

Dear Dr. Graham Mann,

Thank you for your review and your suggestions. We addressed all of your comments and answer below in blue and followed your suggestions. We hope the manuscripts is now ready for publication. Thank you for handling this manuscript.

Best,

Andrea Stenke, Sandro Vattioni & Co-Authors

The three main reviewers (Visioni, Niemeier, Laakso) have each found the manuscript suitable for publication after minor revisions, and have graded the MS excellent or good in all 4 of the categories. Together also with a further review from a 4th scientist (Boucher), the comments together comprised quite a thorough review process.

The authors have replied to the 4 reviews, and I have been through these, and the author replies, and can confirm the authors having replied to each of the specified minor-revisions, and revised the manuscript accordingly.

The revised manuscript then has addressed the minor revisions raised by the 4 reviewers.

However, from checking the revised manuscript it's clear there were still a few further typo-level changes required, and I have listed these below as a final Topical Editor review.

These are very minor changes however, and once these 7 minor edits are addressed, the manuscript can then proceed to publication in GMD.

Topical-editor remaining typo-revisions

1) Abstract lines 1-2 – change of “Solar radiation management” to “Climate intervention”

I can see that 1 of the 4 reviewers suggested to change "solar radiation management", instead to "climate intervention". The authors have made that suggested change in line 1, and have deleted also the term SRM in 5 other places in the Abstract.

As a Topical Editor in this particular field, I was actually quite surprised this reviewer has the opinion the terminology strat-SRM can be “confusing”. I checked for example the recent interactive stratospheric aerosol community intercomparison paper by Weisenstein et al. (2022), and see the Introduction sets the context of the article based primarily on the SRM acronym there.

Whilst I agree the “solar radiation management” could be argued to be a little outdated, the updated SRM terminology “Solar Radiation Modification” is central to the categorizations within both the recent 2022 WMO/UNEP Scientific Assessment of Ozone Depletion report and the WCRP lighthouse activity (e.g. <https://www.wcrp-climate.org/ci-overview>).

Geoengineering is clearly a controversial topic, and whilst I was not involved in the planning of either activity, whereas the term “climate intervention” is central to the WCRP activity, it is noticeable that the term “climate intervention” does not feature (from what I can see) in the 2022 WMO/UNEP ozone assessment text (e.g. <https://csl.noaa.gov/assessments/ozone/2022/executivesummary/#section-5>)

Clearly the ozone assessment focuses on the ozone layer, and this difference may well not be significant, at likely simply reflects the decision of the author-teams and leadership groups as to what might be best, considering the topic is clearly quite controversial.

And whilst I expect some might well argue the framing “climate intervention” could be considered by some to associate geoengineering in too positive or accepted a framing, others might contend that’s not at all the case, the word “intervention” potentially having either positive or negative association.

The point I am trying to make here is it’s clearly a controversial topic, and it’s also clear that choices of terminology can understandably trigger differing sensitivities across different communities (based on experiences or feelings).

The manuscript the authors submitted features both “climate intervention” and SRM.

And given that SRM features in both the recent WCRP and WMO/UNEP reports, and the recent intercomparison, I think on this occasion, the reviewer may be mistaken that the SRM term is confusing.

It’s clear there’s obviously a diversity of opinions on this controversial topic, but

given also there may well be sensitivity to either term, replacing all 6 instances of SRM to CI in response to 1 reviewer's comments seems inconsistent with the manuscript the 4 scientists reviewed.

All the above said, this remains a minor typo-revision, to re-instate the original instances of "solar radiation management", the typo-edit to change "management" to the updated term "solar radiation modification".

The change then I'm requesting is:

1.1) Delete the 1st of the 2 instances of "Climate intervention" in the first sentence of the Abstract, re-instating to "Solar radiation modification" rather than "... management".

Thanks, we corrected this.

1.2) Please re-instate the instances of "(strat-SRM)" on lines 2, 3, 4, 7 and 11. This wording was present in the manuscript reviewed, and I'm not sure why one of the 4 considered confusing. It seems to me a reasonable abbreviation, to be clear this is stratospheric SRM (distinct from marine cloud brightening SRM for example). And for example the deletion on line 4 then loses the specificity of that particular model intercomparison. The previous text seemed more balanced, the term SRM aligning for example with both the WCRP and WMO/UNEP activities.

We replaced all occurrences of climate intervention (except line 1 in Abstract) by "strat-SRM". We also adapted line 35 in the manuscript accordingly. People who will be reading this manuscript will understand what we are talking about anyway.

The reviewer's assertion this is "confusing" is not correct, and reverting to the above is clearer, for example also on line 3 then clear this is stratospheric SRM rather than other climate intervention technologies.

2) Line 437 – grammatical error here – please delete "they" (before "would occur"). The new text says "as they would occur in climate intervention scenarios", but the English grammar is best stated "as would occur in climate intervention scenarios"

Thanks, we corrected this.

3) Line 445 – please change "the use of M7 with lognormal modes results in a minimum..."

Instead to "the use of M7 with lognormal modes can result in a minimum..."

The minimum only occurs when the two modes have similar magnitude concentrations, have a difference in size (to then not be overlapping). And considering also that one mode much higher number of particles than the other, the wording "can result in" is more correct.

Thanks, we corrected this.

4) Line 504 – the term "numerical stability" is not really the issue here. Numerical stability tends to refer to an iterative integration method incorporating a particular algorithmic difference-equation solution method. In this case the text is referring simply to the number of timesteps, and then a simpler issue of the approximation. It's true that changing the timestep can make an algorithm unstable or introduce numerical stability issues, but the context here is not discussing that, it's referring to the simplified process-split methods many of the microphysics modules currently use.

Please change "focusing on the numerical stability" to "including to explore differences among the process-split sub-stepping methods" or similar but slightly reduced words.

Thanks, we corrected this.

5) Line 504 – insert the word "schemes" between "of aerosol microphysics" and "under conditions".

Thanks, we corrected this.

6) Line 513 – delete "small-scale field studies" and suggest to replace instead with "co-ordinated model intercomparison" or similar statement that then aligns with the manuscript's research.

Thanks, we corrected this.

Making any statement about the question of whether small-scale field studies could be beneficial is beyond the scope of this manuscript. And although this was not queried by any of the 4 reviewers, there was quite some controversy for example of the recent SCOPEX planned activity in Sweden, and with the SPICE consortium. Any statement here is clearly beyond the scope of this article's research topic, and then should not feature in this closing sentence.

7) Line 514 – I think the "improve existing numerical models" is here referring to steering to encourage advocating for research projects to include to focus also on improving the algorithmic or sub-stepping methods within interactive stratospheric

aerosol models. Perhaps the authors would argue the types of solvers present in chemical integration methods should consider to align also with aerosol tracers, or allocating some effort/funding towards progression to dedicated aerosol “solvers” within these models? Can the reviewers be more specific here?

We have changed to: “Furthermore, additional laboratory and co-ordinated model intercomparison studies of aerosol formation, growth and dispersion under various stratospheric conditions could also be beneficial to evaluate and improve existing numerical models or to develop new explicit aerosol schemes, which potentially will be directly integrated in chemical solvers.”

The specific types of improvements which could be implemented were discussed in detail in the conclusion section.

References

Weisenstein et al. (2022), “An interactive stratospheric aerosol model intercomparison of solar geoengineering by stratospheric injection of SO₂ or accumulation-mode sulfuric acid aerosols”, Atmos. Chem. Phys., 22, 2955–2973, <https://doi.org/10.5194/acp-22-2955-2022>