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TITLE: Levels and trends of poly- and perfluorinated compounds in the arctic environment

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ABSTRACT:

Poly- and perfluorinated organic compounds (PFCs) are ubiquitous in the Arctic environment. Several modeling studies have been conducted in attempt to resolve the dominant transport pathway of PFCs to the arctic-atmospheric transport of precursors versus direct transport via ocean currents. These studies are generally limited by their focus on perfluorooctanoate (PFOA) fluxes to arctic seawater and thus far have only used fluorotelomer alcohols (FTOHs) and sulfonamide alcohols as inputs for volatile precursors. There have been many monitoring studies from the North American and European Arctic, however, almost nothing is known about PFC levels from the Russian Arctic. In general, there are very few measurements of PFCs from the abiotic environment. Atmospheric measurements show the widespread occurrence of PFC precursors, FTOHs and perfluorinated sulfonamide alcohols. Further, PFCAs and PFSAAs have been detected on atmospheric particles. The detection of PFCAs and PFSAAs in snow deposition is consistent with the volatile precursor transport hypothesis. There are very limited measurements of PFCs in seawater. PFOA is generally detected in the greatest concentrations. Additional seawater measurements are needed to validate existing model predications. The bulk of the monitoring efforts in biological samples have focused on the perfluorinated carboxylates (PFCAs) and sulfonates (PFSAAs), although there are very few measurements of PFC precursors. The marine food web has been well studied, particularly the top predators. In contrast, freshwater and terrestrial ecosystems have been poorly studied. Studies show that in wildlife perfluorooctane sulfonate (PFOS) is generally measured in the highest concentration, followed by either perfluorononanoate (PFNA) or perfluoroundecanoate (PFUnA). However, some whale species show relatively high levels of perfluorooctane sulfonamide (PFOSA) and seabirds are typically characterized by high proportions of the C(11)-C(15) PFCAs. PFOA is generally infrequently detected and is present in low concentrations in arctic biota. Food web studies show high bioaccumulation in the upper trophic-level animals, although the mechanism of PFC biomagnification is not understood. Spatial trend studies show some differences between populations, although there are inconsistencies between PFC trends. The majority of temporal trend studies are from the Northern American Arctic and Greenland. Studies show generally increasing levels of PFCs from the 1970s, although some studies from the Canadian Arctic show recent declines in PFOS levels. In contrast, ringed seals and polar bears from Greenland continue to show increasing PFOS concentrations. The inconsistent temporal trends between regions may be representative of differences in emissions from source regions.

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