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.
Our 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.
(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.
(3) Improve the parameterization of foliar GEM uptake in global mercury models.

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.

Key publication:

Jiskra, M. et al., A vegetation control on seasonal variations in global atmospheric mercury concentration, **Nature Geoscience**, 2018, 11, 244-250