Chemicals of emerging Arctic concern as indicators for Arctic environmental change processes

Roland Kallenborn[1,2], Aasim M. Ali[1], Lars-Otto Reiersen[3]

1.) Norwegian University of Life Sciences (NMBU), Ås
2.) University Centre in Svalbard (UNIS), Longyearbyen;
3.) Arctic Knowledge, Tromsø

Abstract: For several decades now, persistent organic semi-volatile pollutants (POPs) has been investigated and monitored in Polar environments. The early studies on POPs in the Arctic atmosphere revealed long-range atmospheric long-range transport (LRAT) as one major transport pathways into the Arctic. This, in combination with effective bioaccumulation of these lipophilic contaminants explained for many POPs the very high concentration levels (still) found in Arctic top predators. Similar processes were later also identified for Antarctic environments, although at considerably lower exposure levels. High levels of POPs in top predating animals were also of the highest concern for the health of Arctic indigenous people. Arctic populations were found exposed in several Arctic regions since they utilize contaminated marine mammal species as their traditional food source (subsistence hunting). In recent years, highly sensitive trace analytical methods allowed identification and quantification of a largely increasing number of contaminants of emerging concern in the Arctic environment (CEAC = contaminants of emerging Arctic concern). The recently published and updated Arctic Monitoring and Assessment Programme (AMAP) report on CEACs is an impressive testimony of the wide array of contaminants currently investigated and monitored in the Arctic Environment. The, thus, initiated research on contaminants of emerging Arctic pollutants (CEACs, including microplastics = MP) revealed that not only LRTAP is an important pathway for anthropogenic contaminants into polar environments. Also, potential local contamination source needs to be considered for a complete regional environmental assessment. A list of more than 300 CEACs is currently discussed for priority screening in the Arctic. The comprehensive evaluation of fate and distribution properties for POPs and CEACs in combination with associated economic and societal factors (community structures, industry development, tourism, fisheries, geopolitics, etc) allows today a complete evaluation of the pollutant affiliated ecological and environmental human food print on this region which experiences currently tremendous environmental change. Furthermore, sources, distribution pathways and transformation of those substances (POPs and CEACs) are expected to respond directly to environmental changes. Increased ambient temperatures will increase the transformation rates, loss of sea ice is expected to result in increased evaporation of POPs from open sea surfaces, change in food web structures will change the bioaccumulation and magnification profiles for the compounds of interest. These already observed changes in combination with the long data series gather by AMAP and regional monitoring programs, both for the abiotic and the biotic environment (Marine and terrestrial), allows today an in-depth evaluation of consequences for the Arctic environments. Illustrated by several examples, the potential of such a comparative approach will be highlighted and discussed. Potential implications of these complex research and assessment strategies for Polar environmental research, regional screening, monitoring activities and regulatory strategies not just for the Arctic environment will be provided. The close

interdisciplinary linkage between modern environmental chemistry, toxicology, fate modelling on the one side and monitoring, environmental assessment and regulation on the other is considered as mandatory for balanced and sustainable pollution regulations in the Arctic where currently potential conflict scenarios between environmental concerns and geopolitical, economic and strategic interests in the region need to be addressed.