

Interactive comment on “Explicit representation of subgrid variability in cloud microphysics yields weaker aerosol indirect effect in the ECHAM5-HAM2 climate model” by J. Tonttila et al.

Anonymous Referee #1

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Review of "Explicit representation of subgrid variability in cloud microphysics yields weaker aerosol indirect effect in the ECHAM5-HAM2 climate model" by J. Tonttila et al.

This manuscript investigates the mechanisms by which sub-grid variability in aerosol activation and stratiform cloud autoconversion affects clouds in the ECHAM-HAM GCM. It is a follow on paper to Tonttila et al 2013, with a slightly different configuration of the simulations (nudged) and one different method of setting up the model (changing sub-grid activation and autoconversion separately). Statistical significance of differences good. The paper is appropriate for ACP, but needs several important revisions.

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1. The manuscript needs to better illustrate the differences between simulations in a quantitative way (probably with zonal mean figures) as noted below.
2. In addition, given the prominence of autoconversion as a process for the results, it is probably necessary to show some process rates for autoconversion.
3. Vertical velocity distributions and activation rates would also be useful to explain some of the more confusing aspects of the relationship between vertical velocity variance and cloud drop number noted in the text.

Specific Comments:

P15524,L6: should the ACI be negative?.

P15228,I25: what type of cloud is the high cloud cover due to? You are using the ISCCP simulator, so you can discriminate thin and thick clouds, and high and low clouds? Also in Tonttila et al 2013? Or is that a feature of the nudging?

P15529,L29: note that reducing autoconversion might also impact accretion. What is the relative importance of these processes in ECHAM-HAM?

P15530,L6: but above you said sensitivity was low Inge S.H. and higher in the NH. Please clarify.

P15330,I25: again, do the earlier simulations show this with ECHAM ham (high cloud amounts and high tau). Or is this a feature of nudging? From Tonttila et al 2013 it looks like cloud amounts stay high.

Also: perhaps you should show microphysical process rates for autoconversion here.

P15531, L3: these need to be more quantitative. Perhaps zonal means would be better?

P15531,L11: the difference is not easily visible. See comment above.

P15332,L1: can you demonstrate with zonal mean difference plots? I also think an

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analysis of the microphysical process rates would be wise.

P15532,L5: why not show the microphysical process rates for autoconversion and other processes?

P15533,L5: useful to state that ACI seem to follow ΔLWP , not $\Delta CDNC$.

P15541: figure 2 and 3 would be better as zonal means. In figure 2 I cannot see any differences. These could be made more quantitative for figure 3 with zonal means. Could maybe separate land and ocean as well.

P15543: figure 4. Again, this is hard to see any quantitative differences. Perhaps showing a zonal mean on the same plot would be better. Where are differences? Assume this is mentioned in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 15523, 2014.