CONCENTRATIONS OF HEAVY METALS IN MOSS AS INDICATORS FOR ATMOSPHERIC DEPOSITION

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Keywords: Canopy drip; European Moss Survey; minimum sample size

Introduction

Monitoring of atmospheric deposition of heavy metals (HM) by technical deposition samplers can be complemented using moss as bioindicator. The moss technique allows covering areas of large spatial extent and mapping spatial patterns across time. Since 1990, every five years moss specimen have been collected and analysed for a broad range of HM within the framework of the European Moss Survey (EMS). This presentation aims at introducing the audience to that moss technique.

Methods

Within the EMS, sampling of moss at up to 7300 sites across Europe and chemical analysis of HM concentrations in moss specimens collected as well as quality control and statistical evaluation are conducted according to a harmonized methodology (iCP Vegetation 2014). Beyond persistent organic pollutants (since 2010) and nitrogen (since 2005), the EMS regards data on concentrations of the following HM: arsenic, cadmium, chromium, copper, iron, mercury, nickel, lead, vanadium, zinc and since 2005 also aluminium and antimony. In Germany, in addition to the results from chemical analysis information is collected on characteristics of the sampling sites and their surroundings which could influence the HM concentration in moss. The georeferenced data on HM concentration and potential predictors is compiled in a geographic information system allowing for statistical analysis including, e.g., the calculation of minimum sample size needed for reliable statistics, geostatistics in terms of variogram analysis and Kriging interpolation (Fig. 1).

Results

As exemplarily shown for mercury (Fig. 1) the results derived by geostatistics proved that the EMS allows reliable statistics for each HM across the European territory, single participating countries as well as for ecological land classes covering Europe. Geostatistics enabled to map spatial patterns from measurements, i.e. to fill up the space between the measurement sites by spatial estimation. Thus, for the correlation analyses not only the moss measurement values were used but also surface estimation derived by Kriging. The correlations indicated that the organisms used fairly well indicate atmospheric deposition and,

therefore, should be used to enhance the spatial resolution of deposition maps and, subsequently, HM and critical loads

Figure 1. Geostatistical surface estimations (left) and measured values (right) of Hg concentrations in moss (2010)
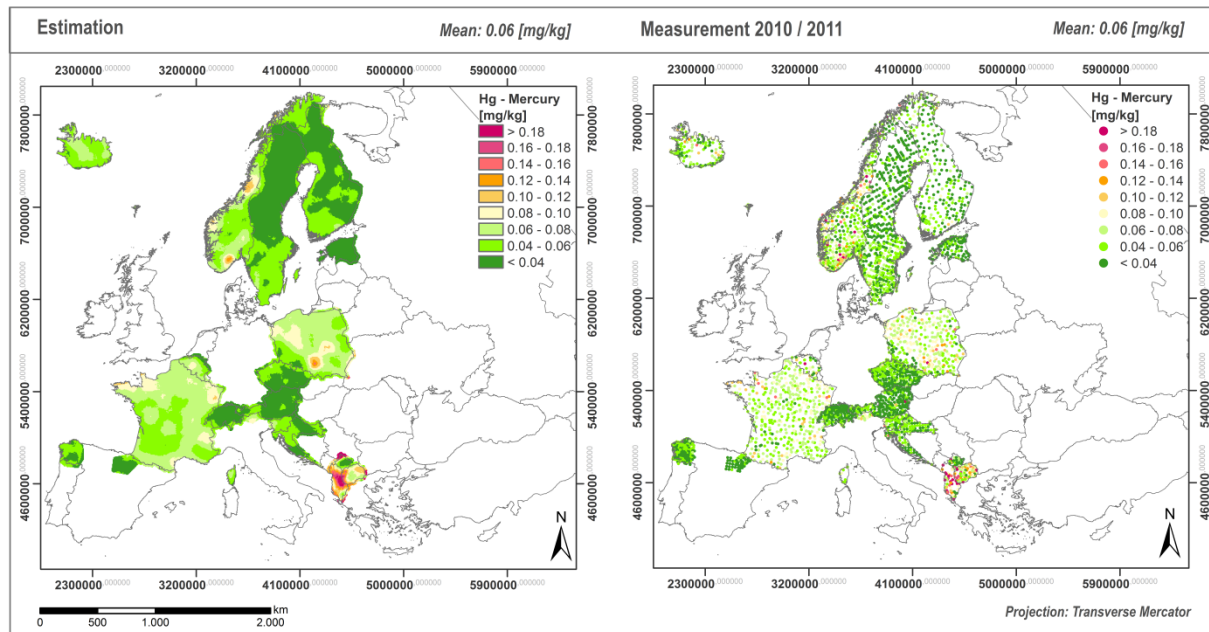
Conclusion

From the results of the investigations presented in this article can be concluded that the EMS yields spatially dense and valid information on HM exposure of ecosystems across areas of large spatial extent. HM concentrations in moss should be linked with emission and deposition data for validating data from emission inventories and deposition models commonly covering the same of several time intervals. Further, data on HM exposure yielded by the EMS should complement forest monitoring and effect assessments.

References

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