

# ***Interactive comment on “Effective radiative forcing in the aerosol–climate model CAM5.3-MARC-ARG” by Benjamin S. Grandey et al.***

## **Anonymous Referee #1**

Received and published: 28 May 2018

Review of “Effective radiative forcing in the aerosol–climate model CAM5.3-MARC-ARG” by Benjamin S. Grandey et al.

This manuscript runs two different aerosol models in a General Circulation Model and analyzes the results with respect to aerosols and their radiative effects, specifically the anthropogenic radiative effects. The manuscript is well written and like suitable for publication in ACP with some important revisions.

There is also zero comment on which of the treatments might be more realistic, and zero justification against observations. The CCN and CDNC differences are large enough to comment on perhaps with respect to observations?

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It is also disconcerting that of the two aerosol models analyzed, the 'more complete' MAM7 treatment does not have a pre-industrial simulation. At the very least, 2000 emissions could be used for 1850 in that simulation where they did not exist, or they could be appropriately scaled. I think this limits some of the utility of the paper.

Specific comments are contained below. The conclusions are that there are different resulting cloud effects starting with Cloud Condensation Nuclei from the different aerosol models. But I think this needs to be analyzed in a bit more depth. It seems to me as if the externally mixed or 'pure' modes for aerosols are increasing lifetime but decreasing interactions with clouds: with lower CCN and lower drop numbers, contributing to larger percentage changes due to anthropogenic sources. I think this needs to be explored a bit more.

In short, I think there needs to be a bit more analysis of the results along the lines above.

Specific Comments:

Abstract: I think more should be devoted to differences in AOD, CCN and CDNC than radiative effects. The radiative effects are the least interesting part.

Page 4, L10: so how many modes/bins in total? Are sea salt and dust only externally mixed in their sectional size bins? Please clarify. Maybe a table?

Page 5, L8: if no MAM7 emissions files, then do you have everything for MARC? What is missing for MAM7? Nitrate? Ammonia? Couldn't you find this information?

Page 6, L3: does this follow Ghan 2013? I think it does. Please state that, or where you have deviated.

Page 12, L15: but this is a key point: the different aerosol representations lead to different CCN activation spectra. Can you focus in on this a bit? This seems to be a key difference.

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Page 12, L15: Marc seems to have a larger percentage change in CCN than MAM3. That probably leads to larger CDNC change (in percent) and hence the difference in LWP and SW radiative effects

Page 12, L26: I think this is a key point that needs a bit more definition. Please elaborate on what parts of MARC are leading to different activation? Can you test whether. MARC or MAM is right with observations?

Page 13, L11: are there any differences in tunable parameters between MARC and MAM simulations for CAM?

Page 14, L8: can you relate regional differences back to specific aerosol modes?

Page 14, L14: how different is the global LW (and SW) CRE between MAM and MARC?

Page 15, L11: why is BC in snow less? Lower BC mass generally? MARC seems to have more BC?

Page 16, L12: yet with longer lifetime there is less CCN? Is this because unmixed aerosol are not CCN?

Does MARC match observations better?

Page 17, L13: can you take this farther? Which specific formulation compares better to observations?

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Interactive comment on Atmos. Chem. Phys. Discuss., <https://doi.org/10.5194/acp-2018-118>, 2018.

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