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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global anthropogenic aerosol effects on convective clouds in ECHAM5-HAM" *by* U. Lohmann

U. Lohmann

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Dear Reviewer,

Please find my replies in italics below:

1. L21-23, P14640: Albedo is a ratio, but here its unit is W m-2, which must be the unit of radiation.

The sentence has been rewritten. Changes in radiative forcing at the top-of-the-atmosphere were meant here.

2. L8-9, P14641: The supercooled drops can be simulated not only because the drops were small and numerous, but also because the ice crystal sizes are below 100 μm (so the collision efficiencies between ice crystals and drops $<$10 μm are close to zero) and graupel particles of 100-200 μm cannot collect drops $<$10 μm.

I added that.

3. L6, P14646: "resp." is an abbreviation. The whole word should be used.

Changed.

4. L8, P14648: "...the changes described above". This is mis-signposted. The description is on the next page.

No, the changes to the model as described above are meant here. I added "to the model".

5. L8, P14648: "It requires an enhancement of the autoconversion and aggregation rates...". The author discussed the enhancement of the autoconversion in L6, P14649. What is the increase in aggregation rate?

Actually, the aggregation rate was not changed. I deleted that.

6. L6, P14649: "In order to bring balance back into equilibrium, the autoconversion rate in stratiform clouds is enhanced by 60%...". Is there any previous theoretic, observational, or modeling support for this magnitude of enhancement? The results obtained in this manuscript are directly linked to the enhancement (along with the enhancement in aggregation rate). If there is no solid background for this enhancement, the author must state the uncertainties due to this treatment in the conclusion section.

No, there is no observational support for the magnitude of this enhancement. The rational for increasing the autoconversion rate as compared to the original values used in cloud-resolving models is that we only consider the grid-mean liquid water content in GCMs. In reality, the autoconversion process will start in a region of the cloud with the largest droplets and highest liquid water content. Since we can not resolve that process with bulk microphysics, we need to enhance the autoconversion rate.

Your question probably relates to the 60% difference in the autoconversion rate enhancement between the different simulations. The rational here is that in the climate model the net shortwave and outgoing longwave radiation at the top-of-the-atmosphere need to be balanced. With

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the introduction of the microphysics in convective clouds, the clouds were more reflective and thus the net shortwave radiation was too small. In order to bring the radiation balance back into equilibrium, the most direct tuning parameter is to convert more cloud water into rain. One could have changed other parameter, but they are less direct. I added this explanation.

7. L20, P14649: It is better to use storm track than "stormtrack". Same in L6, P14650.

Changed.

8. L12-3, P14651: "...peaks between 100 and 300 hPa". It is between 200 and 300 hPa.

Changed.

9. L20, P14652: "Fig. 6d". Which is Fig. 6d?

Panels a-d are indicated in the legend. I added (a)-(d) to the individual panels as well.

10. L2, P14653: "This maybe" should be changed to "This may be".

Changed.

11. L14, P14654: "the 20th" should be changed to "the 20th century".

Corrected.

12. L14-15, P14655: "the wet scavenging has not vastly changed" What is the reason since the autoconversion rate increases by 60%?

The wording was not correct. Indeed the anthropogenic AOD is smallest in simulation ECHAM5-conv, which is a result of the higher autoconversion rate and associated wet scavenging. I changed it.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 14639, 2007.