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Reaching temperature targets using solar geoengineering applied to the P6 Overshoot Scenario SSP5-34-OS

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Geoengineering Model Intercomparison Project (GeoMIP) Tier 1 solar geoengineering experiments for CMIP6 only include pathways that are based on high greenhouse gas forcing pathways (SSP5-85 or 4xCO_2). However, a scenario with a less extreme deployment of solar geoengineering would be in combination with ambitious mitigation efforts and large carbon dioxide removal (CDR) efforts in order to not exceed temperature levels proposed by the COP21 Paris agreement. A Tier 2 GeoMIP experiment has been proposed, which is based on the SSP5-34 overshoot scenario. This scenario describes an emission pathway following SSP5-85 until 2040 and then includes assumption of large negative CO_2 emissions in addition to reductions in greenhouse gas emissions. In this scenario, surface temperatures reach values above 1.5 or 2°C for some time in the future before slowly coming back down. To cut off the peak warming and stay below specific temperature targets, solar geoengineering is applied for a limited time period. It is expected that applying geoengineering to an overshoot scenario is different than using a high greenhouse gas forcing scenario, including impacts on climate, precipitation, but also on chemistry, and stratospheric ozone, due to changes in land surface assumptions and the evolution greenhouse gas and other emissions. Here, we use the NCAR Whole Atmosphere Community Climate Model Version 6 (WACCM6) to simulate the overshoot scenario as the baseline. In a second simulation, we apply solar geoengineering using the same pathway and, in addition, increase the burden of stratospheric sulfate aerosols in a way that temperatures will not exceed 1.5 or 2°C warming above the per-industrial average. We present first results and discuss input datasets that would allow other modeling groups to perform this type of simulation. We further point to the need for designing more scenarios that will achieve critical temperature levels, while combining different mitigation options, including CDR and solar geoengineering.