Conference or Workshop Item

Holy, Marcel; Pesch, Roland; Schröder, Winfried; **Harmens, Harry**; Fagerli, Hilde; Ilyin, Ilia; and the participants of the, European Moss Survey. 2009. First Europe-wide correlation analysis of factors affecting the total nitrogen and heavy metal concentration in mosses including deposition values. In: *Annual symposium of the working group on Environmental Chemistry and Ecotoxicology of the German Chemical Society, Trier, Germany, 23 – 25 Sept 2009*.

First Europe-wide correlation analysis of factors affecting the total nitrogen and heavy metal concentration in mosses including deposition values

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This study aimed at investigating the correlations between nitrogen (N) depositions and air concentrations and heavy metal depositions and element concentrations in mosses collected across Europe to quantitatively characterise the indicative value of mosses as biomonitors of HM and N deposition. Correlations between the total N and HM concentrations in mosses and atmospheric HM and N depositions and air concentrations were examined for the first time at a European scale. In addition to the deposition values, predictors such as urban and agricultural land uses, population and livestock density were integrated in the analyses to account for emission-related influences. The total N concentrations in mosses were determined at 2781 (2005/6) and the HM concentrations up to 7000 sites (1990, 1995, 2000, 2005) across Europe. Modelled atmospheric N and HM deposition and air concentration data were calculated using the Unified Model of the European Monitoring and Evaluation Programme (EMEP) of the Long-range Transboundary Air Pollution Convention. The modelled deposition and air concentration data encompass the metal elements Cd, Hg and Pb as well as several N compounds. Spearman rank correlation analysis and Classification and Regression Trees (CART) were applied.

The Spearman rank correlation analysis showed that the total N concentration in mosses and modelled N depositions and air concentrations are significantly associated ($0.53 \leq r_s \leq 0.69$, $p < 0.01$). Correlations with other predictors were lower than 0.55. Concerning the metal elements, the calculations corroborated that modelled atmospheric Cd deposition and Cd concentrations in mosses were correlated ($0.62 \leq r_s \leq 0.69$, $p < 0.01$). The correlation coefficients for Pb were between 0.67 and 0.73 ($p < 0.01$). Hg deposition and concentrations in mosses were correlated at a much lower level ($0.09 \leq r_s \leq 0.24$, $p < 0.01$). Multivariate correlation analyses showed that the Cd and Pb concentrations in mosses were mainly affected by depositions, emissions and urban land use around the sampling sites. Regarding Hg, in addition to these factors the moss species and analytical methods were found to be relevant. The CART analysis indicated that the variation in the total N concentration in mosses could be mainly explained by the variation in dry deposition of oxidised N, total dry N deposition as well as the livestock density and the ratio of urban land use around the sampling sites. Therefore, the total N concentration in mosses appears to mirror land use-related atmospheric N deposition across Europe to a high degree. The heavy metal and total N concentration in mosses is a valuable tool in identifying areas at risk from high atmospheric heavy metal and N deposition at a high spatial resolution.