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Keywords

- climate change
- geoengineering
- global warming

Index Terms

- Atmospheric Composition and Structure: Aerosols and particles
- Biogeosciences: Climate dynamics
- Atmospheric Composition and Structure: Middle atmosphere: constituent transport and chemistry
- Global Change: Atmosphere
- Global Change: Earth system modeling

- Abstract
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Abstract

Exploring the geoengineering of climate using stratospheric sulfate aerosols: The role of particle size

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Aerosols produced in the lower stratosphere can brighten the planet and counteract some of the effects of global warming. We explore scenarios in which the amount of precursors and the size of the aerosol are varied to assess their interactions with the climate system. Stratosphere-troposphere exchange processes change in response to greenhouse gas forcing and respond to geoengineering by aerosols. Nonlinear feedbacks influence the amount of aerosol required to counteract the warming. More aerosol precursor must be injected than would be needed if stratosphere troposphere exchange processes did not change in response to greenhouse gases or aerosols. Aerosol particle size has an important role in modulating the energy budget. A prediction of aerosol size requires a much more complex representation and assumptions about the delivery mechanism beyond the scope of this study, so we explore the response when particle size is prescribed. More aerosol is required to counteract greenhouse warming if aerosol particles are as large as those seen during volcanic eruptions (compared to the smaller aerosols found in quiescent conditions) because the larger particles are less effective at scattering incoming energy, and trap some outgoing energy. About 1.5 Tg S/yr are found to balance a doubling of CO_2 if the particles are small, while perhaps double that may be needed if the particles reach the size seen following eruptions.

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