Arctic Pollution: The importance of long-term monitoring programmes

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Scientific and public awareness grew in the 1980s of persistent organic pollutants (POPs) entering the Arctic via long-range transport and accumulating in Arctic food webs. As a consequence, indigenous populations were exposed to high POP levels as they relied on Arctic animals in their traditional diet. National contaminant monitoring programmes were established in the 1990s, coordinated under the auspices of the newly established Arctic Monitoring and Assessment Programme (AMAP). These timeseries generally show decreasing concentrations of legacy POPs in the Arctic, which has mainly been attributed to efficient national regulations as well as global measures under the United Nations Stockholm Convention on POPs.

In recent years, this overall development has been disrupted for some environmental matrices and locations in the Arctic, presumably related to climate change influences, for example leading to the remobilization of formerly accumulated pollutants or to changes in ecosystem structures. Together with potentially increasing emissions from local sources in the Arctic, the previously established link between Arctic pollutant levels and regulatory actions is challenged today. Arctic monitoring helps to disentangle these processes and improve our understanding of effects of climate change and local sources.

With approximately 150,000 chemicals registered for commercial use in Europe alone, risks remain of new pollution issues in the Arctic outside the scope of the Stockholm Convention or building up during a comprehensive review process. The existing monitoring programmes provide platforms for screening studies of chemicals of emerging Arctic concern (CEACs), via their sampling procedures, analytical techniques and quality assurance/control systems established for POP monitoring. These screening studies have provided important data for risk assessments under the Stockholm Convention.

In the last few years, new screening techniques have been used increasingly based on high resolution mass spectrometry (HRMS) coupled with either gas (GC) or high-performance liquid chromatography (HPLC). These suspect or non-target screening approaches allow for the identification of hundreds or thousands of compounds in a single analytical run, using advanced deconvolution techniques combined with referencing in mass spectra libraries. While challenges remain with false positives and

false negatives as well as time-consuming data analysis, suspect and non-target screening studies have identified multiple CEACs in Arctic environments as candidates for future monitoring.

Some long-term Arctic monitoring programmes have been extended with a new pollutant in recent years, marine litter and/or microplastics. In addition to the problem of plastic pollution itself, the transport of plastics, or their local emissions, might lead to new entry routes of chemical pollutants, as plastic particles can contain many different types of additives. Some of them might not possess POP characteristics, but still occur in the Arctic environment after leaching from weathered plastic particles.

Keywords

Bioaccumulation, Chemicals of emerging Arctic concern, Greenland, Long-range transport, Persistent organic pollutants (pops), Screening