

Interactive comment on “Sensitivity of remote aerosol distributions to representation of cloud-aerosol interactions in a global climate model” **by H. Wang et al.**

Anonymous Referee #2

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The paper presents some new developments implemented in the global atmospheric model CAM with the objectives to improve the representation of aerosols in regions that are usually poorly represented in models, including the upper troposphere and the Arctic. The CAM model is bench-marked against a model version that includes a more detailed representation of cloud-aerosol interactions through a sub-grid scheme and against observations. The inclusion of a new unified treatment of vertical aerosol transport and convection results in an improvement of the model comparison against observations.

The paper is overall clear and well written and is very well suitable for GMD as it

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describes new model developments that could serve as a useful basis for users of the CAM model and of other models. I do not have any major comment about the manuscript and only small clarifications are suggested below.

Specific comments:

- P342, lines 10-15: Provide some key aspects of the new unified treatment as explained in S1. What are the main new features of this “improved unified treatment”? (Include for example indications such as those provided in lines 58-62 of S1).
- P342, lines 22-30: It is not clear whether a new scheme was applied in this CONV FD simulation, or whether different parameters were applied. In any case, what are these parameters?
- P343: line 5: What are these adjustment factors? How are they “adjust”?
- P366, table 1: Please clarify which simulations use the m7 or m3 configuration.
- Section 3.4: The discussion about the differences between the M3 and the M7 configurations are quite interesting, as it touches upon the level of complexity that is needed in climate models if one wants to represent aerosol processes and their impact on climate. I understand that some of these issues are discussed in other papers but I still think it would be useful to summarize more clearly in this paper the “pros and cons” of using the MAM7 versus MAM3 to represent aerosols burdens in the upper troposphere and the remote regions. Is the slower aging assumption the main difference?
- Section 3.5: On page 342 lines 14-15, it is said that “Note that the change does not directly impact the model’s convective cloud parameterizations involving heat, moisture and momentum”. However the indirect effects, which are already included in the simulation, appear to have substantial impact. Is there a way the Authors can try to distinguish between the direct and indirect processes?
- Section 4: Finally, there are still some differences between the observed and simulated aerosols in the Arctic at the surface. Could the Authors try to elaborate a bit on

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why this might be the case?

Technical/minor comments:

Figure 6, legend: Please indicate “Observations (dotted black lines. . .). A minor comment also in terms of how the model was sampled: does that make sense to sample the model along flight tracks using a 10-year January mean? Would that not be more representative to use a model mean over the latitude-longitude range of each panel?

Figure S1: It is not see easy to see the difference in emissions with the log scale.

Interactive comment on Geosci. Model Dev. Discuss., 6, 331, 2013.

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