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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Geoengineering by stratospheric SO_2 injection: results from the Met Office HadGEM2 climate model and comparison with the Goddard Institute for Space Studies ModelE" *by* A. Jones et al.

Anonymous Referee #1

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This study compares model results of geoengineering the stratosphere with sulphate aerosol obtained with the Met Office HadGEM2 coupled atmosphere ocean model with results obtained in a previous study conducted by A. Robock et al. (2008). The study comprises sections of model set up description and results as to the impact of man-made aerosol on the solar radiation balance, surface air temperature and precipitation. The paper is well written and clearly organized. However the reader might get the impression that it lacks discussion on some aspects that are very relevant to the issue of stratospheric aerosol geoengineering. The model mechanism of aerosol injection is

described and detail on the climate model set up is given. But no information on the particular aerosol scheme and processes taken into account is provided. Reference to the respective aerosol scheme is given but still it remains unclear what the particular model assumptions are. As was pointed out by Robock et al. (2008) and Rasch et al. (2008), and shown by Heckendorn et al. (2009), aerosol processes are likely to play an important role as to the effectiveness of geoengineering of the stratosphere and therefore some detail on particular model assumptions in this study may be expected within the framework of this publication. Man-made stratospheric aerosol is likely to have numerous feedback on the climate system via local heat production, water vapour release and heterogeneous chemistry processes that will interact with the radiation balance and general circulation. These issues are not explicitly addressed in this study, and the results shown should be relativised against them. The results shown in this study seem very interesting and should eventually merit publication. However, I do not understand why the results were not shown in more detail. I would recommend this paper for publication if the authors could include an extended treatment of model experiment conditions, and also a more detailed comparison of model results appears wishful to me.

Particular Remarks.

1) page 7424, line 1-2: "The experimental designs (. . .) are sufficiently similar for a comparison to be useful". I agree with that. The results are comparable in that they cover similar periods and identical IPCC A1B scenario. But from an aerosol dynamical point of view couldn't the set up be much more dissimilar with one grid box injection versus global injection, and with a modal aerosol model with detailed aerosol dynamics versus a passive tracer experiment?

2) page 7425: Why not start result comparison with an overview on the stratospheric aerosol that is obtained? Making inferences on the global stratospheric aerosol from solar radiation incidence is very cryptic for the reader.

3) page 7425, line 10 ff.: Although I see that model runs done under different meteorological conditions may produce complex radiation patterns as to the geoengineered response, I do not really understand what is meant with the “double-call to the radiation scheme”. This may require some clarification.

4) page 7426, line 7 ff.: The authors note that the model relapse response is both quantitatively and qualitatively different. I would be interested in knowing if the authors have an idea as to what the reasons to this differential behaviour might be. If there is a hint in the text it seems unclear to me.

5) page 7426, line 21 ff.: If not compared with ModelE results, it would be interesting to see the HadGEM2 arctic sea ice response.

6) page 7428, line 3 ff: This appears to be the most important result to the reviewer. Although homogeneous aerosol injection may cancel out on global average temperature increase due to GHG relative to the 1990’s, precipitation does vary both on global average and very significantly on a local base. Why not discuss it in more detail?

7) page 7429, line 20 ff.: Stratospheric aerosol geoengineering may have a sufficiently large potential to defer global warming for a certain period but dissimilarities on the regional scale and among different climate factors are likely. To assess the model inherent uncertainties comparisons between models with standardised experimental set ups are required. Isn’t it remarkable then that with a dissimilar model set up one may reach very similar results? Does this point into the direction that further progress also requires the consideration of certain key mechanisms that may be equally unconsidered in these models? Or does it mean that the climate system, and stratospheric geoengineering in particular is insensitive relative to model assumptions?

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 7421, 2010.