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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Adjoint sensitivity of global cloud droplet number to aerosol and dynamical parameters" *by* V. A. Karydis et al.

Anonymous Referee #1

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General comments

The manuscript "Adjoint sensitivity of global cloud droplet number to aerosol and dynamical parameters" presents the development and evaluation of the adjoint of an aerosol activation parameterization. This is further used in 2 global models to analyze sensitivities with respect to the different input parameters. The paper is very well written with proper English, all figures are pertinent and well chosen and the study is in the scope of the journal. This manuscript is very interesting and should be published after some revisions. My main comment is that the simulations for the two models are not consistent: they are from different years and use different emissions. I would like to see the authors to bring one of these simulations as close as possible to the other one which would help unravel the reasons of the discrepancies in a better way.

Specific comments

The choice of running both models for different years and with different emissions makes the comparison between models difficult. Several times along section 4.1 the argument that different emissions are the main reason of the discrepancies is used. More insight into the differences between models could be made if emission and year of run were chosen the same.

It's not clear for how long and what dates does the two models run. The results section says "Given that the years simulated by GEOS-Chem and GMI are 2008 and 1999" so both models run for 1 year? This information should be provided in the methods section. Also, in the GMI description it should be mentioned what base year are the emissions.

In section 4.2, for updraft velocity and uptake coefficient it's mentioned that the main reason for the differences between both models is the higher activated fraction in GEOS-Chem. What is the reason of this higher activated fraction in GEOS-Chem?

Page 12097, lines 19-21: "This discrepancy can be attributed to the higher anthropogenic aerosol concentrations predicted by GEOS-Chem over marine environments compared to GMI." This is because the transport and processes are different? Or because emissions are different? This could be better answered if emissions and year of run were the same.

Page 12098, lines 10-13: "Where GEOS-Chem suggests negative sensitivity, GMI predicts positive sensitivity; the difference is explained by GEOS-Chem predicting higher anthropogenic aerosol concentrations than GMI model over extended regions in the mid-latitudes and Southern Oceans." Again, why does GEOS-Chem predicts higher anthropogenic aerosol? Another reason could be that sea-salt is different in both models and is creating these differences, can you explore this?

Page 12100, lines 2-3 "Over the other arid areas of the world, GMI predicts much

higher sensitivity than GEOS-Chem." Why? Is it due to different dust concentrations in the models? Or other reasons?

Fig 6. The +- 50% lines look odd. This is more clearly seen in the same figure in the Karydis et al. (2011) paper as here the minor tick marks are shown: +50% for Nd=10 would be 15 while the +50% line intersects the Y axes at almost 30. Please correct or clarify this. I'm attaching a figure showing how a +/- 50% line in a loglog plot should look like. Some conclusions about model performance are based on this 50% threshold (page 12116) so this must be revised and clarified.

Fig 6. For Continental locations, a big % of model estimates (for both models) seems to remain fairly constant while observations vary over one order of magnitude. Can you elaborate on possible reasons of this?

Page 12082, Lines 25-26. Add references (e.g. Twomey, Albrech) and also consider macro-physical effects (e.g. Pincus and Baker, 1994)

Fig 7c is not mentioned in the text.

Technical corrections

Page 12086, Line 7. Not clear what "probed" means

Table 1, first aerosol type should be anthropogenic fossil fuel, right? (as described in page 12090, lines 14-16)

Fig 5, (a) might be more clear in log scale

Fig 7. Put labels (a,b,c,d) in the figures

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 12081, 2012.

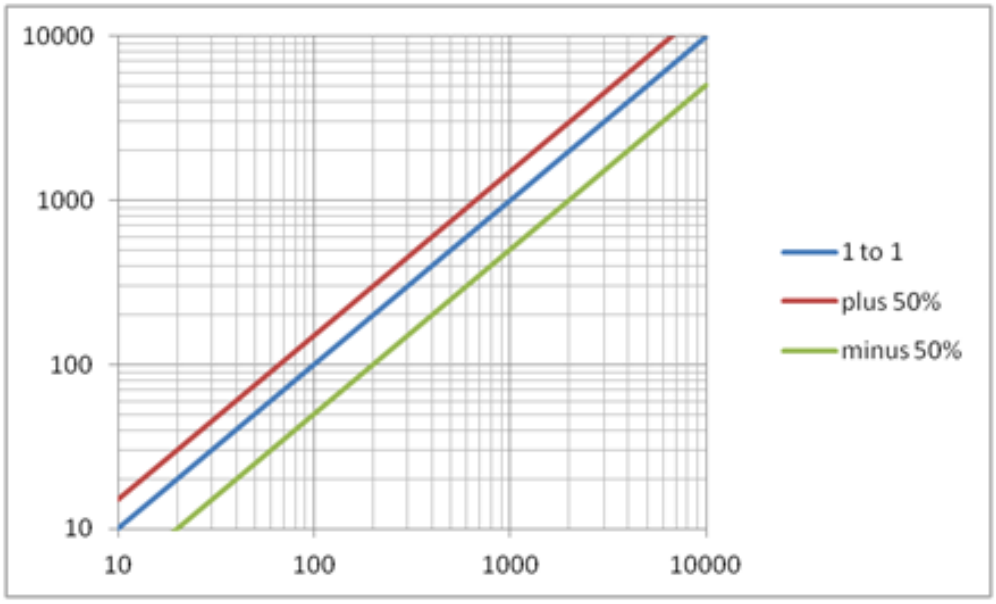

Fig. 1. 1:1, +50% and -50% in a loglog plot