Project: **885**

Project title: **Stratospheric Sulfur and its Role in Climate (SSiRC) data project**

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Report period: **2025-11-01 to 2026-10-31**

Stratospheric sulfate aerosol is an important climate driver, causing solar dimming after large volcanic eruptions. Hence, models are adapting sulfur and aerosol schemes to improve representation of relevant chemical processes and associated feedbacks. However, the reliability of global aerosol model simulations for future scenarios is uncertain. Therefore, an international model data intercomparison project named ISA-MIP (Timmreck et al., 2018; https://isamip.eu) has been established, with project 885 serving as a virtual working environment. Recent ISA-MIP studies have helped to better understand changes in stratospheric aerosol and its precursor gaseous sulfur species under volcanically perturbed (Quaglia et al., 2023) and unperturbed conditions (Brodowsky et al., 2024).

During the reporting period we further investigated the impact of the Pinatubo eruption on atmospheric temperature and dynamics in the ISA-MIP HErSEA Pinatubo experiments (Perny et al., 2026). The results confirm the general understanding of the stratospheric aerosol forcing due to additional volcanic SO2 injection, while simultaneously highlighting structural differences between models. Overall, for the Pinatubo-like experiments the multi-model mean temperature anomalies agree well with meteorological reanalysis data sets, and we find that in most cases, differences between models are larger than differences for individual models across experiments with varying injection amounts and altitudes. Differences in transport, radiative transfer, and microphysics as well as the characterisation of aerosol size distributions, play a crucial role in the emergence of the spread in the modelled temperature response. Our results show further that the sensitivity of the stratospheric temperature response to model selection is also apparent in other MIPs (Figure 1). Hence, we argue for caution in attribution studies and the interpretation of stratospheric aerosol injection experiments relying on individual or few models.

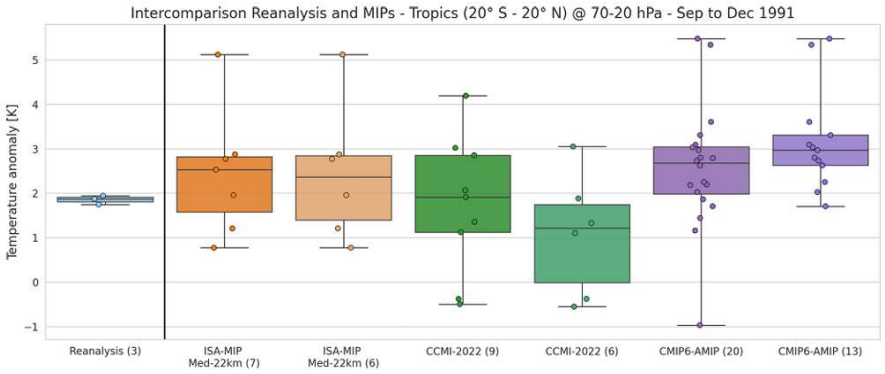


Figure 1 Temperature anomaly distributions for reanalyses (left), ISA-MIP and CCMI-2022 (center) and CMIP6-AMIP (right) in the tropics (20°S–20°N) averaged between 70 and 20hPa in the period September to December 1991. The number in brackets indicates the number of models used. Solid vertical line separates reanalysis from models. Light orange, light green and light purple boxplots represent models with more than one ensemble member. Individual model results are provided as dots in the same colour of the corresponding MIP/sample. (Figure from Perny et al. 2026)

References:

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Perny, K. et al..: Assessing the stratospheric temperature response to volcanic sulfate injections by Mt. Pinatubo: insights from the Interactive Stratospheric Aerosol Model Intercomparison Project, Atmos. Chem. Phys., 26, 10997–11025, https://doi.org/10.5194/acp-26-10997-2026, 2026.

Quaglia, I. et al.: Interactive Stratospheric Aerosol models response to different amount and altitude of SO_2 injections during the 1991 Pinatubo eruption, Atmos. Chem. Phys., 23, 921–948, https://doi.org/10.5194/acp-23-921-2023.

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