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Preface

Levels and trends of new contaminants, temporal trends of legacy contaminants and effects of contaminants in the Arctic: Preface

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The Arctic Monitoring and Assessment Programme (AMAP) was established in 1991 to implement the Arctic Environmental Protection Strategy (AEPS), which had been adopted by the environmental Ministers of the eight Arctic countries: Denmark, Finland, Iceland, Norway, Sweden, Russia, Canada and the USA. The specific task given to AMAP at that time was to prepare an assessment of the state of the Arctic environment with respect to defined pollution issues, including persistent organic pollutants (POPs). This included implementing a circumpolar monitoring programme based on national monitoring programmes in the Arctic countries, initiating some new research and later compiling the data from monitoring and research activities into its first assessment report. At the AEPS Ministerial Conference in Alta, Norway, in 1997, this first assessment report was presented. At the same time the AEPS was transferred to the newly created Arctic Council and AMAP is now a programme under the Arctic Council.

The assessment process included input from hundreds of international scientists as well as from indigenous populations from the Arctic. The Persistent Organic Pollutants (POPs) chapter of the first AMAP Assessment Report (de March et al., 1998) presented the data that were available as of 1996 on POPs in Arctic air, seawater, sediments, soils and plants as well as terrestrial, freshwater and marine biota. The major contaminants included were PCBs, DDTs, chlordanes, hexachlorocyclohexanes (HCH), dieldrin, chlorobenzenes, toxaphene, endrin, mirex, and polychlorinated dioxins and furans, all organochlorine compounds. Many of these were found to be ubiquitous in the Arctic due to long-range transport from source regions further south. Higher concentrations were found in top predators due to bioaccumulation and biomagnification, spatial trends indicated higher concentrations in the European Arctic and concentrations of some POPs (primarily PCB) in some Arctic birds and mammals were high enough to exceed thresholds associated with effects in laboratory animals. Temporal trends indicated declines of PCBs and DDT in the 1970s and 1980s but trends were less clear for the 1990s. This first POPs assessment by AMAP helped stimulate regional and global initiatives to identify and ban selected POPs. In 1998, the United Nations Economic Commission for Europe (UN ECE) negotiated a Protocol on POPs under the Convention on Long-Range Transboundary Air Pollution (LRTAP) to which all eight circumpolar (AMAP) countries were signatories (http://www.unece.org/env/lrtap/pops_h1.htm). In 2001, the United Nations Environment Programme (UNEP) completed global negotiations on banning of POPs with the signing of the Stockholm Convention on Persistent Organic Pollutants in May 2001 (UNEP, 2001; http://chm.pops.int).

The initial chemicals listed under the Stockholm Convention were aldrin, chlordane, dieldrin, dichlorodiphenyltrichloroethane (DDT), endrin, heptachlor, hexachlorobenzene, mirex, toxaphene, polychlorinated biphenyls (PCBs), polychlorinated dibenzo-*p*-dioxins and -dibenzofurans (UNEP, 2001). With global agreement that chemicals with characteristics of POPs include presence in locations "distant from sources" and "monitoring data showing that long-range environmental transport of the chemical … may have occurred", the Arctic has become an important indicator region for assessment of persistence and bioaccumulation. The Arctic environment is well suited as a region in which to evaluate POPs. Cold conditions favor persistence of POPs relative to temperate or tropical environments. The presence of fourth level carnivores (i.e. polar bear (*Ursus maritimus*)), and storage of lipid as an energy source, make Arctic food webs vulnerable to bioaccumulative chemicals.

A second AMAP Assessment Report on POPs was produced in 2004 (de Wit et al., 2004), which presented new data on spatial and temporal trends, as well as biological effects, addressing some of the knowledge gaps identified in the first assessment. It also presented data showing that there were a number of "new" contaminants reaching the Arctic,

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including some brominated flame retardants (BFRs), such as the components of technical PentaBDE (tetra-hexabrominated diphenylethers), and perfluorinated compounds, such as perfluorooctanesulfonate (PFOS). Because of the rapid increase in data from the Arctic, an update on BFRs was produced as a review article to aid AMAP and the Arctic Coucil Action Plan (ACAP) in their work on these compounds (de Wit et al., 2006). In 2006, at the Fifth Arctic Council Ministerial Meeting in Salekhard, Russia, AMAP was given the task of producing an assessment report on new contaminants in the Arctic (Salekhard Declaration, 26 October 2006, http://arctic-council.org/filearchive/SALEKHARD_AC_DECLARATION_2006.pdf). This special issue of *Science of the Total Environment* is the result of this task and includes 5 review articles covering a number of new or emerging chemicals in the Arctic, including perfluorinated compounds, current use pesticides (CUPs), new brominated flame retardants, endosulfan and polychlorinated naphthalenes (PCNs). This series of articles is very timely given that in May 2009, nine chemicals were added to the Stockholm Convention on POPs including α- and β-HCH, lindane, pentachlorobenzene, penta- and octaBDEs, hexabromobiphenyl, chlordecone and PFOS. Several of the compounds reviewed in these articles are also currently proposed or under review as candidate POPs under the UN ECE LRTAP Protocol in 2008–09 (endosulfan, dicofol, pentachlorophenol, trifluralin and hexabromocyclododecane (HBCD)) and in 2007–08 (Penta- and octaBDE, PFOS and PCN) (Denier van der Gon et al., 2007; http://www.unece.org/env/lrtap/TaskForce/popsxg/welcome.html) or are at various stages of assessment under the Stockholm Convention (HBCD and endosulfan).

This special issue also includes two reviews of the temporal trends of legacy POPs in air and in biota as part of AMAP's contribution to the global monitoring and first follow-up of the UNEP Stockholm POPs convention. The issue also includes a review of biological effects in Arctic organisms in relation to current contaminant levels. The final article is a summary and synthesis of the results presented in the reviews. The information in this special issue has also been used as the scientific basis for the POPs chapter in the *AMAP Arctic Pollution 2009 Report*, which provides a popular summary of the assessment for policy-makers including recommendations for actions (AMAP, 2009).

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