Universität Basel

Research Project

Seasonal impact of vegetation on atmospheric elemental mercury dry deposition

Third-party funded project

Project title Seasonal impact of vegetation on atmospheric elemental mercury dry deposition
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Mercury (Hg) is a global pollutant of great concern for human and ecosystem health. The UNEP Minamata Convention on Hg aims to curb global anthropogenic Hg emissions, yet has to balance economic and environmental interests. Major knowledge gaps on the role of terrestrial surfaces in the complex global Hg cycling however hamper a science-based assessment of Hg emission reduction scenarios. This in turn undermines the effectiveness of the UNEP Minamata Convention and calls for new scientific approaches to address this prevailing uncertainty associated with terrestrial Hg cycling.The current paradigm suggests that anthropogenic gaseous elemental mercury (GEM) emissions are oxidized in the atmosphere to reactive HgII forms before depositing through rain, snow and dust to Earth surfaces. Hg stable isotope fingerprint studies however revealed that Hg in continental vegetation and soils corresponds to the isotopic fingerprints of GEM rather than HgII in precipitation. There is now increasing evidence that GEM uptake by vegetation represents a massive, overlooked deposition pathway. The latter would imply that vegetation as a GEM pump could significantly affect the GEM lifetime in the atmosphere and change our understanding of global atmospheric Hg cycling. The goal of this project is to resolve this apparent paradox and better understand the importance of GEM uptake by vegetation relative to HgII deposition by rain and snowfall.The short-term balance between Hg deposition and (re)-emission processes governs the seasonal GEM variations. In Europe, GEM concentrations peak in wintertime and are generally attributed to higher anthropogenic GEM emissions from fossil fuel burning in winter. This conclusion is however unconstrained and seasonal variations in GEM deposition (e.g. less plant uptake during the winter) or oxidation processes have been suggested as alternative explanations. This project aims to assess the impact of GEM uptake by vegetation on global Hg cycling and quantify this unconstrained flux to terrestrial ecosystems using a combination of novel stable Hg isotope analysis, remote sensing data and modeling approaches. The objectives are to:(1)Understand the processes controlling seasonal GEM variation by investigating the isotopic fingerprint of GEM at six European sites to differentiate between the role of foliar GEM uptake and primary anthropogenic GEM emissions.(2)Quantify the flux of GEM uptake by foliage and assess its relevance for total Hg deposition in comparison to HgII wet deposition for continental Europe by analyzing seasonal evolution and spatial variability of the Hg pool in foliage at 10 sites along a transect through Europe.(3)Assess the magnitude of the foliar GEM uptake flux for Europe by extrapolating the site-based measurements to a continental scale using satelite-based remote sensing data on vegetation coverage.(4)Improve the parameterization of foliar GEM uptake in global mercury models and to quantify the global foliar GEM uptake flux with a global isotope mass balance. This project will provide for the first time quantitative insights on the

seasonality of GEM uptake by vegetation on a continental and global scale. The results will lead to a substantial reduction of current uncertainties associated with terrestrial Hg fluxes and will improve the implementation of the Minamata convention.

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Published results

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