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Historical volcanic sulfur emissions and stratospheric sulfate aerosol optical properties for CMIP7

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Explosive volcanic eruptions injecting gases and aerosols into the stratosphere are a key natural driver of climate variability at annual to centennial timescales. They are thus one of the forcings considered by the Coupled Model Intercomparison Project (CMIP) Climate Forcings Task Team, in charge of identifying and implementing the next generation forcings for current and future generations of Earth System models. This presentation will provide an overview of ongoing work to produce volcanic forcing datasets for phase 7 of CMIP (CMIP7).

The datasets we produce will cover the period from 1750 to 2022 at version 1 to meet to the need of modelling groups who might run extended historical simulations starting in 1750 instead of 1850. We are producing one volcanic stratospheric sulfur emission dataset catering for the needs of models which have a prognostic interactive stratospheric aerosol scheme, as well as a stratospheric sulfate aerosol optical property dataset required by models that cannot interactively simulate stratospheric sufate aerosols. For the satellite era (from 1979 onwards), sulfur emissions and sufate aerosol optical properties are based on NASA's MSVOLSO2L4 and GloSSAC datasets, respectively. For the pre-satellite era (1750-1978), the emission dataset is based on ice-core datasets complemented by the geological record, whereas the aerosol optical property dataset is directly derived from emissions using the latest version of the Easy Volcanic Aerosol (EVA) model. This ensures methodological consistency between our emission and optical property datasets, further enhanced by the fact that EVA is calibrated using the same datasets we use for the satellite era. Our choice of methods aims to maximize consistency with methodologies used in individual model intercomparison projects (e.g. PMIP and VolMIP). A major focus of our task team is to produce well-documented datasets, which includes extensive meta-data and flags, detailed documentation, and provision of open-access scripts used to create the datasets, which should facilitate future development and operationalization by the community. We also discuss the most critical challenges for providing accurate volcanic forcing datasets, including the under-recording

of small-to-moderate magnitude eruptions before the satellite era, and the Hunga Tonga-Hunga Ha'apai 2022 eruptions, which injected relatively small amounts of sulfur, but 150 Tg of water into the stratosphere.