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Quicksilver on the Move: Tracking Toxic Mercury Pollution in a Changing Environment

Mercury is a significant global pollutant due to its ability to travel long distances in the atmosphere. Human and wildlife exposure to neurotoxic methylmercury through fish consumption remains a major concern, prompting 152 nations to join the *United Nations Minamata Convention* to reduce emissions. Europe has made strides in reducing mercury emissions from human activities since the 1990s. However, fish in most Swedish lakes remain persistently contaminated with mercury, and nearly all of Sweden's surface waters fail to meet the "good chemical status" required by the European Water Framework Directive.

Since the industrial era, human activities have created thousands of contaminated sites worldwide. Legacy mercury, stored in soils and sediments, can be reactivated – especially as environmental conditions change. In Sweden, mercury-based chemicals historically used in the forest industry have led to hundreds of legacy-contaminated sites. After industrial activities ceased, these sites shifted from being mercury sinks to becoming mercury sources, releasing mercury back into the environment. Across the broader boreal landscape, substantial amounts of mercury have accumulated in soils and sediment via atmospheric deposition. Land use changes and climate change now pose increasing risks of mobilizing this toxin into nearby water bodies. My research focuses on tracking the movement of mercury in contaminated and natural boreal ecosystems, and on understanding how human activities and climate change influence its transformation and mobilization, ultimately aiming to reduce human exposure.

In this lecture, I will present my work on quantifying the land-atmosphere mercury exchange and tracking the processes that drive mercury transformation and mobilization in ecosystems. I will highlight how we apply cross-disciplinary micrometeorological, chemical, and isotopic approaches to better constrain complex mercury biogeochemical cycles. The findings of my work improve risk assessments and inform decision-making aimed at reducing mercury exposure. However, significant knowledge gaps remain, particularly in the context of rapid environmental change. I will discuss these critical gaps, which are linked to my ongoing research, and explain how my work contributes science-based evidence to reduce environmental mercury pollution in the boreal landscape.