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Biogeosciences Discussions

Interactive comment on "A bottom-up quantification of foliar mercury uptake fluxes across Europe" *by* Lena Wohlgemuth et al.

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Referee Comment: Paper by Wohlgemuth et al. dealing with bottom-up quantification of foliar mercury uptake fluxes is really a notable contribution to the field of Hg foliar uptake quantification. This study deals with 10 sites located across a transect from Switzerland to northern part of Finland. Paper is well written and scientifically sound. Four species uptake rates were quantified and results of the study were up-scaled to the European and World measures. I have no major comments that would have to be addressed.

Author Response: We thank the referee for this positive evaluation of the paper and for the comments.

Referee Comment: But after reading, I was left with an unanswered question (mentioned by authors in Introduction) whether coniferous or deciduous trees have greater Hg concentration in their foliage. I looked for the data on Hg concentration (ng/g) in foliage at each site and I only found needle age class concentrations in Fig.SI3. I could not find relevant data for the deciduous species... Could Table S1 be amended with a column of Hg concentrations for all sites? Author could consider comment on differences between deciduous and coniferous trees across sites?

Author Response: The focus of this study was on flux calculation, which is why the subject of foliar Hg concentrations might have been cut short. However, we agree that it is important to clearly resolve confusion related to the difference in Hg concentration and Hg pools between deciduous and coniferous foliage. We believe that part of this confusion originates from the physiological diversity of the two tree functional groups. Coniferous needles accumulate Hg over a life cycle of multiple years but exhibit lower Hg concentrations compared to deciduous leaves of the same age. In order to visualize this discrepancy we created a table including average ($\pm$ std) peak season (August) foliar Hg concentration values measured at the SCCII Forest Site Hölstein. Hölstein is a mixed forest thus allowing the sampling of various tree species side by side. Comparing Hg concentrations of various tree species growing at the same side provides the benefit of eliminating side-specific parameters impacting foliar Hg concentrations like time of sampling, Hg(0) in air (see Section 3.3) or sampling strategy (see Line 404 – 406 in Section 3.5). We thus prefer to answer the question of Hg concentration differences between tree functional groups with data from Hölstein. The average Hg concentration in beech and oak leaves in Hölstein in August is 21.7 $\pm$ 2.9 ng Hg gˆ(-1)d.w. (n = 3 trees sampled at top canopy) and 22.7 $\pm$ 4.1 ng Hg gˆ(-1)d.w. (n = 4 trees sampled at top canopy) respectively. The corresponding average Hg concentration of pine and spruce needles sprouted in the same season as leaves (thus same age as leaves) is lower than in leaves, being 6.5 $\pm$ 0.6 ng Hg gˆ(-1)d.w. (n = 2) and 8.1 $\pm$ 2.2 ng Hg gˆ(-1)d.w. (n = 3) respectively. However, multi-year old pine and spruce needles exhibit average Hg concentration values approaching the range of leaves: 13.2 $\pm$ 3.1

ng Hg gˆ(-1)d.w. (one year old pine needles, n = 3), 12.8 $\pm$ 1.3 ng Hg gˆ(-1)d.w. (one year old spruce needles, n = 3), 20.2 $\pm$ 5.5 ng Hg gˆ(-1)d.w. (two year old spruce needles, n = 2) and 26.6 $\pm$ 7.4 ng Hg gˆ(-1)d.w. (three year old spruce needles, n = 2). We included this table (Table S4, Section S8) along with an explanatory text in the Supporting Information. We expanded the main paper with the following paragraph in Section 3.1: "The continued Hg accumulation by needles over their entire life cycle has implications for the comparability of foliar Hg concentrations in needles and deciduous leaves. Deciduous leaves (beech and oak) exhibit higher average Hg concentrations than coniferous needles (pine and spruce) of the same age (y0) (see Table S4 for data from Hölstein site). However, multi-year old pine and spruce needles can reach average Hg concentration values higher than leaves (Table S4). We stress that needle age has to be reported in publications in order to avoid confusion when comparing foliar Hg concentrations of tree functional groups (deciduous vs. coniferous)." By creating a separate Hg concentration table we hope to provide more clarity on the issue of Hg concentration differences between deciduous and coniferous foliage than an expansion of Figure SI3 could. We do not further expand on the issue in Table SI1 in order to not obscure the distinction between concentrations and fluxes.

Referee Comment: Mentioned wet Hg(II) deposition at 5 selected sites was quite low inline with data from other European sites, could you be more specific of methods or protocols that were used at these sites.

Author Response: We included explanation on wet deposition measurement including references in the Material & Methods part of the paper (Section 2.2): "At 5 locations (Schauinsland, Schmücke, Råö, Bredkälen and Pallas) Hg(II) wet deposition measurements were performed by the operators of the research sites. At Schauinsland and Schmücke Eigenbrodt NSA 181/KD (Eigenbrodt GmbH, Königsmoor Germany) samplers were employed for collecting samples and total Hg was measured using atomic fluorescence spectroscopy (see UBA, 2004 for details on analysis). At Råö, Bredkälen and Pallas wet deposition was sampled according to EMEP protocol (NILU, 2001) (re-

fer to Torseth et al., 2012 for an overview of EMEP)" We do not know why Hg(II) wet deposition is lower compared to other European sites. A possible reason might be low precipitation amounts during the dry summer of 2018.

Referee Comment: Authors postulate that the wet deposition rate covers the same period – so is it or is it not annual wet Hg(II) deposition rate?

Author Response: The wet deposition rate in our paper covers the period from first to last foliage sampling event at each site respectively. To make this clear we included an explanatory parenthesis in Line 439: " (from first to last foliage sampling event respectively)"

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