

TRENDS IN FOREST SOIL HEAVY METAL CONCENTRATIONS AT SWEDISH ICP IM SITES. RESPONSES TO REDUCTIONS IN ATMOSPHERIC DEPOSITION

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Introduction

Long-range atmospheric transport of heavy metals has increased the exposure to forest ecosystems but atmospheric deposition of heavy metals shows decreasing trends over the last decades. Metals in soil and stream water are to a large degree dependent on long-term and long-range atmospheric transport, and the main priority has been on mercury (Hg), lead (Pb) and cadmium (Cd) within the Convention on Long-Range Transboundary Air Pollution (CLRTAP) (UNECE 2003). Evaluations of temporal trends of heavy metals have been included within the ICP IM to support the CLRTAP in subprogrammes for precipitation chemistry (PC), throughfall (TF), litterfall (LF), runoff water (RW) and soil chemistry (SC) (Lundin et al. 2001). Catchment budgets show an ongoing accumulation of heavy metals and the release (RW) seldom exceeds input (PC + TF + LF) (Ukonmaanaho et al. 2001, Grigal 2002, Bringmark et al. 2013). In this study long term trends in heavy metal SC were evaluated across Swedish IM sites between 1994 and 2011.

Methods

Data reported to the ICP IM Programme Centre at the Finnish Environment Institute (SYKE, Helsinki, Finland) were used for the evaluation of temporal trends. Within soil profiles were 6 samples from soil plots (50 * 50 m) at different depths (F+H horizons, 0 – 5 cm, and 5 – 20 cm) taken every 5 to 10 years. At Swedish ICP IM sites (Aneboda, Gårdsjön, Kindla and Gammtratten) soil samples have been collected with regular intervals over the last decades and for the sites metal concentrations at different soil horizons were tested for temporal trends in more detail.

Results

Within Swedish IM sites Pb and Cd concentrations in the forest floor (F+H-horizons) decreased but accumulated in deeper mineral soil layers (Fig. 1). Mercury concentrations in the forest floor on the other hand increased at all Swedish IM sites.

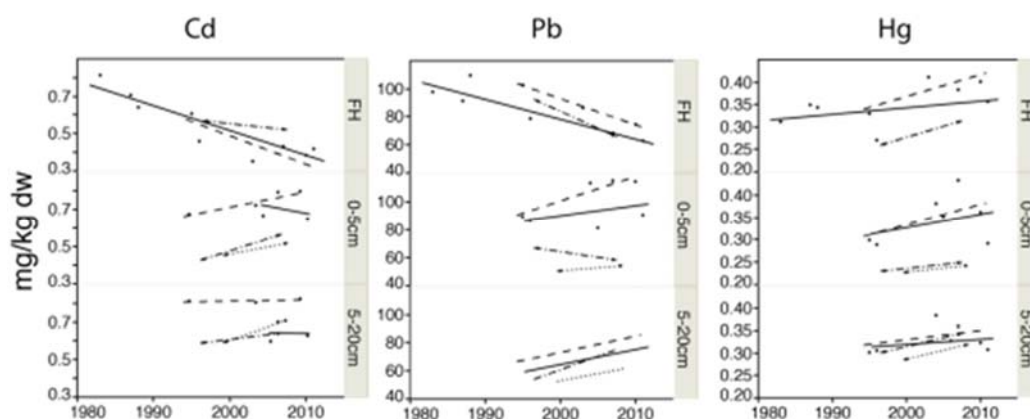


Figure 1. Soil metal concentrations at the four ICP IM sites in Sweden (Aneboda (solid line), Gammtratten (dotted line), Gårdsjön (dashed line), Kindla (dottedashed line)).

Conclusion

- As a response to changes atmospheric deposition did Pb and Cd concentrations decrease in the forest floor at Swedish IM sites
- Both Cd and Pb have accumulated in deeper mineral soil layers between 1994 and 2011
- Despite reductions in Hg emissions to the atmosphere and atmospheric deposition, Hg concentrations in the forest floor increased at all Swedish IM sites
- Large exceedances were found in deposition compared to runoff for all metals indicating an ongoing accumulation of heavy metals in the catchment despite the efforts to decrease anthropogenic emissions to the atmosphere

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