The impact of emission trends and interannual climate variability on selenium deposition patterns

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Selenium is an essential dietary trace element with a narrow intake range for proper physiological functioning. The amount of selenium in food crops varies by location, depending on the levels of bioavailable selenium in the soils where local food is grown. Atmospheric deposition is an important source of selenium to soils, and therefore its distribution can play an important role for human health. However, it is currently unknown how selenium deposition patterns are affected by trends in anthropogenic emissions of selenium and interannual climate variability.

To answer these questions, we have implemented selenium chemistry into a chemistry-climate-aerosol model, SOCOL-AER. Volatile selenium species are emitted by the marine and continental biosphere, anthropogenic activities (e.g. coal combustion, metal smelting), and volcanoes. Our model predicts that these volatile compounds are rapidly oxidized and condense on aerosol surfaces. Despite the short global atmospheric lifetime of selenium (4.5 days), long-range transport can still affect selenium deposition. For example, in most continental areas in the Southern Hemisphere, half of selenium deposition originates from marine biogenic emissions. Wet deposition contributes 75% of selenium deposition, highlighting the importance of precipitation patterns in determining the distribution of selenium deposition. We ran simulations with anthropogenic emission maps from different years (1985, 2000, 2014) to test how selenium deposition is affected by changing emission patterns, specifically the shift in emissions from North America and Western Europe to East and South Asia. To test the impact of the El-Niño-Southern Oscillation on deposition patterns, we forced the model with sea-surface temperatures from different years. Our results suggest that selenium deposition patterns can be impacted by climate change and future changes in anthropogenic emissions.