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SPICE Work Package 3: Modelling the Effects of Stratospheric Aerosol Geoengineering

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This talk presents the results of the SPICE Work Package 3. There is an obvious need for methods to verify the accuracy of geoengineering given no observations of a geoengineering programme. Accordingly, model ability in reproducing the observed dynamical response to volcanic eruptions is discussed using analysis of CMIP5 data and different configurations of the HadGEM2 model.

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 impacts of geoengineering are described, and 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.

Some suggestions for hemispherically asymmetric geoengineering have been proposed as a way to reduce Northern Hemisphere sea ice, for example, with lesser impacts on the rest of the climate. However, HadGEM2 simulations are performed and observations analysed following volcanic eruptions. Both indicate substantial averse consequences from hemispherically asymmetric loading of stratospheric loading on precipitation in the Sahelian region – a vulnerable region where drought has caused hundreds of thousands of deaths and created millions of refugees in the past.