Investigating biogenic sources and speciation of sulfur and selenium in rainfall

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Atmospheric deposition is a main source of essential nutrients and micronutrients (e.g., sulfur and selenium) to terrestrial systems, including agricultural soils. However, due to stricter controls on industrial emissions, especially in Europe and the United States, concentrations of sulfur, selenium and other elements in atmospheric deposition have declined. This decline has resulted in lower inputs of (micro)nutrients to soils, which may eventually result in deficiency in soils and crops and affect human health. Furthermore, declining industrial emissions may lead to a higher relative importance of natural sources to biogeochemical cycles, potentially causing changes in the distribution of (micro)nutrients in terrestrial systems.

The main natural source of atmospheric sulfur and selenium are biogenic emissions. Therefore, given the decrease in industrial emissions, the contents of sulfur and selenium in rainfall and in soils may be increasingly dominated by natural sources. We investigate biogenic sources of sulfur, selenium, and other trace elements in rainfall and their temporal dynamics at different locations in Europe. In addition to measuring total concentrations of sulfur, selenium, and dissolved organic carbon (DOC), we are measuring the isotopic composition and speciation of sulfur and selenium and analyzing atmospheric pathways for specific rain events. Preliminary data show that the total sulfur, selenium, and DOC concentration time-series were markedly different for continental and coastal locations. We found indications that sulfur, selenium and other trace elements were of biogenic origin, with stronger signals in the maritime-influenced areas. Information on the origin of these soil (micro)nutrients, chemical speciation, and quantification of biogenic inputs to soil systems via rainfall is of key importance in atmospheric and terrestrial models for predicting fluxes and fate of (micro)nutrients to soils.