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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Climatic impacts of stratospheric geoengineering with sulfate, black carbon and titania injection" *by* A. C. Jones et al.

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The utilization of a high-top atmospheric model that is independently capable of producing a quasi-biennial oscillation (QBO) provides an important opportunity to study the coupling of radiation and dynamical processes in the stratosphere. This is particularly true in light of recent work highlighting the potential coupling of dynamical changes in the stratosphere and other important climatic changes, such as Antarctic ice (for example McCusker et al. Geophysical Review Letters 2015).

The parameterization of aerosol microphysics could have very substantial impacts on their radiative properties, with additional consequences for other changes within the climate system. Our team has recently published a study in Atmospheric Chemistry

and Physics (Weisenstein et al. ACP vol. 15, 11835-11859, 2015) that utilizes a new microphysical scheme to investigate the chemical risks and radiative efficiency of solid aerosol particles injected into the stratosphere. The particles are allowed to interact with background liquid sulfate-water aerosol particles, and to coagulate to form fractal multi-particle aggregates.

To compute the radiative properties of these aerosols, we applied a fractal scattering model based on Mie theory. Because the coagulation of solid aerosols does not lead to the formation of larger sphere-like particles as for liquid particles, we believe this is a more physically plausible way of describing the behaviour of solid aerosols than the application of a log-normal distribution. The log-normal distribution may result in too large a fraction of total aerosol mass in unrealistically large particles, with consequences for radiative forcing, chemical changes to the stratosphere, and sedimentation rates.

Specific comments:

– The Dhomse et al. 2014 reference on 30051 was not in the bibliography.

– The analysis of the precipitation cycle on p.30054 is significant; it would be valuable to compute the sensitivity of this model in %/K to compare to other models.

– The increase in sea ice extent on p.30056 is impressive, however it is unclear to me how to interpret this in light of the McCusker findings re: continued Antarctic ice loss.

– A significant contribution of this study is affirming correlation between trends in stratospheric warming and zonal stratospheric winds; I would be interested to know how this compares with other models.

– The discussion of surface albedo feedback from black carbon in the conclusion was useful. It seems highly sensitive to deposition, which is dependent on both model (extratropical STE) and microphysical (size distribution and sedimentation) factors. It seems like this merits further investigation.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 30043, 2015.