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Volcanic sulfate deposition to Greenland and Antarctica: A modeling sensitivity study with CESM(WACCM)

Content

Reconstructions of the atmospheric sulfate aerosol burdens resulting from past volcanic eruptions are based on ice core-derived estimates of volcanic sulfate deposition and the assumption that the two quantities are directly proportional. Toohey et al (2013) modelled that the Antarctic and Greenland volcanic sulfate deposition is nonlinear for very large sulfur rich tropical eruptions (Tambora magnitude and larger), with significantly less sulfate deposition to Antarctica than to Greenland using the MAECHAM5-HAM aerosol-climate model.

Here we test the relationship for simulations of explosive tropical and extratropical Northern Hemisphere volcanic eruptions by co-injecting sulfur and halogens into the stratosphere with the CESM2(WACCM) model including aerosol, chemistry, climate, and earth system processes. We consider different eruption parameters varying composition, latitude, season, injection height and magnitude. We run the model injecting 17 Tg and 200 Tg of SO2, together with scaled halogens, at 24 km altitude 15° N and 64° N during January and July pre industrial 1850 conditions. We will analyse the modelled sulphate deposition signals over Greenland and Antarctica and compare them to the volcanic ice core records of known eruptions of comparable strength during the Common Era and the Holocene. The analysis will focus on the deposition fluxes and their Greenland/Antarctica efficiencies in relation to the eruption parameters, sulphate aerosol transport, and the atmospheric circulation and deposition. With the help of the model data we will learn more about the volcanic sources to the sink processes, which will be helpful to better interpret volcanic signals in bipolar ice core records.

References:

Toohey, M., K. Krüger, and C. Timmreck (2013), Volcanic sulfate deposition to Greenland and Antarctica: A modeling sensitivity study, J. Geophys. Res. Atmos., 118, doi:10.1002/jgrd.50428.

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