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Uncertainties of past volcanic forcing - Modelling the impacts of eruption parameters and atmospheric background conditions

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Reconstructions of past volcanic forcing rely on the assumption that the stratospheric sulphur loading from eruptions in the pre-satellite era is directly proportional to the sulphate flux recorded in polar ice sheets. The scaling factors, known as "transfer functions," used for this calculation are currently based on the Antarctic sulphate flux following the 1991 Pinatubo eruption, radioactivity in Greenland ice from nuclear weapon tests, and model simulations of two high-latitude eruptions. However, recent studies have shown that ice sheet deposition of volcanic sulphate varies significantly as a function of both eruptive parameters and the background atmospheric state, presenting an opportunity to enhance the accuracy and reliability of volcanic forcing reconstructions through improving the use of transfer functions.

Here, we investigate how the transfer function depends on eruption parameters and background conditions. Using simulations with the Earth system model CESM2-WACCM6, we explore a wide range of parameters, including eruption magnitude, latitude, plume composition, season, and plume height. By understanding the relationships between eruption parameters and resulting polar sulphate fluxes, we aim to improve the transfer function estimate used in the volcanic forcing for CMIP6 and shed light on the associated uncertainties.