Atmos. Chem. Phys. Discuss.,
doi:10.5194/acp-2016-1109-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Is increasing ice crystal sedimentation velocity in geoengineering simulations a good proxy for cirrus cloud seeding?" *by* Blaž Gasparini et al.

Anonymous Referee #2

Received and published: 12 January 2017

This is a nice and straightforward, if not exactly Earth shattering, modeling study of geoengineering in the form of cirrus seeding. The study includes highly relevant testing of the usefulness of the approach of mimicking cirrus seeding by increasing ice crystal fall speed. The latter has been proposed as an experiment in a new set of GeoMIP simulations, so it is important to understand in what respects this is a useful proxy for explicitly simulating the shift from homogeneous to heterogeneous nucleation that (at least in theory) occurs in response to seeding with INP.
I have a few major/substantial comments, and numerous minor comments which are listed below, and which are intended to help the authors improve the readability of the manuscript. Once the major/minor comments have been addresses, I believe the

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manuscript will be suitable for publication in ACP.
Major comments:
- The authors conclude that the simulation that includes seeding at nighttime only is the most "appealing". To me, that simulation is a purely academic exercise, because in practice it would be impossible to only seed during night-time. It would take time to build up the right seeding INP concentration, and obviously one could not make the particles magically disappear at sunrise. I understand the desire to minimize the SW radiative effect, as well as the effects of increased convection, but I don't understand why the study doesn't include simulations with only high-latitude seeding (and fall speed increases). Seeding only high latitudes would, as opposed to the entire globe at night-time, potentially be possible in practice, and should achieve many of the same advantages. Considering the very large particles that appear to be most favorable seeding INP in this model, it would also be advantageous to seed much smaller areas to reduce the total mass required.
- The simulations with increased fall speed are, while in some respects useful, deeply unphysical. I missed a discussion of this in the manuscript. Specifically, I have problems with the sudden drop in fall speed that all ice crystals will experience as soon as they fall through the -35 degree isotherm. This would naturally lead to an accumulation of ice at mixed-phase levels, which is exactly what can be seen in Fig. 4. The authors seem to attribute this to mid-level convection. This is one important reason why increased fall speed is an imperfect proxy for actually simulating cirrus cloud microphysics.
Minor comments:
- Make sure you're consistent in your use of the abbreviations IC and INP - they are used to represent both the plural and singular forms of the nouns.
- Page 4, Line 20: "precipiation"–>"precipitation"
- Page 5, "for"–>"by"
- Page 5, Line 31-31: inappropriate referencing
- Page 7, Line 11: suggest replacing "affects also part of" with "to some extent also

affects"
- Page 7, Line 19: suggest replacing "temperature decrease anomaly" with "negative temperature anomaly"
- Page 11, Line 15: "twice larger"–> "twice as large"
- Figure 4: Why are ice crystal numbers and sizes not included in this figure? They seem like very important microphysical variables to include.
- Figure 5: Are these in-cloud or grid-box values?

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-1109, 2016.

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