

Progress in the ArcRisk project

ArcRisk reached its halfway point in August 2011 and results and scientific publications are appearing in quick succession.

Much of the work under Work Package 2 on modelling the impacts of climate change on pollutant fate and transport has been completed. Modelling studies have looked at the sensitivity of air-sea exchange of semi-volatile organic contaminants in relation to climate parameters. PCB cycling and transport into the Arctic have also been modelled, to estimate PCB accumulation in the Arctic Ocean. Tracers have been employed to study large-scale oceanic circulation pathways to (and within) the Arctic Ocean and this information has been used to estimate the transport of perfluorooctanoic acid (PFOA) to the Arctic. Air transport models have been used to simulate the influence of climate change on the atmospheric transport and deposition of contaminants in the Arctic by the end of this century.

A great deal of model development has also occurred: Sea and terrestrial ice and snow have now been included into global models used to investigate semi-volatile organic contaminant cycling in the Arctic. Melting/freezing processes have been included in an oceanic model to reflect the recent changes in sea-ice distribution and thickness in the Arctic Ocean and the changes in the location and strength of meltwater fluxes. A global model has been further developed to investigate the dynamic mass balance of specific organic contaminants over their use history and to forecast trends in the near future. To begin to link these results of abiotic processes to human exposure to contaminants, modelling has begun of an Arctic marine food web in the Svalbard region, where many samples of biota have been collected for contaminant analysis under Work Package 3.

Under Work Package 3, fieldwork has been conducted to support process studies of contaminant transfer in the Arctic. With the exception of atmospheric deposition studies, most of the planned sampling has now been

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completed. Fieldwork has investigated the accumulation of persistent organic pollutants (POPs) and perfluorinated compounds (PFCs) in winter snowpack near Tromsø, Norway in combination with an air sampling programme. Samples of sea ice and ice-rafted snow have also been collected off northern Norway to study the behaviour of these chemicals in the marine snow/ice system. Bulk atmospheric deposition samplers have been placed along a transect from the Arctic to central Europe to study the deposition of organic contaminants from the atmosphere. Inventories of PCBs in surface seawater of the pan-Arctic shelf seas have also been estimated and work is underway evaluating the PCB contributions of the six major rivers flowing into the Arctic.

To investigate the transfer of contaminants up the food chain, samples of lower trophic level organisms, such as pelagic copepods, have been obtained off Svalbard and samples of marine fish consumed by humans have been taken for contaminant analysis. Samples of other human foodstuffs have also been obtained for contaminant analysis; these include reindeer and samples of a typical 'food basket' from Greenland.

Progress on Work Package 4 on human health is described in more detail in a separate article in this newsletter.



The R/V Lance expedition near Svalbard, summer of 2010

The previous ArcRisk Newsletter described the two work-packages concerned with ArcRisk's 'environmental components': Modelling impacts of climate change on pollutant transport and fate (WP2) and Contaminant transfer in the Arctic - Process Studies (WP3). In this next article we turn our attention to the third of ArcRisk's main research orientated work-packages.

Work Package 4: Effects of contaminants on human health

Work Package 4 work is divided into three parts. The first focuses on investigating the relationships between contaminant exposure and health outcomes. For this work, a database has been created compiling the results of epidemiological studies and other studies published in the scientific literature. Comprehensive literature reviews, based on searches in databases such as Medline, Scopus, Web of Science, together with selective compilation of data from relevant epidemiological studies underpin much of the work. Proposed relationships are then evaluated using meta-analyses and other statistical methods to identify exposure thresholds for adverse health effects in exposed Arctic populations.

A second major undertaking is the construction of a database on human health and contaminants for use in the estimation of the future health risks in

the Arctic. This database compiles results of the human blood monitoring surveys conducted over the past 20 years under the Arctic Monitoring and Assessment Programme (AMAP). Traditional risk characterization, which is based on exposure assessments, is not possible from this information alone; this requires daily (contaminant) intake values which for the most part are not available. A third part of the work therefore comprises population pharmacokinetic modeling to fill this gap in the information needed for risk estimation.

So far, under the ArcRisk project, meta-analyses and/or critical reviews of relevant literature have been conducted to explore the long-term effects of contaminants on maternal and child health, in particular looking into PCB exposure in relation to sex ratio and birth weight, and mercury exposure in relation to child development. These reviews, especially those concerning PCB-sex ratio effects, show that few data have been produced in a comparable manner - not only due to differences in materials and methods, but also due to the fact that researchers often do not present their information in a clear and consistent manner. This is currently preventing classical meta-analysis of these studies. Work under WP4 is therefore continuing to try to gain access to detailed information from additional epidemiological studies.

WP4 is also working with quantitative risk characterization - based on back-calculation of average and life-long average daily doses using population pharmacokinetic models.

Outside of occupational settings, effects of contaminant exposure during pregnancy and breast-feeding are the most important for a person's whole lifetime. During the ArcRisk project, an additional method for the calculation of contaminant-health outcome risk estimates among Arctic populations is being introduced, suitable for comparison with concentrations of contaminants measured in blood samples. The aim is to develop a realistic human health risk-assessment model for environmental pollutants that includes relevant cut-off points in dose-response curves.

A special focus of the ArcRisk work is on investigating foetal exposure to levels of 'emerging hazardous substances' such as perfluorooctane sulfonate (PFOS), in order to estimate future trends in dietary exposure and health risks. This exposure is being investigated using a technique known as 'placental perfusion' in which the placentas of newly delivered babies are placed in a special apparatus to determine how much contaminant will pass through from the mother's to the baby's side of the placenta. This work is being done at UOULU by Ph.D. student Maria Kummur (see student profile).

WP4 Partner Profiles

With eight contributing partners, WP4 is the largest of the ArcRisk work packages in terms of its institutional membership.

University of Oulu, Finland (UOULU): The research group at UOULU is led by Arja Rautio, the lead of WP4. This group is responsible for the development of the



database on contaminants and health outcomes and the preparation of the critical reviews and meta-analyses to explore relationships between contaminant exposure and health. Researchers at UOULU, together with those at MUNI, are working on the development of new types of models for total risk assessment in relation to contaminant exposure; these will ultimately be used in scenarios to evaluate future health risks. UOULU is also contributing the results of the Northern Finland Birth Cohort, which is a study of a group of children born in 1966 and followed over 40 years to determine their development, health, dietary exposure and blood levels of contaminants. In addition, a PhD student Maria Kummu (see student profiles) is studying the transfer of contaminants from mother to foetus via the placenta.

University of Tromsø, Norway (UiT): UiT is contributing the results of a major trend study from Northern Norway – the Tromsø study – in which repeated studies of the same community have been conducted since 1974. Six surveys have occurred during this period to assess the health of participants; frozen blood from samples taken from 50 men during these surveys are being analysed to determine concentrations of a number of contaminants and compare them with their health assessments.

National Institute of Public Health, Norway (NIPH): NIPH is coordinating the evaluation of dietary exposure to contaminants in the project, beginning with a questionnaire concerning the types of dietary information being collected in the various cohort studies in the ArcRisk project to allow an evaluation of the dietary exposure to contaminants. NIPH is also contributing the results of the Norwegian Fish and Game Study, evaluating a group of people with high fish consumption using a detailed food frequency questionnaire and analysis of concentrations of several types of contaminants in their blood.

Institute of Environmental Assessment and Water Branch, Spanish Council for Scientific Research (CSIC): One interesting and important part of the health work is a comparison between North (Arctic) and South (Mediterranean and Southern Europe) in the exposures and health

outcomes studied in these areas. CSIC is contributing the results of a mother-child cohort from two areas in Spain, including food frequency questionnaires and contaminant levels in mother-child pairs.

CSIC is analysing trace pollutants in newborns and schoolchildren from southern European regions for assessment of the deleterious effects of these pollutants. The goal is to compare these results with those from Arctic areas to explore whether the relationships between pollutants and health disturbances or illnesses observed in Mediterranean areas are also found in Arctic regions, with different climate and lifestyle conditions.

Research Centre for Environmental Chemistry and Ecotoxicology, Masarykova University, Czech Republic

(MUNI): Another time trend study is from the Czech Republic, where breast milk samples (Human biomonitoring project, n= 450 annually) from nine regions have been collected since 1994 to estimate the human health risk assessment based on POPs levels in breast milk.

Institute Jozef Stefan, Slovenia (JSI):

Results from a recently completed EU-funded project PHIME studying mother-child cohorts in various parts of the Mediterranean area are being contributed through JSI. These results include data on contaminant levels in breast milk, urine and blood in the mother-child pairs and outcomes on a number of health parameters.

Northwest Public Health Research Center, Russian Ministry of Health and Sciences (SZNC):

Results from mother-child cohorts in four areas of Arctic Russia, covering blood levels of contaminants, detailed food frequency questionnaires, and in utero exposure, are being contributed to the ArcRisk project.

Healthy Environments and Consumer Safety Branch, Health Canada (HC-SC):

This partner will contribute to the evaluation of the various health-related studies in ArcRisk and may also provide results from one or more studies of the health of indigenous communities in northern Canada in relation to contaminant exposure.

Although not a partner in the ArcRisk project, the **AMAP Human Health Assessment Group (HHAG)** has provided an important forum for developing the

health aspects of the project and advising on further work. WP4 has been integrating information from the AMAP human health reports and other published data for a synthesis of the present situation to estimate human health risks under future climate change.

Collaboration with other EU projects

Collaboration with other on-going health-related EU projects (PHIME-Public health impact of long-term, low-level mixed element exposure in susceptible population strata, CLEAR-Climate change, Environmental contaminants and Reproductive health, ENRIECO-Environmental Health Risks in European Birth Cohorts, OBELIX-Obesogenic endocrine disrupting chemicals: Linking prenatal exposure to the development of obesity later in life, CHICOS-Developing a Child Cohort Research Strategy for Europe) has been very important. This collaboration can be seen, for example, in the selection of the case studies in ArcRisk project.

ArcRisk Partner Forum meeting

A warm and sunny Barcelona greeted the ArcRisk partners as they arrived for the second Partner Forum meeting, which took place on 3 to 5 November 2010 at the Institute of Environmental Assessment and Water Branch of the Spanish Council for Scientific Research (CSIC). Graciously hosted by Joan O. Grimalt and his staff and students, the meeting presented an excellent opportunity to discuss the results of the project thus far and coordinate future activities. Twenty-eight participants from 14 of the 21 partners attended the meeting as well as Andy Gilman, a member of the ArcRisk Scientific Advisory Board from Canada. Presentations by each partner gave overviews of their results and their plans for the next phase of the project. The partners in each Work Package held meetings and there were coordination meetings between each of the scientific work packages to plan the flow of information between the Work Packages. This was particularly valuable with regard to plans for work on the food chain

transfer of contaminants and the requirement to determine the ultimate exposure of humans via their diet of Arctic fish, marine mammals, and some fowl. The meeting resulted in a great deal of coordination and useful discussions among the participants and the venue represented a welcome respite for the many participants from the dark, cold North!

Strong ArcRisk presence at the 'Arctic as a Messenger of Global Change' Conference

ArcRisk results have been presented at several international meetings and conferences this year. The ArcRisk presence was particularly strong at the AMAP 'Arctic as a Messenger for Global Processes – Climate Change and Pollution' Conference in Copenhagen, Denmark (3 to 6 May 2011) where ArcRisk scientists were responsible for over 20 presentations including seven oral presentations (see below).

Why was the Copenhagen Conference so important for ArcRisk? Well, apart from gathering over 400 experts from all around the Arctic – and many of its southern neighbours, the Conference was specifically designed by AMAP to bring together scientists and policy-makers – to foster a dialog between them on matters relating to Arctic pollution, climate change and human health, the key components of the ArcRisk project. The conference was co-organized by AMAP and the Universities of Aarhus and Copenhagen. AMAP has a long track-record in organizing this type of event, and its success can be gauged by the fact that it attracted no fewer than 3 Ministers from Denmark and Sweden together with a number of representatives of regional/local governments and Arctic indigenous peoples. For ArcRisk to succeed in its objectives of informing policy- and decision-making processes, communicating scientific findings to these stakeholders is just as important

as carrying out the world-class research that is the focus of the three main ArcRisk scientific work packages. Some of the words included in the conference concluding statements serve to underline the importance of projects such as ArcRisk, both for Arctic residents and for populations outside of the Arctic:

- Mercury and persistent organic pollutants released globally are deposited in the Arctic and impact ecosystems and human health. Global warming will affect contaminant cycling in the environment and could re-mobilize pollutants from ice and frozen ground. The combination of climate change and pollution puts unique Arctic ecosystems at risk.
- For Arctic ecosystems and human societies, the new Arctic reality is change. This change is occurring more rapidly than was foreseen and challenges resilience. Increased exploitation of Arctic resources is creating opportunities in many places; however, with an associated increase in environmental risk.
- The newest science results emphasize that Arctic processes are intimately connected with processes occurring in the rest of the world. Thus, what happens in the Arctic influences living conditions far away from the Arctic and vice versa. The future of the Arctic and global environment depends on global action founded on sound science.

ArcRisk-related presentations at the Conference 'The Arctic as a Messenger for Global Processes: Climate Change and Pollution' (Copenhagen, 3–6 May 2011) are included in the Conference abstracts available at: <http://amap.no/Conferences/Conf2011/programme.html>

ArcRisk – more Next Generation

The ArcRisk project framework is the ideal training ground for the next generation of Arctic and European scientists – firstly by providing an opportunity to work with leading scientists in a variety of disciplines – secondly, and perhaps more importantly, providing the opportunity to see how their own field of

research can fit into a bigger picture – exploiting the multidisciplinary context of the ArcRisk project.

ArcRisk Young Scientists Profiles (WP4)

Maria Kummu is working at the Department of Pharmacology and Toxicology, University of Oulu, Finland on her PhD



– which is an extension of her Master's studies (M.Sc. 2010, Biochemistry, University of Oulu). Maria's research focuses on ABC transporters and the influence of environmental chemicals on early life development. ABC transporters are located in the maternal facing membranes of the human placenta. When it comes to prenatal exposure to xenobiotic chemicals, the placenta is a critical organ. Exposure to chemicals can affect placental functions such as steroid synthesis and transport function. The photo shows Maria preparing a placenta perfusion. Maria has published six scientific articles and will finish her PhD next year.

Marta Fort Fuster, graduated in Biology and holds a Master's degree in Clinical Laboratory from Pompeu Fabra University, Barcelona, with her thesis on a study of organochlorine compounds in breast milk. As an ArcRisk PhD Student at the University's Institute for Environmental Assessment and Water Research (IDAEA-CSIC) her biomedical research work focuses on:

- Organohalogen compounds (organochlorine, PBDEs, HBCD) in



colostrum samples and maternal serum samples: related maternal factors and serum-to-milk transference.

- Exposure to trace metals during two different stages of pregnancy by analysis in maternal urine samples.
- Organohalogen compounds and trace metals exposure during pregnancy and lactation and future children neurodevelopment.

Esther Vizcaino Garcia is a post-doctoral researcher at the Institute of Environmental Assessment and Water



Research (IDÆA-CSIC) in Barcelona working on health aspects of the ArcRisk project. She received her PhD in analytical and environmental chemistry from the University of Barcelona in 2010, with a thesis on prenatal exposure to organohalogen compounds. Her current research topics include the assessment of prenatal exposure to persistent organic pollutants through biomonitoring pollutant levels in pregnant women and their neonates and evaluation of

their placental transfer during pregnancy. She is also studying the association of possible adverse effects on children's health and developing analytical techniques to determine environmental pollutants. Furthermore, she is investigating socio-demographic factors influencing prenatal exposure to POPs.

ArcRisk Publications

WP2

Cousins, I.T., D. Kong. and R. Vestergren, 2011. Chapter 4: Impact of Climate Change on Exposure to POPs of Wildlife and Humans. In: Climate Change and POPs: Predicting the Impacts. Report of the UNEP/AMAP Expert Group. Secretariat of the Stockholm Convention, Geneva, 62 pp. ISBN: 978-82-7971-065-3.

Li, Z., 2011. Comparing the relative influences of uncertainty in physical-chemical property data and variability in climate parameters in determining the fate of PCBs. Master's thesis. Supervised by Ian Cousins, Stockholm University.

Aksenov, de Cuavas, Gerdes, Golubeva, Karcher, Kauker, Nguyen, Platov, Proshutinsky, Watanabe, Wadley, Woodgate, Arctic Pathways of Pacific Water: AOMIP Model Experiments. (manuscript under preparation for submission to Journal of Geophysical Research).

Karcher, Smith, Kauker, Gerdes, Smethie. Arctic Ocean circulation variability and the dispersion of ¹²⁹Iodine. (manuscript under preparation for submission to Journal of Geophysical Research).

Stemmler, I. and G. Lammel, 2011 Air-sea exchange of semivolatile organic compounds – wind and/or sea surface temperature control of volatilisation studied using a coupled general circulation model. Journal of Marine Systems, 85:11–18.

WP3

Pesticides from meltwater runoff in a Greenlandic fjord. (manuscript under preparation for submission to the Journal of Environmental Monitoring).

Ahrens, L.; Shoieb, M; Del Vento, Codling, G.; Halsall, C. J. Polyfluoroalkyl compounds in the Canadian Arctic atmosphere. Environmental Chemistry (2011) 8: 399-406 DOI: 10.1071/EN10131

Carrizo, D. and Ö.Gustafsson, 2011 Distribution and inventories of polychlorinated biphenyls in the Polar Mixed Layer of the seven pan-Arctic shelf seas and interior basins. dx.doi.org/10.1021/es103542f | Environmental Science and Technology, 45:1420–1427.

Carrizo, D. and Ö. Gustafsson. Pan-Arctic River Fluxes of Polychlorinated Biphenyls. Environmental Science and Technology. (2011) 45, 8377-8384.

Kurková, R., D. Ray, D. Nachtigallová and P. Klán, 2011. Chemistry of small organic

molecules on snow grains: The applicability of artificial snow for environmental studies. Environmental Science and Technology, 45:3430–3436.

Quiroz, R., J.-O. Grimalt and P. Fernández, 2010. Toxicity assessment of polycyclic aromatic hydrocarbons in sediments from European high mountain lakes. Ecotoxicology and Environmental Safety, 73:559-564.

WP4

Nieminen, P., H. Lehtiniemi, K. Vähäkangas, A. Huusko and A.Rautio. Systematic review and meta-analysis of the effect of exposure to polychlorinated biphenyls (PCBs) on birth weight. (re-submitted for publication).

Govarts, E., M. Nieuwenhuijsen, et al. (including A. Rautio). Prenatal exposure to polychlorinated biphenyls (PCB) and dichlorodiphenyldichloroethylene (DDE) and birth weight: A meta-analysis with 12 European birth cohorts. (submitted for publication).

Grimalt, J.O., D. Carrizo, M. Gari, L. Font-Ribera, N. Ribas-Fito, M. Torrent and J. Sunyer, 2010. An evaluation of the sexual differences in the accumulation of organochlorine compounds in children at birth and at the age of 4 years. Environmental Research, 110:244-250.

Vizcaino, E., J.O. Grimalt, M.-J. Lopez-Espinosa, S. Llop, M. Rebagliato and F. Ballester, 2010. Maternal origin and other determinants of cord serum organochlorine compound concentrations in infants from the general population. Environmental Science and Technology, 44:6488-6495.

Vizcaino, E., J.O. Grimalt, D. Carrizo, M.-J. Lopez-Espinosa, S. Llop, M. Rebagliato, F. Ballester, M. Torrent and J. Sunyer, 2011. Assessment of prenatal exposure to persistent organohalogen compounds from cord blood serum analysis in two Mediterranean populations (Valencia and Menorca). Journal of Environmental Monitoring, 13:422-432.

Vizcaino, E., J.O. Grimalt, M.-J. Lopez-Espinosa, S. Llop, M. Rebagliato and F. Ballester, 2011. Polybromodiphenyl ethers in mothers and their newborns from a non occupationally exposed population (Valencia, Spain). Environment International, 37:152-157.

Presentations at international meetings and scientific conferences:

Arctic Council Ministerial Meeting in Nuuk, Greenland in May 2011. Presentation of the report 'Climate Change and POPs: Predicting the Impacts'.

Codling et al. Empirical investigation into the fate of organic contaminants during snowmelt in a sub-Arctic snowpack. Poster presentation at The Arctic as a Messenger for Global Processes-Climate Change and Pollution Conference, Copenhagen, Denmark, 4–6 May 2011.

Cousins, I.T., D. Kong and R. Vestergren, 2011. Impact of Climate Change on Exposure to POPs of Wildlife and Humans. The Arctic

as a Messenger for Global Processes – Climate Change and Pollution. University of Copenhagen, 4-6 May 2011.

Halsall, C. 2011. Unravelling the complexities of snow and ice on the fate of persistent organic pollutants in the Arctic. The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Hansen, K.M., J.H. Christensen, et al., 2011. Increase of contaminant levels in the Arctic due to future climate change. SETAC Europe, 21st Annual Meeting, 15-19 May 2011, Milan, Italy.

Hofmann, L., F. Guglielmo, I. Stemmler and G. Lammel, 2011. The impact of including ice and snow in multicompartmental modelling on persistent organic pollutants' distributions and fate. Poster presentation at The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4-6 May 2011.

Gerdas, R. et al. 2011. Changes in sea ice formation and transport - consequences for contaminant transport in the Arctic Ocean. The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Jenssen, M.T.S., et al. 2011. Mercury exposure and links to human health in Tromsø, Arctic Norway. The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Kallenborn, R, et al. 2011. New contaminants in the Arctic: Pharmaceutical residues, a new contamination issue in cold environments? The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Karcher, M., F. Kauker, R. Gerdas, J.N. Smith. Variability of the Arctic Ocean circulation and its implications for transport of marine pollutants. The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Odland, J.Ø., et al. 2011. Arctic Monitoring and Assessment Program (AMAP), Human Health Assessment Group (HHAG). The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Rautio, A. ArcRisk project on contaminants, human health and climate change. International network for circumpolar health – Summer Institute of Circumpolar Health Research 13.-17.6.2011, Oulu.

Rautio, A. Human health in the context of changing ecosystems and environment (keynote lecture: 20.7.2010), IUTOX, Barcelona, Spain.

Rautio, A. Impact of environmental contaminants on human health in the Arctic. Arctic Science Summit Week (ASSW), Seoul, Korea.

Rautio, A. Environmental health. Arctic Health: Challenges and responses to rapid climate environmental, and social change, Dartmouth College, Dickey Centre for International understanding. UArctic Institute for Applied Circumpolar Policy. 23-25.5.2011.

Rautio, A. Human health and the changing Arctic, 30.5.-1.6.2011, The Arctic and the European Union: Environment and human challenges, Stockholm & Rovaniemi.

Rautio, A., et al., 2011. Impact of climate change on environmental exposure of contaminants and on human health in the Arctic. The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

Rautio, A., A. Huusko, H. Halonen, P. Nieminen, K Vähäkangas. Environmental contaminants and human health in the Arctic. ICASSVII: Circumpolar perspectives in global dialogue: social sciences beyond the International Polar Year, Akureyri, Iceland, 22.-26.6.2011.

Stemmler, I. and G. Lammel. Global cycling of PCBs - Intercontinental and northward migration of distributions predicted by multicompartmental modelling. 21st Society for Environmental Toxicology and Chemistry (SETAC) Europe Annual Meeting, Milan, Italy, 15-19 May 2011.

Stemmler, I. and G.Lammel, 2011. Spatiotemporal variation of the exposure of the Arctic environment towards DDT and PCBs. Poster presentation at The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4-6 May 2011.

Stemmler, I., G. Lammel and F. Guglielmo. Spatiotemporal variation of the exposure of the ocean towards DDT and PCBs. RECETOX/ EuCheMS-DCE/SSC Workshop Research Needs in the Global Assessment of POPs 10 Years after the Signature of the Stockholm Convention, Brno, Czech Republic, 22-24 May 2011.

Stemmler, I., M. Karcher, F. Kauker and G. Lammel, 2011. Pathways of PFOA to the Arctic and exposure of the Arctic Ocean. Poster presentation at The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4-6 May 2011.

Stockholm Convention COP5, Geneva, Switzerland, April 2011. Presentation of the report 'Climate Change and POPs: Predicting the Impacts'

Wöhmschimmel, H., P. Tay, Y.F. Li, M. MacLeod and K.Hungerbühler, 2011. An investigation of causes of the recent discontinuity of β -HCH in the Arctic atmosphere. Poster presentation at The Arctic as a Messenger for Global Processes – Climate Change and Pollution Conference, Copenhagen, Denmark, 4 to 6 May 2011.

UNFCCC COP16 meeting, Cancún, Mexico, December 2010. Presentation of the report 'Climate Change and POPs: Predicting the Impacts'

ArcRisk Meetings

ArcRisk Partner Forum meeting, Barcelona, 3-5 November 2010

ArcRisk WP5 coordination meeting, Brussels, 15 March 2011

ArcRisk WP2 dissemination workshop on initial modelling results / Second ArcRisk WP3 workshop on data elucidation, Copenhagen, 3 May 2011. 28 participants from 17 partners and one guest.

ArcRisk WP3: Second WP3 partner workshop, Copenhagen, 6 May 2011

ArcRisk WP4 partner meeting, Oulu, 24 May 2011

ArcRisk WP4 partner meeting, Oulu, 28 February – 1 March 2011

ArcRisk WP5 coordination meeting, Gothenburg, 20 June 2011

ArcRisk WP4 partner meeting, Ljubljana, 29-30 August 2011

HHAG/ArcRisk WP4 meeting, Torshavn, 17 October 2011

ArcRisk WP5 / WP leads meeting, Copenhagen, 24-25 October 2011

ArcRisk WP2 dissemination workshop, Stockholm, 22-23 February 2012

ArcRisk at International Conferences:

IS-ENES Workshop, Copenhagen, January 2011

EMAR2RES workshop, Oostende, April 2011

The Arctic as a Messenger for Global Processes: Climate Change and Pollution, Copenhagen, May 2011. (see story above).

SETAC Pellston Workshop on the 'Influence of Global Climate Change on the Scientific Foundation and Application of Environmental Toxicology and Chemistry', USA, July 2011

SETAC Europe Meeting, Milan, May 2011

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