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The influence of stratospheric dynamics on the forcing efficacy of tropical volcanic SO_2 injection: a case study around the 1991 Mount Pinatubo eruption

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Major tropical volcanic eruptions exert significant climate impacts principally via enhanced scattering of solar radiation due to the injected SO_2 elevating particle concentrations in the stratospheric aerosol layer. The size distribution of stratospheric aerosol particles also shifts to larger sizes in volcanically-enhanced conditions, which promotes absorption and subsequent stratospheric heating as well as causing faster sedimentation. How the volcanic sulphur cloud is dispersed also strongly affects the longevity of its radiative effects. In this presentation we investigate the role of stratospheric dynamical variability in affecting the temporal evolution of the volcanic aerosol, and also its feedback on subsequent chemical and dynamical ozone changes. Among various processes, the Quasi-Biennial Oscillation (QBO), the dominant mode of dynamical variability in the tropical stratosphere, is known to play a key role in determining the meridional dispersion of the volcanic cloud generated by major tropical eruptions.

We have carried out a series of interactive stratospheric aerosol simulations with the UM-UKCA composition-climate model, to explore how different QBO phase impact volcanic radiative forcing, with a test case based around Mount Pinatubo. We will present results from an ensemble of simulations for different easterly and westerly phases of QBO, comparing simulated stratospheric aerosol properties (e.g. extinction, AOD, effective radius, particle size distribution) against a range of satellite and in-situ observational datasets. Changes in dynamics and temperatures would be compared against reanalysis (e.g. ERA-interim, HaDCRUT4) datasets followed by an analysis of radiative and dynamical changes for contrasting phases of QBO.

References:

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