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Microphysically-consistent volcanic aerosol datasets for the 1963 Agung, 1982 El Chichon and 1991 Pinatubo eruptions

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Major tropical volcanic eruptions inject huge amounts of SO_2 directly into the stratosphere, and create a long-lasting perturbation to the stratospheric aerosol. The abruptly elevated aerosol has strong climate impacts, principally surface cooling via scattering incoming solar radiation. The enhanced tropical stratospheric aerosol can also absorb outgoing long wave radiation causing a warming of the stratosphere and subsequent complex composition-dynamics responses (e.g. Mann et al., 2015; Dhomse et al., 2015).

In this presentation we apply the composition-climate model UM-UKCA with interactive stratospheric chemistry and aerosol microphysics (Dhomse et al., 2014, Brooke et al., 2017) to assess the enhancement to the stratospheric aerosol and associated radiative forcings from the three largest tropical eruptions in the last 60 years: Mt Agung (March 1963), El Chichon (April 1982) and Mt. Pinatubo (June 1991)

Accurately characterising the forcing signature from these major eruptions is important for attribution of recent climate change and volcanic effects have been identified as a key requirement for robust attribution of multi-decadal surface temperature trends (e.g. Marotzke and Forster, 2015).

Aligning with the design of the ISA-MIP co-ordinated multi-model "Historical Eruption SO_2 Emissions Assessment" (Timmreck et al., 2018), we have carried out 3-member ensembles of simulations with each of upper, low and mid-point best estimates for SO_2 and injection height for each eruption.

The 3D model resolves the microphysical-dynamical evolution of the volcanic aerosol plume during global dispersion, with evaluation against satellite, ground-based lidar and in-situ measurements also ensuring the datasets are consistent with a diverse set of observations.

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