Geophysical Research Abstracts
Vol. 20, EGU2018-10240, 2018
EGU General Assembly 2018

The importance of marine selenium emissions for continental selenium deposition

Aryeh Feinberg (1,2,3), Andrea Stenke (1), Thomas Peter (1), Lenny Winkel (2,3)

(1) Institute for Atmospheric and Climate Science, ETH Zürich, Switzerland (aryeh.feinberg@env.ethz.ch), (2) Institute of Biogeochemistry and Pollutant Dynamics, ETH Zürich, Switzerland, (3) Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

Selenium is an essential dietary element for humans and animals. However, widespread regions lack bioavailable soil selenium, leading to low selenium concentrations in food and putting people at higher risk for selenium deficiency. Atmospheric deposition of selenium, especially through rainfall, is an important source of selenium to soils. However, the atmospheric selenium cycle has not been extensively studied. It remains unclear how far selenium can travel in the atmosphere before being deposited, and therefore the spatial distribution of atmospheric selenium is unknown. Previous studies from the 1980s have estimated the magnitude of selenium emissions from different natural and anthropogenic sources. Marine biogenic emissions are responsible for an estimated 60-80% of natural selenium emissions and 30-50% of total selenium emissions, with the remaining emissions attributed to volcanoes and anthropogenic activities. Despite the suggested importance of marine biogenic emissions, most studies measuring selenium in aerosols have focused exclusively on anthropogenic selenium sources to explain their results. Using our global chemistry-climate model SOCOL-AER, we reevaluate the importance of marine biogenic emissions for the spatial distribution of aerosol selenium and selenium deposition.

Selenium chemistry is implemented analogously to the existing sulfur chemistry in SOCOL-AER, due to the expected chemical similarities between selenium and sulfur. In the model, selenium species (e.g. SeO_2, DMSe, OCSe, ...) are emitted from the surface based on estimates from previous field campaigns or atmospheric budgets. Emitted selenium compounds are subsequently oxidized in the atmosphere and can then condense on available aerosol surfaces. In SOCOL-AER, which includes only sulfate aerosols, oxidized selenium is taken up by sulfate aerosols and transferred between different aerosol size bins through sulfate aerosol coagulation, growth, and evaporation. Interactive dry and wet deposition schemes finally remove gas phase and aerosol selenium. By turning marine emissions of selenium off, we can identify the continental regions that are most reliant on marine emissions for selenium deposition. The continental Southern Hemisphere is most influenced by marine selenium emissions, since anthropogenic emissions of selenium are low and the ocean surface coverage is high. We compared the simulated aerosol selenium concentrations to previously measured concentrations. Selenium aerosol background measurements in the Southern Hemisphere cannot be easily explained without marine emissions. Although our model's base configuration includes selenium uptake by only sulfate aerosols, sensitivity tests including additional aerosol types (e.g. sea salt, organic aerosols, and dust) showed similar results. Our results illustrate the role of marine biogenic emissions on the atmospheric selenium cycle and the deposition of selenium to terrestrial environments such as agricultural soils.