



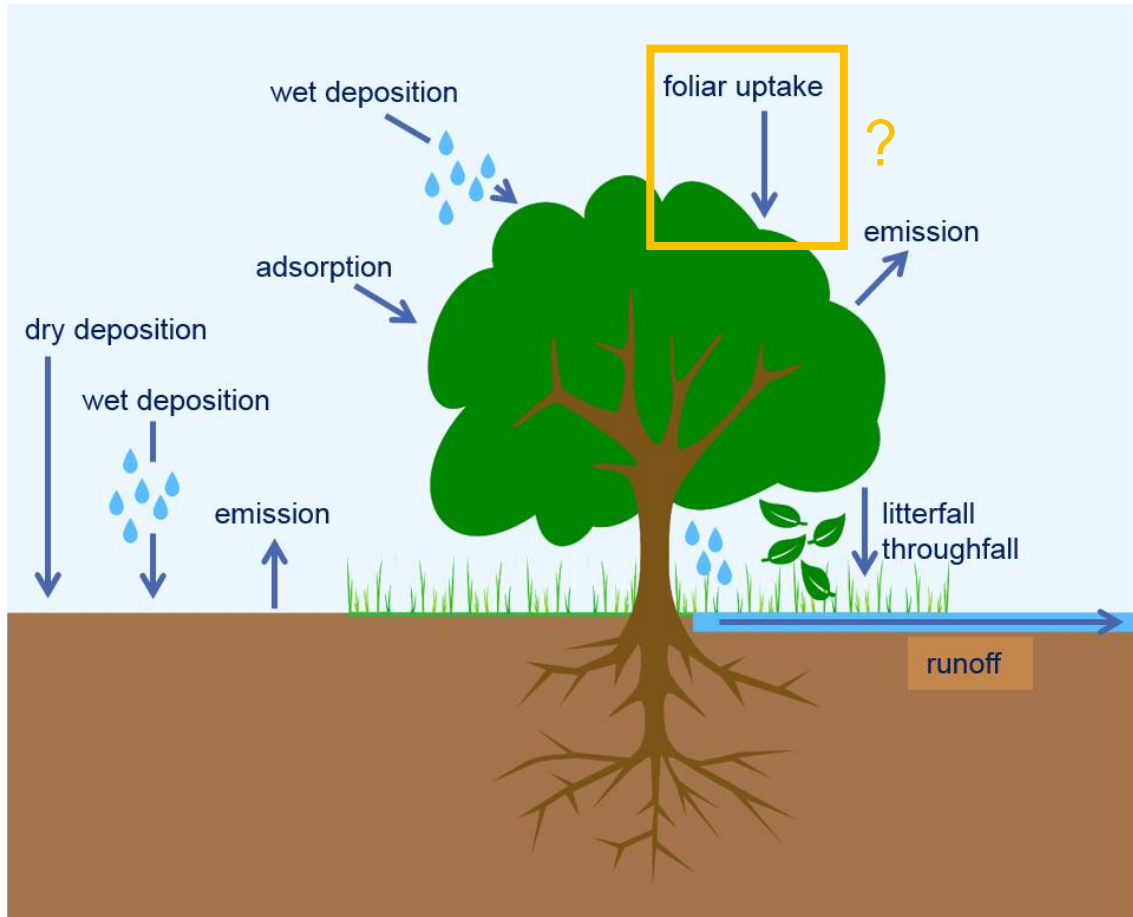
A bottom-up quantification of foliar mercury uptake fluxes across Europe

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Motivation

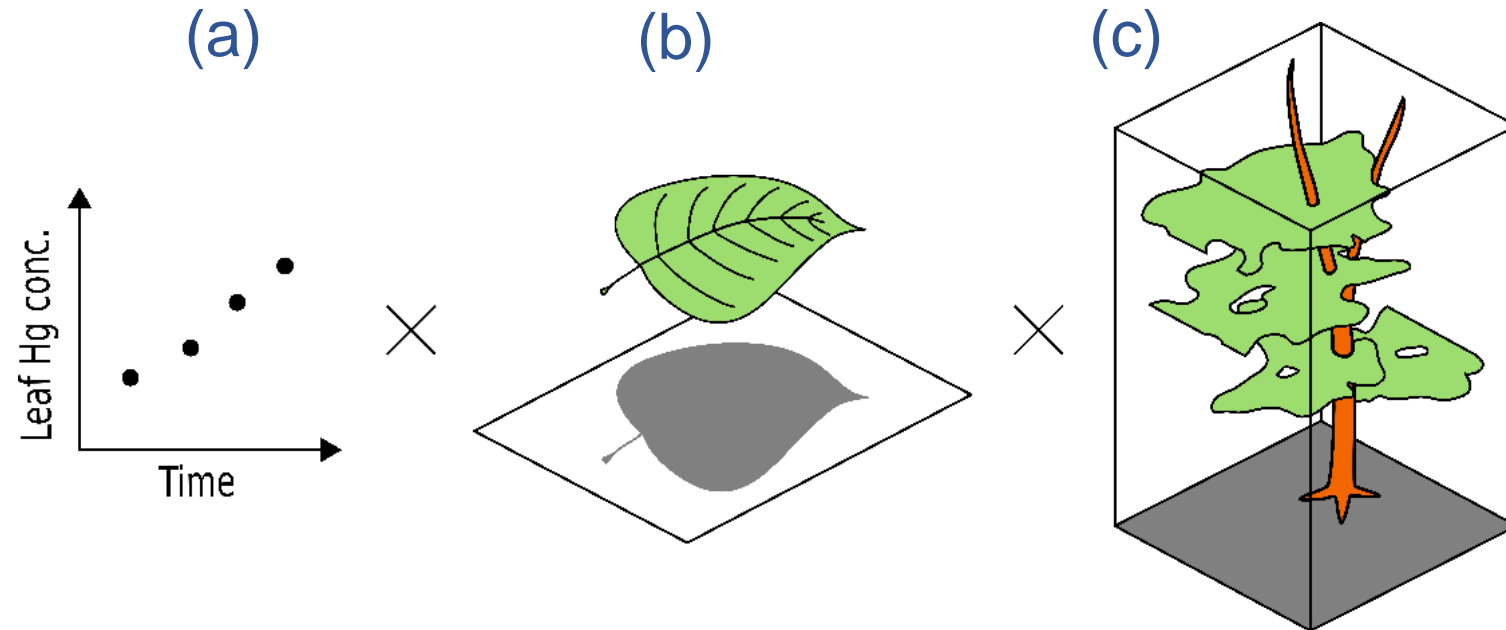


adapted from Ma et al. 2019

The quantity of net foliar Hg uptake fluxes is still uncertain in global Hg cycling assessment (Agnan et al. 2016).

- We applied a bottom-up approach to quantify foliar Hg uptake fluxes in 6 tree species at 10 research sites in Europe.
- We resolved the effect of tree height and needle age on foliar Hg uptake.
- We extrapolated an average foliar flux value to the total forest area of Europe.

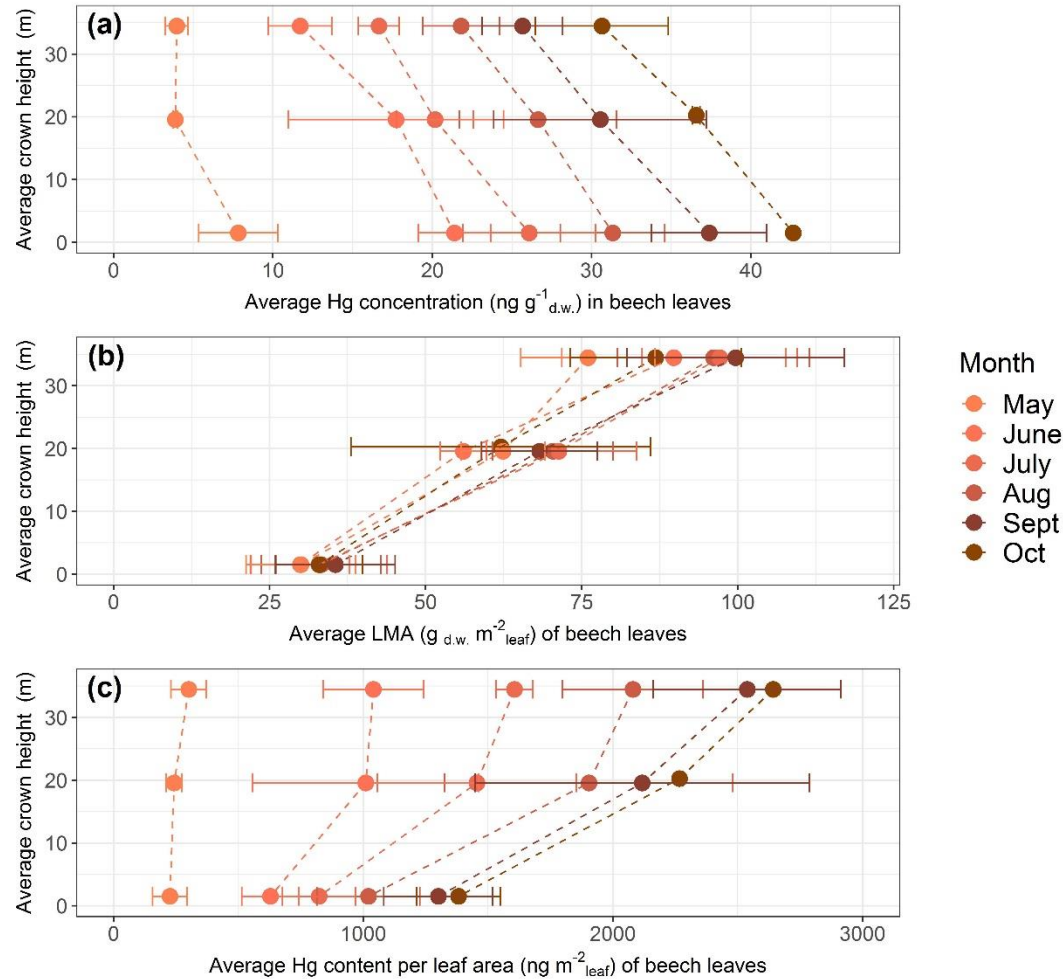
Bottom-up approach to calculate foliar Hg uptake fluxes



In order to obtain a **foliar uptake flux of Hg per unit ground area**

we measured the increase of foliar Hg concentrations per leaf dry weight over the course of the growing season (a), multiplied it with the respective leaf mass per leaf area (b) and the amount of leaf area over unit ground area (c).

Tree height effect on foliar Hg uptake

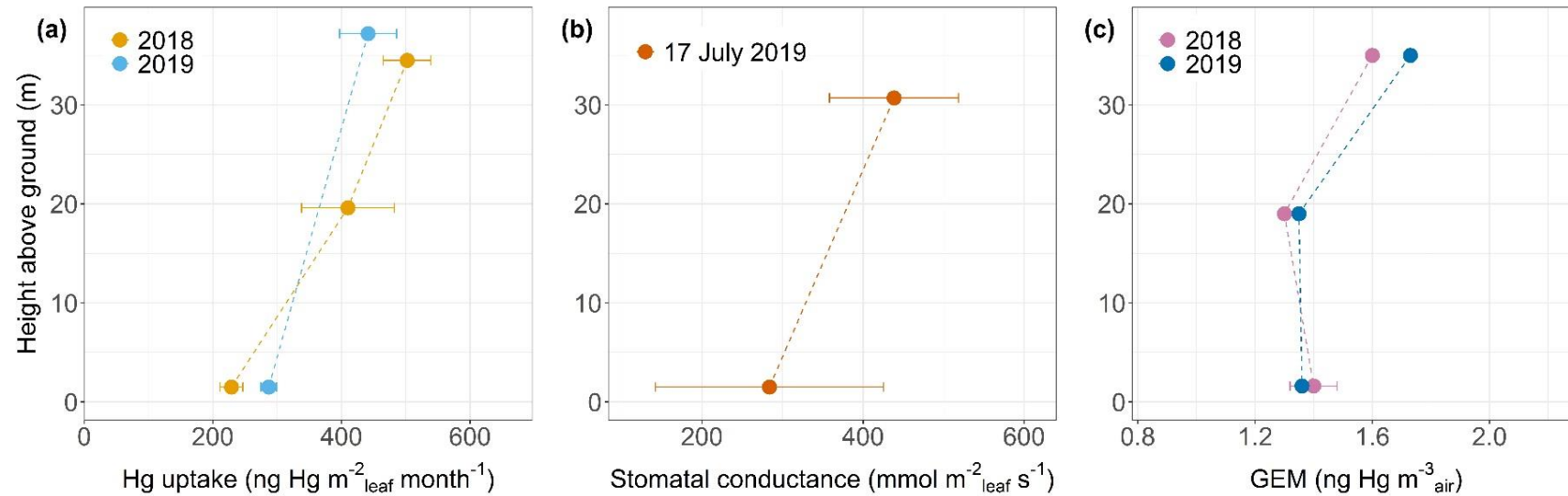


Due to leaf morphological adaptation to sun light availability leaf dry mass per leaf area (LMA) changes with the height of trees.

Consequently, Hg concentration per gram dry weight and per leaf area varies with tree height. This in turn changes foliar Hg uptake rates per gram dry weight and foliar Hg uptake rates per leaf area with tree height.

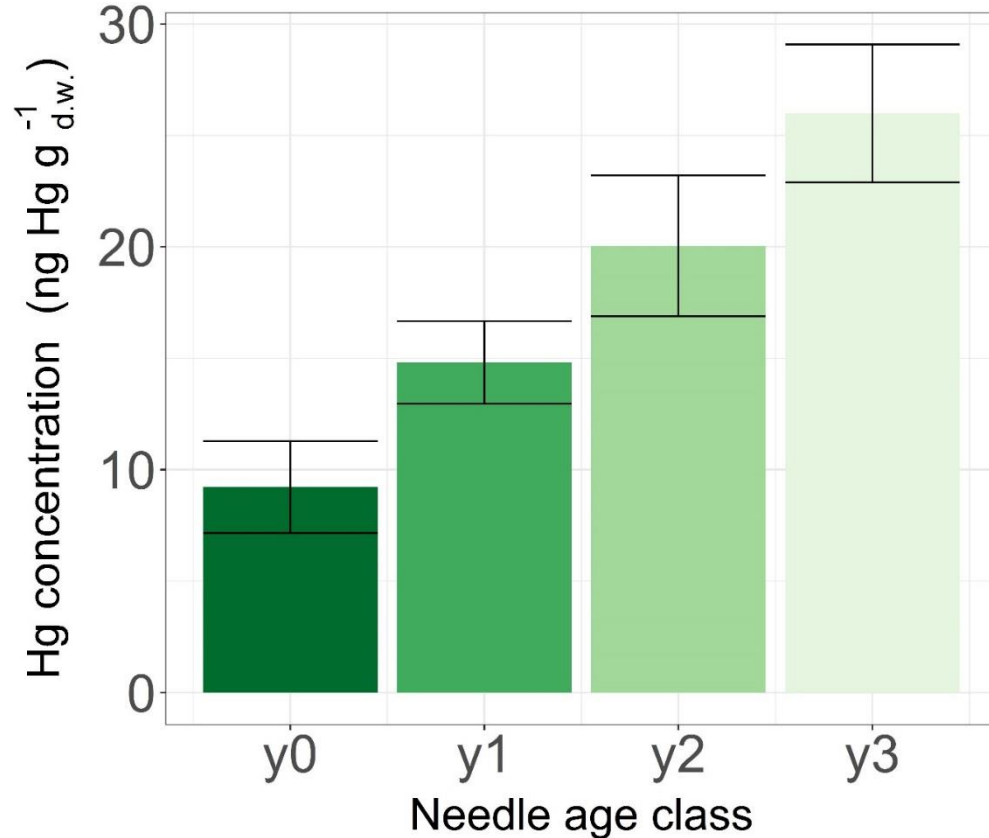
Average (\pm sd) Hg concentrations per dry weight (a), leaf mass per area (b) and Hg content per leaf area (c) measured in beech leaves at our focus research site at each month during the 2018 growing season

Possible reasons for tree height effects on foliar Hg uptake



Foliar Hg uptake rates per leaf area (a) followed a similar gradient with tree height as stomatal conductance (b) and air concentrations of gaseous elemental mercury (c). We hypothesize that there is a correlation between the three quantities.

Needle age effect on foliar Hg concentrations

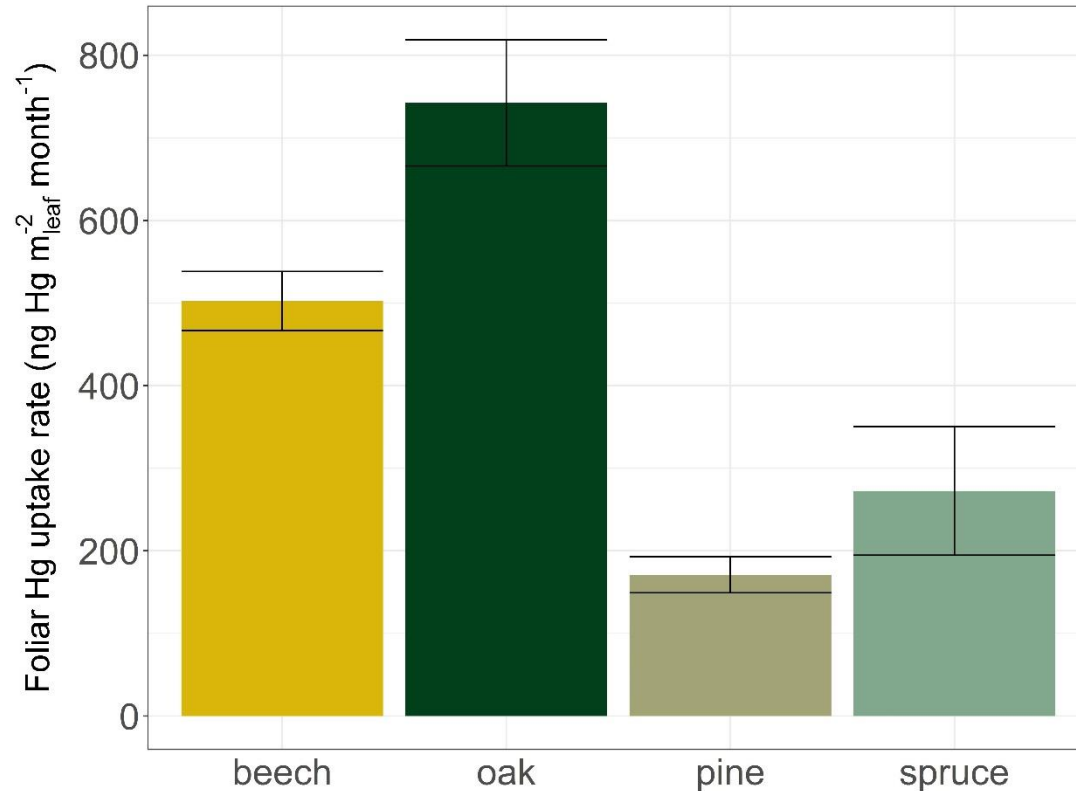


Hg concentrations increased with needle age thus older needles continue to accumulate Hg.

→ both needle age and tree height (slide 4) have to be taken into account when sampling leaves and needles for Hg analysis and Hg flux assessment

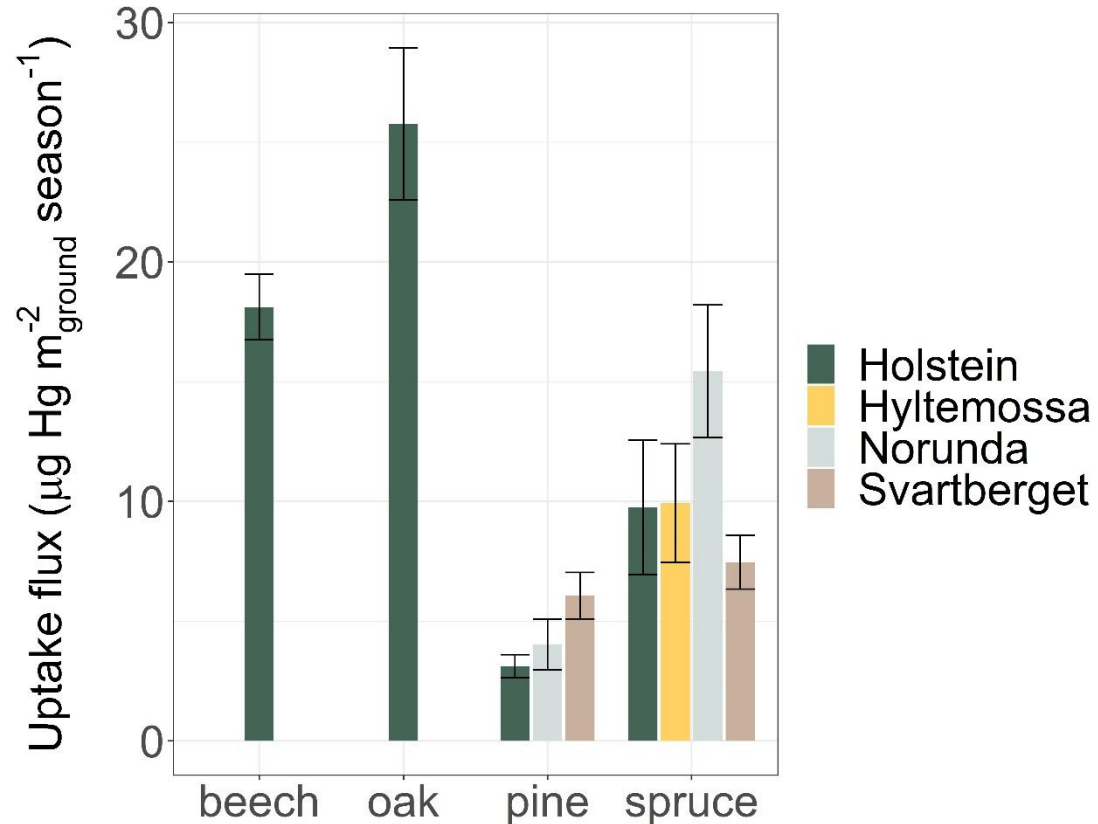
Hg concentrations (mean \pm sd) in needle age classes at our focus research site: y0 represents needles sprouting at current season, y1, y2 and y3 represent one-year old, two-year old and three-year old needles respectively

Foliar Hg uptake per leaf area of different tree species



Broadleaved species at our focus research site exhibited higher foliar Hg uptake rates per leaf area than coniferous species. This might be a result of higher metabolic activity of leaves vs. needles. (Reich et al. 1997; Wright et al. 2004).

Foliar Hg uptake fluxes per ground area



Total foliar Hg uptake flux per unit ground surface area was dependent on tree species composition at each research site.

Averaging foliar Hg uptake fluxes per tree species and weighting with the composition of tree species in Europe resulted in a foliar Hg uptake flux to the total area of European forests (~ 200 million hectares) of approximately 20 Mg Hg during the 2018 growing season.

Foliar Hg uptake fluxes per ground area of foliage of 4 tree species (beech, oak, pine, spruce) at 4 forested research sites (Holstein in Switzerland; Hyltemossa, Norunda and Svartberget in Sweden)

References

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