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Climate Impacts of Stratopsheric Particle Injection

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There is an obvious need for methods to verify the accuracy of geoengineering given no observations of a geoengineering programme. Accordingly, the ability of Coupled Model Intercomparison 5 climate models to reproduce the observed response of volcanic eruptions is analysed. Models are shown to be unable to produce the major observed Northern Hemisphere dynamical response to tropical volcanic eruptions which is noted as a cause for concern of the accuracy of geoengineering simulations.

Simulations are then performed with the HadGEM2 climate model (HadGEM2-L38) and its enhanced stratospheric resolution counterpart (HadGEM2-L60). The HadGEM2-L60 model is shown to reproduce a response substantially closer to that observed than HadGEM2-L38 and mechanisms behind the response are analysed and explained.

With the HadGEM2-L60 model shown to be substantially better in reproducing the observed dynamical response to volcanic eruptions, simulations of GeoMIP's G4 scenario are performed. Simulated asymmetries between the immediate onset and immediate cessation ('termination') of geoengineering are analysed. Whilst a rapid large increase in stratospheric sulphate aerosols (such as from volcanic eruptions) can cause substantial damage, most volcanic eruptions in general are not catastrophic. One may therefore suspect that an 'equal but opposite' change in radiative forcing from termination may therefore not be catastrophic, if the climatic response is simulated to be symmetric. HadGEM2 simulations reveal a substantially more rapid change in variables such as near-surface temperature and precipitation following termination than the onset, indicating that termination may be substantially more damaging and even catastrophic.