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Cycling of Mercury in a Warming Arctic

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The biogeochemical cycle of mercury (Hg) is complex and tightly coupled to the cycling of other elements, including carbon and sulfur. Organic carbon, for example, acts as a key vector for the transport of Hg along the aquatic continuum, and deposition of sulfate may promote the microbial conversion of inorganic Hg to monomethylmercury (MMHg), a highly toxic and bioaccumulative form of Hg. To protect the environment and human health from the adverse effects of mercury, the Minamata Convention on Mercury was adopted in 2013. The effectiveness of this global treaty is, however, not only dependent on the mitigation of anthropogenic mercury emissions, but also on the interactions of Hg with other biogeochemical cycles and their response to future earth system perturbations. In this presentation, I will first introduce Hg's fascinating biogeochemical cycle and how it links to the biogeochemical cycle of other elements. We will then, focusing on the Arctic ecosystem, discuss how future risks of Hg remobilization and exposure may be altered due to climate change.

Northern high-latitude permafrost soils store large amounts of Hg which has been sequestered together with carbon over thousands of years. As the permafrost thaws, Hg may be remobilized and hotspots for Hg methylation and reduction may be created. Our ongoing research projects aim to understand how these processes may alter the risk of Hg exposure in downstream systems. To map pan-Arctic stocks of MMHg, we are currently collecting soil profiles of Hg and MMHg from thaw transects across the Arctic. Here, we will present data from extensive field sampling conducted in Fennoscandian permafrost sites and discuss the variability within and among these systems. The availability of Hg released for (de)methylation and biological uptake will then be discussed based on our studies of Hg adsorption and desorption processes and refractory MMHg pools. Finally, we will discuss the fate of Hg entering the Arctic Ocean and the potential role of dimethylmercury in the bioavailable pool of Hg in marine systems.