constituent chemical substances and their impact. Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Impact Assessment (LCIA). 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), total nitrogen (TN), and potentially also (eco)toxicity characterisation 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 114

Combination of SFA and multi-media fate modeling to assess the consequences of global trade and informal recycling of WEEE in China
A. Dame1, M. Trombetti2, D.W. Pennington3

1Inst. of Agricult. + Env. Chemistry, Univers. Cattolica del Sacro Cuore, Piacenza, Italy

2University Rovira i Virgili, Tarragona, Spain

3School of Chemical Engineering, Universitat Rovira i Virgili, Tarragona, Spain

Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Assessment (LCA). A key issue to be addressed in the impact assessment of complex chemical mixtures, such as industrial effluents, is the list of constituent chemical substances and their impact. Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Impact Assessment (LCIA). 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), total nitrogen (TN), and potentially also (eco)toxicity characterisation 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 115

Modelling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA
C.E. Raptis1, A. Koehler1, R. Jurakse1, S. Hellweg1

1Institut für Agrar- und Umweltwissenschaften, Universität Stuttgart, Stuttgart, Germany

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 116

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


1Harburg University of Applied Science, Hamburg, Germany

2Instit. of Agricult. + Env. Chemistry, Univers. Cattolica del Sacro Cuore, Piacenza, Italy

Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Assessment (LCA). A key issue to be addressed in the impact assessment of complex chemical mixtures, such as industrial effluents, is the list of constituent chemical substances and their impact. Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Impact Assessment (LCIA). 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), total nitrogen (TN), and potentially also (eco)toxicity characterisation 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 117

Modeling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA
C.E. Raptis1, A. Koehler1, R. Jurakse1, S. Hellweg1

1Institut für Agrar- und Umweltwissenschaften, Universität Stuttgart, Stuttgart, Germany

2University of Kiel, Inst. for Natural Resource Conservation, Kiel, Germany

Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Assessment (LCA). A key issue to be addressed in the impact assessment of complex chemical mixtures, such as industrial effluents, is the list of constituent chemical substances and their impact. Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Impact Assessment (LCIA). 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), total nitrogen (TN), and potentially also (eco)toxicity characterisation 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
P. Press1, R. van Dingenen2, F. Dentener1, R. Friedrich1

1Universität Stuttgart, Stuttgart, Germany

2Joint Research Centre, Institute for Environment and Sustainability, CEC, Ispra, Italy
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 and effect assessment models are crucial. 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 including and excluding equity weighting.

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 sustAinability 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.

Within the TM5-FASST modelling framework, the world is divided into 36 regions. Each region serves as a source region and each grid cell (resolution 1°x1°) of the whole world serves as receptor region. Population data and concentration response functions are applied in order to calculate the IF and relevant diseases. Finally, the health impacts are weighted in order to get DALYS per unit of emission, and different external cost estimates, by including and excluding equity weighting.

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

S. Pfister1, S. Suh1
1UC Santa Barbara / ETH Zurich, Zurich, Switzerland

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 spatially explicit level and broad coverage. We started our research on a detailed study assessing impacts of thermal emissions to freshwater bodies 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 used to get site-specific parameters for different types of power plants 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

A.N. Muchada1, R. Van Zelm1, M. van der Velde1, E. Schmid1, M. Obersteiner2, M.A.J. Huijbrugs3
1Radboud University Nijmegen, Nijmegen, Nederland
2International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria
3University of Natural Resources and Applied Life Sciences, Vienna, Austria

Land use is increasing worldwide leading to changes in the ecosystem. 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 (CFs). They form the backbone of the present research and focus on ecosystem services and the TPC (Total Potential Change) approach. We derived a new approach to develop spatially explicit characterization factors (IEs) for ecosystem services and used this approach to develop a spatially explicit Life Cycle Impact Assessment model for rapeseed, soybean and sugarcane cultivation on a global scale.

Background and justification

According to van Oers et al. (2009), there are about 1,000 ecosystem services, making it difficult to assess all these services comprehensively. We therefore select services that are tackled in the scope of the project: carbon sequestration, nutrient cycling and erosion regulation. We discuss the rationale to select these services as well as the methods used to derive the characterization factors. We compare results across the regions and discuss the potential of our approach to derive spatially explicit characterization factors.

Conclusion

Our research showed that all three services are influenced by international cultivation of rapeseed, soybean and sugarcane. Our results indicate that developing spatially explicit characterization factors for ecosystem services is necessary to properly account for the impacts of land use on ecosystem services.

TU 121

Health risk assessment of chlorpyrifos with rice farmers in Vietnam

T. Phung, D. Connell, M. Chu, G.M. Miller
Griffith University, Brisbane, Australia

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. Biological monitoring of rice farmers was used to estimate chlorpyrifos exposure from all pathways during application. Urine samples (24 h) were collected from farmers 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using HPLC-MS/MS. Urinary TCP levels were converted into an absorbed daily dose (ADD) of chlorpyrifos for each farmer. The health risk of chlorpyrifos exposure for the rice farmers was characterised by calculating the ADDs for each farmer. The health risk of chlorpyrifos exposure for the rice farmers was characterised by comparing exposure doses (ADD) with acute guideline doses of chlorpyrifos used by USA and Australian agencies.

Conclusion

Our study found that the rice farmers in Vietnam have a risk of chlorpyrifos exposure comparable to that of the population in urban areas. This risk is mainly related to the use of chlorpyrifos in rice cultivation, which is a major activity in Vietnam. The results of this study suggest that there is a need for better training of rice farmers in the use of chlorpyrifos to reduce their exposure. The results also suggest that there is a need for better regulation of the use of chlorpyrifos in Vietnam to reduce the risk to the population.
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 comply with the standards, i.e. trichlororomethane, 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 96% of the exposed population have exceeded acceptable carcinogenic risk. The main risk factor is inhalation exposure. The presence of the 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 true relationship between elevated blood levels of acetaldehyde, formaldehyde, manganese, nickel, chromium, etc. and blood, immune, hepatic, neurologic and other health alterations. We have determined the reference level of the risk of metal transfer of a site. The ranking of the TAQ emphasize the transfer risk of industrial sites. On these sites, As, Cd and Pb transfers have been identified, putting these sites on top of the management priorities. The tool has helped identify monitoring needs that may lead to identifying future EQS candidates. 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 hazard 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 tool 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 c.g. measures of degradation and bioaccumulation. A separate approach for such chemicals may need to be developed. The tool has also been used to review the outcome of the scheme because this can help introduce relevant new data or information about significant trends in likely exposure (e.g. planned restrictions on use) that will affect the chemical’s priority.

TU 125

Prioritising chemicals for EQS development

H.M. Wilkinson, P. Whitehouse, L.A. Sturdy

Environment Agency, Wallington, United Kingdom

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 categories, based on a biological risk assessment. Unlike more sophisticated schemes, this method does not require a draft EQS in order to prioritise chemicals. Rather, it categorises 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.

TU 126

Klimisch 2.0 - raising the bar to increase the scientific quality of environmental risk assessments


Swiss centre for applied ecotoxicology, Dübendorf, Switzerland

ECT Okotoxologie GmbH, Hürstweil, Germany

CEHTRA, Lyon, France

Royal Institute of Technology (KTH), Stockholm, Sweden

Federal Environmental Agency (UBA), Dessau or Berlin, Germany

German Federal Environment Agency (UBA) Dessau or Berlin, Germany

Wca environment, Oxfordshire, England

Environment Agency of England and Wales, Oxfordshire, United Kingdom

Economic, social and environmental sustainability needs. for the purposes of implementing 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 consequently is subject to expert judgement, which is sensitive to scientific disciplines and the background and experience of the evaluators. Assessments based on the tool 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. 2011a,b, Agerstrand et al. 2011a) have shown that the Klimisch system is not accurate and should be replaced by a tool that provides the same reliability and 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 evaluation between assessors. The detailed methods developed by Kuester 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 tool 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.
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 for PCDD/F concentrations but for dl-PCB there is a non-uniform overall picture showing rather a baseline than a clear decrease at fairly high levels. Generally, for both communications to maintain public trust and to give unambiguous guidance for improved risk management.

The International Fragrance Association expanded the fragrance industry's self-regulatory safety program with the development of IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessments for these Standards are incorporated in the Research Institute for Fragrance Materials' (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and the Expert Panel selected a set of compounds for testing. These data established at RIFM and for Europe and the United States. The framework for this evaluation was published in Environmental Toxicology and Chemistry (Salvi et al., 2002, 1301-1308). Under additional guidance on these materials was also performed and reviewed. A resulting 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 development of IFRA Environmental Standards, reported here are the results of these additional tests (for both risk and hazard assessments). 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.

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

Fish from the German environmental specimen bank - patterns, relations and time trends of PCDD/F and dl-PCB in breans (abramis brama) from German rivers, F. Neugebauer1, C. Schröter-Kermann2, O. Paepke1, M. Opel1, 1Eurofins GIL Lab Service GmbH, Hamburg, Germany, 2German Federal Environment Agency, Berlin, Germany

Environmental specimen banks (ESBs) 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 the opportunity for 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 PCBs) and dioxin-like PCBs (dl-PCB) 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 brean, abramis brama, has been selected as a specimen for this monitoring. It is common, widespread, trophically reasonably well represented and a familiar fish to the public. The German ESB has been under the overall management of the German Federal Environment Agency since its establishment, today the German ESB is administrated by the recently newly founded German Federal Environment Agency, Berlin, Germany.

Environmental specimen banks (ESBs) 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 the opportunity for 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 PCBs) and dioxin-like PCBs (dl-PCB) 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 brean, abramis brama, has been selected as a specimen for this monitoring. It is common, widespread, trophically reasonably well represented and a familiar fish to the public. The German ESB has been under the overall management of the German Federal Environment Agency since its establishment, today the German ESB is administrated by the recently newly founded German Federal Environment Agency, Berlin, Germany.

However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks and targets are standards and help to define how to take action to protect and improve water quality.
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 Biomonitoring System Bank (BBEBS) was designed including specimens for biological endpoints, say biopsies for histopathology/immunochemistry, cryo-specimens for molecular/cellular analysis, and dried mineralized tissues (shells/otooliths) 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 ‘Musel Shell Section’ of the BBEBS (2001-2010) localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Bering coast: Changes in shell size (L, width, W, height), shellometry 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 with other species and the global environmental trends of the Precambrian oil spill. However, only specimen 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 biomonitoring 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 established 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-GORGITZEN project.

TU 135

Using banked seabird eggs for determining geographic patterns of trace elements in marine regions
R.S. Pugh1, W.C. Davis1, D.G. Ross2, T. Burger1
1National Institute of Standards and Technology, Washington, United States of America
2U.S. Fish and Wildlife Service, Homer, Alaska, United States of America

With exception of Elbe/Blankenese 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. Selenium and arsenic occur naturally in the environment but they are also known to be toxic in excess of trace levels. During the 1990s, elevated concentrations of arsenic were reported in liver tissue of ringed seals taken by Alaska Native hunters in Norton Sound, Alaska. To determine whether eggs of colonial seabirds might be good monitoring matrices in both Elbe and Alaskan marine regions, total arsenic (As) and selenium (Se) mass fractions were measured in 78 seabird egg samples collected in 2008 and banked at the US Marine Environmental Specimen Bank (Marine ESB). These eggs were collected from several colonies located within Norton Sound as well as long-term monitoring sites in two other major Alaska marine regions, St. Lazaria Island in the Gulf of Alaska and St. George Island in the Bering Sea and were from three species: common murre (Uria aalge), thick-billed murre (U. lomvia) and glaucous gulls (Larus hyperboreus). Egg samples were analyzed using collision cell kinetic energy discrimination inductively coupled plasma mass spectrometry (ICP-MS). Total arsenic mass fractions ranged from 0.015 µg/kg to 0.320 µg/kg while the levels of Se were more elevated in the Norton Sound colonies than in the other colonies in the Bering Sea. The data reported here illustrates that seabird eggs can be a useful monitoring tool to help determine geographic patterns of trace elements in marine regions, specifically the sub-Arctic regions of Alaska.

TU 136

Specimen security in long term specimen banking - zebra mussel example in the German ESB
M. Paulus1, D. Teubner2, T. Weimann3, T. Bartel-Steinbach2, R. Klem2, K. Tarricone1, G. Wagner2, A. Körner3, M. Veith2
1Trier University, Trier, Germany
2Federal Environment Agency, Berlin, Germany

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. These new settlers provided an excellent opportunity for environmental observers to use an effective plankton filter to indicate bioavailable and bio-accumulative anthropogenic contamination in many areas. The successful invasion of the zebra mussel can be seen as the trigger for a multitude of "mussel watch" programmes across thetomes of Eurasia and North America, and has also led to the zebra mussel's permanent presence in the German Environmental Specimen Bank (ESB) for the last 20 years. In the past few years many areas have seen a dramatic drop in zebra mussel numbers. Now, out of nowhere, what was once a successful model for monitoring waters is endangered by the lack of a sufficient number of specimens for large samples. A possible cause is the receding eutrophication level of the waters and the resulting lack of food. Another invasive species, the quagga mussel (Dreissena 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. Another challenge is the fact that accumulation in both species is also different, which is why 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 that the zebra mussel does not provide the same services provides. This makes clear that, along with the D. polymorpha (Abramsia brama) and suspended particle 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 to:

- develop a method to differentiate unequivocally between both species for large samples.

TU 137

Organic compounds in suspended particulate matter - results from the German environmental specimen bank
K. Weinfurtner1, C. Schroer-Kermen2, M. Ricken3
1Fraunhofer Institute for Molecular Biology and Applied Ecology, Schmallenberg, Germany
2German Federal Environment Agency, Berlin, Germany
3Free University Berlin, Dept. of Earth Sciences, Hydrogeology, Berlin, Germany

Since 2003 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-specimens are chemical characterized for inorganic substances, CHCs and PAHs.

The results of the five years period 2003 - 2009 show considerable differences between the two river systems. The concentrations of PAH16 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 Elbe/Blankenese near Hamburg harbor 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 Blankenese are less than 20 % of the concentrations at other sampling sites. This is probably caused by dilution of the Elbe water with saltwater of the North Sea.

In the region of Blankenese/Elsensees the concentrations of PAH16 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.

Using banked seabird eggs for determining geographic patterns of trace elements in marine regions
R.S. Pugh1, W.C. Davis1, D.G. Ross2, T. Burger1
1National Institute of Standards and Technology, Washington, United States of America
2U.S. Fish and Wildlife Service, Homer, Alaska, United States of America

With exception of Elbe/Blankenese 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.

In the region of Blankenese/Elsensees the concentrations of PAH16 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.

In the region of Blankenese/Elsensees the concentrations of PAH16 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.
Contamination of the Elbe estuary with particle bound compounds mostly (with the exception of TBT which had its source in the Hamburg Harbour) derives from “areas of risk”/upstream of Hamburg such as the Czech Republic for organic contaminants like HCH, HCB, PCB, DDT and TBT, the tributary Mulde for As, Dioxins and HCH, and the Saale for a number of heavy metals like Cd, Hg, Cu, Zn, and Pb. The major transport of contaminants happens during periods of high water discharge, when historic contaminated soil or sediment in the catchment is washed out and during high water in the downstream. For some compounds the yearly load of particle bound contaminants is transported during a few days of a high water discharge (Heise, Krüger, et al. 2008). Up to now, the impact of contaminants on the quality of sediments in the estuary as a consequence of a high discharge event, however, has not been very well investigated. The Elbe mouth is characterized by the second largest harbor in Europe (Hamburg), with a 100-km upstream stretch. Even though the river downstream of Hamburg has been maintained as a deep-water navigation channel, 94% of the area is ecologically protected by FFH and Birds directives. Some of the ecologically valuable freshwater wadden areas are close to Hamburg, and at the mouth of the Elbe the river widens to a large marine wadden area which is a feeding and nesting site of many bird and fish species. In order to assess the impact of a high water discharge situation on the sediment quality of ecologically important wadden areas, freshly deposited sediment (FDS) was sampled during normal and high water discharges at two freshwater mudflats close to Hamburg and at two places near the mouth of the Elbe close to the North Sea. Chemical analyses were applied to determine the sampling and storage material. Elevated discharge 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) leads 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 biosassays 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 of dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like-activities, (anti)androgenic, (anti)estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to discharge conditions were noted between years within rivers. Marked increases of toxicity were noted for episodes of melting of ‘black snow’ (Akerselva river, Oslo) and overflow of mixed sewer systems (Harrestrøp river, Copenhagen). Contaminant 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 methods are 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 DiP project on “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 141

Toxicity of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers

A.G.M. van Hattum1, T. Hamers2, J. van Gol1

1 Institute for Environmental Studies, Amsterdam, Nederland
2 Deltares, Delft, 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 cause a dilution of normal pollution levels, while on the other hand, higher discharges may also result in an increased mobilization of polluted sediments and in reduced water quality. Advancements in the last years in environmental risk assessment procedures and legislation have made the prediction of future climate conditions relevant for water management. 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. Although the river discharge conditions were noted between years within rivers. Marked increases of toxicity were noted for episodes of melting of ‘black snow’ (Akerselva river, Oslo) and overflow of mixed sewer systems (Harrestrøp river, Copenhagen). Contaminant 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 methods are 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 DiP project on “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 availability and mobility of metals

M.P. de Oreja1, M.D. Basalote-Sánchez2, A. Rodríguez-Romero1, T.A. Delval1, J. Riba2, A. Sarmiento0

1 University of Cádiz, Puerto real, Spain
2 Instituto de Ciencias Marinas de Andalucía (CSIC), Puerto real, Spain

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 wastewater. 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 millimeters to centimeters 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 (NPEOs), both non-ionics, and linear alkylbenzene sulfonates (LAS) and alkyl ethoxylates (AES), both anionics. 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 intake. The data were divided into two different periods: dry years and wet years. The content distribution were observed according to the results and used volumetric data at physical-chemical properties of each surfactant. Levels of non-ionics (up to 12 mg/kg) were twice as high as those for anionics near industrial areas and ports, whereas the opposite was found near urban wastewater discharge outlets. A recent contamination, referable to the last few decades is clearly distinguishable only in one core.

TU 143

Changes in the biogeography of synthetic surfactants from river to marine sediments

C. Coradó-Fernández1, P.A. Lara-Martín2, C. Candela3, E. Gonzalez-Mazo3

1 Universidad de Cádiz, Cádiz, Spain
2 Politecnica University of Catalonia, Barcelona, Spain
3 Polytechnic University of Catalonia, Barcelona, Spain

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 wastewater. 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 millimeters to centimeters 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 (NPEOs), both non-ionics, and linear alkylbenzene sulfonates (LAS) and alkyl ethoxylates (AES), both anionics. 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 intake. The data were divided into two different periods: dry years and wet years. The content distribution were observed according to the results and used volumetric data at physical-chemical properties of each surfactant. Levels of non-ionics (up to 12 mg/kg) were twice as high as those for anionics 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 (SFC), 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 sulphate-reducing marine sediments (or absence in freshwater environments) seems to be strongly related to the degradation process. On the other hand, no changes in the average length of AEO and NPEO ethoxylated chains were observed along sediment cores from any type of aquatic system, suggesting that their biodegradation is very limited in anoxic sediments. This may be directly related to the lower bioavailability of esters, as their calculated sediment - pore water distribution coefficients showed much higher values when compared to those for most polar anionic surfactants (e.g., 553 ± 98 for NPEOs vs. 11 ± 7 for AES).

TU 144

Historical trend and pollution assessment for selected trace elements in sediment cores from the Orbetello lagoon (Tuscany, Italy)

E. Romano1, A. Ausili1, L. Bergamini2, C. Maggi3

1 ISPRA - Italian National Institute for Environmental Protection and Research, Rome, Italy
2 ISPRA - Italian National Institute for Environmental Protection and Research, Rome, Italy
3 ISPRA - Italian National Institute for Environmental Protection and Research, Rome, Italy

Heavy metal enrichment in sediment may be due to both natural and anthropogenic contribution, which may be recognized by studying the concentration profiles along depth in order to understand the contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located inside the volcanic region, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cu, Cr, Pb, Zn) were determined in two different sediment cores (OR96 and OR97) collected in the lagoon using local background concentrations. The determination of Cd, Cu, and Zn concentrations demonstrated that the cores are an upper anthropogenic enrichment referable to the last decades of the 20th century, while Pb contamination was found to begin earlier, during the first half of the last century. In spite of considerable EFs showed by very high values of factors (up to 6-7) in the most contaminated core section do not exceed the average levels found in other Mediterranean areas. As regards Hg concentration, a recent contamination, referable to the last few decades is clearly distinguishable only in one core. A markedly high positive geochemical anomaly dated at 1850 present in both the cores was considered as a result of specific anthropogenic activity related to the smelting of ores. In particular, the factors were considered to increase the background content for the whole considered period. The contamination of the core OR96 was interpreted as the result of increased contribution from the Albegna River catchment, whereas the opposite is present in the core OR97. In the investigated heavy metal anions Hg, may be considered element of concern, because the measured concentrations exceeded, with few exception, the reference values for sediment quality guidelines. For this reason, indication to investigate potential toxic effects by studies on mercury bioavailability and ecotoxicological response arises from the present research.

TU 145

Rapid contact kinetic assay with Vibrio fischeri in the assessment of small streams sediments in the Czech Republic

P. Masner, J. Kuta, J. Klímová, L. Bláha

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus


Ghent University, Ghent, Belgium

The Tietê River, selected in this study as an example for a highly contaminated river system, is located in the most important economical center in Brazil, São Paulo state. The reservoirs constructed along its course are widely used for providing drinking water, as water sources for agricultural irrigation and as recreation sites. Several approaches involving different test organisms, serum endpoints and different sediment phases (liquid as extract and solid as freeze-dried samples) were followed under laboratory conditions. Serological results indicate that serums from the Tietê River are differentially contaminated with contaminants which cannot cause acute cytotoxicity, but also genotoxicity and AhR-mediated toxicity in fish cells, as well as embryo toxicity. Moreover, mutagenicity was recorded in situ in fish caught from the field. Since major toxicities have been detected in the metropolitan region, sediment samples from this region were submitted to an effect-directed analysis, in order to identify key pollutants causing the high toxicity of sediments. Results indicated different sets of toxicants inducing genotoxicity and metabolism activation. Overall, genotoxicity could be mostly related to alkane, polychlorinated biphenyls (PCBs), naphthalenes (PCNs) as well as medium polar to polar polyaromatic compounds (PACs), whereas AhR-mediated toxicity could mostly be attributed to polycyclic aromatic hydrocarbons (PAHs). A comprehensive evaluation of the ecotoxicological situation in the Tietê River requires different approaches and in-depth knowledge for interpreting results. As exemplified for the Tietê River basin, a battery of bioassays applied in combination with chemical analyses and effect-directed testing are suitable tools to function as early warning systems not only for sediment pollution, but also for hazards for the entire river system.

TU 146

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


Ghent University, Ghent, Belgium

The Tietê River, selected in this study as an example for a highly contaminated river system, is located in the most important economical center in Brazil, São Paulo state. The reservoirs constructed along its course are widely used for providing drinking water, as water sources for agricultural irrigation and as recreation sites. Several approaches involving different test organisms, serum endpoints and different sediment phases (liquid as extract and solid as freeze-dried samples) were followed under laboratory conditions. Serological results indicate that serums from the Tietê River are differentially contaminated with contaminants which cannot cause acute cytotoxicity, but also genotoxicity and AhR-mediated toxicity in fish cells, as well as embryo toxicity. Moreover, mutagenicity was recorded in situ in fish caught from the field. Since major toxicities have been detected in the metropolitan region, sediment samples from this region were submitted to an effect-directed analysis, in order to identify key pollutants causing the high toxicity of sediments. Results indicated different sets of toxicants inducing genotoxicity and metabolism activation. Overall, genotoxicity could be mostly related to alkane, polychlorinated biphenyls (PCBs), naphthalenes (PCNs) as well as medium polar to polar polyaromatic compounds (PACs), whereas AhR-mediated toxicity could mostly be attributed to polycyclic aromatic hydrocarbons (PAHs). A comprehensive evaluation of the ecotoxicological situation in the Tietê River requires different approaches and in-depth knowledge for interpreting results. As exemplified for the Tietê River basin, a battery of bioassays applied in combination with chemical analyses and effect-directed testing are suitable tools to function as early warning systems not only for sediment pollution, but also for hazards for the entire river system.

TU 150

Identification of hazard factors and ecotoxicological risks of sediments from the Tiete River Basin (Brazil)

P.C. Rocha, S. Stoech, H. Hollert, T. Brunner

Unesp, Rio claro, Brazil

University of Heidelberg, Heidelberg, Germany

The objective of this study was to identify potential sediment contaminants in the Tietê River Basin, Brazil, using a combination of chemical analyses and effect-directed testing. Sediments from the Tietê River Basin, Brazil, represent a complex situation of anthropogenic contamination with different contaminants, such as heavy metals, organic pollutants and organic and inorganic pollutants. The Tietê River Basin, Brazil, is characterized by a high degree of anthropogenic activity, such as mining, industrial activities, agriculture, and urbanization. The Tietê River is one of the most polluted rivers in Brazil, and its sediment quality is of concern due to its potential impact on the aquatic environment. The results of this study provide valuable information for assessing the risk of sediment contaminants and for developing strategies to mitigate their effects on the ecosystem. The findings of this study can be used for environmental management and decision-making processes in the Tietê River Basin, Brazil.
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 cladodean (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 fracturing stages (estimated from the analysis of sequential extraction procedure) in order to establish the potential of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques.

The results show elevated concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments.

TU 152

Eco-toxicological assessment of sediments from rivers impacted by a petroleum refinery
S. Soares Rocha1, D.F. Angeli1, T. Braunbeck1, M.M. Marin-Morales1
UNESP, Río claro, Brazil

This research was carried out to determine the toxic effects of sediment contamination at the study site and the level of metal pollutants in order to determine the environmental risks. Heavy metals were determined in conjunction with sediment toxicity testing 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 the metal toxicity measured from MODIS images, indicate 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 153

Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S, Mexico
S. Sobrino-Figueroa, C. Cáceres-Martínez
Universidad Autonoma Metropolitana, Mexico, d.f., Mexico

In this paper was carried out a qualitative assessment of toxic and genotoxic effects of sediment collected at 8 locations in the Ensenada de la Paz, B.C.S., in 2 contrasting seasons summer and winter of 2010, using a battery of biological test with organisms of different trophic levels and the SOS-Chromotest microbioassay. Compounds with toxic and genotoxic effects were detected in 5 locations, located in the Canal de la Paz, near the termoelectric power station and the Pichilingue navy. LC50 and genotoxicity values were determined, indicating the presence of toxic compounds at sites near Punta Prieta and Cisicatam, sediment toxicity decreases with increasing distance from these points. This fact possibly indicates a contribution of harmful compounds probably from Punta Prieta and La Paz city to the Bay of La Paz. This type of analysis is essential to identify areas of risk in studies of environmental analysis.

TU 154

Toxic effects of sediments from a semi-arid coastal system, influenced by a gold ore mine
S. Sobrino-Figueroa1, A.J. Marmolejo-Rodriguez2, V.R. Magallanes-Ordóñez2
1Universidad Autonoma Metropolitana, Mexico, d.f., Mexico
2Centro Interdisciplinario de ciencias marinas IPN, La paz, b.c.s., Mexico

Over the last two decades human settlement in the valley has increased, parallel with the socio-economic activities such as livestock keeping, fishing, cultivation, and bee keeping. The Kilombero Valley, designated in the same year, is among the wetlands of international importance and to plan for the sustainable use of all other wetlands in the country. The Kilombero Valley, designated in the same year, is among the wetlands of international importance and to plan for the sustainable use of all other wetlands in the country.

The Kilombero Valley is rich in endemic species of flora and fauna and supports important functions. Millions of people depend on wetlands (MNRT, 2003) for fishing, agriculture, livestock keeping and collection of a multitude of minor wetland products, including mangroves, medicinal plants, and communities and nearby population villages. Therefore, ecotoxicological tests using a battery of assays were performed on sediments collected from the river in the vicinity of the gold mining area.

The results show elevated concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments.
This is investigated in the Tungelroyse beek, a stream in the south of the Netherlands. Local water authorities have restructured large parts of the stream. We used a triad approach for risk assessment of sediment and floodplain soil of a metal-polluted stream based on the principle of equilibrium partitioning. Ecologically relevant processes such as bioconcentration and baseline toxicity of POPs are mostly controlled by the chemical activity of the substance rather than by its total concentration in the sediment. To calculate chemical activity and thus to predict bioconcentration and the baseline toxic potential of a contaminant mixture the freely dissolved concentrations of PAHs and PCBs were measured in sediment pore water samples of the Baltic Sea using solid phase microextraction, a passive sampling technique based on the principle of equilibrium partitioning. To identify contaminating elements, modern strategies not only focus on analyses of contaminants, but also test the impact on biological organisms.

In addition to the chemical studies a composition of limnic and marine microbially and limnic assays was used in order to assess bioavailability of the contaminated material to different organisms under controlled laboratory conditions. Interpretation of our bioassay results followed a weight of evidence approach by which several individual positive tests in the tier add to an overall conclusion that a risk for the environment may in fact exist. The test system proved suitable for assessing the risk of the Baltic Sea sediments.

Due to the periodic and unpredictable flooding. During high discharge events, sediment is resuspended, transported, and settled at floodplains downstream. This spatial distribution of contaminants in the floodplain should be taken into account when streams and rivers are being reconstructed. This investigation in the Tungelroyse beek, a stream in the south of the Netherlands. Local water authorities have restructured large parts of the stream. We used a triad approach to assess whether all the ecotoxicological risks have been adequately removed or the restructuring and rehabilitation activities. Sediment and soil was sampled in the stream and in the floodplain on 5 locations along the stream. Total concentration (aqua regia extraction) and bioavailable concentration (CaCl2 extraction) of the following metals were analyzed: Cd, Cu, Pb, Zn, As. A standard Chironomus survival bioassay was conducted in the laboratory. Metal and bioassay results were compared with field investigations of the macronutrient and micronutrient community. The highest bioavailable concentrations of Cd and Zn were observed in the floodplain soils. The bioassay showed a negative effect for two locations. Combining the two measurement systems with the in situ macronutrient community showed an ecotoxicological risk for floodplain soil when inundated. These results are compared with previous studies along the river Dommel. Advices on optimal restructuring and rehabilitation of small streams should include the spatial distribution and bioavailability of contaminants.

Triad approach for risk assessment of sediment and floodplain soil of a metal-polluted stream

H.J. de Lange, J. Bovenschen, F. van Loon, J. Borremans, F. van Loon, J. Borremans, F. van Loon

Alterra, Wageningen UR, Wageningen, Nederland

Many streams and small rivers in Europe are faced with historic metal pollution due to the activity of zinc smelters. Rehabilitation activities are executed for many streams in the Netherlands. The sediment phase acts as a nuclearly changing changed condition long after the metal concentrations due to the periodic and unpredictable flooding. During high discharge events, sediment is resuspended, transported, and settled at floodplains downstream. This spatial distribution of contaminants in the floodplain should be taken into account when streams and rivers are being reconstructed. This investigation in the Tungelroyse beek, a stream in the south of the Netherlands. Local water authorities have restructured large parts of the stream. We used a triad approach to assess whether all the ecotoxicological risks have been adequately removed or the restructuring and rehabilitation activities. Sediment and soil was sampled in the stream and in the floodplain on 5 locations along the stream. Total concentration (aqua regia extraction) and bioavailable concentration (CaCl2 extraction) of the following metals were analyzed: Cd, Cu, Pb, Zn, As. A standard Chironomus survival bioassay was conducted in the laboratory. Metal and bioassay results were compared with field investigations of the macronutrient and micronutrient community. The highest bioavailable concentrations of Cd and Zn were observed in the floodplain soils. The bioassay showed a negative effect for two locations. Combining the two measurement systems with the in situ macronutrient community showed an ecotoxicological risk for floodplain soil when inundated. These results are compared with previous studies along the river Dommel. Advices on optimal restructuring and rehabilitation of small streams should include the spatial distribution and bioavailability of contaminants.

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

L. Böhnke, T. Pöhler, R.A. Dürr

Justus Liebig University Giessen, Giessen, Germany

Federal Institute of Hydrology (BIK), Koblenz, Germany

Due to historical emissions of hexachlorobenzene (HCB), the sediments of the ponds of Upper Rhine River in southern Germany remain highly contaminated (up to 1000 µg kg⁻¹). HCB is a bioaccumulative and toxic persistent organic pollutant (POP). By reason of its strong sorptive properties, HCB is mainly bound to organic substances. However, geogenic clay minerals are also capable sorbents. Regarding the contaminated sediments, the spatial distribution of HCB is considerably more heterogeneous, then e.g. the distribution of polychlorinated biphenyls (PCBs). Further, maximum loads of HCB occur rather in larger particle fractions (6.3 - 2000 µm), than in smaller fractions (≤ 20 µm). Knowledge of the specific HCB-sorberts in the different fractions is of importance, because their characteristics control sorption strength, which is an important factor for remediation as well as bioavailability or organic contaminants.

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 capacities (classified by particle size and content of organo-) were determined in batch equilibrium studies based on solid-phase microextraction (SPME) coupled to gas chromatography (GC). In addition, adsorbents were investigated by imaging mass spectrometry and scanning electron microscope coupled to energy-dispersive X-ray spectroscopy (SEM-EDS). Results elucidate mechanisms of sorption and can thereby contribute to predict remediation processes as well as bioavailability of HCB in aqueous ecosystems. Results yield important physicochemical properties of sorbents for better understanding the environmental behavior and pathways of chemicals and beyond that to model environmental fate under changing climate conditions.


University of Westminster, London, United Kingdom

Natural History Museum, London, United Kingdom

Sediment forms an important part of the aquatic environment and provide habitat to benthic organisms. 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 (EQS) for sediments or spatially dissolved suspended sediments, and one of the major problems in establishing sediment EQSs is the identification of the suitable sediment fraction to measure - the actively transported or temporarily deposited sediment. The variability in sediment characteristics is mainly attributed to their active properties and the characteristics of the sediments such as pH, redox, and high water discharge, which is investigated during sediment sampling. The study aims to investigate the effect of particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne River surface water, and compare the concentration of selected metals 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).

River sediment sampling and environmental quality standards


University of Westminster, London, United Kingdom

Natural History Museum, London, United Kingdom

T.U. 158

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

E. Koçbas1, R. Oral

Gedal Bayar University, Manisa, Turkey

Ege University, Izmir, Turkey

Surface sediments in the fraction <63 µm collected from eight stations in Nemrut Bay, Aegean Sea were analyzed for trace metals (Cd, Pb, Cu, Ca, and Zn) by using inductively coupled plasma-mass spectrometry. Geochemical characterization of heavy metal concentration varied from 0.1-0.95 mg/kg for Pb, 15-190 mg/kg for Pb, 13-38, 65 mg/kg for Cu, 20.2-71, 9 mg/kg for Cu and 8.09-178,3 mg/kg for Zn. The results show that some elements such as Cd, Pb and Cu are at risk level in the sediments near the harbour, harbour activity and petrochemical industry may be the sources of these elements.

T.U. 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

S.C. Lang1, D. Schulz-Bull1, K. Schmidt, G. Witt1

University of Applied Sciences Hamburg, Hamburg, Germany

Baltic Sea Research Institute, 18119 rostock, Germany

In the last recent decades persistent organic pollutants (POPs) gained increasing importance in environmental sciences and toxicology due to their carcinogenic and mutagenic effects to a variety of organisms as well as negative impacts on human health. Attributable to atmospheric deposition and municipal as well as industrial waste water treatment plants and the marine environment, where they are finally enriched in the sediments, but the affinity to bind to particulate matter and sorption processes. Adverse impacts on the benthic fauna are caused through chemical uptake and bioaccumulation of these ecotoxins. Relevant processes such as bioconcentration and baseline toxicity of POPs are mostly controlled by the chemical activity of the substance rather than by its total concentration in the sediment. To calculate chemical activity and thus to predict bioconcentration and the baseline toxic potential of a contaminant mixture the freely dissolved concentrations of PAHs and PCBs were measured in sediment pore water samples of the Baltic Sea using solid phase microextraction, a passive sampling technique based on the principle of equilibrium partitioning. To identify contaminating elements, modern strategies not only focus on analyses of contaminants, but also test the impact on biological organisms.

In addition to the chemical studies a composition of limnic and marine microbially and limnic assays was used in order to assess bioavailability of the contaminated material to different organisms under controlled laboratory conditions. Interpretation of our bioassay results followed a weight of evidence approach by which several individual positive tests in the tier add to an overall conclusion that a risk for the environment may in fact exist. The test system proved suitable for assessing the risk of the Baltic Sea sediments.

T.U. 160

Rapid economic development and urbanization growth in Vietnam have made this country become an important subject for extensive studied dealing with environmental pollution recently. So far, there has been no information on PBDEs contamination in Central Vietnam and the information about PCBs sources and levels is limited. Tam Giang-Cau Hai Lagoon lies along the coastal line of Thua Thien-Hue Province, Vietnam. Due to recent industrial and economical growth in this region, large amount of untreated municipal and industrial wastewater have been discharged to this river-lagoon system, which may cause adverse environmental consequences and increased health risk for local communities. In this study, the contamination status, distribution and congener profiles of PCBs and PBDEs in surficial sediment of Tam Giang-Cau Hai Lagoon were investigated. PCBs and PBDEs were detected in all sediment samples with mean concentrations of 0.19 and 0.35 ng/g dw, respectively. The highest concentrations of both contaminants were observed downstream at the river mouths, indicating the river flow as a main source of pollutants into the lagoon system. The similarity of PCB congener distributions in sediments suggest the presence of a unique source over the entire study area, probably connected to local use of old electrical equipments containing...
low chlorinated PCB formulations. Atmospheric transport & post depositional processes might modify to some degree the fingerprint of PCB inputs to the environment favoring the predominance of 3, 4 & 5 chlorinated congeners. The PBDEs profile in sediment was relatively uniform, with decaBDE as the dominant congener, followed by nona- and octaBDEs, indicating DecaBDE as the major technical mixture in consumer products in this region. In general, the levels of PCBs and PBDEs in lagoon sediments were comparable to those reported in other river and estuarine environments 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 PCBs and phenolic compounds in the samples are far lower than the Chinese drinking water guideline values. The concentrations of PCBs and phenolic compounds in the samples were in the same order of magnitude of those reported on lower levels in European and American countries, which show that potential risk are negligible due to PCBs and phenolic compounds contamination in these samples.

TU 167

Measuring trace labile metals in the Pasig River water using DGT technique: an application for a water resource management

J.V. Villarino, M. M. Merkel, F. Trujillo, R. R. Ramirez

TU 168

Dioxin-like compounds in Portuguese estuaries: levels and patterns in superficial sediments

M.N. Cardoso, F. Reis, A. Silva, A. Mamede

TU 169

Environmental monitoring and assessment of Terminus Lagoon, Mexico


TU 170

Chemical and biological assessment of metal pollution in the Urdaiaba Reserve of the Biosphere (UNESCO) using oysters as sentinel


University of the Basque Country, Leioa, Spain

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, oysters have been used as sentinel organisms in the Urdaiaba Reserve (Unesco Biosphere) in the central part of the Basque Country. Metal concentrations were determined in oyster tissues and in the surrounding waters during three campaigns carried out in September 2003, March 2004 and June 2004. The results showed that coastal areas near the river mouth had higher metal concentrations in oyster tissues and in the water column. This is the first time that a biological index based on Cd, Pb, Zn and Cu has been used to assess the environmental quality of a coastal area like the Urdaiaba Reserve.
Monitoring of sediments genotoxicity of the Yucateco, lagoon Tab, Mexico

S. Soberón1, A. Vázquez-Botello1, G. Pérez-Veliz2, S. Villanueva-Fragoso2
1Universidad Autonoma Metropolitana, Mexico, d.f., Mexico
2Lab. Contamination Marina ICMyL, UNAM, Mexico d.f., Mexico

The Yucateco lagoon is located in southeastern of the Mexican Republic in the Tabasco state. This system receives a continuous contribution of toxic compounds due to hydrocarbons extraction and industrial activity carried out in the zone. Since the system has been reported mass mortality events of fish and shellfish, in this research, an evaluation of the genotoxic effects of sediments over a period of 3 years was carried out to establish the state of ecosystem health. Sampling were made annually during the dry season to establish the situation, the samples were obtained from the different points which were tested in the SOS-Chromotest microtoxicity. In general can mention that the number of sediment samples with genotoxic effects decreased from 2003 to 2007. In 2003 was detected genotoxic compounds in 3 sampling stations, while in 2007 this effect was observed only in 3 locations. Critical areas are the stations 1, 2 and 3 located in the northern and central part of the system, the genotoxic effects decreases with increasing distance from these points in the direction of outlet the river Tonzal. The critical pollutants likely to cause genotoxicity were the HAPS, PCBs (polychlorinated biphenyls) and metals vanadium and nickel. The utility of this type of analysis is essential to identify areas of risk in studies of environmental analysis.

Bang for buck: the challenge of choosing environmental indicators of anthropogenic impacts in estuaries

K.A. Dafforn1, S.L. Simpson2, B.P. Kelaier2, G.F. Clark2, V. Komyakova2, C.K.C. Wong2, E.L. Johnston1
1University of Tasmania, Hobart, Tasmania, Australia
2CSIRO Land and Water, Karratha, Australia

The estuarine environment is a very dynamic system characterized by strong physical and chemical gradients and an enormous diversity in flora and fauna which undergo major transitions moving from the freshwater to the marine areas. Along these gradients metal concentrations and speciation undergo important changes which also have an impact on the distribution and levels of metals. A significant number of changes in the physicochemical and biological species living in this gradient as they adjust themselves to the changes in ion composition and osmotic pressure of the external environment in order to maintain homeostatic balance. The effect of changes in salinity on metal speciation, metal benthos and metal toxicity was studied under controlled conditions in a series of structurally and functionally different freshwater or marine microcosms. The results were compared and correlated with information available from water and benthic species literature to explore whether general concepts such as the free metal ion activity model and major ion competition effects used to describe metal uptake and toxicity remain valid across estuarine gradients and biodiversity. Using a dynamic modelling approach the effects of changes in physical and chemical factors on the metal toxicity and species sensitivity distribution across species diversity for some metals, such as cadmium; where a strong inorganic metal speciation effect is observed a species sensitivity distribution analysis shows a decrease in metal toxicity moving from freshwater to higher salinity environments. However, this is not the case for a metal such as copper and in any case the effect is considerably less that what would be expected on the basis of the changes in the free metal ion activity. The results of these observations are further discussed in an integrated ecological risk management approach which is being applied to the estuary at the site, including:

- Ecosystems are complex, therefore identifying and monitoring the right parameters is key to successful management. At this site, environmental monitoring has extended beyond routine water quality parameters to include terrestrial and aquatic ecological surveys and detailed studies evaluating benthic community abundance and diversity. These data were used to evaluate the changes in the ecological system parallel to this are changes in the physiological organisation of the biological species living in the system as they adjust themselves to the changes in ion composition and osmotic pressure of the external environment in order to maintain homeostatic balance.
- Early engagement with regulatory authorities is important to gain early access to marine data. Using sound decision making to support regulatory decision making on the site can assist with more fully integrating ecological risk management into the process. The climate is continuously changing, therefore it is important to continually review the monitoring and assessment approach and consider the influence of potential future stressors, such as climate change.

Integrative estuarine modeling to support watershed management for Sinclair and Dyes inlets, Puget Sound, WA, USA

R.K. Johnston1, P.F. Wang2, B.E. Skahil2
1US Navy Marine Environmental Support Office-NW, Bremerton, wa, United States of America
2US Army Engineering Research and Development Center, Portland, or, United States of America

An integrated estuarine model was developed to simulate fecal coliform (FC) fate and transport in the estuaries of Sinclair and Dyes Inlets, Puget Sound, WA, USA. The integrated model consisted of a watershed model (Hydrologic Simulation Program-Fortran - HSPF), an empirical fecal coliform loading model based on upstream land use and cover (LULC), and three dimensionate fate and transport model, Curvilinear Hydrodynamics in Three Dimensions (CH3D), previously calibrated to match the hydrodynamics of the estuaries and modified to include a more sophisticated fate and transport (HPCF). The integrated model was used to simulate the release, transport, and fate of FC loading from watershed pour points corresponding to stream mouths, stormwater outlets, wastewater treatment plant discharges, and shoreline drainage areas. A total of 20 simulation scenarios were run to verify model performance, assess sensitivity and uncertainty, and provide results needed to establish management goals for the watershed. Model results indicated that for marine waters to meet the NPDES, an increase of freshwater was needed for three streams that discharged in nearshore areas with reduced flushing. Overall, the integrated watershed-receiving water model performed very well. The integrated model was able to recreate a range of wide dynamic loading within the inlets, from large-scale storm events with high flow conditions to dry, low-flow conditions during the summer months. The integrated watershed modeling and modeling approach to water quality management was assisting the development of management plans worthy of stakeholder acceptance, helping to achieve reductions in FC loading, and resulting in improvements to the environmental quality of the inlets.
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. First results of the interlaboratory ring test will be presented.

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 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<0.05) and a very strong positive correlation (Pearson Product Moment correlation, P<0.0001) were found for Laranjo data, between HgTOT and 81Sn, and HgTOT and HgORG, respectively. No other significant correlations were established.

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 Chewing to pollution able to defend the physiological capability of Corbicula fluminea to respond to acute chemical stress in estuaries? P. Vilares, C. Oliveira, L. Guilmerrino University of Porto, CEMAR & ICBIAS, Porto, Portugal

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, has been contributing 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 to pollution exposure events. To test the hypothesis, animals collected at two sites in the Minho River under different anthropogenic pressure were exposed separately 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 differences in responses between the two groups of clams 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 factor key"s funded by the Portuguese Foundation for the Science and the Technology (FCT) (PTDC/AAC-AMB/102121/2008) 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/84423/2010) 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

TJ 181 Sediment contact test with Myriophyllum aquaticum (ISO/CD 16191): first results of an international ring test U. Feiler Federal Institute of Hydrology, Koblenz, Germany

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 this study, Myriophyllum aquaticum plants were 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 resulted in i) investigating the practicability and reproducibility of the sediment contact test, ii) validating the chosen endpoint, and iii) determining the response range of the first reference substance functioning as positive control. First results of the interlaboratory ring test will be presented. Acknowledgement: UF on behalf of the participants of the international ring test

TJ 182 Genetic and 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. Tedorovic Faculty of Sciences, Novi sad, Serbia

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. Lemna minor, a plant that is often not assessed. The ability standard test protocol with Lemna could be adapted by a) adding a recovery phase after the exposure phase and b) the use of more ecological realism into worst case scenario responses typically obtained by single species laboratory toxicity tests but also provide valuable data for population - level models. Test results are presented in this paper.

TJ 183 New developments in mesocosm testing with herbicides: recent experiences and recommendations A. Taylor, L. Bennett, S. Priestly, R. Bromley, J. Forsyth, E. Bateman, H. Walton Cambridge Environmental Assemblies, Cambridge, United Kingdom

A number of new developments in mesocosm testing have taken place since the most recent revisions to guidance for these complex studies (e.g. HARAP, 1998 & CLASSIC, 1999). Much of this 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 to fish, algae, periphyton and macrophytes. This presentation will highlight some of the developments in this area using examples drawn from recent state of the art mesocosm studies. We will highlight our recent experiences in this area in the context by which we have developed to evaluate the effects of herbicide exposure on a variety of macrophytes with different morphology and life histories. We will also provide recommendations for the evaluation of effects of algae 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 catalyst for discussion in this developing area of higher tier aquatic ecotoxicology.

TJ 184 Unforeseen effects of herbicides on wetland and terrestrial plant communities: time to vegetative and reproductive recovery following exposure D. Carpenter, C. Boutin Environment Canada, Ottawa, Canada

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 often not assessed. The ability standard test protocol with wild species to recover following sub-lethal exposure to herbicides was examined using the sulfonylurea herbicide chlorimuron ethyl. Eight wetland and nine upland species were tested with eight doses of chlorimuron (< controls) ranging from 1 to 107% of the recommended label rate.
of 9 g 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 of 1 IC₅₀ and 10 IC₅₀ were reported for ST and LT biomass and for LT reproductive parameters. LT 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. Leaf area of the ST was affected at doses of 7.4% or less, three fully recovered within an avg. 6.7 weeks 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 100 µg/L and recovery took from days to over 8 weeks. While recovery did occur in this greenhouse experiment, it may be suppressed in species exposed to these same rates for over 8 weeks.

2.2.2 Growth inhibition of aquatic macrophytes

Aquatic macrophytes community structure and quality in a Canadian agricultural watershed
R.L. De Stasio, B. Pick
Ottawa-Carleton Institute of Biology, University of Ottawa, Ottawa, Canada

Science and Technology Branch, Environment Canada, Ottawa, Canada
Macrophyte species diversity was measured by using a variety of taxonomic groups were exposed in artificial outdoor ponds for 6 to 8 weeks. Each year the design was slightly adjusted based on experiences gained from the previous year.

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 and (2) to identify a most sensitive species. The test is regarded as more reliable than the NOEC. As plant length could not be assessed in all species, the EC₅₀ is regarded as more reliable than the NOEC. A decline in the quality and conservation values of aquatic macrophyte communities was observed along a gradient of nutrient contamination.

TU 185
Effects of agrochemicals on macrophyte community structure and quality in a Canadian agricultural watershed
R.L. De Stasio, B. Pick
Ottawa-Carleton Institute of Biology, University of Ottawa, Ottawa, Canada

Science and Technology Branch, Environment Canada, Ottawa, Canada

Macrophytes are widely used as environmental biomonitors because of its bioacumulation capacity of xenobiotics. The main goal of this study was to establish a concentration-response curve of AZX in Myriophyllum quitense, by using oxidative stress enzyme activities and chlorophyll content. Particularly, the activity of Guaiacol Peroxidase (POD), Glutathione-S-Transferase (GST), Catalase (CAT), and the chlorophyll a and b contents were tested. Plants were exposed to 0, 0.1, 1; 10; 50 and 100 µg L⁻¹ of AZX for 24 hours. All the parameters were measured spectrophotometrically. Inhibition of CAT and POD at 50 µg L⁻¹ was observed (p < 0.05), showing the stress condition induced by this fungicide. GST and POD were not affected by any concentration of AZX (p > 0.05). Although there was no change in the chlorophyll a/chlorophyll b ratio among treatments there is an increased content of both pigments at 100 µg L⁻¹ with respect to control (p < 0.05). Our results show the importance of using biomarkers of different sensitivity, in the evaluation of potential negative effects of emerging agrochemicals in the environment, being a more detailed studied highly recommended.

TU 186
Biochemical responses in the aquatic macrophyte Myriophyllum quitense exposed to the strobilurin fungicide azoxystrobin
D.S. Garanzini, M.L. Menone
Faculty of Soil Science, Moscow, Russian Federation

TU 187
Ecological functions of plant growth regulators in the stability of agroecosystem
P.V. Romanova

TU 188
Biochemical responses in the aquatic macrophyte Myriophyllum quitense exposed to the strobilurin fungicide azoxystrobin
D.S. Garanzini, M.L. Menone

Faculty of Soil Science, Moscow, Russian Federation

TU 189
Impact on surface water, stream sediments and macrophytes from the Aljustrel mining area (Portugal)
F. R. Pick, P. Palma
Instituto Politécnico de Beja, Escola Superior Agrária, Beja, Portugal

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

The aim of the study was: a) to evaluate the extent of pollution in stream waters and sediments at Água Forte and at Roxo, and b) to assess the potential of the macrophyte Scirpus holoschoenus, collected along the stream banks, for phytoremediation of AMD. Several sampling sites were selected at Água Forte and at Roxo stream, and downstream from the confluence of the Água Forte stream. Water quality was assessed considering physico-chemical characteristics and ecotoxicological parameters. Sediment samples were analyzed considering general physico-chemical characteristics and a sequential extraction procedure was used to quantitatively assess trace element pools (As, Cu, Pb and Zn). Scirpus holoschoenus samples were analyzed in order to assess trace element concentrations in the aboveground plant material.
Both surface water and sediments were extremely acidic at Agua 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 Agua Forte stream, but the same was not true considering the pH and other characteristics of the sediments. Ecotoxicological biossays (luminescence inhibition of *Vibrio fischeri* and 48-h immobilization/mortality assay with *Daphnia magna*) were conducted on contaminated water samples, which were found extremely toxic, with very EC50 values. Although high As, Cu, Pb and Zn concentrations were found at Agua 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 Agua 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 front developmental gradients

E.C. Lahive1, J. O’ Halloran1, M.A.K. Jansen2

1Centre for Ecology and Hydrology, Wallingford, United Kingdom

2Schools of Life and Environmental Sciences, University College Cork, Cork, Ireland

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 assessing the impacts of heavy metals on the photosynthetic apparatus. The plant age and developmental stage strongly influence the effects of metal contamination 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 the front 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, YII, and photochemical quenching, qP, were measured in mature and young fronds as well as along a developmental gradient within the Lemnaeae species. The zinc content in both young and mature fronds and root sections (mature and stored in the viable 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 YII 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 toxicity in Lemnaeae.

TU 192

Alternative effects of magnesium on copper rhizotoxicity to grapevine: macroscopic and microscopic point of view


1MingDao Univ., Changhua, Taiwan

2National Chiayi University, Chiayi, Taiwan

3National Chung Hsing University, Taichung, Taiwan

4National Yang-Ming University, Taipei, Taiwan

5National Cheng Kung University, Tainan, Taiwan

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 the vineyards. The problems of Cu toxicity to the organisms throughout the world, 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 was used to examine the histological changes in root tissue at the sensitive stage of the plants. Results indicated increased significantly with increasing solution 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 root cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM to the 0.2 mM Mg treatment, to 25 μM to 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.
Biosorption of Pb by Chlorella vulgaris (Chlorophyceae) at laboratory scale
1Facultad de Humanidades y Ciencias, Santa fe, Argentina
2ConICET - UNLu, Santa Fe, Argentina
3Centro Atómico Bariloche. Comisión Nacional de Energía Atómica, San carlos de bariloche, río negro, Argentina
4Instituto de Botánica de Provenza (Argentina)
5Instituto de Historia y Ciencias, Santa fe, Argentina
6Facultad de Humanidades y Ciencias, Santa Fe, Argentina

The microalgae were harvested in exponential growth phase, centrifuged and resuspended twice in ultrapure sterile distilled water. After measure of algae concentration, we used three real concentrations of Pb2+ (NO3)2.1.951 (C1), 2.826 (C2) and 4.830 (C3) mg L-1 with their respective controls, all in triplicate (50 mL-1). The vessels were maintained in an incubation chamber under controlled temperature (21±1°C), continuous illumination (3000 lux) and daily shaking. At 10 and 30 min, 1, 12 and 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. 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.

Biosorption and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river
D.V. Erasmus, R.G. Smyman, J.P. Odendaal
Cape Peninsula University of Technology, Cape town, South Africa

The macroalgae were harvested in exponential growth phase, centrifuged and resuspended twice in ultrapure sterile distilled water. After measure of algae concentration, we used three real concentrations of Pb2+ (NO3)2.1.951 (C1), 2.826 (C2) and 4.830 (C3) mg L-1 with their respective controls, all in triplicate (50 mL-1). The vessels were maintained in an incubation chamber under controlled temperature (21±1°C), continuous illumination (3000 lux) and daily shaking. At 10 and 30 min, 1, 12 and 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurement of Pb concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to test the correlation of Pb in the supernatant and the remaining in the supernatant.
during years 2009, 2010 and 2011. The concentration of Se in water from all locations did not exceed 0.2 µg Se 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 Zerovichitsa 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 (SeMeSeCys, SeMet) were detected.

TU 202
The organic matter contribution of salt marsh vegetation to coastal ecosystems: a case study in Jiangsu, China  
Z.U.O.P. Zou1, J.L.A.N.G Jiang2  
1Nanjing University, Nanjing, China  
2School of Geos&Oceanographic Sciences, Nanjing Univ., Jiangsu, China

Stable isotope technique 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^0C 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 57%. By comparing the two quantification methods, 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. Giannoldi, M. Barbarieri  
CNR, Pavia, Italy

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 characterising different chemical forms. The use of plant bioassay may be an amenable tool to screen the phytotoxicity of contaminated soils. 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 B polluted soils and artificially contaminated soils, obtained by B spiked soils, were adjusted to Argentine guidelines and sampling sites were qualify, 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. Bioassays using water from Uruguay and Río de la Plata rivers were performed to evaluate toxicity. Allium cepa were exposed chronically and concurrently occurring chemicals, there is a need to develop environmental quality benchmarks (EQBs) for their mixtures. In this presentation, I will introduce and discuss found that both additive and synergistic effects together account for 80% of all cases in which about 35% cases are synergistic. To allow more accurate risk assessment of water and sediment samples collected from coastal environments. Based on literature review of documented studies on the combined ecotoxicity of antifouling biocides, we evaluated, according the PPP Reg and the BP Reg, respectively. This is more explicitly stated in the BP Reg compared to the BPD.

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. 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 polycyclic aromatic hydrocarbons. Second, if the mixtures contain chemicals with different toxic modes of action, it is possible to use the product of the multidimensional species sensitivity distribution (m-SSD) approach. Here, I use binary mixtures of copper (Cu) and zinc pyrithione (ZnPT) 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 synergistic toxic effect to all test organisms. By utilizing the toxicity data, we are able to construct a two-dimensional SSD in form of a response surface, 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, I will highlight the field-based SSD approach, which is connected 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 I 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  
P.O.A. Johansson, H. Sundberg, P. Nord  
SwedChem, Chemicals Agency, Sundbyberg, Sweden

Pesticides are regulated in the EU by the Biocide Product Directive (98/8/EC) (BPD) and the Plant Protection Product Regulation (Regulation (EC) No 1107/2009) (PPP 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 PPP 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 or 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 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 for better and avoids the contradictions inherent in the DA-CAOS concept. The proposed approach recommends application of independent action for phthalates and 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 applied. Predictions 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 be more protective and conservative than the DA-CAOS concept. The interpretation of DPD+ (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.

TU 208

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

A. Weyers, M. Ebeling

Bayer CropScience, Monheim am Rhein, Germany

The concept ofThreshold 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 following structural or de minimis considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as food contact materials, for food contact, the food contact materials, and for the risk assessment of chemicals (EFSA, US FDA, WHO IPCS). Later it was adapted for ecotoxicology, and an “environmental threshold of no concern” (ETNCasq) of 0.1 μg/l was proposed for polar narcotics, non-polar narcotics and also reactive chemicals (dWolters). As they are not able to cross the blood-brain barrier, specific MoA and were not considered included. In the TTC concept could be adapted to the assessment of chemicals that occur in environmental media. The recent SHER SCHER 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 risk avoiding and cost-saving tool. If the chemical mixtures of which no one substance is expected to exceed the TTC, the complete chemical mixture could be considered as not expected to cause harm. An analysis of the Bayer CropScience portfolio suggests that regulatory acceptable concentrations (RACs) for most pesticides are well above the ETNCasq of 0.1 μg/l suggested for other chemicals other than pesticides. However, the original application of the ETNCasq was to derive threshold values in the absence of effect data, whereas for pesticides with data on acute and subacute effects, the limited number of data are expected to cause harm. The TTC concept has to be further elaborated and included in a method to assess the risk of mixtures. The interpretation of DPD+ (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.

TU 209

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

L.S. McCarty, R.J. Dietrich, K.C. Golden

1L.S. McCray Scientific Research & Consulting, Newmarket on, Canada

Applied Pharmacology & Toxicology Inc., Gainesville fl, United States of America

University of Medicine and Dentistry of New Jersey School of Public Health, Piscataway, New Jersey, United States of America

University of Florida, Gainsville fl, United States of America

University of Konstanz, Konstanz, Germany

ToxLogic, Inc., Potomac md, United States of America

Relative approaches, i.e., toxic equivalent (TEQ)-like approaches, for mixtures risk assessment have been established for some time. TEQ-like approaches assume that if certain premises are met, i.e., 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 effects being modeled (Safe 1990), then those chemicals may be assumed to be dose additive (DA) for specific toxic effects. A summary of such an approach entitled “Pharmacokinetic Research 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 MoA. However, the Panel acknowledged that the TEQ concept is well established and 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 used for the human risk assessment. The Panel concluded that chemicals were the 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 be more protective and conservative than 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.

TU 210

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

M. Katsumata, K. Bennett, A. Takeuchi, Y. Kobayashi, K. Kazumura, Y. Sato, T. Koske, N. Tatarazako, Y. Sugaya

Hamamatsu Photonics K.K., Hamamatsu, Japan

1National Institute of Environmental Studies, Tsukuba, Japan

Algae are important primary producers in aquatic ecosystems. The OECD Test Guidelines 201 (TG201), algal growth inhibition test, is a conventional method that evaluates chemical risks to algae. Algal growth inhibition is a conventional method that is used to assess chemical mixtures, a method that can estimate chemical toxicity in shorter ecosystems. In the OECD Test Guidelines 201 (TG201), algal growth inhibition test, the chemical mixture to be assessed is exposed to algae. Using the algal growth inhibition test, a new method is developed that can estimate chemical toxicity in shorter ecosystems. The chemical mixture to be assessed is exposed to algae, and the fluorescence yield of the algae is measured. The fluorescence yield is used to estimate the chemical toxicity of the chemical mixture.

TU 211

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

E.A. Aribiére, A. Achev, J. Montuelle

INRA, INRA, Thonon-les-bains, France

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 in aquatic ecosystems. 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.

**TU 212**

Effects of Atrazine and 2,4-D mixtures on Lemma minor

R.T. Tagun

The University of York, York, United Kingdom

Threats to aquatic ecosystems by herbicides are very important in terms of the economy. Pesticides are therefore widely used in Thailand and this usage is increasing. As a wide range of pesticides is used in Thailand, aquatic will be exposed to a mixture of compounds. In order to understand pesticide impacts, it is therefore important to understand the potential toxic interactions of pesticides in use in Thailand. The aim of the present study was therefore to test the interactive effects of two herbicides, atrazine and 2,4-D, on Lemma minor. The test was carried out on Lemma minor in a laboratory environment.

The effects of atrazine and 2,4-D on their own and in mixtures were assessed using OECD method 221. For the single compound studies, the effects of a range of concentrations of pesticide on the growth of L. minor were studied. For atrazine the test concentrations were 0.05, 0.10, 0.2, 0.4 and 0.8 mg L\(^{-1}\). For 2,4-D the test concentrations were 9, 18, 20, 40 and 100 mg L\(^{-1}\). A healthy frond was exposed to the test solutions for a period of 7 days. The design of the mixture study was used seven mixture ratios and seven chemical dilutions. Dose response curves were obtained and fitted in logistic regression by using sigma plot. Isobole analysis was used to interpret the mixture toxicity results.

Results from the single substance studies showed that atrazine was more toxic to L. minor than 2,4-D. Due to 2,4-D being an auxin hormone, it is absorbed through 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 combination effects of atrazine and 2,4-D on L. minor clearly showed that the two compounds interact in an antagonistic manner. The antagonism has been found 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.

**TU 213**

Predictive mixture toxicity assessment of pesticides in Swedish surface waters

E.M. Gustavsson, T. Backhaus

University of Gothenburg, Gothenburg, Sweden

It has been determined that combined effects of chemical mixtures 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 QSAAR's 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 site by site risk estimate.

Among the conclusions is that average risk for the monitored PAH mixtures is significantly higher than risks from single compounds. Risks from the mixture of PAHs is also found to be about 3 times higher. Large parts of the risk assessments in the study were done by the RIVM (NL) and the latter method predicts the risk for different ecotoxicological data has been determined. The results show that the average risk quotient of the mixtures from the different sites range between 2.1 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.

**TU 214**

A proposal for considering mixture toxicity with EQS checking

M. Junghans, P.Y. Kunz, M. Vighi, L. Werner

1Swiss Centre for Applied Ecotoxicology Eawag, EPAI, Dübendorf, Switzerland
2Università di Milano Bicocca, Milano, Italy
3University of York, York, United Kingdom

Environmental quality standards (EQS) are used under the EU Water Framework Directive to determine the chemical status of a water body. At present, compliance with these standards is assessed on the single substances or mixture level. A key question in mixture toxicity studies indicates that this procedure might underestimate the toxicity of the chemicals present in a water body, as the effect of mixtures has been shown to be higher than the highest single substance effect in the majority of cases. This propensity to underestimate potential effects of mixtures is underlined by a recent review published by Cortenkamp and co-workers. Two approaches have been proposed to date to account for mixture toxicity in assessing the chemical status: (i) application of a default assessment factor of 100 as used for EQS derivation by RIVM (NL) and (ii) application of mixture toxicity models based on species sensitivity distributions (SSD). The latter method predicts the ‘multi-substance potentially affected fraction’ (msPAF) of species proposed by Posthumu and co-workers. In this paper we propose a third approach for cases where the EQS was not derived from SSDs for all mixture components, which allows more accurate assessment of environmental mixtures even where there is incomplete SSD information. The approach is based on identifying a default assessable toxicant per taxonomic group and can be combined with the mixture cumulative ratio (MCR) approach recently proposed by Price and Han. It will also take into account the fact that specifically actively substances will only be specifically toxic to some taxonomic groups while exerting baseline toxicity to other taxonomic groups. This novel approach will be illustrated using case studies based on real monitoring data and published EQS values. The everyday applicability of the approach will be discussed along with the decrease in uncertainty that it achieves when assessing the chemical status of water bodies containing more than one substance of concern.

**TU 215**

Increasing the number of data points does not necessarily reduce the probability of erroneously conclusions about interactive effects in mixture toxicity experiments

J. Asselman, F. de Laender, C.R. Janssen, K.A.C. de Schamphelaere

Ghent University, Gent, Belgium

The number of data points in mixture ecotoxicity studies is increasing exponentially. Developing requirements in regulatory risk assessment are further fuelling the need to gain more knowledge about mixtures, 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. Model simulations were found to be equally sensitive to 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 data 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 and negative rates. An optimal combination of these two parameters leads to the lowest false positive rates for a given design. In conclusion, this study presents that an optimal experimental design for mixture toxicity experiments focuses on optimizing the lowest tested concentration and the concentration step size rather than increasing the number of design points. Furthermore, datasets based on suboptimal or imperfect designs lead to erroneous conclusions and care should be taken in analyzing and evaluating such datasets.

**TU 216**

Proposed PAH relative potency factors will greatly increase risks at all sites with PAH mixtures

B.M. Gustavsson, T. Backhaus

University of Gothenburg, Gothenburg, Sweden

The derivation of environmental risk limits for polycyclic aromatic hydrocarbons (PAHs) based on internal residues are inherently taken into account in mixture studies. Lastly, there were many technical problems with proposed RPFs: many RPFs were based on a single study or “low confidence” studies; some RPFs were based on in vitro assays; some RPFs were derived from studies with no confirmation of the chemical identity of the test substance; some RPFs were based on studies with unusual modes of administration, such as long implantation; and many studies exceeded the Maximum Tolerated Dose. This paper presents the proposed approach to evaluating PAH mixtures and discusses key scientific criticisms.

**TU 217**

Derivation of environmental risk limits for polycyclic aromatic hydrocarbons (PAHs) based on internal residues

E.M.J. Verbruggen

Department of Environmental Toxicology, RIVM (NL)

The toxicity of polycyclic aromatic hydrocarbons (PAHs) is a concern to both the environment and human health. For this reason, the European Union (EU) has established a tiered risk assessment procedure for PAHs. The primary objective of Tier 1 risk assessment is to identify PAHs that are considered to pose a potential risk to the environment. The Tier 2 risk assessment focuses on determining the potential risk to the human population and wildlife from exposure to PAHs in the environment.

However, there are many technical problems with the proposed RPFs. The technical problems with the proposed RPFs are presented in this paper. The paper presents the proposed approach to evaluating PAH mixtures and discusses key scientific criticisms.
Polycyclic aromatic hydrocarbons (PAHs) are substances that have both natural and anthropogenic origins. They can be formed as a result of combustion, and are constituents of many petroleum products as well. Environmental risk limits (ERLs) were derived for 16 PAHs that were also considered in the European Risk Assessment. Testing 26 individual PAHs and 12 oxy-PAHs and different mixture combinations of these compounds in the Ah receptor based H4IIE-luc assay. The observed mixture toxicity will then be compared with the mixture toxicity predicted by the CA model, assuming for additivity. 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.

TU 221
Characterization of the multixenobiotic resistance (MXR) mechanism in Daphnia magna and studies on its role in tolerance to single and mixtures of toxicants
B. Campos, T. Luckenbach1, C. Barata,2, C. Barata1
1IDAEA-CSIC, Barcelona, Spain
2UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

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 multixenobiotic resistance (MXR) mechanisms can generally defend many radinone and freshwater organisms against environmental toxicants. In this work, the detection and functional characterization of toxicologically relevant efflux transporters were studied for the first time in Daphnia magna. P-gp and MRP transporter gene expression was studied by RT-PCR, and its associated efflux activity was monitored using the fluorescent dye rhodamine 123 combined with specific MXR transporter inhibitors (piperonyl butoxide). Toxicity bioassays with model substrates of P-gp (mitoxantrone) and MRP (chlorambucil, mercury) applied singly and in combination with different chemosensitizers were performed to elucidate the role of P-gp and MRP efflux transporters. Results show the existence of the P-gp and the associated efflux activities of ABC transporters in juvenile stages of D. magna. Specific inhibitors of P-gp and/or MRP transport activities including cyclosporine A and verapamil but not MK571 and reversin 205 resulted in a dose dependent inhibition of rhodamine 123 transport in D. magna juveniles. Binary mixtures, of the tested transporter inhibitors, with the pharmaceutical drugs and P-gp substrates chlorambucil and mitoxantrone and the MRP substrate, differences between the toxicity of the individual compounds (e.g., benzo(a)pyrene more than adriamycin as a P-gp substrate) and the independent inhibition concept. These results indicate that P-gp transporter activity is present in D. magna and that this may play an important role in its tolerance to environmental contaminants.
TU 223
Prediction of mixture toxicity for metals in soil: a reality-check
K.J. Oorts1, V. Veroustraete2, I. Schoeters
1. ARCHE, Maastricht, the Netherlands
2. Eurometaxus, Brussels, Belgium

Tuino, Timo, London, United Kingdom
Today's regulatory frameworks for toxic mixture assessments are based predominantly on assessments carried out on individual substances. However, mixture toxicity is an emerging 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 most commonly selected as a default for mixture toxicity. This is partly due to the high proportion of mode of action studies and the limited information about the mode of action of most substances. The applicability of these models in a regulatory framework for assessing the ecological effects of naturally occurring elements, as well as mixture toxicity, is crucial. Regulatory frameworks must be able to reflect the potential for toxic effects in multimetallic contaminated soils. The future regulatory framework should take into account the toxic potential of the mixture in soil and the number of elements to be considered, and should appreciate the proposed bioavailability corrected data. 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 GENMS project). The distribution of the number of metals to be taken into account is expected with 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
Institute of Industrial Organic Chemistry Branch Pszczyna, Pszczyna, Poland

Exposure of organisms to chemical mixtures found in the environment 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 indicates 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, namely 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
Y.J. Lim, M.P. Ling, C.M. Liao1
1. National Taiwan University, Taipei city, Taiwan
2. Chosun Medical College, Tachung city, Taiwan

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 arsenic, copper, and zinc mixture from farmed milkfish (Chanos chanos) consumption in blackfoot disease (BFD)-endemic area in Taiwan. The interaction risk assessment recommended model 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 (HBINT) of non-carcinogenic mixture toxicity. The mixture toxic interactions of AsCu and AsZn were both antagonistic, whereas CuZn was both additive and synergistic. The 90th percentile of HBINT of AsCu and AsZn ranged from 0.94 to 1.78, 0.37 to 3.7, and 0.73 to 2.13, respectively. Our study indicates that As, Cu, and Zn mixture exposure may pose potential non-carcinogenic risk to human consuming farmed milkfish. The present interaction assessment model provides an illustration for assessing the potential threat to human health posed by the mixture toxicity of metals from seafood consumption.

TU 226
Whether BDE209 interferes with Cd hepatotoxicity?
M. Cutic1, S.A.N. J. Stankovic1, S.A.A. Jankovic1, V.E.S.N.A Jacevic1, S.L.A.V.I Vucinic1, K. Durgo1, B. Antonijevic1
University of Belgrade, Faculty of Pharmacy, Belgrade, Serbia

Military Medical Academy, Belgrade, Serbia

Military Academy, Belgrade, Serbia

University of Zagreb, Faculty of Food Technology and Biotechnology, Zagreb, Croatia

In the last ten years, mixture toxicology has undergone a remarkable and productive development. In fact, combined toxicity, which more accurately represents real environmental exposure, may be the reason for the apparent lack of asss in the demonstration 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. The following end points were examined: liver weight, morphology, histology as well as biochemical liver functions (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 compared 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, karyomegaly, vascular bleedings and disruption of vascular membranes. Average histological scores on scale from 0 to 5 were: 0.13, 1.26, 2.26, 3, 3.4, 2.3, 2.03 and 2.26, for control, BDE209, BDE209+Cd2.5, BDE209+Cd7.5, BDE209+Cd15, Cd2.5, Cd7.5 and Cd15, respectively. AST values in general did not change, although, decreased in some single compound groups than in mixtures. Furthermore, ALP was significantly lower in Cd groups, while in mixture and BDE209 groups decrease 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 compared administrated alone. Biochemical scores of histological changes and γ-GT activity, we may assume that BDE209 potentiate Cd effects on liver.(Partly supported by Ministry of Science project IIH6009)

TU 227
Waste recovery - a special treatment under REACH
E. Vermelen, A. Vassart, P. Anthonio, N.M. Delebecque
ACIB'S, Brussels, Belgium

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 'cease 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.

Once it is established that Art.2.7(d) can be applied, the recovery operator needs to fulfill certain obligations, such as the derivation of the classification of substances and mixtures, the notification of substances, the preparation of Art.2.7(d) doress (substantiating the application of the exemption article) and the development of mechanistic pathways. Unfortunately, little information is available on the mixture itself due to the often changing composition, nor on the impurities due to limited access to the raw data as recovery operators are not participating in SIEFs or consortia. This lack of data influences the derivation of C&L of the mixture since this will often be derived based on the impurities classification alone (e.g. summation method). Furthermore, with the exemption from registration, the recovery operator is not required to perform an exposure and risk assessment.

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 mainly address 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
I. Vacchi, G. Honório, R. Ribeiro, G.A. Umbuzeiro
University of São Paulo, 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 PNEC prediction was not possible for Pseudokirchneriella subcapitata was 0.1 ppm and the NOEC obtained for Ceriodaphnia dubia in a reproduction inhibition test (8 days) was also 0.1 ppm. For the secondary consumer Hydra attenuata, the NOEC obtained was 1 ppm in a reproduction inhibition test (7 days). For planarian and fish, only acute tests were performed. For Girardia tigrina newborns the EC50 (96h) was 80 ppm and for fish (Danio rerio, larvae, 96h), it was >50 ppm. This dye also showed mutagenic activity in the Salmonella/microsome assay but did not present genotoxicity in a NERGET assay. Based on these results, Disperse Red 1 contains 4-(4-nitrophenylazo) aniline of 0.6 gpp, considering that this compound would be responsible for the toxicity of the commercial product. This value was based on the lowest NOEC 0.1 ppm (chronic assay P. subcapitata and C. dubia) divided by an assessment factor of 10 because no chronic assay for fish is available and additional and 10 because of its mutagenic potential. More studies are being conducted to verify the mutagenic effect of this product in microcrustacea as well as monitoring studies in river waters that receive textile discharges to determine exposure concentrations.

335
SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
Enzymes can with regard to their ecotoxicological profile be grouped in proteolytic and non-proteolytic enzymes. Within these two groups read-across can be applied.

Industrial enzymes are generally of low ecotoxicity except for proteolytic enzymes, where some exhibit acute aquatic toxicity. Based on the available ecotoxicity data industrial assessment used by a policy maker can make a difference to the quality of life and health of (animal or human) populations living at a certain location. In the context of the exposed to chemical mixtures rather than single substances.

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

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 action of chemicals. However, current risk assessment frequently focuses on individual chemical substances, although most living organisms are substantially exposed to chemical 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 component produces 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-IA M was validated by different datasets on mixture toxicity. The results showed that the prediction capability of the PLS-IA M outperformed reference models, the CA, IA, and IAM based on ordinary least squares.

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

Enzymes are readily biodegradable to peptides and amino acids, then further to environmentally harmless carbon dioxide and water as degradation products. Additionally, for further ecotoxicological evaluation can be focused on the enzyme protein itself.

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.

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

CO2U 232

Practitioners and developers often communicate single values for model parameters and characterization factors, negatively impacting on the transparency, usability and trustworthiness of the output of the models.

The use of LCA for the support of public decisions has contributed to the increased attention to the quality of data reported by LCA studies. In many cases the result of an assessment used by a policy maker could make a difference to the quality of life and health of (animal or human) populations living at a certain location. In the context of the study of noise, an understimation error could, for instance, prompt a local authority to cease investing in systems which could prevent the propagation and impact of noise.

We proposed a new approach [4] that allows for the characterization of any noise-emitting source and its impact on humans, creating the necessary theoretical structure to accurately study LCA and possibly also make it available for policy advice. Our follow up research aims at testing, analysing and further developing the noise characterization model applying sensitivity analysis (SA) techniques to demonstrate how uncertainty from the input of the model propagates to the output and how each single variable affects the overall variance of the output.

TU 233

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

P. Heiniger

We herein propose a method to estimate and propagate uncertainty due to spatially explicit characterization factors (CF) on national or global levels. This 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 added 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 scope 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 the 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 1.81 on the endpoint level. The aggregation from watershed to country level resulted in an average uncertainty of k=19.2 for the endpoint characterisation factor (CF). To our knowledge, no comprehensive standardisation of the variability of water consumption CFs exists in the literature. The results show high spatial diversity of k-values and make it difficult to derive generic estimates of uncertainty, especially regarding the endpoint CFs. However, they can be used to produce maps of uncertainties and also to indicate in which regions

TU 234

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

R.G. Garrido, J.L. Pereira, B.S. Nunes, J.M. Gonçalves, R.J. Costa

Enzymes can with regard to their ecotoxicological profile be grouped in proteolytic and non-proteolytic enzymes. Within these two groups read-across can be applied.

Industrial enzymes are generally of low ecotoxicity except for proteolytic enzymes, where some exhibit acute aquatic toxicity. Based on the available ecotoxicity data industrial assessment used by a policy maker can make a difference to the quality of life and health of (animal or human) populations living at a certain location. In the context of the exposed to chemical mixtures rather than single substances.

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 scope 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 the 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 1.81 on the endpoint level. The aggregation from watershed to country level resulted in an average uncertainty of k=19.2 for the endpoint characterisation factor (CF). To our knowledge, no comprehensive standardisation of the variability of water consumption CFs exists in the literature. The results show high spatial diversity of k-values and make it difficult to derive generic estimates of uncertainty, especially regarding the endpoint CFs. However, they can be used to produce maps of uncertainties and also to indicate in which regions
We present the result 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 some case, it is possible to identify the best building solution even with up to 50% standard deviation on some primary data. Stand 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. 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 data for which more than one value is available. (multiple sources and conflicting information) as the possibility to discuss validity of each parameter value. 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)

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. In approaches to reduce the uncertainty, database documentation, substance coverage, as well as user interaction are key issues. The description of the true value for a parameter requires research, experiments and therefore tim. 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 user to view, add, or revise the documentation of a specific parameter. Reporting an error in a parameter value also have to be, as well as the basis for validation of each parameter value.

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 aims at reducing uncertainty. In order to achieve this, database documentation, substance coverage, as well as user interaction are key issues. The description 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 user to view, add, or revise the documentation of a specific parameter. Reporting an error in a parameter value also have to be, as well as the basis for validation of each parameter value.

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 data for which more than one value is available. (multiple sources and conflicting information) as the possibility to discuss validity of each parameter value. 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)

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, we applied variance-based sensitivity analysis techniques to find out those environmental parameters explaining 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 the 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.

Dealing with uncertainties in UNEP SETAC toxicity model C. Rousset1, J. Payet2
1Tools for environment, La tour-de-trème, Switzerland
2Cycleco, 01500 ambergue, France

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. In approaches to reduce the uncertainty, database documentation, substance coverage, as well as user interaction are key issues. The description 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 user to view, add, or revise the documentation of a specific parameter. Reporting an error in a parameter value also have to be, as well as the basis for validation of each parameter value.

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 aims at reducing uncertainty. In order to achieve this, database documentation, substance coverage, as well as user interaction are key issues. The description 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 user to view, add, or revise the documentation of a specific parameter. Reporting an error in a parameter value also have to be, as well as the basis for validation of each parameter value.

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 data for which more than one value is available. (multiple sources and conflicting information) as the possibility to discuss validity of each parameter value. 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)

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, we applied variance-based sensitivity analysis techniques to find out those environmental parameters explaining 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 the 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.
EC05P - Occurrence, fate and impact of atmospheric pollutants on environmental and human health

TU 241

Urban background levels of novel brominated flame retardants in ambient air in Southern Bavaria, Germany
S.H. Harder, D.H. Huber, W.K. Korner

 Bavarian Environment Agency, Augsburg, Germany

After the technical penta- and octabromodiphenyl ether mixtures (PBDE) were banned in the European Union in 2004 and deca-brominated 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 contamination of these substances in ambient air. Therefore, ambient air was collected between March and September 2011 at the urban background air monitoring station on the premises of the Bavarian Environment Agency, Augsburg, Southern Germany.

Halogenated flame retardants (HFRs), which are applied to reduce the inflammability of various consumer products have been industrial chemicals of growing worldwide environmental and public concern. Concentrations of these flame retardants were found in the air of remote environments.

The present study is required for the understanding and control 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 those pollutants on environment. The utility of these methods in the framework of the Air Pollution Monitoring Programs is of interest.

TU 242

Contamination of the marine biological reserve of atol das Rocas (Brazil) by persistent organic pollutants
P.S. Dias, E.L. Colabuono, S. Taniguchi, R.C. Montone

University of Sao Paulo, Sao Paulo, Brazil

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 biomagnified effects on typical top predators. This proposal aimed to determine the occurrence and concentrations of those pollutants in respective avifauna.

One expedition was performed in February, 2010, where 16 liver samples from two species: Anous stolidus (n=14) and Onychoprion 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 GPC column as clean-up stages.

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 the framework of the Air Pollution Monitoring Programs is of interest.

TU 243

Seasonal variation of specific toxic effects of organic air pollutants from year-long sampling campaign
A. Möller1, Z. Xie2,1, H.-J. He1, J.-H. Hung2, J. He3, J. Ion4, F. Wania1

1Research Centre for Toxic Compounds in the Environment (RECETOX), Brno, Czech Republic
2Aboriginal Affairs and Northern Development Canada, Whitehorse, Canada
3Environment Canada, Downsview, Canada
4Department of Biological Sciences, University of Toronto, Toronto, Canada

The present study is required for the understanding and control 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 those pollutants on environment. The utility of these methods in the framework of the Air Pollution Monitoring Programs is of interest.

TU 244

Profiles and cold trapping of polyacrylic aromatic hydrocarbons and polychlorinated biphenyls in Canadian mountain soils
J.N. Westgate1, M.O. Mitchell2, H. Hung3, P. Roach4, Y.D. Ying5, F. Wania1

1University of Toronto Scarborough, Toronto, Canada
2Environment Canada, Downsview, Canada
3Aboriginal Affairs and Northern Development Canada, Whitehorse, Canada
4Environment Canada, Kanaskis, Alberta
5Environment Canada, Whitehorse, Yukon

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) and 20 congeners of hexabromocyclododecane (HBCD) from 4500 m on the summit of Vancouver Island to 600 m on the summit of Mount Robson, British Columbia. A total of 110 samples were collected on the 13 mountains studied. Air pollution is a concern in the Greater Vancouver region due to auto exhaust and industrial emissions. Air pollution in the mountains is not as well documented as in the lowlands. Following the hypothesis that the biomass burning in the lowlands could be transported to the mountains, the air plumes could deposit organics within the mountains.

This work 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 the framework of the Air Pollution Monitoring Programs is of interest.
3. Results and discussion

Particle and gaseous PAHs were analyzed in air samples taken on an expedition of the Scholar Ship from January 16th to March 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 15PAHs in the particulate phase were found at Chennai Harbor and close to Guinea. An additional factor of coal and coke related combustion emission from Mainland China could be a marker of coal and coke related combustion emission from Mainland China. The elevated high-molecular-weight PAHs in particle 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 15PAH sources in China, India and Africa on the global marine atmosphere.

3.2. Altitudinal Distribution

PAH amounts in the PAS samples (ng PAS \( \sum_{15PAHs} \)) were elevated on the approach to China and India, while the highest PAH amounts were found at Chennai Harbor and close to Guinea. The high proportion of fluorene over the East and South China Sea could be a marker of coal and coke related combustion emission from Mainland China. The elevated high-molecular-weight PAHs in particle 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 15PAH sources in China, India and Africa on the global marine atmosphere.

4. Conclusion

The filter effect of the canopy was observed along the Mont Mars and higher factors were related to low altitudinal sites and atmospheric particle. \( K_v \) values can influence the effect of forest canopy.
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
Potential input of organic pollutants to the Mar Menor lagoon: estimation of seasonal air concentrations using passive and active air samplers
A. Carratalá1, R. Moreno-González2, V.M. León2
1University of Alicante, Alicante, Spain
2Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain

A significant fraction of organic pollutants is made to air and can be transported far from their sources associated to particulate material or dissolved. Pesticides are widely applied for agricultural treatments and polyyclic aromatic hydrocarbons are formed as consequence of urban, transport and industrial activities. Mar Menor lagoon is the leading point of drainages from a large agricultural area where a variety of pesticides are used. This lagoon is surrounded by several villages and that have, especially in summer, an intense touristic activity. There is also a military airport close to the lagoon and this area is influenced by a very industrialized pole, which is located at 20 km south.

There were not previous data of pesticides and PAHs concentrations in air of in this area. In order to estimate the levels of organic pollutants in air and the potential atmospheric input in Mar Menor lagoon, passive samplers consisting of polyurethane foam (PUF) disks housed in chambers were deployed at six sites around the basin of this lagoon. Replicates at each point and calibration with a DIGITEL active sampler (at one point) equipped with a PUF module are used to improve the confidence of the determinations and to estimate the sampling rates for the different detected species. PUF samples have been extracted with hexane using a pressurized liquid extractor. The extract was concentrated and was analyzed gas chromatography with mass spectrometry. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants and polyyclic aromatic hydrocarbons and up to 23 have been identified. PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (10pg/m3-2ng/m3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables.

TU 252
Biomonitoring of polyyclic aromatic hydrocarbons by pine needles - analytical alternatives and levels in Europe
N. Rato1, P. Herbert, J.M. Amigo, S. Lacorte, D. Barceló, E. Pullaliski, A. Alves1
1LEPA-DEQ-EUP, Porto, Portugal
2University of Copenhagen, Copenhagen, Denmark
3IDAEA-CSIC, Barcelona, Spain
4Technical University of Crete, Chania, Greece

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 passive sampler since the 1960s, allowing the passive sampling of a wide range of compounds (especially of atmospheric origin). Both, soil and vegetation are prone to partition into the air by evaporation and volatilization or by uptake to vegetation leaves, even if it is not the main source of the compound. In this study, the methodology for the analysis of PAHs in pine needles was developed offering excellent reproducibility, recoveries 63-113% and 40-112% and limits of detection 400 and 1600 pg/g and 0.5 and 7.5 pg/mL in biota and wastewater, respectively.

TU 253
Analysis of cyclic and linear volatile dimethylsiloxanes in aqueous samples and biota
1IDAEA-CSIC, Barcelona, Spain
2University of Copenhagen, Copenhagen, Denmark
3University of Crete, Chania, Greece

As a result of their wide use, siloxanes are spread into the environment both via point sources and via atmospheric long range transport and may be found everywhere in the terrestrial environment. As previously reported, dimethylsiloxanes are known to be present in the environment even at trace levels. Therefore, the monitoring of these compounds in different biota samples from the Llobregat River, the Mediterranean Sea and krill (Euphausia Superba) samples from the Antarctic ocean will be presented and discussed.

TU 254
Analysis of cyclic and linear volatile dimethylsiloxanes in aqueous samples and biota
1IDAEA-CSIC, Barcelona, Spain
2University of Copenhagen, Copenhagen, Denmark
3University of Crete, Chania, Greece

Even though the production and usage of many POPs have been banned decades ago, due to their persistence, they can be still found in the global environment, where they partition into the air by evaporation and volatilization or by uptake to vegetation leaves, even if it is not the main source of the compound. In this study, the methodology for the analysis of PAHs in pine needles was developed offering excellent reproducibility, recoveries 63-113% and 40-112% and limits of detection 400 and 1600 pg/g and 0.5 and 7.5 pg/mL in biota and wastewater, respectively.

TU 255
Exchange and partitioning of POPs between the atmosphere-vegetation-soil environments
A. Cabreroz1, J. Dachs, K.C. Jones2, D. Barceló
1Institute of Environmental Assessment and Water Research (IDAEA-CSIC), Barcelona, Spain
2Lancaster Environment Centre, Lancaster, United Kingdom

The objective of this work is to assess the role that vegetation plays in the overall air-soil-vegetation partitioning and as a control of POP concentrations in the atmosphere. Vegetation can also deliver POPs, especially the less volatile ones to the atmosphere, even though soil and vegetation seem to be in close equilibrium. The influence of surface temperature, liquid and gas phase partitioning on the magnitude of re-emission were also studied. Results from temperate and polar environments will be compared.
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 areas. One potential source of nutrient 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. The major source for the atmospheric degradation 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 r-endosulfan fraction (r/e-r) was used to examine the contribution of pesticides to the atmospheric degradation to the overall endosulfan degradation. The trend for the fraction has an r fraction of approximately 0.5, whereas volatilization is predicted to have an r 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 degradation. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.0 year indicating air concentrations are primarily influenced by regional volatilization. The near-inversable isomerization after application of r-endosulfan also influences the value of the r fraction.

TU 257

Assessment of flame retardants in human dust samples from the Netherlands and indoor air: comparison between occupational and domestic exposure settings from Pakistan


University of Education, Lahore, Pakistan

This study was conducted to compare the levels of flame retardants in different indoor and occupational settings. The levels of brominated diphenyl ethers (BDEs), polybrominated dibenzo-p-dioxins (PBDDs), polychlorinated dibenzo-p-dioxins (PCDDs), polychlorinated dibenzofurans (PCDFs), and polycyclic aromatic hydrocarbons (PAHs) were measured in the indoor dust samples. The results showed that the levels of flame retardants in indoor dust samples were significantly higher than those in occupational settings. The study concluded that the levels of flame retardants in indoor dust samples were higher than those in occupational settings, indicating a higher exposure risk for individuals in indoor settings.

TU 261

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

J. Kaumanns

University of Bayreuth, Bayreuth, Germany

This study compared the levels of volatile organic compounds (VOCs) in consumer products between Europe and the United States. The results showed that the levels of VOCs in consumer products were significantly higher in the United States than in Europe. The study concluded that the levels of VOCs in consumer products were higher in the United States, indicating a higher exposure risk for individuals in the United States.

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 341
The highest concentrations of PBDEs were found in bats; in particular, D5 represented the principal compound probably due to its dominant presence in most of hair products, absorbents, cosmetics, and other flame retardants. A notable exception to this was pentabromomethylbenzene, which was not detected in any sample. Pentabromoethylbenzene and hexabromobenzene were found in a few samples, often in combination with other compounds. In conclusion, this is the first study that we are aware of to report tissue concentrations of PBDEs and some of their emergent replacement compounds in bats from Europe.

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 sum of the PBDEs analyzed showed a wide range (10.4 - 8191 ng g⁻¹ wet weight (ww)) of concentrations, with a mean of 961 ng g⁻¹ ww. Males had on average twice the concentration of PBDEs than females, possibly due to different levels of exposure. However, this difference was not statistically significant. This suggests that the levels of PBDEs in bats may be influenced by factors such as age, sex, and location.

The study also highlights the importance of monitoring the levels of PBDEs in bats, as these compounds can accumulate in the food chain and have the potential to biomagnify. This is particularly relevant for bats, as they are often used as indicators of environmental quality. The results of this study will contribute to our understanding of the impact of PBDEs on bat populations and help to inform conservation efforts.
option of using alternative fuels in cement plants working with the Best Available Technologies (BAT).

TU 267

Should the neighbourhood of cement plants be concerned when alternative fuels are used? J. Rovera 1, M. Mari, M. Nadal 1, M. Schuhmacher, J.L. Domingo 1

1 Universitat Rovira i Virgili, Tarragona, Spain

Department of Engineering Química, Universitat Rovira i Virgili, Tarragona, Spain

Laboratory of Toxicology and Environmental Health, School of Medicine, ISPV, Reus, Spain

In recent years, co-combustion of alternative fuels in cement plants has become an increasing practice in many countries. The benefits associated to the replacement of fossil by-products and the reduction of fuel savings (e.g., reduction of CO2 emissions, reuse of by-products) evident. These benefits are more important taking into account that cement production is one of the main CO2 emitting manufacture industries, but also due to the important rising of fossil fuel prices. Furthermore, considering the notable consumption of fossil fuels by the cement industries, the European Union is encouraging the enhancement of the amount of alternative fuels in cement kilns.

In the present work, the result of a 3-year (2008-2011) environmental monitoring campaign around a cement plant located in the metropolitan area of Barcelona (Catalonia, Spain) was presented. The aim of this study was to evaluate the potential changes in the environmental levels 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 terms, 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.

TU 268

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

Universitat Rovira i Virgili, Reus, Spain

Due to legislative, environmental, economic, and social limitations, the identification of sustainable disposal pathways for the management of municipal solid waste (MSW) is a very important task. The mechanical-biological treatment (MBT) approach presents many advantages in comparison to other waste management possibilities. However, adverse health effects related to this practice are not negligible, such as those caused by fungi, and chemical pollutants, such as volatile organic compounds (VOCs), are generated during waste composting and similar processes. Some of these contaminants can be the cause of a variety of infectious diseases, as well as allergies and toxic effects or generating malodorous and hazardous properties. In 2010, a program was initiated to monitor air levels of VOCs and microbiological pollutants near a MBT plant near a MBT plant in Montcada i Reixac, (Barcelona, Catalonia, Spain) To investigate the temporal and seasonal trends of chemical and microbiological pollutants, four monthly campaigns were performed. Air samples were collected at different directions and distances from the facility. The levels of total bacteria ranged from 160 to 1054 cfu/m3 (colony-forming units per cubic meter) with a high increase in the last campaign (summer 2011) compared to the initial (winter 2010) sample. In fact, the highest concentrations were detected in the summer campaigns. Fungi at 37ºC were also important in the hot seasons with values of 726 and 1065 cfu/m3 (summer 2010 and 2011, respectively) versus 60 and 614 cfu/m3 (winter 2010 and 2011, respectively). The concentration of the remaining microbiological agents (gram-positive bacteria and the more specific Aspergillus fumigatus) was rather low, with a lack of temporal/seasonal differences. On the other hand, the highest mean concentration of VOCs was detected in two winter campaigns. The current exposure to those chemicals, estimated from the environmental burdens, should not mean additional non-carcinogenic or carcinogenic health risks for the population living nearby. Finally, a fate and transport model was also executed to validate the acquisition of data from outdoor, as well as comparing modelled and experimental results.

TU 269

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

Ca’ Foscari University of Venice, Venice, Italy

Propagating 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 cellulolytic 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 environmental 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 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 no particles, solely deionized water.

In this way, it was possible to:

- identify microbial species present both in the air and on the documents and then identify those potentially cellulolytic and those dangerous for human health;
- define the conservative situation of the Archive;
- propose measures to improve air archive's 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. Abdu Kumi1, J.K. Klonova2, K.A. Asante2

1 IPS, Ghana

2 ENVIIRONMENTAL PROTECTION AGENCY, Accra, Ghana

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

4 Levels of 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 (PAS) (referred to as PUF-disks samplers). 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 in selected edible fish from three freshwater bodies, namely Lake Volta, Lake Bosumtwi and Weja 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. Abi2

1 Techn. Universität Hamburg-Harburg, Hamburg, Germany

2 University of Konstanz, Konstanz, Germany

(TU)-Hamburg-Harburg/Inst. of Energy and Environmental Techniques, Hamburg, Germany

Burnout management of fossil power stations has become an important popular worldwide, rising 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 people nor for microorganisms. Thus there is a need for established microscale toxicity screening of unknown combustion born particulates.

Here we demonstrate a microscale method of two ISO standardised bacterial contact assays and one yeast biotest were modified for the use with fine dust. Having different endpoints these tests provide a toxicological “fingerprint”. In order to account for bioavailability of contaminants adsorbed on surfaces of fine particles, such tests were used as a whole not as extracts. Particles matter was measured electrostatically from different furnaces in the flue gas channel. Suspended in water, vortexted for 1 min, and ultrasonificated for 15 min samples 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 no particles, solely deionized water.

Cytotoxicity in the aerobic Archaeobacter globiformis contact assay was determined via dehydrogenase activity (DHA). Genotoxicity was determined via Umu-Test using a genetically modified Salmonella strain. The Yes-Test was employed to determine potential estrogenicity of particle samples.

Contrary to FP A, FP B exhibited cytotoxicity between 0.1 and 1 mg FP/mL. High contents of Zn supposedly caused cytotoxicity in B. FP A was slightly genotoxic (+9) at 1 mg/mL and potentially estrogenic. Besides PAh, other heterocyclic compounds might have caused this result. Further investigations are under construction. These preliminary results suggest suitability of endpoints determined in the modified tests for risk assessment of fine particles.

TU 272

Airborne particle 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
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 worldwide health.

The objective of this study was to compare the toxicological effects of different source-related particles in regard to their 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 significant 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 seem to induce a concentration-dependent 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 elemental/organic 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 acute and subacute effects are possible.

The low level analysis of ambient PM can be used for various sampling and emission 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 PCBs at low level with high precision using GC-MS/MS Triple Quadrapole

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

Thermo Fisher Scientific, Austin, tx, United States of America

The low level analysis of polychlorinated biphenyls at levels required by EPA method 1668 has required the need of a high resolution GC/MS system. Using triple quadrupole GC-MS/MS can achieve the needed detection limits plus offer specificity for confident identification and confirmation. This application will explore the relationship between resolution, selected reaction monitoring (SRM) and speed of acquisition to achieve precise quantification and identification of the chlorinated compounds. The studies were performed in matrix demonstrating that this isolation can readily remove matrix interference at low target compound concentrations. In addition, this method will demonstrate that the quality control criteria of EPA Method 1668 can be met using a GC/MS triple-quadrapole system. Advantage for the laboratory are the reduction in cost of the equipment relative to high-resolution GC-MS systems, along with the ability to use the system for more than just specialized applications. In addition, a library of transitions for the PCBs and other compounds simplifies method development and verification, simplifying the adoption of GC-triple quadrapole MS for this analysis.

TU 274

Analysis of pesticides in water samples based on the combination of solid phase extraction and solid phase microextraction coupled to gas chromatography mass detection

K. Hund-Rinke1, T. K Terryte2

1Universidad Nacional de Córdoba, Córdoba, Argentina
2Universidad Nacional de Còrdoba, Facultad de Ciencias Químicas, CONICET, Còrdoba, Argentina

The sensitivity of the extraction process of surface water has triggered a general interest in the geographical area of Argentina in the last years, which are spread across soils contaminating both surface and ground-waters. The aim of this study was: (a) develop a sensitive GC Chromatography tandem Mass Spectrometry (GC-MS) method for the quantification of the most widely used pesticides at environmental relevant concentrations and (b) test this method with surface waters collected from the Suquía River basin, Córdoba, Argentina. Sample preparation was a combination of Solid Phase Extraction (SPE) and Solid Phase Microextraction (SPME) affording highly effective enrichment of six pesticides, which can be analyzed at ppb levels. We tested the effect on SPE of cartridges and elution solvents as well as type of fiber, absorption-desorption temperature and time, head-space or immersion for SPME. A fractional factorial design was applied to obtain optimal conditions. GC and MS operational issues were also optimized to afford LODs in the ng/L range for most compounds. The optimal methodology was validated for linearity and repeatability, showing that the proposed procedure is selective (LODs ranging 0.2 to 3.5 ng L^-1), precise and robust (recovery ranged 61 - 104%, RSD varied from 4.0% to 22.6 %), with a linear analytical range from 0.1 to 10 ng L^-1.

A new methodology was successfully applied to natural water samples, collected at five monitoring sites along Suquía River, considering pre and post-application of agricultural pesticides. Most samples were collected during the period present throughout the entire period. Nevertheless, post-application period showed concentrations of atrazine, acethochlor, endosulfan, endosulfan sulphate and cypermethrine 1.5 to 3 fold higher than the corresponding to pre-application. As expected, highest levels of pesticides were observed in areas with intensive agricultural practices, being atrazine, cypermethrin and endosulfan sulphate predominant. In urban or recreational areas the prevalent pesticide was cypermethrin. Some values surpass the National Guidelines for Pesticides in freshwaters, pointing out the need of controls in addition to the evaluation of damage to aquatic biota.

TU 275

Simulating the bioavailability of mineral hydrocarbons for earthworms using different extraction methods

K. Hund-Rinke1, K. Terryte2

1Forschungszentrum Berlin, Berlin, Germany
2Fraunhofer Institute for Molecular Biology and Applied Ecology, Schmallenberg, Germany

In the context of assessing the habitat function of contaminated sites only the bioavailable contaminant fraction of is of relevance. Information on the habitat function, therefore, can be obtained in ecotoxicological tests performed with representative soil organisms. Depending on the test organism the duration of effect measurements varies between several weeks and several months. In order to obtain results focusing on bioavailability faster, chemical methods are being developed to predict the amount of contaminant that can be taken up by a specific organism. Suitable methods have to simulate the respective exposure pathways and represent the bioavailable fraction of the contaminant.

Extraction procedures for mineral hydrocarbons were regarded with respect to their suitability for simulating the bioavailable fraction for soil organisms. As effect parameter the reduction of reproduction activity according to OECD Test Guideline 222 was selected. The test was performed in eight sandy soils that had been contaminated with mineral oil for many years. The results obtained in the earthworm studies were compared with the concentration of the mineral hydrocarbon contamination using different extraction procedures: (I) total content using exhaustive extraction (C10 - C40 fraction); (II) fraction of C10-C22 performing exhaustive extraction; (III) water based extraction - shaking water based extraction - column procedure (IV) water based extraction - use of an extra solid phase: HPCD.

The best relation between an increased concentration of contamination and a reduced habitat function was detected for the C10-C22 fraction of the HPCD-extraction.

Relations with the C10-C40 fraction of the HPCD-extraction and with the C10-C22 fraction of the exhaustive extraction were less pronounced. No relation was observed for the C4-C10 fraction using shaking water procedures.

Earthworms are soft bodied organisms and exposed to contaminants mainly via soil pore water and skin. For mineral hydrocarbons the mobile fraction of C10-C22 of the HPCD extraction model (PBET) that is simulating the conditions in the human gastrointestinal tract, it is possible to determine the bioaccessible fraction of soil-bound contaminants.

In this study, the geosorbents sand, clay, peat and char coal, which had been characterized in various previous studies, spiked with 16 deuterated EPA-PAH, were extracted with Benzo[a]pyrene (BaP) according to OECD Test Guideline 222. The test was performed in eight sandy soils that had been contaminated with mineral oil for many years. The results obtained in the earthworm studies were compared with the concentration of the mineral hydrocarbon contamination using different extraction procedures: (I) total content using exhaustive extraction (C10 - C40 fraction); (II) fraction of C10-C22 performing exhaustive extraction; (III) water based extraction - shaking water based extraction - column procedure (IV) water based extraction - use of an extra solid phase: HPCD.

The bioaccessible fraction of contaminants was analyzed by gas chromatography-mass spectrometry.

In this study, the geosorbents sand, clay, peat and char coal, which had been characterized in various previous studies, spiked with 16 deuterated EPA-PAH, were extracted with Benzo[a]pyrene (BaP) according to OECD Test Guideline 222. The test was performed in eight sandy soils that had been contaminated with mineral oil for many years. The results obtained in the earthworm studies were compared with the concentration of the mineral hydrocarbon contamination using different extraction procedures: (I) total content using exhaustive extraction (C10 - C40 fraction); (II) fraction of C10-C22 performing exhaustive extraction; (III) water based extraction - shaking water based extraction - column procedure (IV) water based extraction - use of an extra solid phase: HPCD.

The results show that the different geosorbents impact bioavailability as expected from the aqueous phase. Pyrene-d10 often showed highest bioaccessibilities: 45.3 % ± 11.1 (sand), 10.2 % ± 5.4 (clay), 3.5 % ± 3.2 (peat) and 0.2 % ± 0.1 (char coal). As it is known from aqueous sorption-desorption experiments, here also char coal significantly reduced bioaccessibility more than the human intestinal juice. We conclude, that currently bioavailability of PAH from soils and sediments rich in coal, char coal and soil may be significantly overestimated.

1 Siciliano et al. 2010. Chemosphere 80: 1101-1108
3 Cornelissen et al. 2006. Environ Sci Technol 40: 1197-1203

TU 280

Bioavailability measurements in risk assessment - conformity of methods

I. Allan1, A. Raus2, S. Øxnevad2, M.T. Schaanning2, K. Borgia1, K.J. Macrae3, T. Bakke2, K. Næs2

1NIVA, Oslo, Norway
2Norwegian Institute for Water Research, Oslo, Norway

Bed sediments often act as a sink for nonpolar organic pollutants released into the aquatic environment. When sources of contamination cease or when emissions are strongly
Bioavailability studies: the last available tools for evaluating PAH risks realistically
B.H. Magee, G.C. Hoeger

ARCADIUS, Chelmsford, United States of America
Polycyclic aromatic hydrocarbon (PAH) risk assessment is currently overly conservative in the U.S., with Screening Levels that are orders-of-magnitude below anthropogenic background in most urban areas. Additionally, the United States Environmental Protection Agency (USEPA) is proposing to increase the Relative Potency Factors (RPFs) for 7 PAH and to increase the number of carcinogenic PAHs with RPFs from 6 to 26. Several proposed RPFs are 10x or greater including dibenz[a,h]anthracene (10x), benzo[b]fluoranthene (20x), dibenz[cd]pyrene (30x), and benzo[ghi]perylene (60x). If this approach is adopted, human health risks from exposure to PAHs will increase considerably, and risk-based clean-up levels will drop to below background even for commercial/industrial receptors and a 1x10-4 risk level. It is clear from the literature that the mammalian bioavailability of PAH from weathered soils/sediments is considerably less than 100%. Agencies in the U.S. have increasingly rejected the use of bioavailability adjustments in the literature. USEPA recently supported a policy of performing in vivo bioavailability studies of site-specific media impacted by complex organic compounds. The authors have designed such an in vivo study and are seeking its regulatory approval for execution in 2012. This paper will summarize literature bioavailability results for PAHs and discuss methodological issues regarding the on-going study, which is a robust, internally consistent animal bioavailability study with site aged soils' infrared spectra and desorption data were incorporated into a multivariate statistical approach (partial least squares regression, PLS) to determine bioavailability results for PAHs and discuss methodological issues regarding the on-going study, which is a robust, internally consistent animal bioavailability study with site aged soils.
Influence of rhizosphere ooyceme mycelia on bacterial biodegradation of phenanthrene present in nonaqueous-phase liquids (NAPLs)

M. C. Tejeda-Agredano, J. J. Ortega-Calvo
Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain

Sunflower root exudates were extracted using mild conditions to isolate rhamnolipid biosurfactants, produced by the soil bacterium Mycobacterium gilvum VM552. The selected oomycetes showed no antagonistic effects on the bacterium in co-culture assays. An optimized production protocol was established for oomycete mycelia using a direct scrape-out method with solid agar, which prevented the contamination by carbon-rich medium components. Mineralization of 14C-phenanthrene present in hexadecane-fuel-NAPL mixtures by M. gilvum VM552 was increased in the presence of P. oligandrum mycelia. The fungus showed a preference for long-chain hydrocarbons and delayed and decreased the mineralization plateau. However, there was no stimulation of mineralization when the NAPL was composed of a heptamethylnonane/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 interface fertilization, thus increasing the bioaccessibility of PAHs for bacteria.

TU 287

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

M. C. Tejeda-Agredano, J. J. Ortega-Calvo, P. Mayer

In this study, we focus on the capacity of rhamnolipid biosurfactants, produced by the soil bacterium Mycobacterium gilvum VM552, to promote the colonization of the bacterial colonizing the root surfaces. Moreover, we found that biosurfactants can promote desorption of solid PAHs and enhance desorption when they are present as rapidly desorbing fractions (> 0.1 h). 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 rhizomylipid biosurfactants, produced by Pseudomonas aeruginosa 195J, to enhance the bioavailability of different soil-sorbed 14C-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 transport of fast and slow desorbing fractions of 14C PAHs from soil. Sorption kinematics of 14C PAHs from soil were performed by Tanx solid-phase extraction and compared to mineralization kinetics by 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 288

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

C. J. S. Jimenez-Sanchez, J. J. Ortega-Calvo
Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain

Institute of Natural Resources and Agrobiology of Seville (IRNASE), Sevilla, Spain

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 and behavior of organic contaminants in the environment depend largely on the ability of degraders of contaminants in soil and plant growth 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) 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 in modulating the deposition and motility of degraders in porous media. Our results of sunflower root exudates indicated laboratory conditions a similar stimulation of the slow desorption of PAHs in soil slurries. The stimulation of the indigenous bacterial population resulted in both situations in a similar residual concentration of PAHs. We can conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurry, shaking and the addition of root exudates.

TU 289

Biosurfactants and sustainable bioremediation: effects on slow desorption PAHs

C. E. Conigam, J. J. Ortega-Calvo
Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain

Aarhus University, Roskilde, Denmark

Slow desorption from 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-sorbed PAHs and their bioavailability for biodegradation. In this study, we focus on the capacity of rhizomylipid biosurfactants, produced by Pseudomonas aeruginosa 195J, to enhance the bioavailability of different soil-sorbed 14C-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 transport of fast and slow desorbing fractions of 14C PAHs from soil. Desorption kinematics of 14C PAHs from soil were performed by Tanx solid-phase extraction and compared to mineralization kinetics by 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

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

D. C. C. Mostert, T. Backhaus, H. H. Jakobsen
University of Gothenburg, Göteborg, Sweden

Aarhus University, Roskilde, Denmark

Behavioural changes of microorganisms may reveal subtle adverse 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 polyatomic hydrocarbons (PAHs) on the behaviour of the ciliate Tetrahymena pyriformis. Motile cells and organisms that are able to sense chemical signals may direct their movement 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 swimming behaviour of the cells, was then applied to the data. 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.
influence of charge and molecular structure on the sorption process. Representative emerging contaminants were selected, covering hormones, pharmaceuticals, personal care products, and pesticides. Batch sorption studies were conducted with natural DOM-containing water samples obtained from Finland, United Kingdom, and the Netherlands and by using polyacrylate passive samplers to determine aqueous contaminant concentrations. The DOM samples were characterized by chemical and physical fractionation methods, and their effects on charge and adsorption to both DOM and polyacrylate were investigated. Positively charged compounds showed a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polyacrylate. Negatively charged compounds showed the lowest affinity to both DOM and polyacrylate. For most neutral compounds investigated, the water phase represented a more favorable medium compared to DOM. The obtained results may increase our knowledge on the sorption of organic polar contaminants to DOM, which is currently based on only limited data.

TU 293

Binding can increase the mobility and targeting of hydrophobic organic compounds
V. Gouliarmou1, K.E.C. Smith2, L.W. de Jonge1, C. Collins1, P. Mayer1

Aarhus University, Roskilde, Denmark

The binding of hydrophobic 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 both physiological and environmental processes occur. 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 and therefore not suitable for low or non-saturating levels in vitro or in vivo systems.

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 and therefore not suitable for low or non-saturating levels in vitro or in vivo systems. 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 and therefore not suitable for low or non-saturating levels in vitro or in vivo systems.

References


TU 294

Dynamic passive dosing for studying microbial PAH degradation: a comparison of experimental and model results

Aarhus University, Roskilde, Denmark

Technical University of Denmark, Lyngby, Denmark

Biodegradation plays a key role in PAH fate, and understanding kinetics as a function of (bio)availability is critical for elucidating their persistence. However, biodegradation mainly occurs in an aqueous environment, posing technical challenges for producing reliable kinetic data because of low PAH solubilities and sorptive losses. To overcome these, an experimental approach based on dynamic passive dosing is presented which: avoids using co-solvent for introducing the PAHs, buffers substrate depletion so that other factors such as PAH toxicity or essential nutrient availability play a role. Therefore, combining measurements of PAH biodegradation kinetics at defined concentrations with dynamic passive dosing, and their interpretation by modelling is a useful tool to further understand their bioavailability, biodegradation and persistence.

TU 295

Enhanced mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase by dissolved organic carbon
K.E.C. Smith1, M. Thullner1, L.Y. Wick1, H. Harns1

Aarhus University, Roskilde, Denmark

UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

Hydrophobic organic compounds (HOCs) are often found as mixtures in the form of non-aqueous phase liquids (NAPLs). Due to their hydrophobic nature, the HOCs preferentially remain in the NAPL with slow mass fluxes into the aqueous phase. However, since water dissolved HOCs play a key role in diffusive uptake into organisms, microorganisms using HOCs as a source of carbon and energy face a large reservoir of inaccessible food in the NAPL which is often reflected in slow bioremediation of NAPL contaminated sites. Interestingly, mobile "colloidal-like" phases can contribute to diffusive mass exchange processes between surface and the bulk aqueous phase, a phenomenon termed enhanced or facilitated diffusion. Therefore, this study investigated the role of dissolved organic carbon (DOC) in enhancing the mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase above that attributable to dissolved molecular diffusion alone. In controlled experiments, mass transfer rates were increased by up to a factor of four in the presence of DOC, with the greatest enhancement being observed for the highest dissolved organic carbon concentrations. These increases could not be explained by dissolved molecular diffusion alone, and point to a parallel DOC-mediated diffusive pathway. The nature of the DOC-mediated diffusion pathways for HOCs is dependent on the DOC concentration and composition and sorption concentration, for "super" hydrophobic compounds this pathway could both dominate but also increase mass transfer rates by orders of magnitude, even at environmental concentration.

This has important implications for their bioremediation, as well biocatalytic conversion.

TU 296

On the effect of vitamins and nutrients on the solubilization of petrodiesel/biodiesel blends in water
M.I. El-Awady1, A.A. Sattar1, A.S. Yaqub1

1University of Cincinnati, Cincinnati, United States of America
2American University of Beirut, Beirut, Lebanon
3U.S. Environmental Protection Agency, Cincinnati, Ohio, United States of America

The effect of mineral salts on the aqueous solubility of nonelectrolytes is largely assumed to exhibit the “salting out” or “salting in” effects in which the aqueous solubility of nonelectrolytes is decreased or increased upon the addition of salts. Pioneering investigations by Setschenow [1] and later by Carter and Hardy [2] among others, resulted in successful empirical relationships that describe the dependence of the solubility of nonelectrolyte solutes on salts concentrations. We conducted equilibrium experiments of petrodiesel/biodiesel blends (B0, B0, B20, B40, B60, B80, and B100, where B100 is 100% biodiesel) in water in the presence and absence of standard vitamins and nutrients used for bacterial growth studies. The solubility of aromatic compounds was found to be in agreement with the salting out effect in the presence of the added nutrients. The solubility of aliphatic hydrocarbons (C21 n-alkanes, hexadecane, and heptadecane) was found to be significantly enhanced (p < 0.005), up to 4-fold in the presence of the fatty acid methyl esters (FAMEs) and the vitamins and nutrients medium, compared to FAMEs and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkanes and aromatic compounds in the presence of fatty acid soap solution. They reported that, in the presence of soap, aliphatic hydrocarbons are markedly lower, while the solubility of fatty acids is markedly higher and that of aromatic hydrocarbons is lower. Those observations are found to contribute significantly to the bioavailability of the n-alkanes in the water column. Biodegradation studies conducted in our laboratory showed significant enhancement for the microbial utilization rates of the n-alkanes in the petrodiesel/biodiesel blends, which we interpret to be due to the increase in aqueous concentrations of the n-alkanes in the presence of the FAMES and nutrients.

References


TU 297

Photo-transport of 2,3,7,8-TCDD in presence of natural organic matter studied by in vitro bioassay
M.I. El-Awady1, J.P. Geczy1, L. Bah1

1Research Centre for Toxic Compounds in the Environment (RECETOX), Brno, Czech Republic
2Department of Biomedical Veterinary Sci. and Tox. Centre, Univ. of Saskatchewan, Saskatchewan, Canada

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as a representative of hydrophobic organic compounds (HOCs), frequent anthropogenic environmental pollutants comprising also many adverse effects in organisms. Activation of arylhydrocarbon receptor (AhR) can be very important mechanisms of toxicity for so-called "dioxin-like" HOCs. Natural organic matter (NOM), being naturally occurring compounds (up to 50 mg/L in waters), occurs together with HOCs in contaminated water. Besides other important ecological properties, NOM serves as a natural source of reactive oxygen species that are formed after NOM irradiation. Direct photolysis of HOCs is a very important way of their degradation in the aquatic environment. Nevertheless, oxygen species, formed after HS irradiation, can theoretically enhance the photochemical degradation of HOCs. In our present study, we have assessed the ability of various NOM concentrations to enhance photo-degradation of TCDD. Aqueous TCDD+NOM
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 HHIEC-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) have significantly extended 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 298
Remediation of PCB- and PAH- contaminated soil with modified clays
B.I. Olu-Owole\textsuperscript{1}, L. Böhm\textsuperscript{2}, E.I. Unuabonah\textsuperscript{2}, R.A. Dürring\textsuperscript{2}
\textsuperscript{1}University of Ibadan, Ibadan, Nigeria
\textsuperscript{2}Rheinenergie University, Institute of Chemical Engineering, Science, Redeemer, Nigeria

Contamination of soils and sediments by polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) is a major concern worldwide. This is connected with their persistence and the threat they pose to the environment and human health. Development of efficient and reliable strategies to reduce PCB and PAH concentrations in contaminated soils has been a crucial task for scientists. Immobilization of these organic contaminants is the most preferred way to total removal of pollutants is hardly possible. This study is therefore aimed at evaluating the potential of modified clay minerals (with surfactants, humic acid and papaya seed) in the retention of PAHs and PCBs in soils.

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 CaCl\textsubscript{2} in the dark for 20 days. After equilibrium analysis of the contaminated soils was carried out using SPE coupled with GC/MS.

The results of this study indicate the 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
F.R. Storck\textsuperscript{1}, C.K. Schmidt\textsuperscript{1}, R. Wülser\textsuperscript{2}, C. Awele\textsuperscript{3}
\textsuperscript{1}Technologiezentrum Wasser (TZW), Karlsruhe, Germany
\textsuperscript{2}Rheinenergie, Cologne, Germany
\textsuperscript{3}IWB, Basel, Switzerland

Fate of iodinated X-ray contrast media (X-RCM) is important for assessing the risk of pesticide contamination of the succeeding crop. Soil adsorption of nonionic pesticides

TU 299
Effect of pH and electrolyte concentration on soil adsorption of pesticides
M.Y. Motoki\textsuperscript{1}, T. Iwafune\textsuperscript{2}, N. Seike\textsuperscript{1}, T. Otani\textsuperscript{1}
\textsuperscript{1}National Institute for Agro-Environmental Sciences, Tsukuba, Japan
\textsuperscript{2}Food 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, several 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 extended 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 pesticides is strongly influenced by soil organic matter 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 CaCl\textsubscript{2} solutions (0.01, 0.1, and 1 mol/L) and 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 equilibrium period for all experiments. Increasing the CaCl\textsubscript{2} concentration from 0.01 to 0.1 mol/L had a significant effect on soil adsorption of pesticides, but the Kd values with 1 mol/L CaCl\textsubscript{2} solution were slightly higher than those at the other two concentrations. Pesticide adsorption increased with pH level. In general, Kd values were negatively correlated with pH levels, and the rate of Kd change, calculated by dividing the Kd values at pH 3 by those at pH 9, was greater in the case of soils with higher organic carbon contents and of pesticides with higher octanol/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 301
Relationships between soil adsorption of pesticides and pesticide/soil properties
T.I. Iwafune\textsuperscript{1}, M.Y. Motoki\textsuperscript{1}
\textsuperscript{1}Food and Agricultural Materials Inspection Center, Kodaira, Tokyo, Japan

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. In order to prevent excess of the residue level 0.01 mg/kg in the succeeding crop, the succeeding crop must be cultivated in consideration of Kd. The physicochemical properties of pesticides 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 soil adsorption) 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 (Kd values). The results of relationships between Kd values and pesticide/soil properties will be presented.

TU 303

Leaching of aged DD'Ts and current use pesticides in undisturbed soil columns: non-ionic surfactant and carboxylic acids effects

M. Gonzalez1, F.M. Mitton2, S.L. Grondona1, A. Peña2, K.S.B. Miglioranza1

1Lab. Ecotoxicologia FCENyN-UNMdP, Mar del plata, Argentina

2Instituto de Tecnologia de la Tierra (CISC-UFRJ), Granada, Spain

Soil pollution by Persistent Organic Pollutants such as DD'Ts (p,p'-DD'T and its metabolites p,p'-DDE and p,p'-DDD) represents a continuous source to the environment. As a consequence of their high persistence DD'Ts occur up to 60 cm on agricultural soils. The Current Use Pesticide (CUP) endosulfan is characterized by its high lixiviation potential, which can be favored by low Kow value or low sorbing irrigation or flooding events as well as plant growing may modify pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agricultural uses that will account for a variety of compounds of soils, surfactants and dissolved organic carbon. This work studies the vertical distribution and movement of aged DD'Ts and endosulfan in undisturbed soil columns irrigated with riverine water, 2-Tw-80 (riverine water + Tween 80 0.5 cmc), and Acids (riverine water + sodium citrate and sodium oxalate, 0.05 M) respectively. Experiments were carried out with 13 cm x 30 cm soil columns taken from Aridisol soils from a fruit field in Patagonian, 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 sampling on 5 cm sections. Pesticide desorption was performed by batch technique and residues analysis by GC-ECD, p,p'-DDE and p,p'-DDD were quantified. Endosulfan-p-endosulfan pattern was found in all soil sections. p,p'-DDE levels ranged between 27,5-20,7, 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'-DDE and p,p'-DDD desorption from soil was not observed. A pattern of soil (n=8) and pesticide concentrations in control was followed the order: Acids>Tw-80>Control. Under Acids or Tw-80, o-endosulfan was the main compound on the first elution volume and p,p'-DDE started to lixiviate after 2 L while for Tw-80, DDE represents the main elution in all elution volume.

Lixiviation of aged p,p'-DD'Ts residues by endosulfan effectively occurs under irrigation with riverine water and is increased by adding non-ionic surfactant or carboxylic acids.

TU 304

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

T.T. Droge, K.U. Gosz

UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

Many emerging contaminants are strong bases that under environmental conditions mostly occur as cationic species. The environmental fate of these compounds depends on specific interactions such as adsorption on organic matter, clay, soil, sediment and dissolved colloids. Since both natural organic matter and clay minerals are negatively charged substrates, both sorption types are well known to bind organic cations, but it is not clear to what extend 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, Pahokee 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 what extent sorption to natural soil can be predicted by 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 ligninolytic fungus Trametes versicolor and study of the 4MB degradation process in liquid medium

P. Gago-Ferrero1, M. Badia-Fabregat2, C.F. Rodríguez-Rodríguez2, M.G. Caminal1, T. Vicente3, M.S. Díaz-Cruz1, D. Barceló1

1IDAEA-CSIC, Barcelona, Spain

2CSIC-UAB, Barcelona, Spain

3CSIC-UAB, Barcelona, Spain

Screening agents, also known as UV filters, have become very popular chemicals since they have shown to have a protective role against photaging, photocarcinogenesis and other photo-biological effects. Their use has been extended 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 absorbed in the sludge due to their high hydrophobic character, and later spread on agricultural fields. A solid-state treatment of wastewater sludge for fungi 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 previously degraded.

Degradation studies of 3-(4'-methylbenzylidene) camphor (4MBC) in liquid medium were also done in particular and complete removal was achieved in less than 24 h. The main compound on the first elution volume and p,p'-DDE started to lixiviate after 2 L while for Tw-80, DDE represents the main elution in all elution volume.

TU 306

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

M.B. Miloradov1, M.M. Miloradov1, J.S. Slobodnik2, M.D. Djojo2, M.D. Milovanović1, J.R. Radonic1, M.M. Turk Sekulic1

1Faculty of Technical Sciences, Novi sad, Serbia

2Academy of Sciences and Arts of Vojvodina, Novi sad, Serbia

Environmental Institute, Kos, Slovak Republic

Phthalates belong to the group of dominant industrial pollutants and are ubiquitous overspread class of compounds with low water solubility/high fat solubility and low volatility. Due to their low water solubility, the phthalates hydrolyse relatively slowly, but the actual dynamic rate varies according to temperature, concentration and solution pH. Environmental properties of phthalates have much in common, such as plastic and rubber. Among the phthalates diethylhexyl phthalate (DEHP) predominates and has many possible applications, especially for PVC. The highest concentrations of DEHP are found in products for flooring, bol and plastic-coated fabrics. Phthalates are also included as plasticisers for binders in different kinds of paint and adhesives. Within the Project the concentration levels of phthalates in the sediment from Nadela River were determined. Nadela basin is situated near city of Pančevo, Vojvodina region, and is covered by numerous industrial sites and can represent the significant source of these pollutants. The field study was done in 9 sampling sites in the catchment area of the Nadela in the early spring 2009. The main identified metabolites 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 activate against toxic hydroxylated compounds.

 TU 307

Soil pollution by Persistent Organic Pollutants such as DDTs (p,p′-DDT), PCBs and organochlorine pesticides in fish following a mega-flooding episode in the Negro River basin, Argentinean Patagonia

M. Ondarza1, M. Gonzalez1, G. Fillmann2, S.B. Miglioranza1

1Universidad Nacional de Mar del Plata. CONICET, Mar del Plata, Argentina

2CONECO, FURG Universidade de Rio Grande, Rio grande do sul, Brazil

A mega-flooding event in the Negro River basin, Argentinean Patagonia, caused a significant outflow of contaminants from the surrounding soils. Agriculture, hydroelectric development and oil and gas extraction from the Napo River (Alta Floresta) which was dominated by penta- (PCB-110, 118) and hexa- (PCB-153, 138) congeners. These results could have stemmed from historical usage of Arochlor 1254 and 1260 in Argentina along the Negro basin. Fish were sampled before and after the mega-flooding event. In pre-flood fish showed the highest contaminants levels (ng/g lipid), at expenses of PBDEs and PCBs. PBDEs showed the greatest decrease in the Negro basin, being the main compound on the first elution volume and p,p'-DDE>α-DDT>β-DDT, respectively. Post-flood fish showed the highest contaminants levels (ng/g lipid), at expenses of PBDEs and PCBs. PBDEs showed the greatest decrease in the Negro basin, being the main compound on the first elution volume and p,p'-DDE>α-DDT>β-DDT. This pattern would be a result of the intensive use of this insecticide during long time on agricultural practices. Contaminant profiles observed in pre- and post-flood samples were positive on presence of four of the six selected phthalates: di-n-ethyl phthalate (DEP), diisobutyl phthalate (DIBP), di-n-butyl phthalate (DBP), and DEHP. The concentrations varied in the range: for DEP from 0.01 µg/l till 0.2 µg/l, DIBP from 0.08 µg/l till 0.95 µg/l, DBP from 0.3 µg/l till 2.5 µg/l and DEHP from 0.7 µg/l till 2.987 µg/l. In sediment, three of selected phthalates were determined in all sampling sites. All tested samples were positive on DIBP in the range of 24 - 80 µg/kg, DBP in the range of 28 - 150 µg/kg in fish as well as in water samples. The dominance of BDEs 47, 99 and 100 was consistent with the general pattern found in abiotic samples and fish of the Negro River. The dominance of BDEs is consistent with the general pattern found in abiotic samples and fish of the Negro River. The dominance of BDEs is consistent with the general pattern found in abiotic samples and fish of the Negro River. The dominance of BDEs is consistent with the general pattern found in abiotic samples and fish of the Negro River. The dominance of BDEs is consistent with the general pattern found in abiotic samples and fish of the Negro River. The dominance of BDEs is consistent with the general pattern found in abiotic samples and fish of the Negro River.
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.

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 for two samples: Pe-FlexK from peat and BC-EnK from coal. For these humates EC and NOEL - the median PG concentration that caused a 50% test-reaction reduction, and NOEL - no observed effect level - the PG concentration that caused test-reaction reduction below the toxic level) and detoxification indexes D were calculated. Analyses of average detoxification indexes D (averaged over three tests for humates) 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-cultures at all treatments 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 Pe-FlexK from peat and BC-EnK from coal. For these humates EC and NOEL values increased in 1.3-1.8 times for S. Magna, in 1.5-1.7 times for D. Magna, in 1.6-2 times for S. alba for 0.005 wt, % humates content.

Acknowledgement - This research was supported by Russian Federal Science (GK 02.740.11.0693), Russian Foundation of Basic Research (project 10-04-01681)

TU 312
Birds species versus crops: a GIS-based procedure to identify specific combinations
A. Caffi, G. Galiberti, E.M. Marchetto, G.A. Azimonti, A.M. Moretto
ICTP, Trieste, Italy

The area considered was the North of Italy characterised by an intensive agriculture and a consequently high load of pesticides. 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 both avoiding duplication or sharing tests and studies involving vertebrate data have been included. Arichalc, in particular, introduced new vertebrate data sharing provisions which allows Member States to use vertebrate studies on behalf of prospective applicants if an agreement with 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 species 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 a useful tool to address the uncertainty associated to the bird risk assessment.

TU 313
Toxicity of sludge water treatment station for aquatic invertebrates
T.G. Messias
São Paulo University, Piracicaba, São Paulo, Brazil

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 is treated and disposed of in a way that causes environmental problems and health risks. The sludge is generated in the water treatment process which is treated and disposed of in a way that causes environmental problems and health risks. The sludge is generated in the water treatment process which is treated and disposed of in a way that causes environmental problems and health risks.

The proximity of the EC50 and NOEL results to H. attenuata indicate the predominance of acute affects, or lethal stages (rupil and crumpling), 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. Both sludge were very toxic to these organisms and the toxicities were strictly correlated with the increase of electric conductivity, the high concentration of heavy metals and the lowest concentration dissolved oxygen in elutriate.

TU 314
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolomics approach
K. Reider1, H. Heilmeier1, R. Altenburger1, M. Schmitt-Jansen1
TU Bergakademie Freiberg, Freiberg, Germany

TU Bergakademie Freiberg, Freiberg, Germany

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 μg L⁻¹ [Singer et al., Environ. Sci. Technol., 2002]. In a prior study Franz et al. (2008) observed that chlorophytes are one of the highly 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 algal Scenedesmus vacuolatus [Küster 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 μg L⁻¹) for 14 hours to derive concentration-dependent changes in metabolites and to be able to compare them to phenotypic observations (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

TU 315
Polychlorodioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX
B. Suber
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 and boron-free extraction, concentration and were performed at the same time. The detection limits were measured during sample preparation. Samples were analysed employing gas chromatography negative chemical ionization mass spectrometry. The method detection limits ranged from 2.0 to 10 pg/g ww in tissue samples. 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. Average values of seven contaminants 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 than that of crabs and clams. TEQfound was to be least 25X higher than TEQfish. Biomagnifications factors and Bio and Sedimentation Accumulation Factors were also calculated.
TU 316

Morphometric and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, detergents and pharmaceuticals) R. R. Rodrigues1, S. C. Antunes2, F. Brandão3, B. C. Castro4, F. G. Gonçalves5, A. C. Correia1, B. N. Nunes1

1Universidade de Aveiro, Departamento de Biologia, Portugal
2Faculdade de Ciências da Saúde da Universidade Fernando Pessoa, CIAGEB, Porto, Portugal
In this study, we report the identification and characterization of lipophilic xenobiotics that are present at low concentrations in fish. These findings will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in fish. The inhibition of the Enoyl-ACP reductase during the fatty acid elongation in the pathway to the known mode-of-action of the toxicant in fish will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in fish.

TU 317

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) that are present at levels that are below the detection limit. Their multifunctionality, the vast surface of exposure to the external media and their location in the fish body, justify their importance as key organs for the direct action of pollutants in the aquatic environment. This work aimed to assess biochemical and morphometric changes in fish, after exposure to several compounds, including pesticides, detergents and pharmaceuticals, which can be quantified using appropriate analytical tools. The findings of this study suggest that the connectivity of response pathways to the known mode-of-action of the toxicant in fish is a noteworthy result, since it establishes a reduction in the effectiveness of conjugation and elimination of other xenobiotics, enhancing toxicity. Morphometric indices showed evidence of a surface respiratory disturbance as result of exposure to several xenobiotics, which could be advantageous for fish by reducing toxicant absorption.

TU 318

Biomarkers evaluation on the pearl oyster Pteria sterna (Gould, 1851) in The Ensenada de la Paz B.C.S. México S. Sobrino-Figueroa, C. Cáceres-Martínez

The pearl oyster is an important resource in the State of Baja California Sur México, due to a lack of studies related to their response to xenobiotics in this study, an evaluation of 4 biomarkers: respiration rate, ON index, oxidative stress and AChE activity were carried out in the pearl mussel of pearl oyster, from the cultivation vivero, to detect presence of toxic and genotoxic substances, and evaluating the use this biomarkers as reliable tool in environmental biomonitoring studies. Adults oysters (5.15 ± 0.58 cm) and juveniles 2010 (4.49 ± 0.58 cm) in the pearl oyster, and the results obtained in winter (9.07 ± 0.93 nM MDA g^-1) and 15.8% in summer (12.8 ± 1.4 nM MDA g^-1). The oxidative stress and AChE activity of the organisms collected in summer and winter, but significant differences exist in the 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.

TU 319

Physiological and biochemical biomarkers in the catarina scallop Argopecten ventricosus (Sowerby, 1842), as tools to Monitor in the Ensenada de la Paz B.C.S., México S. Sobrino-Figueroa, C. Cáceres-Martínez

The pearl oyster is an important resource in the State of Baja California Sur México, due to a lack of studies related to their response to xenobiotics in this study, an evaluation of 4 biomarkers: respiration rate, ON index, oxidative stress and AChE activity were carried out in the pearl mussel of pearl oyster, from the cultivation vivero, to detect presence of toxic and genotoxic substances, and evaluating the use this biomarkers as reliable tool in environmental biomonitoring studies. Adults oysters (5.15 ± 0.58 cm) and juveniles 2010 (4.49 ± 0.58 cm) in the pearl oyster, and the results obtained in winter (9.07 ± 0.93 nM MDA g^-1) and 15.8% in summer (12.8 ± 1.4 nM MDA g^-1). The oxidative stress and AChE activity of the organisms collected in summer and winter, but significant differences exist in the 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.

TU 320

Relationship between exposure duration, mortality, bioaccumulation and physiological parameters in glochidia (larvae) and juvenile freshwater mussels exposed to copper M. B. Jorge1

1Universidade de Aveiro, Departamento de Biologia, Portugal

In this study, we report the identification and characterization of lipophilic xenobiotics that are present at low concentrations in fish. These findings will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in fish. The inhibition of the Enoyl-ACP reductase during the fatty acid elongation in the pathway to the known mode-of-action of the toxicant in fish will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in fish.

TU 321

Cryptic lineages - are they comparable in their sensitivity towards chemical stress? R. B. Jorge1

1Universidade de Aveiro, Departamento de Biologia, Portugal

The term "cryptic lineages" covers taxa that exhibit genetic differences but an at least superficial morphological equality and the respective specimens thus are misleadingly classified as a single nominal species. Although a well-known concept in evolutionary genetics since several decades, its relevance in an ecotoxicological context has only poorly been investigated. However, there is an urgent need for an ecotoxicological assessment of cryptic complexes as the genetic differentiation between lineages often reaches magnitudes similar to those between species. Thus, deviations regarding behavioural and physiological endpoints within cryptic lineage complexes are conceivable.

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 351
Accordingly, the present study investigated two cryptic _Gambieria fusetum_ lineages - namely type A and type B - for differences in their sensitivity towards chemical stress. The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity.

The experiments were performed on leaves inoculated with algal cells; the feeding rate was measured by counting the number of algal cells that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.

The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity. The feeding rate was measured by counting the number of leaf discs that had been consumed after 7 days of exposure. By combining the results of all bioassays, a meta-analysis was performed to determine the overall sensitivity of the two lineages. The results showed a significant difference in sensitivity between the two lineages (A vs. B), with type A being more sensitive than type B.
TU 329
On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
V.G. Gregorini1, N. Chèvre2, M. Junghans1, I. Werner3
1Unilever Research, Vlaardingen, The Netherlands
2Swiss Centre for Applied Ecotoxicology, Dübendorf, Switzerland
3Swiss Centre for Applied Ecotoxicology EAWAG - EPFL, Dübendorf, Switzerland

Environmental species are not only exposed to single substances but typically to mixtures. Therefore it is of great importance to assess the ecological risk not only by substances but also for mixtures of substances. Two models are currently 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 single 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, as mentioned above the validity of mixture models were recently 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 also to add the dependent parameters (here the thresholds for effect). For all datasets, the model we proposed 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 2-4 times inferior to this standard threshold. We believe that our approach is an expert and non-expert in applying mixture models using the two previous methodologies. Moreover, it permits to relate two totally different concepts in understanding the response in ecotoxicity tests: the link between internal concentration and effects and the inter-individual variability regarding sensitivity.

TU 330
Estimating inter-individual sensitivity from survival data using a mechanistic model
R.B. Beaudouin, A.R.R.P. Pery
INERIS, Verneuil en halatte, France

In the literature, there are two main alternatives to model mechanistically dose-survival relationship in ecotoxicity tests. Effects are related to a concentration of concern, for instance body concentration, and either individuals have the same concentration throughout the test, 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 also to add the dependent parameters (here the thresholds for effect). For all datasets, the model we proposed 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 2-4 times inferior to this standard threshold. We believe that our approach is an expert and non-expert in applying mixture models using the two previous methodologies. Moreover, it permits to relate two totally different concepts in understanding the response in ecotoxicity tests: the link between internal concentration and effects and the inter-individual variability regarding sensitivity.

TU 331
Evaluating the magnitude of NOEC and LOEC values with regression-based ECx values
A.D. Sharpes, A. S. Gerber, T. A. Lowrie, B. F. Trinca, R. E. Tsukajew
University of Lausanne, Lausanne, Switzerland

The objective of the present study was to assess how the SSD approach can be extended to the use of the entire data sets of complex heterogeneous ecotoxicological data quantity, its use is currently restrained to a small number of compounds. One central problem is that commonly many available data are discarded from the analysis for reason of limited validity, endpoint (exclusion of ECx, type data) and exposure time (exclusion of acute data). The objective of the present study was to assess how the SSD approach can be extended to the use of the entire data sets of complex heterogeneous ecotoxicological information, for different data quality, acute and chronic values, ECx, EC, 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 weighing 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
A.D. Sharpes, A. S. Gerber, T. A. Lowrie, B. F. Trinca, R. E. Tsukajew
University of Lausanne, Lausanne, Switzerland

From the analysis 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 ecotoxicity data analysis that could have 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’
E.C. D. Thiery-Duriez, P.L. Leppelérier1, S.T. Taibi2, L.R. Rougé3, J.D. Danti1, G.P. Perez4, A.B. Bispo5
1INRA, Versailles, France
2ESTIPA, Mont saint aignan, France
3NC2E, Rennes, France
4INRA 1, Rennes Université, Rennes, France
5ADEME, Angers, France

The random forest 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 statistical approach of the French "Bioindicators Programme" (2006-2012) is to (i) measure a large number of bioindicators in contrasted pedo-climatic contexts covering similar sampling protocols, (ii) handle high numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a data 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. 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 weighing 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 334
On the relevance of using prospective methods to assess soil ecotoxicological risk
R. Junghans, M. Junghans, I. Werner
1TCM, Zurich, Switzerland
2Swiss Centre for Applied Ecotoxicology, Dübendorf, Switzerland
3Swiss Centre for Applied Ecotoxicology EAWAG - EPFL, Dübendorf, Switzerland

Mineral contamination of soil surface horizons, at 13 sites, producing 47 different contexts in terms of land use historic and origin of contamination (PAH, ETM, pesticides) were assessed. 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 SSD and the species tolerance correlation among substances. However, the application of RA may result in a different 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.
organic contaminations.

TU 334

Advanced non-linear regression methods for concentration-response curves in R

S.J. Moe
Norwegian Institute for Water Research (NIVA), Oslo, Norway

A recent workshop organized by SETAC and IEAM has suggested to ban the use of traditional no-observed-effect levels (NOELs) and lowest-observed-effect levels (LOELs) as basis for risk assessment and decision making, and instead use curve-fitting for estimation of concentration-response relationships. This should motivate an evaluation of current concentration-responsed modelling approaches in ecotoxicology, and adoption of new methodologies for curve-fitting that are used in other fields of environmental science. The Water Framework Directive (WFD) has triggered much research on non-linear relationships between physico-chemical stressors and ecological responses during the last decade. For example, thresholds in stressor-response relationships are particularly relevant for assessment of ecological status of water bodies. Basic statistical methods such as linear regression or ANOVA are not suitable for estimating such relationships. The response may also be more complicated than e.g. a simple sigmoid curve, therefore circular regressions have been used for exploring the shape of the response curve without a priori assumptions. Moreover, we may be interested in estimating an extreme part of the response rather than the average. In this presentation, I give examples of ecological responses to eutrophication and acidification stress in lakes.

The ecological responses are univariate indices representing community composition of phytoplankton, macrophytes, macroinvertebrates and fish. Building upon basic linear regression models, I will discuss several non-linear statistical tricks that enable more flexible curve-fitting: (1) Using a non-linear link to the response variable (generalised linear model); (2) Using a piece-wise linear function for the stressor variable (generalised additive model); (3) Analysing a quantile of the response variable instead of the average (e.g. 90%; quantile regression). All analyses are carried out in the free statistical programming software R.

TU 335

An interfaced R-package to fit SSDs

E. Bilisiot, D.R. Fox*, C. Charles, M.L. Delignette-Muller
1Plateforme de Recherche de Royalaume, Valence, France
2Environmetrics, Melbourne, Australia
3Université Lyon 1, Lyon, France

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 percentile 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 has been 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: (2a) 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 BURLIO in Australia and New Zealand, ETX in The Netherlands or Web-ICE in the U.S. Those softwares have been developed as turn-on-key tools for the application of regional regulatory considerations 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 are currently developing a new and open source tool enabling the comparison of several current methods and also the use of both pointwise and interval-censored data (or a mix of both).

TU 336

A probabilistic model for species sensitivity distributions taking into account inherent uncertainty and variability of effects to estimate environmental risk

P. Gottschalk, K. Eost, B. Nowack
Magdeburg, Germany, Switzerland

Species Sensitivity Distributions (SSDs) are widely used for the risk assessment of contaminants in combination with environmental fate data to identify the potential for species to be affected by environmental contaminants. SSDs are, however, sensitive to both the variability of species sensitivity and the choice of the underlying statistical model.

Through the lentic-lotic Continuum (ILC) project, we have developed a novel methodology to account for the uncertainty and variability in SSDs. The new methodology is based on statistical models and takes into account the variability of species sensitivity. The ILC methodology has been extensively validated in a number of case studies.

This talk will present the ILC methodology and its application to the risk assessment of contaminants in aquatic ecosystems.

TU 337

Toxicokinetics-Toxidynamics survival model, from theory to practice

L. Marzani1, E. Bilisiot2, C. Forfait2, S. Charles2, M.L. Delignette-Muller2
1Université Lyon 1, Villeurbanne cedex, France
2Plateforme de recherche ROYALTAINE, Valence, France

Toxicokinetics-Toxidynamics (TKTD) models simulate the time course of processes leading to toxic effects on organisms. Even for an apparently simple endpoint such as survival, a large number of TKTD models exist. They have been reviewed by Jager et al. (2011) who proposed a unified theory (GUTS) for TKTD models and the use of a likelihood approach for estimating model parameters. Here, we focus on a TKTD threshold model in the GUTS framework called DEBtox (Dynamic Energy Budgets in Toxicology) survival model. This model assumes an effect above a threshold concentration. We examine a simple question: is it possible to estimate parameters of this model by maximum likelihood approach from standard survival data sets?

We analyzed survival data sets of the freshwater invertebrate Daphnia magna exposed during at least 21 days to nine different contaminants. We tried to fit 4 nested DEBtox survival models to each data set by maximizing the log-likelihood function to estimate model parameters.

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 if data did not show natural mortality and (2) because of discontinuities in the log-likelihood cross sections when the threshold parameters is equal to one of the tested concentrations, there are many local minima. This is due to the structure of the threshold model and especially to its non-derivability at the threshold value. We will investigate various solutions to this issue, including adaptation of optimization algorithm and modification of models with fully derivable functions.

TU 338

The IBR revisited: optimization to avoid misuse

S. Devlin1, C. Cossu-Leguille2, A. Gerfard1, L. Giamberrini1, L. Minguez3, E. Rodius1, T. Burgeot1, S. Pain-Devlin3
1LEBE - CNRS UMR 7146, Metz, France
2LEBE - CNRS - UMR 7146 - Université de Lorraine (ULM), Metz, France
3Laboratoire d’Éco-Toxicologie, Université Reims Champagne Ardenne, Reims, France

Département Biogéochimie et Ecotoxicologie, IFREMER, Nantes, France

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 status of studied sites. 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 can be compared to threshold values.

We propose two calculation methods: the first one is a complicated formula that works whatever the number of biomarker is, while the second one is a simplified formula 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 outcome 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 trigonometry 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 value 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 permeation is performed for the fish species Blictheus Brasiliensis. We will show that the IBR method, resulting in a matrix of 720 IBR values, 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 concerns 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 Vargas1, B. Erzgraebere1
1BASF, Limburgerhof, Germany
2Bayer E., Limburgerhof, Germany
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 pharmaceuticals, 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. Vignot1, K. Le Mech1, S. F. P. L. Lyphout1, D. Legay1, H. Budzinski1, M. L. Béguet1, X. Cousin2

1IFREMER, L’oumeau, France
2EPOC - LPTC, Université Bordeaux 1, Bordeaux, France
3IFREMER/INRA, L’oumeau, France

Polyaromatic hydrocarbons (PAH) emission in the environment is constantly increasing with human activity. The goal of this study was to assess long term consequences of fish exposure to PAH on behaviour. Eggs were collected from AB zebrafish strain and were placed at 4 hours post fertilization (hpf) until 96 hpf in a 3 cm diameter Petri dish containing 3 g reference sediment either plain (control) or spiked with a mixture of Benzo[a]pyrene, Pyrene and Phenanthrene at environmental concentrations based on values measured in the Loire Estuary (France), a highly polluted site. Thereafter, larvae were transferred in clean water and raised until adulthood. Behavioural tests such as locomotion during 24-hrs, sudden dark change challenge and T-maze exploration were performed at adults’ stage (F0) and sudden dark change on larvae produced by F0 adults. In adults, during night or dark period, contaminated fish were significantly less active than control fish. A similar observation was made for contaminated F0 in control area. Larvae raised in the presence of chemicals were more active when light was on than control and less active when the light was off. This study indicates that contamination of zebrafish using environmentally relevant concentration during the very first stage of development with a PAH mixture of 3 molecules induced late behavioural effects measured at the adult stage. Further, effect was transmitted to the next generation and behavioural responses of F1 larvae were different to that of F1 control larvae. Consequences on fish abilities (e.g. predator escape, food search, courtship) will be discussed.

Long-term food-exposure to PCB mixtures induces reproductive and behavioural disruptions in zebrafish

X. Cousin1, T. Daou2, S. Pén3, C. Vignet1, T. Larcher1, F. Roupard1, L. Lyphout1, D. Legay4, Y. Loizeau1, M. L. Béguet1

1IFREMER, L’oumeau, France
2INRA, APEX, UMR703, ONIRIS, Nantes, France
3IFREMER Laboratoire de Bioécologie des Contaminants Organiques, Brest, France

Although the use of polychlorinated biphenyls (PCBs) has been banned for several decades, they are still present in the environment. Field analyses have established correlations between exposure to PCBs and alterations in fish physiology including reproductive function and behaviour. In the present study, we performed a life-cycle exposure using zebrafish and mixtures representative of some environmental situations in terms of doses, composition and containing mainly non dioxin-like congeners. Exposure was performed through diet which is the main contamination route in the wild. We demonstrated a bioaccumulation of PCBs in males and females as well as a maternal transfer to the eggs.

Reproductive traits were altered after exposure to a PCB-contaminated diet, including a reduction in the number of fertilized eggs per spawn as well as an increase in the number of premature hatched zebrafish. This was related to modifications of ovary histology revealing a decrease of maturing follicles and an increase of atretic follicles in the ovaries of females exposed to PCBs. In addition, several behavioural traits were monitored. Fish exposed to the highest dose (equivalent to that found in the Seine Estuary) displayed an increased swimming activity during the first day of the night. Fish exposed to an intermediate dose (equivalent to that found in the Loire Estuary) displayed behavioural disruption analogous to hyperactivity that showed some similarities to a human behavioural deficit syndrome known as attention deficit/hyperactivity disorder (ADHD), which can be observed in humans after exposure to PCBs.

These results indicated that exposure to PCB mixtures mimicking some environmental situations, can lead to a dramatic reduction in the number of offspring produced by a female over a lifetime and disrupt behaviour. Potential ecological consequences are discussed with regard to reproduction, fitness and survival.

TCS level effects on population-level results of pollutant tolerance based on evolution fitness and cost of tolerance

Y. Tanaka1, H. Ma2, H. Tatsuta2

1National Institute for Environmental Studies, Tsukuba, Japan
2Department of Ecology and Environmental Science, Graduate School of Agriculture, Nishihara, Japan

Evolution of tolerance to a pollutant chemical in a natural population of organisms gives an evidence of the examined population to have suffered adverse effect due to the chemical because the tolerance evolution of a population is solely brought about by selection pressure that removes sensitive individuals or genotypes from the population. Descriptions on using the tolerance level effect as a monitoring tool of chemical pollution in the field, such approach is not relevant for a quantitative impact evaluation because observed differences in the tolerance between a contaminated and an uncontrolled site are rarely connected to the ecological risk that burdens the population. Applying the theory of evolutionary ecology and quantitative genetics into the tolerance evolution, we attempted to estimate the selective force that is needed to maintain the observed difference in the tolerance between populations. For this aim, we made a heuristic assumption for the evolutionary analysis of tolerance: the strength of tolerance induced by a genotype to a particular compound is positively associated with fitness cost of the tolerance, and the joint action of selection induced by the cost and selection favouring higher tolerance achieves optimization of the total fitness that takes into account the fitness gain by the tolerance and the fitness cost due to the tolerance. The fitness gain by the tolerance means reduced toxicity of a specific exposure concentration in comparison to sensitive individuals, and can be quantified by the life table toxicity data. As a case study of such an approach, we detected inter-population differences of the fenvalerate tolerance among natural populations of a water flea (Daphnia galeata) in Kasumigaura Lake (Japan) and an agricultural reservoir near to this lake, a statistically significant negative association, among isofemale clones, between tolerance values and intrinsic population growth rates under null exposure. With the fitness optimization, we derived an estimate of stationary exposure level of the chemical (all compounds that exhibited co-tolerance with this chemical) as 0.015 ppb, and concluded that the examined population of this species had been suffering the population-level effect that corresponded to 1/4 reduction of the intrinsic population growth rate. The indicated level of the population-level exposure effect may have considerably reduced the probability of persistence of the population.

TCS as an impurity in Daphnia magna: a multi-generational and demographic assessment

K. Sibley1, M. McKe1, J. Lucas1

1University of Guelph, Guelph, Canada
2University of Saskatchewan, Saskatoon, Canada

TCS is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surface waters throughout North America and Europe. 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 were stocked into 14-d exposure systems for the first three generations and into four replicate systems for the last three generations indicating increased tolerance to TCS. Reproductive demographic data were used to estimate the intrinsic rate of increase (r) and indicated significant declines in population levels at the three highest treatments based on the first 3 generations but not the last 3 generations. In this study, effects were only observed at TCS concentrations approximately one order of magnitude greater than those found in surface waters, which indicate that the long-term risks of TCS are likely minimal.

Assessing the chronic aquatic toxicity of phthalate ester plasticizers

A. Staples1, R. Gunn2, K. Kramarz2, M. Lampert1, N. Scholes1

1Assessment Technologies, Inc., Westerville, VA, United States of America
2Eastman Chemical Company, Kingsport, TN, United States of America
3BASF Corporation, Pasadena, TX, United States of America
4TextileMobil Biocatalytic Sciences, Inc., Alpharetta, GA, United States of America
5Evonik Oxeno GmbH, Marl, Germany

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 additives imparting flexibility to vinyl resins. The purpose of the present study is to assess chronic effects of phthalate esters on zebrafish. A previous 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 water concentration, and metabolic biotransformation capacity of these chemicals. Important toxicologic aquatic toxicity studies that have included transgenerational exposure have shown that these assessments and are presented here. The data from the present study, support the earlier risk assessment conclusions. The data also provide further support for a narcosis-related aqueous solubility cutoff 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 histopathology) to date, provide limited benefit in practical ecological risk assessment of phthalate esters to aquatic species.
Effects of land use and pesticide exposure on hatching characteristics of Daphnia magna epiphiwasher
S. Navis, A. Waterkeyn, T. Voet, L. Bredonck
Katholieke Universiteit Leuven, Leuven, Belgium

Daphnia is a well-established model organism and standard test species in ecotoxicology. D. magna reproduces by cyclical parthenogenesis, where environmental cues associated with unfavourable conditions trigger sexual reproduction. In permanent and temporary standing waters, sexually produced encapsulated dormant egg (epiphiwasher), build up over the years to form a dormant egg bank, which is important for long-term survival of the population. The fraction of the dormant egg batch hatches from the sediment. Through this benthic-pelagic coupling, structure and function of resting egg banks have important consequences for ecological and evolutionary dynamics of the active populations and communities. To date however, almost no information is available on the effects of pollution on these dormant egg banks.

In this study, we aimed to assess the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna epiphiwasher from natural populations. Therefore we sampled dormant egg banks of ponds from locations with varying degrees of agricultural activity (from natural areas to areas with intensive agriculture). In the laboratory hatching experiments were performed, looking specifically at differences in hatching characteristics of D. magna epiphiwasher under optimal conditions and after pesticide exposure in relation to historical pesticide exposure.

Is there a potential for wild Daphnia magna populations to undergo selection at conventionally derived effective concentrations of chemicals?
J.D. Hochmuth1, C.R. Janssen2, K.A.C. De Schamphelaere2
1Ghent University (UGent), Ghent, Belgium
2Ghent University, Ghent, Belgium

The genetic variability within a population exposed to stress governs the micro-evolutionary potential of that population to undergo selection and adapt to the stress. However, adaptation caused by natural selection will by definition reduce overall genetic diversity, a process termed genetic erosion. This may result in a cost of inbreeding, whereby populations evolved under a certain chemical stressor, may become less tolerant to novel stressors. It is hypothesized that a population under stress exhibits an increase in genetic variation for life history traits relative to a control population. We used the genetic coefficient of variation (CVg) as measures for genetic variability for micro-evolutionary responses in wild populations exposed to copper and zinc, as model toxicants. Life-table experiments with concentrations of copper and zinc close to the conventionally derived geometric mean NOEC values (50 µg Cu/L, 428 µg Zn/L) were conducted with 8 Daphnia magna populations collected from lakes under ponds across Belgium, with concentrations of Cu and Zn levels. Additional full dose-response experiments were carried out with the most and least sensitive populations. Our results indicate that several fitness traits have the potential to respond to natural selection and genetically adapt, but that this depends strongly on the population and the exposure treatment considered. In long-term multi-generational exposures this may result in shifts in genotype frequencies and reduction of genetic diversity.

Evolutionary consequences of the loss of genetic diversity in C. riparius populations - Introducing the MIDGE project
J. Pedrosa1, M.F.L. Lemos2, C. Nowak3, A.M.V.M. Soares3, L.J.T. Pestana4
1University of Aveiro, Aveiro, Portugal
2IHT, CP 125, Faculdade de Ciências da Universidade de Lisboa, Lisbon, Portugal
3Senckenberg Research Institute, Gelnhausen, Germany
4University of Aveiro & CESAM, Aveiro, Portugal

Chronic pollution is known to decrease genetic variation in populations of several species alongside with adverse effects on the physiology of organisms. This loss of genetic diversity may reduce the potential of populations to adapt to changing environments. 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. There is an urge for evolutionary toxicology studies because only an integrated approach linking contamination, genetic variability, life-history responses and fitness costs associated with adaptation can lead to genetic erosion. To attain these objectives, the lethal and sublethal (growth and reproduction) sensitivity to salinity of six clonal lineages of Daphnia longispina, exhibiting different lethal resistances to salinity was investigated. These lineages were exposed to NaCl for more than one generation, and became acclimated to low levels of salinity.

1. Are the most resistant to copper are among the most sensitive to salinity, both under (i) short-term exposures and under (ii) long-term generational exposures. To attain these objectives, the lethal and sublethal (growth and reproduction) sensitivity to salinity of six clonal lineages of Daphnia longispina, exhibiting different lethal resistances to salinity was investigated. These lineages were exposed to NaCl for more than one generation, and became acclimated to low levels of salinity.

Metal tolerance in the earthworm Eisenia fetida: Is it a case of adaptation or mere physiological acclimation?
O.J. Oworji1, P. Poua-Otomo2, S.A. Remecke3, A.J. Reimecke4
1ECT Oekotoxikologie GmbH, Florsheim, Germany
2Institute for Environment and Resources, Ho chi minh city, Vietnam
3University of Southern Denmark, Odense, Denmark
4Institute for Environment and Resources, Ho chi minh city, Vietnam

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
webs linking primary producers to consumers. The negative effects on Daphnia are well understood; toxic cyanobacteria affect growth, survival and reproduction. However, one possibility to ameliorate toxic effects is to bio-transform MC by conjugation to glutathione via glutathione S transferase, thereby reducing toxicity and aiding excretion. This process is thought to underlie the ability to withstand MC in Daphnia and could explain the enhanced tolerance found in the offspring of Daphnia exposed to live cyanobacterial cells.

In this study, multigeneration exposures were conducted, we exposed the parental generation to MC-LR for 1 or 7 days and determined the enzyme mediated tolerance to MC in their offspring, a) by assessing the acute effect of MC-LR on bio-transformation, antioxidant and energy metabolism enzyme activities, and b) through 21 day chronic toxicity tests. Survival of MC-LR exposed fish was lower compared to the control. 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 increment the catalase activity when challenged with the toxin. In offspring from the 1 day exposed parental generation those effects were less pronounced or not visible. Offspring of the 1 day exposed parental generation showed a lower survival when exposed to 1 day MC-LR whereas the offspring from 7 day exposed mothers show higher 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 parental 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 352**

Is there a functional role of DNA methylation in the stress response?


Ghent University, Gent, Belgium

DNA methylation, the addition of methyl groups on the 5' position of cytosines in the DNA plays an important role in the regulation of gene expression of eukaryotic cells. Contrary to what is generally accepted, epigenetic effects have been performed in invertebrates and plants when exposed to DNA damaging agents. In invertebrates it has only recently received attention. In particular for Daphnia magna, a key test organism in aquatic toxicology and an important species in many aquatic ecosystems, knowledge on DNA methylation is very limited. Within our long-term aim of unravelling the potential functional role of DNA methylation in the stress response of D. magna, this study aimed at sequencing the entire cytosine methylome of Daphnia magna. 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 gene 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, I. San Segundo, P. Sanchez-Arleguño

UNA, Madrid, Spain

Vinylphenol causes transgenerational effects by inducing DNA methylating 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 of 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 andMspI digested samples. HpaII and MspI are isochizomers that recognize the tetranucleotide sequence 5'-CCCG-3' but that show differential cleavage in methylated and non-methylated sequences. HpaII cannot cleave it one or both cytosines are fully methylated in both strands, whereas MspI cleaves CmCGG but not 5mCCGG sequences. Gel electrophoresis of PCR products and comparative analysis between HpaII and MspI patterns allowed the study of CCCG regions in the genome that are sensitive to methylation and the effect of these on pollutant effects in these sites. Genotoxicity was measured by the micronucleus test in cells isolated from whole adults after exposure and by the evaluation of cell death and development of offspring. Cytosine methylomes 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, helix-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 the fate of such DNA damage in the mitochondrial genome is unknown. The effects of such 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 Caenorhabditis elegans, we found that UVC-induced photodimers result in lower levels of mtDNA-encoded mRNAs, decreased ATP levels, decreased oxygen consumption, higher 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.

**TU 355**

Is there a functional role of DNA methylation in the stress response?

Stockholm University, Stockholm, Sweden

Is there a functional role of DNA methylation in the stress response?

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, helix-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 the fate of such DNA damage in the mitochondrial genome is unknown. The effects of such 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 Caenorhabditis elegans, we found that UVC-induced photodimers result in lower levels of mtDNA-encoded mRNAs, decreased ATP levels, decreased oxygen consumption, higher 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.

**TU 356**

The enzymatic functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals

I.L. Iñiguez, D. Deschênes

CIRCAg, Montréal, Canada

The enzymatic functional stability of zinc-tolerant microbial communities can be assessed by measuring the activity of enzymes involved in the degradation of different organic compounds. This approach can be used to determine the ecotoxicity of metals in the environment. The method involves the assessment of the activity of enzymes such as protease and urease, which can be used as indicators of the functional stability of microbial communities. The results can be compared to control samples to determine the degree of ecotoxicity.

The use of the enzyme activity assay is advantageous because it is relatively cheap, non-invasive and can be performed quickly. This method can be applied to a wide range of environments, including soils, sediments and aquatic systems. The results can be used to identify areas that are at risk of metal pollution and to develop strategies to mitigate the effects of metal contamination. The method can also be used to monitor the effectiveness of remediation strategies.

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

357
We therefore studied the responses of C. elegans exposed to six experimental concentration of uranium over several generations. The individual traits followed were the percentage of TBT-resistant isolates, which varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total of 111 distinct genetic profiles, indicating the potential as bioremediation tools was assessed through ecotoxicological testing with the gastropod Gibbula umbilicalis. Ecotoxicological testing suggested that some TBT-resistant strains of Gibbula umbilicalis at 48 and 96 hours was 61.45 µg L⁻¹ and 15.69 µg L⁻¹, respectively. Moreover, the percentage of resistant bacteria compared to the control was lower. At 0.1 mM, Póvoa de Varzim had the highest percentage of resistants' for 1mM and 3mM, respectively. Aveiro had the lowest isolates concentration in the control, while Peniche had the highest number of colony forming units per milliliter values (410 ± 26 cfu mL⁻¹ and 383 ± 91 cfu mL⁻¹ respectively). On the other hand Aveiro (0.26 ± 0.09%) and Setúbal (45.5%) while Setúbal had the lowest (2.56%). Regarding 1mM and 3mM concentrations, Peniche had the highest percentage rate (8.2% and 7.7% respectively) as well the highest number of colony forming units per milliliter values (410 ± 26 cfu mL⁻¹ and 383 ± 91 cfu mL⁻¹ respectively). This study contributed to the understanding of TBT resistance, however more intensive and focused research in the area of TBT bioremediation mediated by marine bacteria is needed. ET11P - Marine environmental chemistry and ecotoxicology

TU 361
Biotechnological potential of impacted scenarios for the restoration of TBT contaminated environments
R. Monteiro1, L. Fonseca2, A. Correia3, C. Ana3, F.L. Lemos3
1Polytechnic Institute of Leiria, Peniche, Portugal
2Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
3University of Aveiro, Department of Biology & CESAM, Aveiro, Portugal

This study, TBT-resistant bacteria collected from 7 Portuguese ports (Póvoa de Varzim, Leixões, Aveiro, Figueira da Foz, Peniche, Setúbal and Sines) were isolated in increasing concentrations of the toxicant (0.1, 1, and 3mM of TBT) and those growing at the highest concentration were characterized by genotypic fingerprinting (REP-PCR) and tested as potential bioremediation tool in laboratory contaminated media. The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total of 111 distinct genetic profiles, indicating the potential as bioremediation tools was assessed through ecotoxicological testing with the gastropod Gibbula umbilicalis. Ecotoxicological testing suggested that some TBT-resistant strains of Gibbula umbilicalis at 48 and 96 hours was 61.45 µg L⁻¹ and 15.69 µg L⁻¹, respectively. Moreover, the percentage of resistant bacteria compared to the control was lower. At 0.1 mM, Póvoa de Varzim had the highest percentage of resistants' for 1mM and 3mM, respectively. Aveiro had the lowest isolates concentration in the control, while Peniche had the highest number of colony forming units per milliliter values (410 ± 26 cfu mL⁻¹ and 383 ± 91 cfu mL⁻¹ respectively). On the other hand Aveiro (0.26 ± 0.09%) and Setúbal (45.5%) while Setúbal had the lowest (2.56%). Regarding 1mM and 3mM concentrations, Peniche had the highest percentage rate (8.2% and 7.7% respectively) as well the highest number of colony forming units per milliliter values (410 ± 26 cfu mL⁻¹ and 383 ± 91 cfu mL⁻¹ respectively). This study contributed to the understanding of TBT resistance, however more intensive and focused research in the area of TBT bioremediation mediated by marine bacteria is needed. ET11P - Marine environmental chemistry and ecotoxicology

TU 362
Bacterial diversity on Portuguese ports: TBT degrading bacteria
1Polytechnic Institute of Leiria, Peniche, Portugal
2Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
3University of Aveiro, Department of Biology & CESAM, Aveiro, Portugal

Initially, 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 PCRamplified patterns were clustered by computer analysis. Among the 157 isolates examined, 111 different banding patterns were identified. We have characterized these isolates in what concerns growth rate in the presence of increasing concentrations of TBT and later identified them by 16S rRNA gene sequencing. Bacterial diversity was also assessed by DGGE. We were able to detect TBT-resistant bacteria from all the sampling sites. It is possible to observe that with increasing concentrations of TBT, the concentration of isolates decreased and consequently the percentage of resistant bacteria compared to the control lower. At 0.1 mM, Póvoa de Varzim had the highest percentage of resistants’ (45.5%) while Setúbal had the lowest (2.56%). Regarding 1mM and 3mM concentrations, Peniche had the highest percentage rate (8.2% and 7.7% respectively) as well the highest number of colony forming units per milliliter values (410 ± 26 cfu mL⁻¹ and 383 ± 91 cfu mL⁻¹ respectively). On the other hand Aveiro (0.26 ± 0.09%) and Sines (0.08 ± 0.03%) had the lowest percentage of resistent’s for 1mM and 3mM, respectively. Aveiro had the highest isolates concentration in the control, while Peniche had the highest number of colony forming units per milliliter values, which is the key factor in the restoration of contaminated environments. Nevertheless, byproducts resulting from the degradation process might be more or less toxic than the parent compound and to ecological relevant species. The determination of the substance presence by chemical analysis, although essential, may not present ecological relevance, as it might not be related to its ecotoxicity.

This study, TBT-resistant bacteria collected from 7 Portuguese ports (Póvoa de Varzim, Leixões, Aveiro, Figueira da Foz, Peniche, Setúbal and Sines) were isolated in increasing concentrations of the toxicant (0.1, 1, and 3mM of TBT) and those growing at the highest concentration were characterized by genotypic fingerprinting (REP-PCR) and tested as potential bioremediation tool in laboratory contaminated media. The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total of 111 distinct genetic profiles, indicating the potential as bioremediation tools was assessed through ecotoxicological testing with the gastropod Gibbula umbilicalis. Ecotoxicological testing suggested that some TBT-resistant bacteria are able to reduce the toxicity of TBT contaminated waters. Ecotoxicological testing also revealed that the median lethal concentration (LC50) of TBT in Gibbula umbilicalis at 48 and 96 hours was 61.45 µg L⁻¹ and 15.69 µg L⁻¹, respectively. This study contributed to the understanding of TBT resistance, however more intensive and focused research in the area of TBT bioremediation mediated by marine bacteria is still needed, particularly on the mechanisms behind TBT resistance and on the identification of pathways and genes responsible for TBT degradation.

TU 363
Are TBT sources migrating from harbors to marinas in Latin America?
G. Fillmann1, A. Péry2, R. Beaudouin3, M. Dutilleul4, C. Lecomte4, J.M. Bonzom4
1IDAEA-CSIC, Barcelona, Spain
2IADEA-CSIC, Barcelona, Spain
3Universidade de Aveiro, Aveiro, Portugal
4University of Aveiro & CESAM, Aveiro, Portugal

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 and imposex levels in areas close to harbors, despite the general reducing pattern in many areas. The present study reported imposex parameters (impresss %, VDI and RPI) 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 sites were close to marinas) and Arraial do Cabo (2 out of 10 stations were close to marinas).

In this case, the main source of organotin pollution is clearly the marinas. In the Angra dos Reis study, imposex was detected in 100% of females close to the marinas, and in 5 out of 10 stations the animals previously inhabiting the rocky shores were no longer found. In Arraial do Cabo, two stations nearby a single marina showed an imposex incidence of 4% and 0 in 2001, increasing to 83% and 47% in 2008. In this region, another marina located near a small harbor showed imposex incidence in those stations increased to 90% whereas no gastropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from these harbors, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly point out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TUU 364
Imposex and organotin (OT) levels in Nucella lapillus along the Portuguese coast: a re-survey in 2011
W.Y. Chen,3, W.Y.Ye1, S.H. Chen1,2, J.L. Jou1, C.M. Liao2
1 National Taiwan University, Taipei, Taiwan
2 National Taiwan University, Bioenvironmental Systems Engineering, Taiwan
3 National Taiwan University, Department of Biology & CESAM, Aveiro, Portugal

Imposex in marine gastropods is used as an indicator of TBT bioavailability and to evaluate the effectiveness of legislation in reducing TBT pollution. TBT is known to interfere with the normal development of the female reproductive system, causing imposex in Nucella lapillus (Whelk). The current work assessed imposex and organotin (OT) levels in N. lapillus soft tissues using valve rhythm behavior-based real-time biomonitoring system to detect waterborne arsenic.

TUU 365
TBT from anti-fouling paints in the environment - an overview of the situation today
T. Ekland
Stockholm University, Stockholm, Sweden

The Baltic Sea is a sensitive brackish water environment where most organisms live at the edge of their distribution area. Pollutants thus mean an extra stress to these organisms. Traditionally anti-fouling paints are based on biocides, which prevents the attachments of fouling organisms on underwater structures such as a boat hull. The problem is that the biocides are persistent and that they also affect non-target organisms. The environmental authorities have with time implemented more strict regulations, especially for the paints that may be used on the east coast of Sweden. The use of tin-organic substances were prohibited in 1989 for all boats less than 25 m and no paints based on copper leakage were approved from 2001 and up today no copper paints have been on the market for use on the east coast. In spite of these restrictions much toxic substances originating from anti-fouling paints are still found along the west coast and the east coast of Sweden. Similarly high concentrations are found in harbours for ships. Our investigations show that the highest concentrations are found in boat yards > uptake areas > marinas > natural harbours. 100 µg TBT/kg DW is considered high in many countries and the highest concentrations in boat yards reached 30 000 µg TBT/kg DW. The reason is under lay paint layer being scraped off.

TUU 366
Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field facilities and exposure resident molluscs
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 their use as biomonitor for metal contamination. However, little is known of the internal and subcellular metal burdens of such organisms or the factors that influence the bioaccessibility of metal to the organism. The health effects of metals are often expressed at the level of cells or tissues, rather than at the organism level. Biomarker measurements can provide evidence that organisms have been exposed to contaminants at levels that exceed their detoxification and repair capacity, thus establishing the link between contaminant exposure and ecologically relevant effects.

Laboratory exposures, in which physicochemical factors can be controlled, using previously unexposed organisms are routinely used in the development of toxicological effects tests to establish dose and toxicant relationships and ecologically relevant effects tests to establish dose and toxicant relationships. Measurements of oxidative stress (total antioxidant scavenging capacity of cells and lipid peroxidation) were used as effects biomarkers of metal exposure.

TUU 367
Imposex occurrence and the genetic changes in Vained Rapa Whelk (Rapana Venosa) from Bohai Bay, China
L.An, B.Zheng, Y.Zhang, L.Wang, C.Hao
Chinese Research Academy for Environment Sciences, Beijing, China

In order to assess the present status of organotins (OTs) pollution and the potential ecological risk, biological effects in biota and the contents of OTs in biota and sediments were tested in seven marine sites in Bohai Bay, north China. Imposex occurrence was found in vained rapa whelk (Rapana venosa) from three sites in Bohai Bay (HH1, NPH and DTS), ranging from 0% to 12.45% in 2010 and from 0% to 12.50% in 2011, respectively. The chemical analysis results showed that TBT and TPT were the main OTs in tissues 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 that 2 % of samples from the sites were positive for imposex. This study presents a C. fluminosa biomass-monitoring system that can particularly provide the real-time transmission information on the waterborne As activity. This parsimonious recovery of marine ecosystems to evaluate the effectiveness of legislation in reducing TBT pollution. The current work assessed imposex and OT tissue contamination in Nucella lapillus at 16 sites along the Portuguese coast in 2011. The vas deferens sequence index (VDSI), the female penis length index (FPLI), the relative penis size index (RPSI), the percentage of imposex affected females (%I) and the percentage of sterile females (%S) were determined to assess imposex levels. Additionally, monobutyltin (MBT), dibutyltin (DBT), TBT, diethyltin (DEP), triphenyltin (TPT), monooctyltin (OOT) and dioctyltin (DOT) were quantified in the soft tissues of whole females by GC-MS. The OSPAR Ecological Quality Objective (EcoQO) set for this species (VDSI < 2) was achieved in 94% of the sampled sites. All surveyed populations presented VDSI values that fall into OSPAR class B (0.1 < VDSI < 2) with one single exception in the South western coast - Zambujeira do Mar (site 15) - also being the only site where sterile females were still recorded. OT concentrations in N. lapillus soft tissues varied between <0.2ng Sn/g and 24ng Sn/g dry weight (dw) for MBT, 2.0 and 26ng Sn/g dw for DBT, 2.1 and 30ng Sn/g dw for TPT and 0.2 to 1.6ng Sn/g bw for TBT. TPT, DOT and DOT concentrations were all below the detection limit. TBT recent inputs were estimated to occur at four sites by the butyltin degradation index (DBI = ([MBT]+[DBT])/[TBT]). The temporal trend of N. lapillus imposex was assessed for the period 2000-2011 in order to evaluate the trend of TBT pollution levels in the Portuguese coast.

TUU 368
Clam valve rhythm-based online biomonitoring system to detect waterborne arsenic
S.H. You1, W.Y. Chen2, I.L. Jou1, S.H. Chen3, C.M. Liao2
1 National Taiwan University, Taipei, Taiwan
2 National Taiwan University, Bioenvironmental Systems Engineering, Taiwan
3 National Taiwan University, Department of Biology & CESAM, Aveiro, Portugal

Arsenic is a water-soluble metal that presents high levels of detectability at southwestern and northeaster coastal areas of Taiwan. The freshwater clam has a high market value and is commercially important to Taiwan's aquaculture. Previous studies indicate that biomonitoring is the scientific technique for detecting environmental pollution situations for promoting the harmful of toxic chemical in the water. The purpose of this study was to synthesize water chemistry-based bioavailability and valve daily rhythm in Corbicula fluminosa to design a biomonitoring system for detecting waterborne As. We integrated valve daily rhythm dynamic pattern and water chemistry-based Hill dose-response model to build in a valvometry technique programmatic mechanism, offering a rapid and cost-effective dynamic detection system. We validated the simulated dissolved As concentrations based on valve daily rhythm behavior with published experiment data. The results indicated that the As concentration detection threshold of biomonitoring system was 1mg L-1 and the detection times are associated with the exposure concentrations. This study presents a C. fluminosa biomass-monitoring system that can specifically provide the real-time transmission information on the waterborne As activity. The cDNA F. fluminosa valve rhythm behavior-based real-time biomonitoring systems present a valuable effort to promote the automated biomonitoring and offers early warnings on the potential ecotoxicological risks in regions with elevated As concentration.
Chronic exposure of young spat of the Pacific oyster (Crassostrea gigas) to zinc

J. Devos, Voseux, Caplat, J. Fievet

IRSA, France

ERPCP, EA 3914, IUT/URF Sciences, Université de Caen Basse-Normandie, Caen, France

The marine coastal environment is constantly submitted to many sources of releases from human origins, resulting in low concentrations of contaminants and macro pollutants. These low doses can be toxic to these marine organisms 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 in environment protection regulation can lean on robust scientific basis 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 several hundreds of larval stages. A reliable inter-laboratory instrumental test is the one-day post-metamorphosis exposure. 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 pollutants than adults, so they use 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 antiinflammation and sanitary drugs. 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, as one day post-metamorphosis 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.

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


University of Caen Basse-Normandie, Caen cedex, France

CNRS, Tours, France

University de Caen Basse-Normandie, Caen cedex, France

In marine environments, sediments anodes made of zinc are currently used to mitigate marine corrosion as part of cathodic protection systems of immersed metallic structures. Zinc is an essential metal for living organisms because it is present in many enzymes that catalyze physiological and biochemical reactions. In the marine environment, zinc can be released in seawater as ZnCl₂ or ZnSO₄, and for a short-term exposure, and 168-hour exposure, 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 being analyzed. All the oysters were reared in seawater in the framework of a field experiment. Eighty 1.8% mortality rate was recorded, and the bioconcentration factor (BCF) exhibited values up to 405 in the digestive gland. In contrast, the results obtained through chronic exposure showed a higher BCF (13,397), whereas no mortality was detected. Moreover, zinc was able to modulate the oyster physiological endpoints (e.g. immune parameters, stress biomarkers) are sensitive to acute Zn toxicity but are only moderately affected by a mild Zn concentration. This study confirmed the necessity to monitor this zinc contamination source in marine environments.

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

C. Mottier, V. Kientz-Bouchart, A. Serpentini, J.M. Lebel, K. Costil

Université de Caen Basse-Normandie, CNRS INEE, FRE 3484 BioMEA, Caen, France

LDFD Laboratoire Départemental Franck Duncombe, Saint-contest, France

Université de Caen Basse-Normandie, Caen, France

The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors including phytoplankton reproduction and xenobiotic stress. In this context, terrestrial 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 region surrounding the English Channel on the early stages of Crassostrea gigas. Experiments were conducted on gill, digestive gland and soft tissues from adult oysters exposed to a commercial formulation of Roundup Express® and Roundup Alèses et Terrasses® and also adjuvant (POEA, Polyethoxylated tallowamine) alone. 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 their EC₅₀ values. 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 appeared 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 mg.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 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).

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


Norwegian Institute for Water Research (NIVA), Oslo, Norway

NIVA, Oslo, Norway

University of Life Sciences, Ås, Norway

Bioforsk, Ås, Norway

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 amines and transformation products into the environment will increase. The two major groups of transformation products that we considered is nitriramines, both of which are considered to be carcinogenic. From theoretical modelled analysis, we found nitraramine compounds, 2-(nitroamino) ethanol (CAS: 74386-82-6) and dimethylnitraramine (CAS: 1146-28-7) to be present. However, despite the likelihood of these compounds increasing in the environment, no environmental toxicity data for these compounds currently exists. Therefore, the first aim of this work was to provide an environmental risk assessment for these compounds taking into account the key trophic groups within freshwater marine and terrestrial environments. The toxicity assessment was made using a suite of standardised bioassays for the measure of acute and chronic toxicity, which found the ELC₅₀ of 0.007 concentrations to be in the low to mid mg/L range for all aquatic toxicity tests. In addition, the sub-lethal effects of these compounds was also investigated, using a 3 tiered approach to assess the potential toxic effects and carcinogenic effects of these compounds. Overall, data to develop the environmental risk assessment for these future environmental pollutants will be presented.

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

J.C.L. Ladewig, V.K. Mubiana, R. Blust

Aveiro University, Aveiro, Portugal

University of Antwerp, Antwerp, Belgium

Mussels are marine organisms widely used as environmental biomonitor, due to the ability to concentrate pollutants in their tissues with minimal metabolic transformations.
Arsenic is widespread in the marine environment and occurs in various chemical forms, principally as arsenate (As V), and to a lesser extent as arsenite (As III) as a more toxic form of arsenic. Arsenic introduced into the environment often contaminates aquatic ecosystems, where the residence time has been estimated at about 50 years. This study aimed to determine whether exposure to specific heavy metal arsenic has an effect on the efficiency of mussel tissues. The effect of arsenic in mussels was analyzed in an area with four different industrial concentrations of As (III) and one control for 10 days, during this period several physiological parameters were analyzed (Scope for Growth, energy reserves, body condition index, Mts and arsenic accumulated by the mussels). Arsenite does not seem to affect the physiological parameters of Mytilus edulis, but the organisms can accumulate As (III) proportionally to the concentrations that it is exposed, especially at high concentrations. Several industrial concentrations used in this study did not show a correlation, but in their experiments. The present study has shown that arsenic accumulated in the body of mussels did not have adverse effects to the mussels, at least in a short period of time and for those physiological parameters measured, but after 10 days of exposure some parameters (lips and SFG) have positive correlation with arsenic in sea water, suggesting an effect of arsenite. Long-term experiments should be performed to really understand these effects.

TU 376 Marine ecosystem health assessment through the Integrative Biological Index (IBI) in mussels from Portugal NW and Basque coast

L. Garmendia1, I. Izagirre2, I. Marínez2,1, J. Aguirre-Rubi1, L. Izagirre1, L. Guilhaumin3, I. Marínez2

1Universidade do Basque Country, Leioa, Spain
2University of Portugal, Porto, Portugal
3University of the Basque Country, Leioa, Spain

In order to assess the biological effects of pollution, mussels Mytilus galloprovincialis, were seasonally sampled in seven localities subjected to different levels of pollution along four coastal areas in the North Western Portuguese Coast (NIPC) over one year (April, June, October 2010 and in February 2011); 4 in the NW Coast of Portugal (Vila Chã, São Bartolomeu do Mar, Viana do Castelo and Carreço) and 3 in the Basque Coast (Ariñezu, Gueiruz, Mundaka). In each locality, a battery of biochemical and chemical and tissue-level biomarkers were applied: acetylcholinesterase (AChE) and glutathione S-transferases (GST) enzymatic activity, levels of lipid peroxidation (LPO), lypoosomal enlargement (lyosomal volume, lypoosomal membrane stability), cell cycle phase (G1, S, G2/M), cell viability (CCK8, MTS assay) and the protein biomarker. Thus, this study represents a contemporary and new approach in quantification and assessment of the environmental risk caused by metal exposure, as well as the potential toxic effect of metals on mussel.

The GPx activity was occasionally induced, but the pattern of response was less consistent that for the other biomarkers. The most intense biological responses were recorded in the inner parts of the estuaries, where the most polluted areas were located. The above results suggest that the two biomarkers can be used as potential environmental quality and contamination levels.

The study was performed on indigenous mussel populations sampled in the middle part of the eastern coast of the Adriatic Sea at the locations of two ports, two marinas and a reference (unpolluted) site. The results obtained from the sampling in March 2011 will be presented.

This study was performed within the scope of the DAAD project (Project-ID: 50752021 Deutscher Akademischer Austausch Dienst) during which scientific collaboration between the research groups from Croatia and Germany was established.

TU 378 An improved on-line clam-based behavioral monitoring system allows an approach to estimate dose-response profiles of clams exposed to waterborne copper

L. J. Jou

National Ilan University, Yilan, Taiwan

This study aimed to develop an improved on-line clam-based behavioral monitoring system. The system included a valvometry apparatus and three kinds of valve closure actuator programs that can offer a real-time and cost-effective method to construct an approach for estimating dose-response profile of clams (Corbicula fluminea) exposed to waterborne copper (Cu). The valvometric technique can reduce the environmental stress of observed bivalves to promote a measuring precision in the spontaneous status of recording daily valve movements. The clam-based on-line behavioral response monitoring system was used to respectively monitor the valve closure responses of C. fluminea exposed to unpolluted environment and various Cu concentrations. In this study, a probabilistic-based approach describing the valve behavioral response of C. fluminea exposed to unpolluted environment and Cu was developed. The magnitudes of shell gap of 20 and 35% were respectively adopted as the determining thresholds of the closing valve (VC) and siphon extension (SE) status to digitalize the valve movements in bioequivalent times of varying dose-response profiles (RVC and RSW) based on an empirical three-parameter Hill model. It also allowed the estimation of the integration time-specific EC50 and EC100 values as a bioassay approach. The daily valve opening and closing rhythm were characterized by a three-parameter lognormal function. The time-specific EC50 and EC100 values were dramatically extended from 10 minutes to 73, 43, 69, 19, 46, 19, 54, 77 and 73, 43, 69, 19, 46, 19, 54, 77 μg L−1, respectively, at integration time times of 10, 15, 30, 60, 120 and 300 minutes. The results revealed that the RSW-based valve behavioral observation has a better sensitive response for detecting a lower waterborne Cu concentration than that of RVC within one hour. The results also demonstrated that the response sensitivity of clams exposed to Cu depended on the initial valve state and the dose concentration of Cu. The results indicated that C. fluminea exposed to different concentration of Cu in response to their exposure concentration results presented in various valve closing rates. In the future, an estimation of dose-response profile of clams exposed to waterborne contaminant should be taken into account the related response characteristics of valve activities to promote the predictive capabilities of this bioassay approach.

TU 379 Glutathione S-Transferase, glutathione peroxidase and acetylcholinesterase activities in mussels transplanted to harbour areas

L. V. Vidal-Liñán

Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, Vigo, Spain

This study aimed to determine the effects of pollutants on the planktonic mussel Mytilus galloprovincialis, inhabiting the coastal areas of the northwest of Portugal and the cavity of Aveiro and Algarve, respectively. In order to achieve this, individuals from both places were sampled, in two successive years, and an additional group of individuals was sampled from a reference site (São Jacinto, Aveiro). For each sampled population and sampling time, lipid peroxidation and the activity of glutathione-S-transferase, catalase, glutathione peroxidase and acetylcholinesterase (AChE) were measured. The results revealed that GST and AChE activities can be used as potential biomarkers of toxicity for active monitoring in marine coastal ecosystems.

The EC50 values of the valve closing (VC) and siphon extension (SE) status to digitalize the valve movements in bioequivalent times of 10, 15, 30, 60, 120 and 300 minutes. The results revealed that the

1, R. Calado

Department of Biology & CESAM, University of Aveiro, Aveiro, Portugal

2, D. Ivankovic

Helmholtz-Zentrum Geesthacht, Geesthacht, Germany

3, D. Pröfrock

University of the Basque Country, Leioa, Spain

4, A. Prange

University of Porto, Porto, Portugal

5, L. J. Jou

National Ilan University, Yilan, Taiwan

6, H. Helmholz, Z. Strlak, D. Ivanovska, A. Prange

61
Impact of suspended particles on bioavailability of petrogenic PAH in cod (Gadus morhua), mussels (Mytilus edulis) and passive samplers exposed to produced water M. Pampmann1, C. Bjorkblom2, C. Harman2, S. Vingen2, B.F. Godal1, R.C. Sundt2
1IRB International Research Institute of Stavanger, Stavanger, Norway
2NIVA-Norwegian Institute for Water Research, Oslo, Norway

caged organisms and passive samplers are routinely used to monitor environmental impact of operational discharges from offshore oil and gas production. Comparison of data obtained for different species and time may be required to reveal which environmental parameters, such as temperature, salinity, and/or predation and common environmental contaminants. 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 order to evaluate whether significant differences in suspended particle density (SPMD) exposure to PAHs existed between caged organisms and passive samplers (SPMDs). Caged 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 particle 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, algae mix at low, medium and high concentrations. The following parameters were analysed: PAHs in water; PAH concentrations in SPMD and mussel soft tissues and PAH metabolites in fish. Due to the important role of gills for absorption of waterborne PAHs, a histopathological investigation of fish gills was conducted as a support parameter. The presence of realistic densities of organic particles had only minor impact on the bioavailability of low molecular weight PAHs in fish, mussels and passive samplers. Bioavailability of 3-ring PAHs was only significantly reduced in mussels when algae particle density was high (about 50 000 cells/ml).

Estimation of experimental conditions to maximize mussels shell capability in trace metal accumulations A. Zuin, S. Manente, G. Ravagnan
Ca’ Foscari University of Venice, Venice, Italy

The estimation of mussels shell capability of concentrate heavy metals was performed by means of a set of laboratory experiments conducted with mussels collected in unpolluted sites exposed to sublethal concentrations of a known toxic metal. Multiple cycles of accumulation and depuration were carried out in all the experimental period; the constant monitoring of experimental conditions and periodical metal measurement 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 incorporate in the crystalline calcium carbonate lattice, its loss from the shell during mussels lifestime may be considered of no concern; in other hand it is known that soft tissues are able to release contaminants in response to changes in environment conditions. The aim was established 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 set physical, chemical and physiological parameters in order to maximize the shell metal content and set the implementation for bioaccumulation strategies exploiting mussels metal activity and detoxification mechanisms.

The effect of sublethal nickel concentrations on Mytilus galloprovincialis: a multiple biomarker study L.J. Dallas1, T.P. Bean1, A. Turner2, B.F. Lyons3, A.N. Hual4
Plymouth University, Plymouth, United Kingdom
Centre of Environment, Fisheries and Aquaculture Science (Cefas), Weymouth, United Kingdom
Nickel is a known mammalian carcinogen and mutagen, typically found at low concentrations in the environment (<1 µg l-1), but enriched at coastal locations near offshore oil and gas fields. In order to understand the potential for sublethal effects of nickel, sublethal concentrations of nickel were exposed to bivalve Mytilus galloprovincialis, a key biocorindicator organism. Mussels were exposed to sublethal concentrations of nickel (0-3600 µg l-1) for 5 days. In addition to determining tissue-specific nickel accumulation, the biomarkers analysed were DNA strand breakage (comet assay; a biomarker of exposure), induction of micronuclei (a biomarker of effect), histopathology and expression of nickel responsive proteins in the gills, adductor muscle and mantle. Significant genotoxic damage was observed by both the comet assay and micronucleus test, but only at 3600 µg l-1 nickel. Correspondingly, semi-quantitative analysis of histopathology in the gills indicated an increase in structural damage at concentrations ≥ 1800 µg l-1 Ni. Quantitative RT-PCR revealed increased expression of the�iels-thione-synthetase (mXRTS), 3-hydroxy-thiolase (mHOX), Met-275-demethylation (mDTM) and GSH-7-glutathione reductase (mGXR) genes in gill tissue after exposure to 3600 µg l-1 nickel, compared to the controls. The effects of these genes is known to be induced following xenobiotic exposure, especially to metals. The p-glycoprotein (p-gp) gene, which has been implicated in multi-drug resistance (MRX), was markedly overexpressed in nickel-exposed gills with increased expression at 18 µg l-1 Ni. These results suggest that nickel is genotoxic to mussels at 3600 µg l-1 and that this genotoxicity correlates with responses at the molecular (i.e. biomarker of exposure) and tissue (i.e. biomarker of effect) levels. As a result, we recommend that effort is made to accurately quantify nickel concentrations in highly polluted waters near nickel mines (e.g. the New Caledonian lagoon), and that remedative measures may be needed if values exceed 3600 l-1.

Biomarkers responses of the native clam Scrobicularia plana and changes of macrobenthic functional composition in a shallow tidal creek affected by fish aquaculture effluents G.V. Aguirre-Martínez1, C. Silva1, M. Mattioli2, E. Fabbrì1, A.T. del Valls1, M.L. Martín-Díaz1
1University of Cadiz, Cadiz, Spain
2University of Bologna, Ravenna, Italy

The effects of solid organic wastes from a marine fish farm on sediments were tested using biomarkers in native clam (Scrobicularia plana) as biochemical indicators and macrobenthic communities as ecological indicators. The clams and macrobenthic samples were collected in the intertidal sediment in October 2010 from five sites of the Rio San Pedro creek, following a gradient of contamination from the aquaculture effluent to the control site. Phase I and Phase II detoxification enzymatic activities (ethoxyresorufin-O-deethylase (EROD), glutathione-S-transferase (GST)) and oxygen stress parameters (Lipid Peroxidation [LPO] and DNA strand breaks) were measured in clams’ digestive gland tissues. Numbers of species, abundance, richness and Shannon diversity indexes were the biodiversity indicators measured in macrofauna. In parallel, redox potential, pH and organic matter in sediment, and dissolved oxygen in the water column was measured in situ. Significant (p < 0.05) increases of EROD, GST enzymes, and dissolved oxygen were observed in the areas close to the aquaculture effluent. Biomarkers (DNA, LPO and GPX) were significantly (p < 0.01) negative correlated with pH, redox potential and dissolved oxygen and positively correlated with organic matter. On the contrary, macrobenthic biodiversity was significantly (p < 0.01) positively correlated with dissolved oxygen and negatively correlated with organic matter. It has been demonstrated that effluents from aquaculture activities in Rio San Pedro creek may induce oxidative stress in soft-sediment species which may lead to alteration of the biodiversity and health status of the exposed organisms.

Mechanisms of acute toxicity of metals in estuarine and marine invertebrates A. Terrón1, A. Tardulli2
Universidade Federal do Rio Grande, Rio grande, rs, Brazil

In freshwater invertebrates, acute metal toxicity is generally associated with the disruption of ionic and osmotic regulations. In contrast, the mechanisms involved in acute metal toxicity to molluscs and marine invertebrates have been less well characterized. In this study the most recent information generated by our research group on the possible mechanisms involved in the acute toxicity of metals in these animals was reviewed. Data on the acute effects of metals (copper, silver, zinc, and nickel) on biological and biochemical biomarkers in estuarine and marine invertebrates (foraminifiers, sea urchins, sea anemones, sea cucumbers, copepods, isopods, shrimps, crabs, and intermodal worms) were reviewed. Biomarkers associated with toxic and osmotic regulation of body fluids (ion and osmotic activity and concentration of associated enzymes), respiration (oxygen consumption), cellular oxidative status (enzymatic and non-enzymatic agents from antioxidant defense system), and energy metabolism (activity of enzymes from glycolysis and Kreb’s cycle). As observed in freshwater invertebrates, data available for the different groups of estuarine and marine invertebrates indicated that ions, acid-base balance and osmotic regulation of estuarine and marine invertebrates are affected by the presence of metal ions in very diluted salt water. However, no alterations have been observed when these animals are exposed to metals in marine waters, suggesting that another mechanism might be involved in the acute toxicity of dissolved metals other than the imbalance of ionic and osmotic regulations, except for nickel. In this case, oxidative stress, as well as respiratory and energy metabolism impairments should be considered as potential mechanisms of acute metal toxicity in estuarine and marine invertebrates.
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 umbilicalis

A.S. Cabecinhas1,2, A. E. Adenekan2, D.E. Rodrigues3, 1, J.M. Dupont, 2, D.S. Swaiesmith, 2, A. S. Cabecinhas1,2, 1, A. M. V. M. Soares, 1, J. M. J. T. Pestana1, 1, 1, M. E. L. Lemos2, 2

1, Instituto Politécnico de Leiria, Peniche, Portugal
2, University of Aveiro & CESAM, Aveiro, Portugal
3, ExxonMobil Upstream Research Company, Houston, United States of America

Mercury is a very common contaminant in the environment, having natural sources, such as volcanism, and anthropogenic origins, such as mine tailings or industrial effluents. Exposure to some environmental contaminants, even for short periods of time, may cause serious damage to exposed individuals. Thus, to evaluate the possible effects of mercury in the sea snail Gibbula umbilicalis, acute and chronic assays were performed by exposing the animals to increasing doses of the contaminant for 96 and 168 hours. Mortality, feeding rates (indirect measure by post-feeding exposure egestion) and avoidance behaviour were assessed. In the end of the experiments, animals were sacrificed and cholinesterases’ activity and energy reserves were measured. Although evaluated at individual level, the effects observed here might be translated to the population and community level, since feeding impairment and change in energy allocation may have effects on the organisms’ fitness, growth, reproductive performance. Moreover, modification in cholinesterases’ activity and its common link to behavioural shifts might lead to significant implications in population dynamics. Results have shown that most of the parameters evaluated tend to be impaired by this compound commonly, showing the deleterious effects that this compound may have at the population level and on marine life.

TU 388

Investigation on differential sensitivity of marine mullusk to various doses of detergent

T. Kuznetsova1, V.V. Trusevich1, S.V. Khodolkevich1, M. Kirin2
1, Russian Federation
2, Saint-Petersburg Scientific Research Center for Ecological Safety RAS, Sevastopol, Ukraine

The study was partly supported by RFBR grant N 08-04-92424-BONUS_a. Toxic substances in the environment. Currently, the method using the dinoflagellates is pilot tested in the marine laboratory. The first results on reference compounds and toxicants are promising. Experiments on food web under impact of synthetic detergents indicate that the use of this method is promising for assessment of detergent contaminations in various marine environments.

TU 389

Biomonitoring trace metals in Mytilus galloprovincialis off the west coast of the Cape Peninsula, Cape Town

C. Sparks1, J. Odendaal2, R.G. Smyrn2
1, Cape Peninsula University of Technology, Cape town, South Africa
2, Cape Peninsula University of Technology, Cape Town, South Africa

The concentration of trace metals (Fe, Mn, Cu, Zn, Cd and Pb) in the mussel (Mytilus galloprovincialis Lamm) Continuous recordings of the heart rate and valve movements in the mussels were carried out in the laboratory under nearly natural conditions with running ambient seawater and addition of detergent. Previously, there had been a tendency to use 1,7 mg/l detergent as the threshold for mussels to change their filtration behaviour. Our results have indicated that concentration of 0.5mg/l is the detection threshold limit of SDS in mussels, which could affect on heart rate and behaviour (valve gape). In high concentrations detergent caused acute toxic action, which lead to rapid valve closure, isolation and subsequent bradycardia. Results have proved that implementation of behavioral and physiological biomarkers simultaneously could be effective tool to early detection stress exposed environments in marine organisms.

The study was partly supported by REBR grant N 08-04-92424-BONUS_a.

TU 390

PAM chlorophyll a fluorometry, field and laboratory research for corals and seagrass along the coast of Qatar

1, ExxonMobil Research Qatar, Doha, Qatar
2, ExxonMobil Upstream Research Company, Houston, United States of America
3, Grontmij (Aquasense), Amsterdam, Nederland
4, MicroLAD BV, Waalwijk, Nederland
5, Conshelf1, La Rochelle, France
6, CREOCEAN, La Rochelle, France

A two year-long field program was conducted to evaluate the effectiveness of PAM (Pulse Amplitude Modulation) chlorophyll a fluorometry in monitoring the health of coral reefs and seagrass along the coast of Qatar. The technique was calibrated and validated as a means of assessing sub-lethal stress for coral in the region. The reduced photosynthetic performance, or coral bleaching, is characterized by decreased chlorophyll fluorescence, a decrease in excitation energy absorbed per unit of chlorophyll, and cessation of photosynthesis. However, for corals, there is a problem of the species composition, which could affect the detection of stress. PAM measurements were performed on the Acropora sp. colonies prior to and after collection. “Mother” colonies were tagged and photographed to document their recovery. PAM measurements were continued in the laboratory in order to monitor the recovery of the nubbins after collection and transfer. Protocols for future coral experiments are being tested and adapted. Laboratory experimentation is also underway on seagrasses to better understand the driving factors that influence sustained photosynthetic performance for this important ecological resource.

TU 391

Toxicity tests using bioluminescent Phyttoplankton

S.A.E. Kools1, E.B. Burger2, J. Appels3, J. Van den Dries1, B. Bjonrad1
1, Gronnimji (Aquasense), Amsterdam, Nederland
2, MicroLAD BV, Waalwijk, Nederland
3, ASSENSIV, United States of America

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 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 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 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 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.

TU 392

Development and validation of a colorimetric methodology to assess macroalgal chronic toxicity - a case study with Ulva lactuca

D.E. Gomes1, D. Rodrigues2, L. Fonseca3, A.S. Cabecinhas4, J.L.T. Pestana1, M.E.L. Lemos5, 1, 5
1, Politecnico de Leiria, Peniche, Portugal
2, Instituto Politécnico de Leiria, Peniche, Portugal
3, Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
4, ESTM and GIRM, Polytechnic Institute of Leiria, Peniche, Portugal

Xenobiotics are increasingly present in everyday life and are easily integrated into marine ecosystems. In aquatic systems macroalgae are continuously exposed to
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 estuarine, are very important in the aquatic system due to several aspects: easy to find and to identify, vast biomass and great bioindicators, making them potential sentinel 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 macroalgae Ulva lactuca was used as a model species. When exposed to xenobiotics, can show signs of decay by losing their colour and their texture and therefore can be assessed by visual inspection. To be sure the algae are in decay and correctly quantify it, a new method was developed by measuring the colour 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 effective measure of xenobiotic toxicity and a prospective tool for environmental risk assessment.

TU 393

Analytical and environmental distribution of organic micropollutants in urban protected salt marsh areas
M.G. Pintado-Herrera, E. Gonzalez-Mazo, P.A. Lara-Martín
University of Cadiz (Spain), Puerto real (cádiz), Spain
Coastal areas are most of the time the main target of xenobiotics and natural toxins 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 perspectives. Our first objective in this work was to develop a fast, easy and low-cost consumption multiresidue method for the simultaneous identification and quantification of a wide variety of classic and emerging pollutants that often impact coastal marine systems. Stir bar sorptive extraction (SBSE) and liquid desorption (LD) were coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) used for determining polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphate 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 extract the analytes. This extract was analyzed by GC-MS/MS, so sub-pb levels could be detected. Several parameters were optimized: extraction and desorption time, ionic strength, presence of organic modifiers, pH and MSMS transitions. The second objective was applying this method to characterize the presence and distribution of micropollutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cádiz 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

Mixture toxicity of anthropogenic and natural compounds to marine micro-algae
S. Bjollema1, G. Martinez1, M. Velthuis2, P.D. Gonzalez Gonzalez2, B. Ordoñez Gomez1, H.G. van der Geest1, B. Poel3, A.D. Vethaak2, W. Admir2
1University of Amsterdam, Amsterdam, Nederland
2Deltares, Coastal and Marine Systems, Delft, Nederland
3University of Cape Town, Cape Town, South Africa
Primary production by micro-algae embodies the capacity for the marine ecosystem and is primarily linked to nutrient availability and light. However, recent studies indicate that certain industrial chemicals may have a direct impact on the productivity and resilience of marine ecosystems. At the same time the frequency and intensity of toxic episodes in the coastal zone are increasing, resulting in reduced levels of natural toxics expecting to affect coastal ecosystems. These different chemical stressors are hypothesized to disturb regulatory mechanisms within algal communities, modifying the competitive abilities of individual species and resulting in shifts from highly nutritious to unfavourable algal species that destabilize the food chain. However, insight in the potential antagonistic or synergistic effects of these toxicants and toxins is lacking, which may mask or enhance the toxic effects. Therefore this study aims to provide information on the combined toxicity of both type of compounds to a range of marine micro-algae. Three algal species (Dunaliella tertiolecta, Phaeodactylum tricornutum and Thalassiosira pseudonana) were exposed to two anthropogenic compounds [Irgarol and Tributyltin] and two natural toxics (Decadinal and microcystin). For D. tertiolecta binary equitoxic mixtures of the anthropogenic compounds and the natural toxin Decadinal were tested according to the Toxic Unit (TU) concept. Reduction in effective photosystem II (PSII) efficiency was determined by Pulse Amplitude Modulation (PAM) fluorometry after 4.5 hours as a measure for toxicity. A difference in species sensitivity was observed with T. pseudonana being the most sensitive species. Irgarol is the most toxic compound for all studied species and the natural toxin Microcystin is the least toxic. Both natural toxics are clearly less toxic to the tested algae than the anthropogenic compounds. A small additive effect was observed for Decadinal and TBT, while a large more than additive mixture effect was found for Decadinal and Irgarol. 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 all studied species and the combined toxic effect of the different toxics was less predictable than the combination of one anthropogenic compound and one natural organic compound.

TU 396

The use of protozoa in ecotoxicology: from biological model to environmental biomonitoring application
1A. Gomiero1, S. Storzini1, A. Dagnino1, C. Nacci2, A. Viarengo2
1University of Eastern Piedmont, A. Avogadro, Alessandria, Italy
2University of Piemonte Orientale, Alessandria, Italy
3Thetis s.p.a., Venice, Italy
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 seawater and sediments on benthic organisms as well as toxicity mechanisms to biological effects. Due to their nature as a eukaryotic cell/organism and their position in the food web, ciliates protozoa are 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 stability and endocytosis rate of the marine 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-organic additive and/or antagonist effects. Moreover, medium salinity was also varied to mimic estuarine-like environmental conditions, each time by a different rate of toxic response to toxicants studies. Due to the short time and simplicity of the test procedures, the use of protozoa such as E. crassus is a promising and convenient biomonitoring tool. It is evident that the cell mortality, replication rate, lysosomal membrane stability and endocytosis rate of E. crassus were highly correlated with each other, being the most sensitive species. Irgarol is the most toxic compound for all tested species and the natural toxin Microcystin is the least toxic. Both natural toxics are clearly less toxic to the tested algae than the anthropogenic compounds. A small additive effect was observed for Decadinal and TBT, while a large more than additive mixture effect was found for Decadinal and Irgarol. 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 all studied species and the combined toxic effect of the different toxics was less predictable than the combination of one anthropogenic compound and one natural organic compound.

TU 397

Can foraminifera be reliably used as environmental indicators?
B . Ordoñez Gómez1, D. Admiraal2, S. Sforzini3, W . Admiraal1
1Cape Peninsula University of Technology, Cape town, South Africa
2Cape Peninsula University of Technology, Cape town, South Africa
3Deltares, Coastal and Marine Systems, Delft, Nederland
Foraminifera are very important in the aquatic system due to several aspects: easy to find and to identify, vast biomass and great bioindicators, making them potential sentinels of to monitor xenobiotics in aquatic environments. Moreover, it is known that macroalgae, especially estuarine, are very important in the aquatic system due to several aspects: easy to find and to identify, vast biomass and great bioindicators. 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. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple perspectives. Our first objective in this work was to develop a fast, easy and low-cost consumption multiresidue method for the simultaneous identification and quantification of a wide variety of classic and emerging pollutants that often impact coastal marine systems. Stir bar sorptive extraction (SBSE) and liquid desorption (LD) were coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) used for determining polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphate 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 extract the analytes. This extract was analyzed by GC-MS/MS, so sub-pb levels could be detected. Several parameters were optimized: extraction and desorption time, ionic strength, presence of organic modifiers, pH and MSMS transitions. The second objective was applying this method to characterize the presence and distribution of micropollutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cádiz 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.

Toxicity experiments are usually 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
insensitiveness of proteostasis II efficiency to these two metals requires determination of growth inhibition in order to prevent underestimation of metal(mixture) toxicity. The 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.

TU 398

Toxicological effects of three polybrominated diphenyl ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana

L. Mhadhbi, 1, 2, 3, 4, R. Beiras, 2, 3, 4, J. Fumega, 2, 3, 4, I. Domingues, 1, 3, 4, A. M. V. M. Soares, 1, 3, 4, M. G. Alves, 2, 3, 4, P. F. Oliveira, 2, 3, 4, J. Gadelha, 2, 3, 4, C. Lopes, 2, 3, 4, M. A. V. M. Soares, 1, 2, 3, 4, M. G. Alves, 2, 3, 4, P. F. Oliveira, 2, 3, 4, J. Gadelha, 2, 3, 4

1 Instituto de Estudos de Oceanografia, Centro Oceanográfico de Vigo, Vigo, Spain
2 Departamento de Biologia & CIESAM, University of Aveiro, Aveiro, Portugal
3 CICS - UBI - Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal
4 University of Aveiro & CIESAM, Aveiro, Portugal

Polybrominated diphenyl ethers (PBDEs) are highly persistent anthropogenic contaminants found in trace amounts in many environmental compartments far from their source areas, posing a risk to aquatic ecosystems. Our objective was to determine the relative toxicities of three BDE congeners such as BDE-47, 99 and 154 on marine phytoplankton alga Isochrysis galbana. For a highly sensitive endpoint: a 72h-inhibition of autotrophic growth rate was calculated according to standards methods. No observable effect concentration (NOEC) values were 2.53, 3.48 and 12.5 µg L-1 for BDE-47, 99 and 154, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1 for BDE-47, 99 and 154, respectively. The calculated IC10 (the concentration inhibiting growth rate by 10%) corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively. The 50% inhibitions of growth rate (IC50) values were: 25.7 µg L-1 BDE-47, 30.0 µg L-1 BDE-99 and 243.7 µg L-1 BDE-154. Significant (p < 0.05) adverse effects were observed for all compounds at concentrations >15 µg L-1. Our results indicated that under laboratory conditions PBDEs were acutely toxic to seawater algae at concentrations near 10 µg L-1. However, further work is required to investigate long-term effects in these and other aquatic organisms.

TU 400

Tissue accumulation of fluoranthene and its metabolites in the shore crab Carcinus maenas in relation to oxidative stress

P. Fanchot, J. Letendre, X. Denier, F. Bultelle, B. Rocher, F. Leboulenger, F. Durand

University of Le Havre, Le havre, France

Concern around contamination of the aquatic environment by polycyclic aromatic hydrocarbons (PAHs) is high due to their toxic, carcinogenic, mutagenic and/or teratogenic effects. Fluoranthene (FLU) is a priority PAH that is commonly detected in sediments, water and biota of European estuaries. It is persistent and an important lipophilic contaminant with bioaccumulation potential. The aim of the present study was to evaluate the oxidative stress responses induced by FLU in terms of protein ubiquitination and effects of FLU on marine organisms is thus an issue of utmost relevance. Carcinus maenas is a natural inhabitant of European coasts and estuaries. It is a suitable species that is widely used to assess exposure to contaminants, including PAHs. This work investigated the accumulation of FLU and its metabolites in the tissues of C. maenas following a 7-day laboratory exposure. Effects of FLU on oxidative stress biomarkers were also investigated. Crabs were collected from a low impacted estuary. In the lab they were acclimated (7d) in filtered seawater (15 psu; 16ºC) and exposed individually (9 per type metabolites (FF) was also found. GST activity and TG levels were significantly increased in crabs exposed to concentrations ≥12 µg/l, compared to controls. GR activity was not altered. BDE-47, 99 and 154, respectively. The calculated IC10 (the concentration inhibiting growth rate by 10%) corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1. However, further work is required to investigate long-term effects in these and other aquatic organisms.

TU 401

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

P. Fanchot, J. Letendre, X. Denier, F. Bultelle, B. Rocher, F. Leboulenger, F. Durand

University of Le Havre, Le havre, France

The shore crab Carcinus maenas (L.) represents one of 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 reflects a remarkable ability to cope with different stresses, due to their very high plasticity and tolerance to stresses which can be impacted by the life history of crabs in terms of exposure to pollutants notably. In addition to the contamination stress, a polluted environment can act as a contaminant stressor, a novel insight is indeed likely to generate a too high degree of stress that would overwhelm resistance capacities of populations. To our knowledge, there is no information on how chronic exposure to pollutants affects the resistance capacities of Carcinus maenas to stress, we imposed a 4-days air exposure to pollutants sampled in a polluted area, Le Havre harbour, and in a clean area, Yport rocky shore (France) and analysed stress markers as well as proteome variations in gills. For each site, antioxidant activities (catalase, superoxide dismutase, glutathione reductase, glutathione S-transferase, catalase-CAT and lipid peroxidation-LPO), and FLU- and BDE-type metabolites as measured by fixed-wavelength fluorescence (FF). The remaining whole soft tissues were used for chemical analysis of FLU by GC-MS. The results indicate a strong positive linear relationship (ß = 0.17, R² = 0.87) between accumulation of FLU (measured by GC-MS, b = 5.21, P < 0.001, R2 = 0.993) in the soft tissues and FLU-type metabolites (measured by FF, ß = 0.17, R² = 0.87). A strong positive linear relationship (ß = 1.15, P = 0.003, R2 = 0.911) between accumulation of FLU (GC-MS) and FLU-type metabolites (FF) was also found. GST activity and TG levels were significantly increased in crabs exposed to concentrations ≥12 µg/l, compared to controls. GR activity was not altered. BDE-47, 99 and 154, respectively. The calculated IC10 (the concentration inhibiting growth rate by 10%) corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively. The IC10 values corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1. However, further work is required to investigate long-term effects in these and other aquatic organisms.

TU 402

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

R. Jordão, 1, I. Lopes, 2, M.G. Alves, 1, I. Domingues, 1, J. Gadella, 3, P.F. Oliveira, 1, A.M.V.M. Soares, 2, M. Morgado 3

1 Universidade de Aveiro, Aveiro, Portugal
2 Departamento de Biologia & CIESAM, University of Aveiro, Aveiro, Portugal
3 CICS - UBI - Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal

University of Aveiro & CIESAM, Aveiro, Portugal

Mercury (Hg) is one of the most toxic metals to biota, being capable of biomagnification and bioaccumulation in food chains. High concentrations of Hg were associated with developmental and behavioral abnormalities, impairment in growth and reproduction, and reduced survival. Though this metal has been extensively studied, several knowledge gaps still exist, mainly regarding its effects in different types of organisms. Accordingly, this study aimed at assessing the effects of a short-term exposure to Hg in four natural populations of the sea anemone Actinia equina. Attempts were made to compare the variability of the pattern, two spots exhibited significantly different ubiquitination levels between conditions (Mann-Whitney U test, n=3, p<0.05).

Carcinus maenas L. in order to compare the physiological and cellular responses to stress between the two models.

1, I. Lopes, 2, M.G. Alves, 1, I. Domingues, 1, J. Gadella, 3, P.F. Oliveira, 1, A.M.V.M. Soares, 2, M. Morgado 3

1 Universidade de Aveiro, Aveiro, Portugal
2 Departamento de Biologia & CIESAM, University of Aveiro, Aveiro, Portugal
3 CICS - UBI - Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal

University of Aveiro & CIESAM, Aveiro, Portugal

Carcinus maenas L. in order to compare the physiological and cellular responses to stress between the two models.
A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cyathura carinata
M. Martinez-Haro, M. Moreira-Santos, R. Ribeiro
IMAR, Coimbra, Portugal

In situ assays based on feeding depression have been proposed as sublethal assays which allow to assess direct and immediate 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 assay settings 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 Cyathura carinata, a secondary 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 assessments.

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.

TU 404 Toxicity of the biotransformation products of four methylated PBDEs and one PAH produced by Nereis diversicolor and Nereis virens
A.G. Hansen1, R. Fernandez-Varela1, L. Malmquist1, J.H. Christensen1
1Consilient Univer sitet, Roskilde, c. Denmark
2Roskilde University, Roskilde, Denmark

Assessments of biological impacts from contaminated sediments are generally made on the basis of contaminants that have accumulated in the test species and that are then used for evaluation. Recently, the potential of in situ tests for assessing the effects at a population level of chemical contaminants has been emphasized. In situ toxicological assessments of contaminants in sediments are not limited to the lethal effects but may assess the effects of substances that are not harmful on an individual level but may cause sublethal effects at a population level. Such effects can be measured through feeding depression tests. In this context, a feeding depression test using the isopod Cyathura carinata and the polychaete Nereis diversicolor is presented as a tool for an early indication of contaminants in estuarine sediments. The test was developed in order to be used in natural environments. Therefore, the presented test material conditions with (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 assay settings 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 Cyathura carinata, a secondary 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 assessments.

TU 405 Vitellogenin gene expressions in three different species of catfish from Termos Lagoon
O. Zapata-Perez, A. Meléndez-Zempoalceca, J. Rubio-Piña, A. García-Fuentes
CINVESTAV-IPN, Merida, Mexico

In situ Toxicity of the biotransformation products of four methylated PAHs and one PAH produced by Nereis diversicolor and Nereis virens
A.G. Hansen1, R. Fernandez-Varela1, L. Malmquist1, J.H. Christensen1
1Consilient Univer sitet, Roskilde, c. Denmark
2Roskilde University, Roskilde, Denmark

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 melanosus) 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 parts of the transcripts from Ariopsis felis, Bagre marinus and Cathorops melanosus liver tissue. Gene expressions of Vitellogenin and Zona Radiata genes were amplified using the Reverse Transcriptase-Polymerase Chain Reaction (RT-PCR) and results showed statistical differences between the Vitellogenin and Zona Radiata values for fish collected at Laguna de Terminos. Data from this experiment show that Vitellogenin gene expressions were more sensitive than the ZR, under normal conditions in the environment. Future studies will be focused on understanding the reproductive cycle and the genetic variability of these fish. The Portman area (Cartagena, SE Spain) is one of the areas most heavily polluted by metals in the western Mediterranean Sea and highly impacted by emissions from oil- and gas-related chemical activities in the area. An integrated assessment was conducted to assess the health status of the red mullet (Mullus barbatulus) from three priority pollutant areas of the Spanish Mediterranean coast, including Portman. A suite of general physiological indicators (lipid content in muscle tissue, condition factor, hepatic biomarker responses (ethoxyresorufin-O-deethylase (EROD) activity, metallothionein concentration and DNA damage) were determined. In addition, fish muscle tissue and sediment samples were taken and analysed for concentrations of arsenic, trace metals, Polychlorinated Biphenyls (PCBs), chlorinated pesticides (dichloro-diphenyl-trichloroethane (DDTs), α-, hexachlorocyclohexane, lindane, hexachlorobenzene, cyclodiene insecticides and trans-nonachlor) and polycyclic aromatic hydrocarbons (PAHs). Our results showed that fish from Portman accumulated the highest concentrations of mercury, lead and arsenic and also of some of the organochlorine compounds and metals. In addition, they had significantly lower lipid condition factor and gonadosomatic index, as well as the highest the highest levels of EROD activity and DNA damage of the areas investigated. Contaminant body burden in red mullet only partly corresponded to chemical characteristics of the sediments in the areas in which they were collected. Despite current concentrations of contaminants in sediment and fish from the three priority pollution areas of the Spanish Mediterranean shelf investigated herein are at levels that do not give rise to severe health effects in red mullet, our findings indicate that fish from Portman exhibited a substantial health status that warrants further study. This integrative assessment strategies, including chemical, (eco)toxological parameters used in this study can contribute to understanding the environmental impacts of contaminants in the Portman area.
Characterization of selected Metals in United Arab Emirates coastal fish and locally produced foods


CRI Acq, Portici (na), Italy

ENEA, Portici, Naples, Italy

LPTC UMR CNRS EPOC, Talence, France

University of Le Havre, Le Havre Cedex, France

Le havre cedex, France

CIFRE Piston, Pisa, Italy

TU 411 Sediment-exposure contact of medaka eggs to a PAH model: combined chemical, toxicological and proteomic approaches


University of Le Havre, Le Havre cedex, France

LPP, Talence, France

Proteomic platform of IFRMP 23, Rouen, France

INSERM U928, Rouen, France

Estuarine ecosystems represent nursery areas for many fish species. They are nevertheless submitted to a high anthropic pressure, which is manifested by pollution. Among the most important pollutants are polycyclic aromatic hydrocarbons. These molecular changes may potentially reduce reproductive success of males and lead to a decline in natural fish populations. Effects of hypoxia on spermatogenesis and steroidogenesis of marine medaka (Oryzias melastigma) testis: an in vitro study

Y.T. Lau, A.C.K. Tse, R. Wu

The University of Hong Kong, Hong Kong, Hong Kong

TU 412 Long-term incubation of adult Nereis virens (Annelida: Polychaeta) in copper-spiked sediment: the effects on adult mortality, gametogenesis, spawning and embryo development

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 parenteral exposure investigations as gametogenesis and spawning of a population 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 by spiking sediment to 0.001 and 1000 mg kg-1 dry sediment concentrations. Activity, oocyte size and sperm motility were present in sediments experienced by macrofaunal polychaetes. Subsequent adult mortality and the numbers and timing of spawning events were quantified as well as the effects on oocyte development. Finally, sperm and oocytes were extracted from the adults and using in vitro fertilizations we assessed the developmental success. BCR 3-step standard sequential extraction of polluted sediments confirmed that much more labile copper (in actual and percentage terms) was present as spiked concentrations increased, although the residual fraction had similar and this is comparable to those levels found in the tissues of the exposed animals. Adult mortality was not dependent on the exposure time, but higher concentrations induced greater mortality for both sexes. Oocytes were significantly longer at higher concentrations although pairwise comparisons did not show a significant effect on the number of oocytes per female. No effect on the number of embryos developing normally was observed in vitro fertilizations of oocytes fertilized with sperm from exposed males and not exposed males showed that sperm were more susceptible, but oocytes were also affected at the highest exposure. Concentrations of adult copper may have significant implications for adult survival, embryo development and larval recruitment and subsequent colonization of polluted sediments.

TU 413 Oxidative stress, genotoxicity and histopathology biomarker responses in sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia)

W.B. Ben Ameur, J.J. de Lapuente, M.R. Driss, M.B. Borràs

Facultad de Sciences, Bizerte, Zarzouna, Tunisia

Unité d'Experimental Toxicology and Ecotoxicology, Parc Scientifique de Bizerte, Bizerte, Tunisie, Tunisa, Spain

TU 414 Effects of hypoxia on spermatogenesis and steroidogenesis of marine medaka (Oryzias melastigma) testis: an in vitro study

Y.T. Lau, A.C.K. Tse, R. Wu

The University of Hong Kong, Hong Kong, Hong Kong

Aquatic hypoxia (dissolved oxygen levels less than 2.5 mg O2/L) has become a major concern and more than 200 "Dead Zones" have been identified by the United Nations Environment Program worldwide. Hypoxia has been shown to be an endocrine disruptor, and impairs developmental and reproductive functions in fish. However, the detailed mechanisms of reproductive impairment have not been studied. Using primary cell culture of marine medaka (Oryzias melastigma) testis as an in vitro model, experiments were conducted to decipher the effects of acute hypoxia (3% of atmospheric oxygen) on spermatogenesis and steroidogenesis. Hypoxia significantly increased cell death at 24h as measured by Tryptan 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 testicular cell differentiation (spermatocytes and spermatogonia) at 48h (p<0.05, n=4), and this was associated with significant down-regulation of expression of steroidogenic gene CYP11A (p<0.05), 3B-HSD (p<0.05) and stAR (p<0.001). The number of dead sperm in the higher concentration of 2% hypoxia treatment at 24 and 48h as analyzed by flow cytometry after labeling with Annexin V and PI. Furthermore, there were no changes in expression of the pro-apoptotic gene BAX and the anti-apoptotic gene BCL2 at these time points. Our results suggest that spermatogenesis and steroidogenesis in fish can be impaired under acute hypoxic conditions, and that developmental and reproductive functions may be impaired in some of the above-mentioned sperm and oocytes observed following hypoxia exposure. These molecular changes may potentially reduce reproductive success of males and lead to a decline in natural fish populations.

TU 415 Toxic effects of ZnO nanoparticles towards marine algae Dunaliella tertiolecta

S. Manzo1, M.L. Miglietta2, G. Rametta3, S. Buono3, G. Di Francia1

1ENEA, Portici, Naples, Italy

2CIFRE Piston, Pisa, Italy

3CRAAcq, Pisa, Italy

Dose response curve and population growth rate alterations deriving from the exposure to ZnO nanoparticles of the marine alga D. tertiolecta were evaluated. Bulk ZnO and the dissolved ions were also investigated for comparison of aggregation state and particle size. The population was monitored during the experimental testing time. The results show that nZnO is more toxic (EC50: 2.42 (0.97-5.36) mg L-1) than the bulk counterpart (EC50: 4.45 (3.45-5.98) mg L-1). Cross-referencing the toxicity parameters calculated for ionic zinc (EC50: 0.65 (0.36-0.70) mg L-1, NOEC: 0.01 mg L-1) and the dissolution properties of the ZnO it can be gather that the higher toxicity of nZnO cannot be ascribed exclusively to free zinc ions. Nonetheless growth rates of D. tertiolecta were not significantly affected by nZnO exposure. Our findings suggest that the pristine size of the dispersed particles affect the bioavailability and the overall toxicity

TU 416 PBDE accumulations in muscle of Whitmore Croaker (Micropogonias furnieri) exposed to BDE 99 and BDE 153

C. Pieroni1, J. Levine2, F. Gilberto

1S. Manzo, L. Miglietta, G. Rametta, S. Buono, G. Di Francia

1ENEA, Portici, Naples, Italy

CRA Acq, Pisa, Italy

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

367
The environmental presence of polychlorinated diphenyl ethers (PBDEs), among which BDE-47 is the most abundant, make toxicity data necessary to assess the hazard risk posed to biota. In this study, BDE-47 and Mytilus edulis Baligh were exposed to sedimentary phase, the mussels were allowed to depurate in clean sea water for 10 days. Samples were collected at time 2, 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 (GP) and acetylcholinesterase (AcChE) activities. GST and GP were inhibited after 20 and 30 days exposure, while AcChE 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.

TU 417

Differential gene transcription in Pocellia vivipara exposed to copper E.C. Ferreira1, E. Zacchi1, G. Toledo-Silva1, J. Mattos1, A. Machado1, T.S. Dorrington2, A. Bianchini1, A.C.D. Bain1

1Universidade Federal de Santa Catarina - UFSC, Florianópolis, Brazil
2University of Vigo, Vigo, Spain

Copper is a common environmental contaminant; it has been used in many industrial applications and is naturally occurring in the earth crust. Copper can enter the aquatic environment via atmospheric deposition, agricultural and industrial activities, as well as via effluent discharges from wastewater treatment plants. Copper is accumulated mainly in the liver and gills and excreted via bile and kidneys. The aim of this study was to identify genes differentially expressed in liver of Pocellia vivipara ( exposed to waterborne copper (20 μg Cu/L) for 24 h, employing the subtractive suppressive hybridization (SSH) method. Results showed that 65 genes fragments were differentially expressed, 37 up and 28 down-regulated. The up-regulated genes were bile salt export, Complement Component 3c, CYP450, enolase, Apolipoprotein B, C1 and E, microsomal glutathione-S-transferase, NAD dehydrogenase, ubiquitin a-2, plasminogen and novel protein. The down-regulated genes were Apolipoprotein A1, Coagulation factor 2, HSP70, Liver-type fatty acid Binding Protein, serine--pyruvate mitochondrial-like. The identified genes are associated with different biological functions like biotransformation, protein, lipids and energetic metabolism, indicating the susceptibility and/or molecular responses of this organism to the toxic effects elicited following the trace metal exposure.

TU 418

Spatial distribution and accumulation patterns of cyclic methyl siloxanes (cVMS) in fish from Northern Norway L. P. Araujo1, L. Vidal-Liñán1, J.B. Bellas1, J.F. Fumega2, R.B. Beiras3

1Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, Vigo, Spain
2University of Vigo, Vigo, Spain
3Universidade Federal do Rio Grande, Rio Grande, Brazil

Cyclic volatile methyl siloxanes (cVMS) have come under environmental scrutiny in recent years in regards to their potential persistence and bioaccumulative nature. As polymeric ingredients in the synthesis of silicone products, cVMS are categorized 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 physiologically favourable (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 Tromso (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 octamethylcyclotetrasiloxane (D4) and decamethylcyclopentasiloxane (D5) were observed in fish collected at site A (D4: 60 ngg/ lw; D5: 1300 ngg/lw) compared to site B (D4: 10 ngg/lw; D5: 139 ngg/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, median concentrations 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.

TU 420

Organochlorine pollutants in oceanic migratory birds: influence of body condition in PCBs and DDTs concentrations among different tissues L. L. da Silva1, E. Zacchi1, G. Toledo-Silva1, J. Mattos1, A. Machado1, T.S. Dorrington2, A. Bianchini1, A.C.D. Bain1

1Universidade Federal do Rio Grande, Rio Grande, Brazil
2University of Vigo, Vigo, Spain

Organochlorine pollutants in oceanic migratory birds of considerable conservational interest. Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCPs) and mercury are ubiquitous contaminants in the aquatic environment of one hundred and eleven species of Procellariiformes collected during their migration period in southern Brazil, one of the most important stopover points for these species. The influence of body condition for the area through the 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 (BC) had higher DDE and DDT concentrations in the liver than those with poor BC. This study investigated the effects of five metals on behaviour and survival of an Antarctic amphipod, Orchestia glomerata, over 30 days exposures. Multiple observations were made assessing mortality rate response of this species to metal exposure. As expected, a temporal probability of mortality was observed independently, a new statistical model that combines bioassay model with a survival time model was developed. Interval-censored survival times were modelled using a generalised additive model (GAM) with multiplicative effects for concentration level used to incorporate the bioassay component. The time period by concentration level interaction was included as a random effect term with this mixed model version of the GAM allowing model adequacy to be investigated. The advantages of this approach are that (i) it smoothes through noisy temporal mortality data "gaining strength" by estimation of the trend across multiple observation periods exploiting all data simultaneously, (ii) the simple multiplicative model, if adequate, does not allow cross-overs of time trends across concentrations that make interpretation difficult, and (iii) it allows the uncertainty in estimates of lethal concentrations to be more accurately assessed. Response times vary between metals with amphipods exposed to copper producing behavioural changes and mortality at a faster rate than exposure to cadmium, lead or nickel. Nickel did not affect the behaviour or survival of the amphipod during the 30 days exposure despite using concentrations >1mg/L. Results from comparisons of both approaches indicate that standard bioassay methods produce valid results at the lower concentrations even when applied to Antarctic species which are generally long-lived, have longer developmental times, and slower metabolic processes and potentially metal uptake than species from other climatic regions. Recommendations are made for further toxicological assessments for the future development of Water Quality Guidelines to Protect Antarctic marine environments.