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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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We thank the referee for their comments on our manuscript. Our replies are as follows:

"p 7425 l10: "scatter in HADGEM2 probably larger because no ensembles": ??? Well - this could be tested since MODEL E results should be known per single member as well."

1. There is indeed more variability in ModelE when one considers just single simulations rather than ensemble means. This section of the manuscript has been corrected

and rewritten to improve clarity, including changing from a zonal-mean plot to maps, which show the general similarity of the distributions better.

"p7425 l18: Please document the geoengenic mean global AOD change and sulphur loads from both simulations, also cloud cover changes. Maybe together with a standard deviation for the 10 year period investigated."

2. We now report the AODs (lines 88-89) and burdens (caption to new Fig. 1) from geoengineering, as well as the changes in total cloud cover (lines 109-110).

"p7425 why is the net SW forcing at TOA not provided?"

3. Values for ToA SW forcing were not initially provided as the forcing was calculated differently in the two models. We now explain the two different methods and the estimate of the SW forcing produced (lines 111-123).

"p7425-6: There is decadal cooling rate of 0.46 K/decade mentioned for the GISS model. But then the Model E arrives at 0.69 K cooler in the second decade. Does this mean that the GISS model is still constantly cooling further in the second decade? This is kind of in contrast to the rapid warming after the end of geoengeneering. Could this be explained?"

4. As noted in the second sentence of Section 3.3 (line 128), the cooling rate of 0.46 K/decade is for the trend over the first decade of the ModelE simulation, after which the temperature stabilises, as can be seen in figure 3(b). The temperature difference of 0.69 K in the second decade is the difference between the geoengineered run and the A1B run, meaned over the second decade. As well as the geoengineered run cooling, the A1B run has warmed, giving a greater temperature difference than the cooling rate of 0.46 K/decade might initially suggest.

"p7426 l18 on: The forcing in the HADGEM model should be more uniform than in the GISS model due to the SO2 injection scheme. Is that a reason for stronger cooling in the HADGEM model?"

5. As can be seen in the new figure 1, the sulphate aerosol burdens (and hence the forcing distributions) are in fact very similar in the two models, notwithstanding the different injection methods. We do not therefore think this is the reason for the stronger cooling in HadGEM2.

"p7429:'The stratospheric SO2 injection geoengineering simulations produce geographic responses which, being more homo1geneous, more closely counteract the responses due to increasing concentrations of GHGs than do the responses from stratocumulus modification.' Isnt that simply due to the fact that the SO2 is injected homogeneously? Is that really realistic? Isnt that too idealistic when the comparison to the sea salt injection scheme is sought?"

6. As noted in point 5 above, the SO2 injection method is not very important in determining the aerosol distribution (for the injection cases considered here, i.e. equatorial or uniform), and so the distributions of the climate responses are not due to the form of the injection.

"And a final question: Are the differences between the two models important? Are they reason to worry? How certain are the differences? Would the result change if another 10 year period were taken for comparison?"

These are all good questions which call for a broader study, which is why we encourage just such a larger-scale intercomparison via GeoMIP (Kravitz et al., 2010) in the last paragraph.

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