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## ***Interactive comment on “Impact of the representation of marine stratocumulus clouds on the anthropogenic aerosol effect” by D. Neubauer et al.***

### **Anonymous Referee #1**

Received and published: 26 June 2014

Review of "Impact of the representation of marine stratocumulus clouds on the anthropogenic aerosol effect" by D. Neubauer, U. Lohmann, C. Hoose, and M. G. Frontoso

General: this manuscript analyzes several changes to the low cloud scheme in a general circulation model (ECHAM6-Ham). The paper is well written and appropriate for ACP, but requires major revisions.

My general concerns are as follows:

1. The use of in cloud and regional averages in stratocumulus regions is confusing.
2. I am concerned that the tuning parameters may have an influence on AAE, and not

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enough detail is provided.

3. I am not certain that looking at global AAE while just focusing on the stratocumulus regions is helpful. Model biases do not appear to be confined to low clouds, and the response to aerosols and AAE may also not be confined to low stratocumulus clouds.

4. Some further analysis of the effects of the tuning parameters and time stepping probably needs to be performed or assessed in more detail.

Specific Comments are below:

P13683, L 23: unclear. Did Carslaw use microphysical retrievals from ISCCP in their model?

P13685, L 13: do you discuss sensitivity to the choice of empirical thresholds (e.g. LTS)? What is the area of the planet you are addressing with stratocumulus clouds?

P13686, L16: is AAE evaluated everywhere? Can you isolate AAE to stratocumulus regions? What does this mean and is there compensation? If this is discussed later, you might need to mention it here.

P13686, L27: what does internal variability can become comparable to model changes mean?

P13687, L7: these should probably not be in a supplement if they are important to the paper.

P13687, L24: it is not clear to me what you will be comparing for differences. Is it just AAE or many variables?

P13690, L9: what is the effect of timestep ping alone? Can you repeat the analysis with L31 but  $dt=300s$  and  $180s$ ?

P13691, L16: if the AMIP simulations have annual varying SSTs, then what years we're used? I assume the CLIM experiments are an average? I'm not certain I believe that 5

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years with variable SST is enough: I think it is with CLIM SSTs.

P13691, L21: what is 'free mode'. It seems like everything is run in the same way (fixed SST and ice and free atmosphere). Is there something other than free mode, which would imply nudging? Or did I misunderstand something?

P13692, L1: in other models the autoconversion tuning parameter has a large effect on AAE (e.g. Work with the GFDL model by Golaz). Are you sure this is true in the version of ECHAM you have? Typically autoconversion is related to drop number, so it directly links to aerosols.

P13692, L11: please be quantitative throughout this section: how much more frequently.

P13692, L22: this is unclear to me. Do you mean in-cloud properties, or just properties when clouds occur?

P13693, L10: this is difficult to understand: on the one hand LWP is lower, and then it is higher. The words seem to say the same thing : LWP in stratocumulus areas and LWP in the stratocumulus regime. I think you need new terms for this.

P13693, L22: then this bias cannot be fixed with changes to the low cloud scheme. Or is the inversion going to help that?

P13694, L5: figure 10 mentioned before figure 8 and 9?. Given the disparity in regions in the observations, the model should be represented by dotted lines for each region.

P13696, L12: how far out was the radiative balance? It seems you are going to be shifting the cloud forcing around spatially with these changes. Are you use they do not affect AAE? Again, I am not sure whether you are using a local or global AAE.

P13697, L10: what is the effect of timestep alone? Can you separate that from the vertical resolution change?

P13699, L20: I worry strongly about the significance of these changes given the rela-

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tively short (5 year) runs. What is the significance level for table 2 and figures 14 and 15.

P13700, I27: are there aerosol effects in deep convection? How could that affect AAE? Are the changes in deep convective regimes? In the VRES Experiments, do the same susceptibilities act as in the other Experiments? Does aerosol decrease? It is not clear this is the case from table 2. Please clarify.

P13701:I8; given the bias in middle and high clouds, might these be contributing to the effects seen? Please comment.

P13792,L3: does it change mid and high level cloudiness biases? I am assume not from the comment, but please clarify.

P13703,L1: what is the AAE when shallow convection is turned off? Are their aerosol effects in shallow convection? If not, then more regimes are treated by stratiform clouds with aerosol effects. Please comment.

P13704'L14: I think the supplement could be incorporated and integrated into the manuscript.

P13729: figures 14 and 15 need to have some estimate of significance: what changes are significant?

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Interactive comment on Atmos. Chem. Phys. Discuss., 14, 13681, 2014.

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