Impacts of Stratospheric Sulfate Geoengineering on PM2.5

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Particulate matter (PM) includes sulfate, organic carbon, elemental carbon, soil dust, and sea salt. The first three components are mostly present near ground as fine particulate matter with a diameter less than 2.5 μm (PM2.5), and these are of the most concern for human health. Here we examine the impact of stratospheric sulfate geoengineering on PM2.5, taking advantage of the Stratospheric Aerosol Geoengineering Large Ensemble (GLENS) project by Tilmes et al. (2018). GLENS is an ensemble of a 20-member climate model simulation injecting SO_2 into the lower stratosphere at 15°N, 15°S, 30°N, and 30°S to balance RCP8.5 forcing using the Community Earth System Model, version 1, with the Whole Atmosphere Community Climate Model as its atmospheric component. This model simulation is performed with comprehensive stratospheric chemistry, and simplified tropospheric chemistry in order to represent aerosols processes. Variables including precipitation along with other climate changes under geoengineering play an important role in determining the surface PM2.5 concentration. Stratospheric sulfate geoengineering reduces PM2.5 as compared to RCP8.5 because changes in precipitation and surface cooling change soil moisture and plant growth, which impacts dust emissions, which reduces the dust concentration over desert regions. PM2.5 other than dust increases under geoengineering relative to RCP8.5, and this is dominated by the response of secondary organic aerosol (SOA). Since gas precursors of SOA are prescribed in the simulations, the increase of SOA is mainly a result of climate changes from geoengineering, which impact the formation and deposition of SOA. Precipitation changes, including total amount, frequency and duration under geoengineering, determine the wet deposition of components. We also found that the fall-out into the troposphere of injected sulfate aerosol does not increase its contribution to PM2.5, because it mainly concentrates in larger particles.

Key words: geoengineering, climate intervention, GeoMIP, PM2.5, dust

Reference

Tilmes, S. et al., 2018: CESM1(WACCM) Stratospheric Aerosol Geoengineering Large Ensemble (GLENS) Project *Bull. Amer. Meteor. Soc.* (submitted)