

Assessment of Hg pool in European foliage

Improving our understanding of the Hg cycle
by taking advantage of long-term forest monitoring

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Motivation

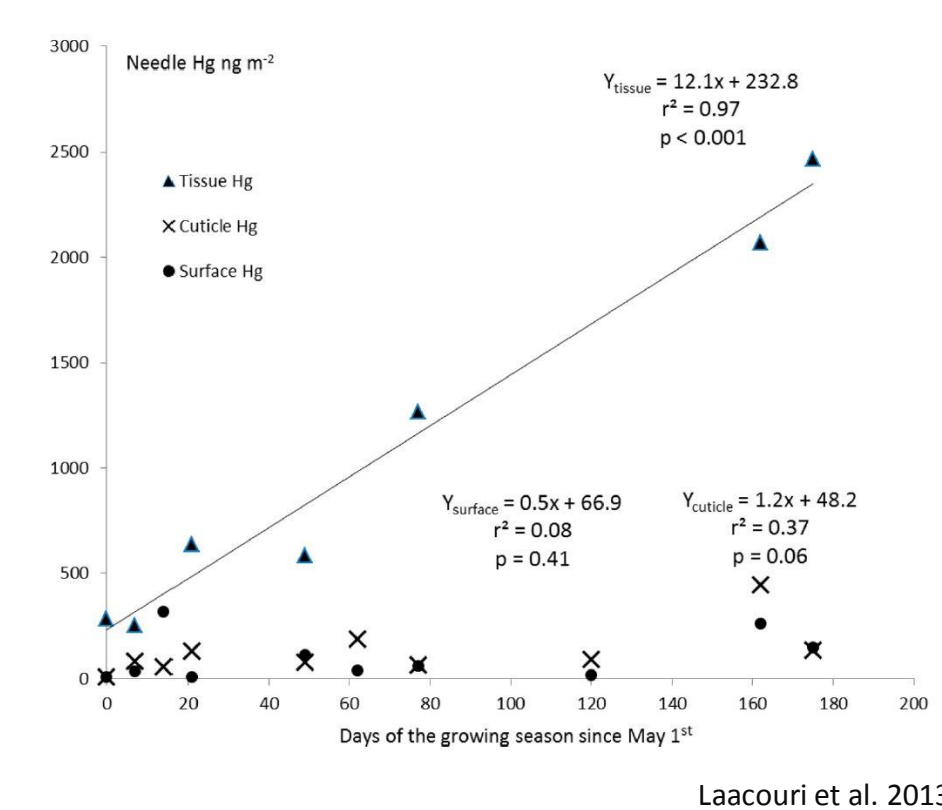
- Novel stable isotope studies suggest that 65 – 90% of total mercury (Hg) deposition flux to terrestrial ecosystems originate from dry deposition of gaseous elemental Hg, rather than wet deposition of Hg(II) in precipitation¹
- There is a need to create a comprehensive data set on Hg concentrations in plants in order to further quantify the amount of gaseous elemental Hg deposited via vegetation uptake from the atmosphere

Outlook

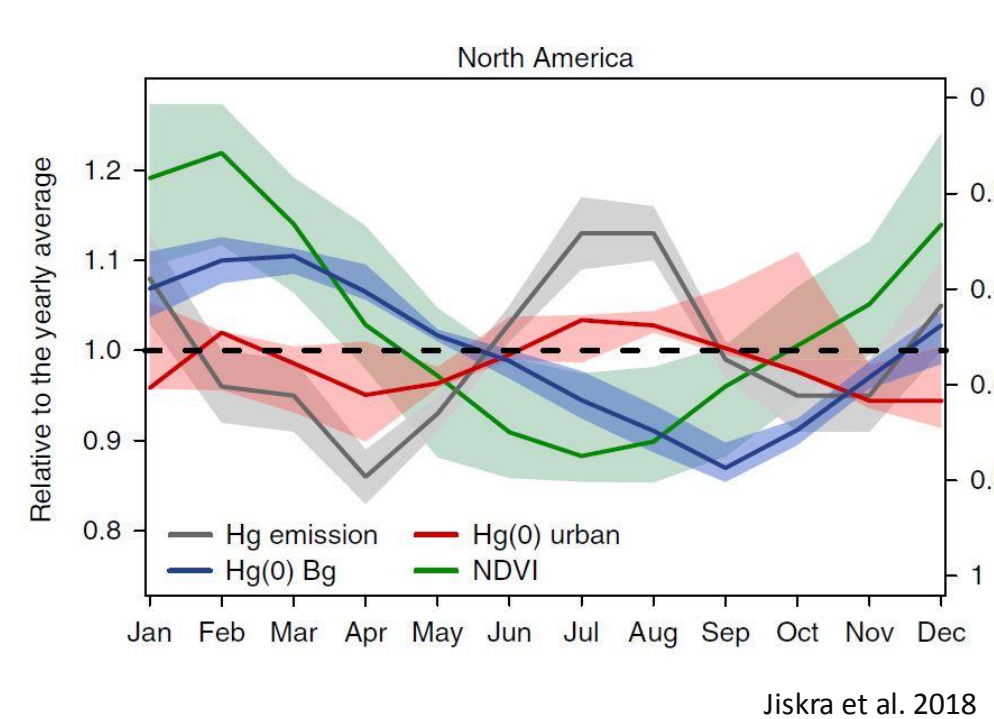
- Seasonal measurements of Hg in foliage at several sites in Central and Northern Europe; small-scale and high-resolution study at a forest site (Hölstein) close to Basel, Switzerland
- Upscaling by use of satellite derived LAI data (MODIS on Terra)

Background information

Current knowledge

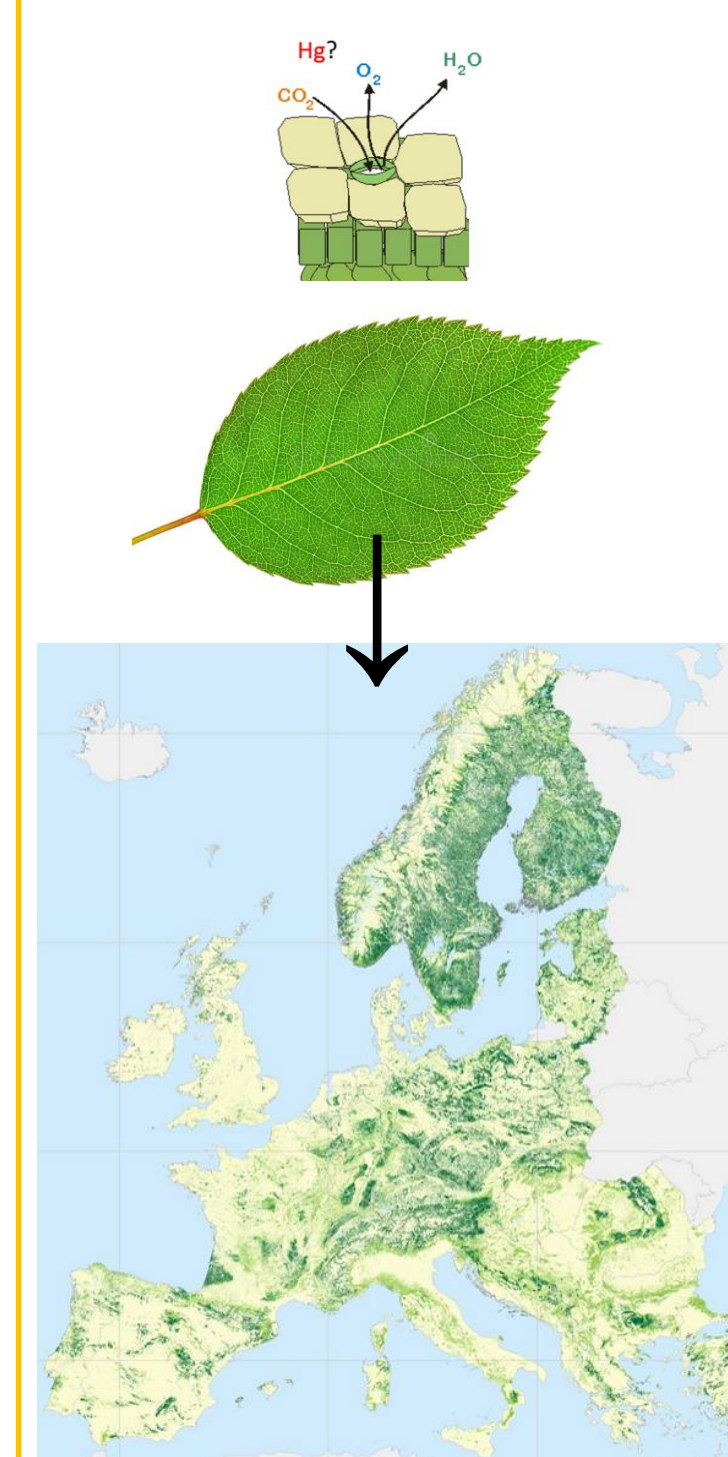


Measurements of Hg concentrations (ng/m² leaf area) in common broadleaf trees at the University of Minnesota showed an increase of Hg in leaf tissues over the course of one growing season²



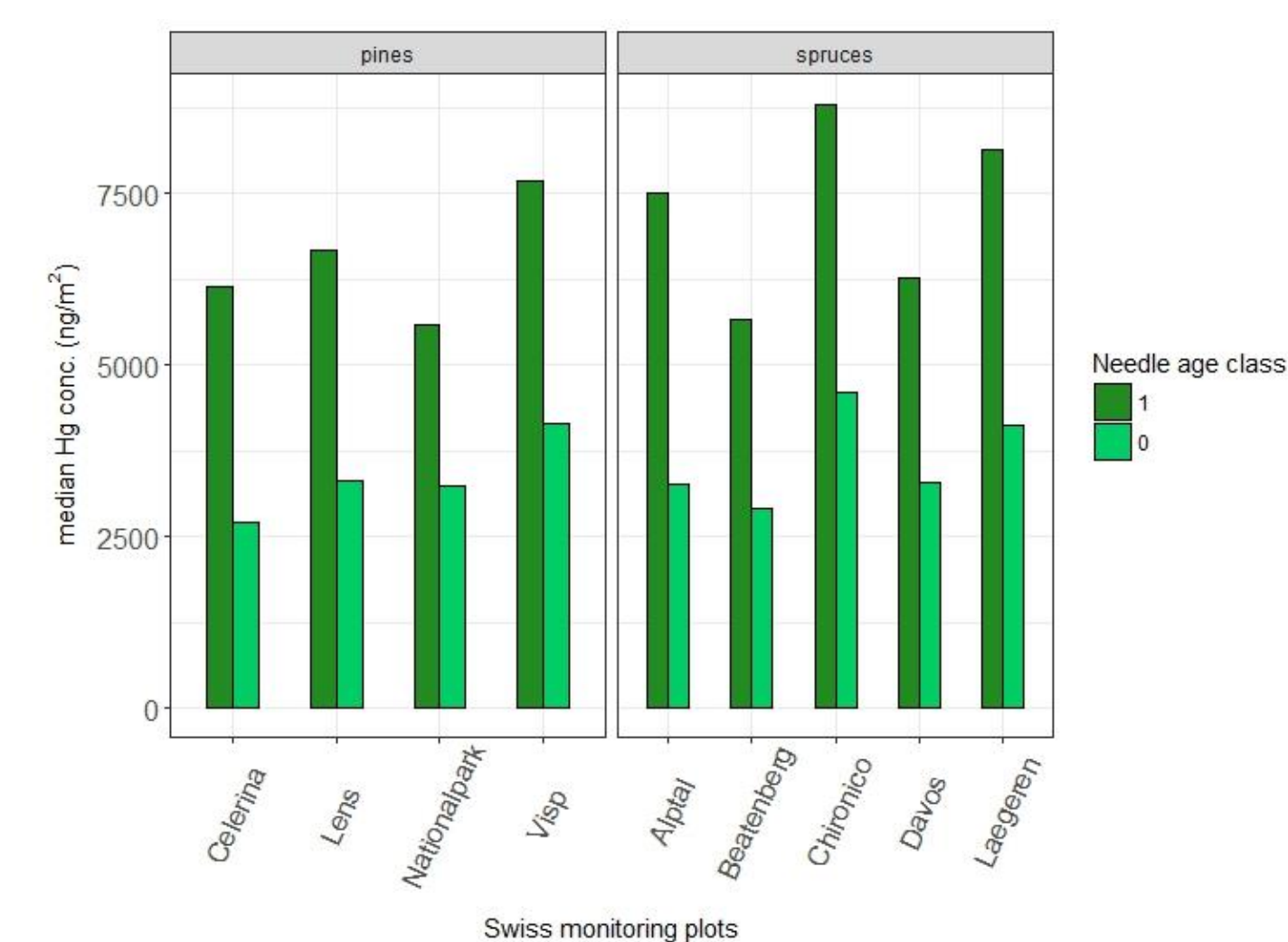
Atmospheric concentrations of gaseous elemental Hg(0) correlate with normalized difference vegetation index³

We investigate:

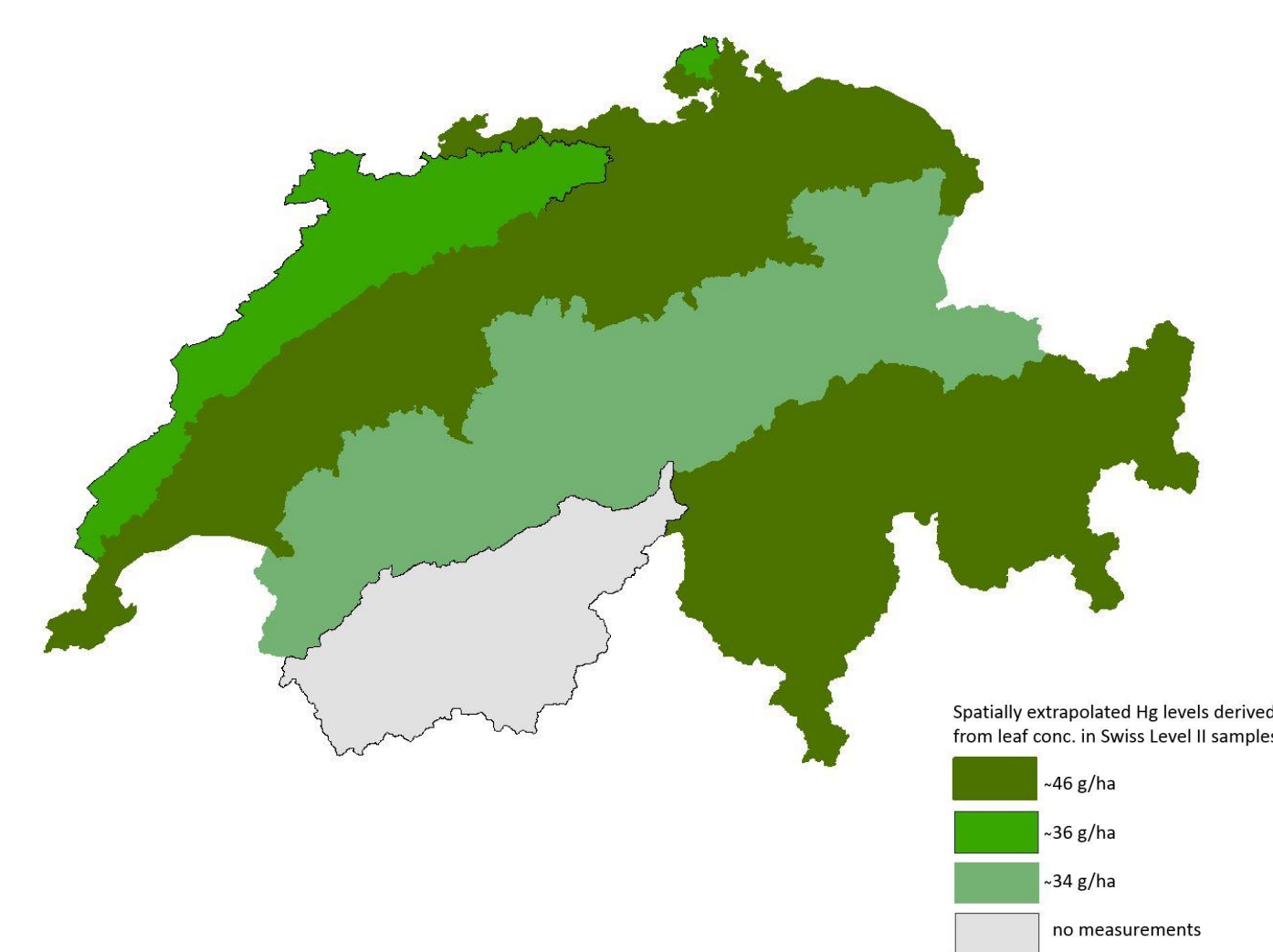


What is the current state of Hg in European vegetation and how do concentrations evolve on a continental scale over the course of a growing season?

First results from Swiss samples, taken in 2015



Median Hg concentrations (ng Hg/m² needle area) in one-year-old (2014) and current season needles sampled in 2015 from pine and spruce trees at 9 Swiss Level II plots.



Spatial extrapolation in Switzerland: We obtained data of biomass of leaves of live trees per ha from the Swiss National Forest Inventory (LFI)⁴ and multiplied the LFI values with mean Hg concentrations measured in leaf samples from Swiss Level II plots. Spatial division of regions with different Hg concentrations is based on a statistical segmentation of the floristic and faunistic distribution patterns and on municipal boundaries.

Call for samples

For quantifying the uptake flux of Hg(0) by vegetation we determine concentrations of Hg in foliage samples all over Europe; thus creating a map of Hg levels in European foliage. Data on surface leaf areas and leaf area indices will help us to upscale concentration levels for the whole continent. The long-term monitoring of ICP Forests members creates the unique opportunity to tackle an upcoming research question by measuring Hg in a large amount of samples distributed over a wide area. We therefore ask for your assistance by sending us small amounts (0.5 g) of your samples you collected on Level II plots and contribute to the project.



DMA-80 instrument, available in Basel

Conclusion

Measurements of one-year-old needles and current season needles at Swiss Level II plots showed elevated Hg concentrations [ng Hg/m² needle surface] in older needles compared to younger needles growing at the same trees. This demonstrates the uptake capacity of needles. The analysis of the temporal Hg evolution in foliage is thus a promising approach to determine the Hg uptake rate. ICP Forests monitoring programs, LAI values and data on biomass per surface area will provide the opportunity to assess Hg fluxes to foliage in Europe.

References

1. Jiskra et al. (2015) Mercury deposition and re-emission pathways in boreal forest soils investigated with Hg isotope signatures. Environmental Science and Technology, 49
2. Laocouri et al. (2013) Distribution and uptake dynamics of mercury in leaves of common deciduous tree species in Minnesota, USA. Environmental Science and Technology, 47
3. Jiskra et al. (2018) A vegetation control on seasonal variations in global atmospheric mercury concentrations. Nature Geoscience
4. Abegg, Brändli, Clodi, Fischer, Herold-Bonardi, Huber, Keller, Melle, Rösler, Speich, Traub, Vidondo (2014) Swiss national forest inventory – Result table No. 194510: mass of needles or leaves of live trees. WSL

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