Session 26: Mitigation scenarios including overshoot and climate intervention

(Abstract N° 1112)

Comparison of UKESM1 and CESM2 simulations using the same multi-target stratospheric aerosol injection strategy

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Abstract

Solar climate intervention using stratospheric aerosol injection (SAI) has been proposed as a method which could offset some of the effects of global warming. The Assessing Responses and Impacts of Solar climate intervention on the Earth system with Stratospheric Aerosol Injection (ARISE-SAI) set of simulations is based on a moderate greenhouse gas emission scenario and starts injection of sulfur dioxide, which oxidises to form stratospheric sulfate aerosols, in the year 2035 to keep the global-mean surface temperature at 1.5 K above preindustrial conditions (ARISE-SAI-1.5). The injection occurs in the lower stratosphere at four locations and a controller algorithm is used to maintain the global-mean temperature as well as the latitudinal gradient and inter-hemispheric difference in surface temperature. This is the first comparison between two models (CESM2 and UKESM1) applying the same multi-target SAI strategy. CESM2 is successful in reaching its temperature targets, but UKESM1 has considerable residual Arctic warming. This makes the controller algorithm change the latitudinal distribution of injection after 2050 as it focuses on satisfying the interhemispheric temperature target and does not seek to satisfy the equator-to-pole temperature gradient target. We find that the pattern of cooling from SAI is dominated by the climate models' feedbacks rather than the aerosol optical depth latitudinal pattern. Therefore research which further constrains the level of future Arctic warming will inform any hypothetical SAI deployment strategy which aims to maintain the interhemispheric and equator-to-pole temperature differences. Furthermore, though there is broad agreement in the precipitation response in the extratropics, precipitation changes over tropical land have important intermodal differences, even under greenhouse gas forcing only. This ensemble comparison is the first step in comparing policy-relevant scenarios of SAI, and will help in the design of an experimental protocol which both reduces some negative side effects of SAI and is simple enough to encourage more climate models to participate.

Keywords

Climate Intervention, Solar Geoengineering, Model Intercomparison