Earth System
Dynamics
Discussions

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Interactive comment on "Reaching 1.5 °C and 2.0 °C global surface temperature targets using stratospheric aerosol geoengineering" *by* Simone Tilmes et al.

Anonymous Referee #1

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This study seeks to propose new testbed model experiments for studying scenarios of stratospheric aerosol geoengineering (SAG) designed to limit global warming to fixed global mean surface temperature targets, with some additional constraints to limit undesirable side-effects. I appreciate the interest that the authors' idea has for the earth system community, and I find the paper to be generally well-structured and with a clear logical flow. However, as far as I can tell the main novelties of the study lie in the use of a very recent CMIP6 model, and in the combination of a feedback controller modelling approach with overshoot climate scenarios – neither of which is novel in isolation. Several of the conclusions are likely highly model dependent, and the broader considerations echo the results of other recent studies. Furthermore, some aspects

of the manuscript – for example the figures – have a very unrefined feeling. Finally, I have two major concerns on the structure and contents of the study, which I detail below. Based on this, even though the topic of the study is well-suited to ESD, I am not convinced that it is suitable for publication in this journal.

Major Comments

1. The study performs only one simulation for each geoengineering experiment, citing computational limitations as the main reason. Since the authors state that the study's goal is to establish a protocol for new model experiments, this is justifiable. However, the authors then perform only three SAG experiments; the obvious absent is Geo-SSP85 2.0. Given that comparing SAG interventions with the same temperature goals under different scenarios is a major focus of the study, and that – as the authors themselves underscore – past simulations with earlier model versions show significant differences from the ones presented in this study, I struggle to see the logic in not including such a simulation.

2. The study reads as a generally well-structured, primarily descriptive report of a set of three SAG model simulations. If the aim of the study is indeed to describe new numerical simulations, then I would expect to see a larger number of different experiments, ensembles etc. If, instead, the goal is to establish a protocol for new model experiments, I would expect significant additional analyses and tests on the feedback controller, the latitudes of injection of the aerosols etc. The study is therefore in a grey area between a description of new numerical simulations and a more technical/mechanistic experiment design work, and I find it somewhat unsatisfactory under both categories.

3. I find the figures unsuitable for publication. Some examples: the styles differ across figures and panels within the same figure (e.g. Fig. 4, top row vs. middle and bottom rows), colour-coding/labelling of experiments is inconsistent (e.g. cf. Fig. 1, 3, 11), some figures have panel labels (e.g. Fig. 9), while others do not, different map projections are used (e.g. cf. Figs. 5, 8 and 9) etc. I provide an incomplete list of suggestions

in the minor comments below.

Some Minor Comments

1. Introduction: keeping in mind the relatively broad readership of ESD, it would be useful to add one or two sentences explaining what a "feedback controller" is in this context.

2. Sect. 2.2: echoing the above comment, the description of the feedback control algorithm in this section is poor. Please rephrase and expand it. A practical example of its functioning would be beneficial.

3. p. 2 ll. 44-46 This is a somewhat awkward sentence, please rephrase.

4. p. 6 l. 164 algorithem –> algorithm

5. Sect. 3 The authors use the term "efficiency" in the title, but never refer back to this in the section. I would suggest either discussing this in the text or removing the term altogether.

6. p. 6 l. 184 tropospheric –> troposphere.

7. p. 8 l. 222 "For the baseline simulations, temperatures in high latitudes are higher than in mid and low latitudes" Perhaps the authors mean "temperature anomalies"?

8. p.8 l. 230 "1.5 ËŽC and 2.0 ËŽC" –> 1.5 ËŽC or 2.0 ËŽC

9. Table I: I would suggest adding a column with the models used, as I understand that these vary between the RCP and SSP simulations.

10. All figures: add panel letters to all figures, which makes referencing more straight forward and concise (avoiding sentences like: "Fig. 4, middle and bottom panels on the right").

11. Fig. 1 In the top panel there seems to be a large gap between the SSP scenario and the beginning of the Geo SSP5-34-OS 2.0 experiment. Is that due to the choice of

using RCP8.5 for initialisation? If so, what effects may this have on the results? If not, what is it due to?

12. Fig. 1 Please fix in-panel labels in bottom panel (space between parentheses and "dotted"/"solid").

13. Fig. 2 Top row: the black and blue lines are almost indistinguishable. Please make them thicker, use different line styles, or otherwise modify them to make the figure clearer.

14. Fig. 3 Please move the legend to the top panel.

15. Fig. 3 The title of the top panel is chopped off in the PDF I downloaded.

16. Fig. 3 In the legend, please use full name of the experiments as done in other figures.

17. Fig. 6 Caption: "scenario's" –> "scenarios".

18. Competing interests: "There is are competing interests at present". Barring the "is are", shouldn't these be stated?

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