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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.

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To begin with, we thank the referee for the comments on our manuscript. In response to the referee's specific comments:

"Anyhow, some important issues are missing, mainly regarding the setup of the experiments. The model description is very short and information on the vertical extension of the model used in this study are missing. The vertical extension is crucial for such simulations and might not be sufficient in this case."

We have revised the paper to include information on the vertical extent of the atmosphere in both models, and have explained why the lower model top in this version of HadGEM2 made us decide to use a different SO2 injection approach (lines 36, 50 and 73-76).

"Heckendorn et al (2009) show the impact of the experiment design regarding the emissions of SO2 on the results. The here reviewed paper misses almost any information on the simulated aerosol. A short description of the aerosol physics is essential for the reader. In order to understand the results and to put them in the context with previous results, 2d informations on the aerosol distribution and structure should be given. See Heckendorn et al (2009) and Rasch et al (2008) on details, e.g. lifetime of theaerosol, AOD, SAD, and radiative forcing."

We have now included descriptions of the aerosol schemes used in both models (lines 38-47 and 51-58), and also a discussion of the resulting distribution of sulphate aerosol from geoengineering (new section 3.1 and Fig. 1). Despite the different model formulations, different vertical extents and different SO2 injection methods, the resulting aerosol burdens are very similar in distribution. Aerosol lifetime is already noted (line 80), as is the radiative impact of the geoengineered aerosols (Section 3.2 and Fig. 2). We now state that the changes in surface short-wave is for all-sky conditions (line 99).

"Another weak part of the paper is the experimental design and the missing information of the aerosol behavior. The design of the experiments is rather simple compared to previous publications. Following the results of Heckendorn et al (2009) it is strongly questionable, if the experimental design is sufficient similar for a comparisonto be useful as mentioned by the authors. The globally uniform injection of SO2 is for sure not realistic. The aerosols are transported poleward anyhow. Aerosol physics isvery different for emissions into one box, as done for ModelE, compared to global emissions, resulting in very different radiative impact of the aerosols (Heckendorn et al (2009)). As no distribution of the aerosol is given in the paper, the reason for described differences remains unclear, especially as the given SW radiation is calculated differently. Please,

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add also a word if you show clear sky or all sky conditions. I strongly recommend to change the design of the HadGEM2 experiments toward a more realistic approach and toward a more similar one to the ModelE simulations and repeat the comparison. This would bring this paper to a state of the art level regarding previous publications."

The Referee quotes Heckendorn et al. (2009) as evidence that the two experiments are not similar enough for a comparison to be of use. We disagree. Firstly, Heckendorn et al. (2009) notwithstanding, the aerosol distributions from the two models show very similar characteristics, despite the different injection approaches of the two models. Secondly, and more importantly, even though the absolute magnitude of the geoengineered aerosol burdens differ (along with the resulting magnitudes of the changes in surface solar radiation), the important result is that a given amount of SO2 injected at the same altitude in two models produces climate changes which are generally similar, despite all the differences between the models. We have revised the Abstract and the first paragraph of the Conclusions to emphasise this. It is precisely because the models differ that this comparison and its result are, we believe, useful, and this is why we encourage comparison between as many models as possible in the final paragraph.

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