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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Influence of Giant CCN on warm rain processes in the ECHAM5 GCM" *by* R. Posselt and U. Lohmann

R. Posselt and U. Lohmann

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The authors wish to thank the referee for the helpful comments on this manuscript. Below please find the point by point response to your comments.

Due to the revision of the first part of this paper the model changed. Thus, the global simulation were redone which lead to quite significant changes in the results. Thus, some comments about specific numbers and results are redundant. Nevertheless, we tried to follow the suggestions of the reviewer as much as possible.

Reply to "General comments":

- The first part of this paper ("Introduction of Prognostic Rain in the ECHAM5..." was revised and the suggestions of the reviewers were included. Thus, the prob-

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lems stated by the reviewers of the first part are solved.

- We are aware that dust as GCCN act as very good ice nuclei. But the current study focuses on the impact of GCCN on warm clouds only for which sea salt is the more important GCCN. The inclusion of dust as IN is a future task that goes along with the introduction of prognostic equations for snow.

Reply to "Specific comments":

1. The abstract is revised and shortened.
2. References are added.
3. The reference is added as well as the information that sea salt is the most dominant species regarding particulate mass.
4. The Woodcock reference is added.
5. This part is extended with the results of cloud seeding experiments presented by Cooper et al (1997) and by Ghate et al (2007). The statements criticized by the reviewer are taken from the paper by Zhang et al (2006). For further information refer to their publication.
6. A paragraph about the paper layout is added.
7. A reference to the sensitivity study is added.
8. This figure should give a justification that a particle of a certain size can reach $25\,\mu m$ within a model time step (of 15-30 min). We are aware that just assuming condensational growth does not represent all processes but as a first estimate it is sufficient.

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9. Regarding Fig. 6, GCCN do not compensate for the CCN effect regarding same GCCN concentration and same rain drop size.

10. The process of the water transfer as done in the model is artificial and can cause exaggerated transfer so that no cloud water is left. This will not happen in nature as condensational growth does not favor the large activated drops but rather the smaller ones. Thus, as soon as some of the CCN are activated they would grow faster. But this and also the competition effect is not included in the model, yet. Statements about this issues are added to the revised manuscript.
There is no entrainment or mixing for stratiform clouds within ECHAM5 yet. This is a future task.

11. The section is revised and additional plots added. The mentioned sentence is removed. The model applies a 2-moment bulk scheme for rain. Thus, rain drops are represented by their mean mass and by their number. Due to the underlying rain drop distribution (Marshall and Palmer, 1948) also large rain drops can occur.

12. Fig. 4 is removed.

13. This section is shortened and revised also following comments from reviewer #1.

14. The section with the validation of the GCCN concentrations is moved to section 2.

15. The size of the figure is increased.

16. The whole results section is rewritten, thus, this statement is removed.

17. The whole results section is rewritten. Further evidence about the feedback mechanism between stratiform and convective precipitation is added. For the IN see reply to “General Comments”.

18. see above (10)

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19. Fig. 3 shows that simulated GCCN are found mainly over the oceans and adjacent coastal regions. The statement is revised accordingly.

19.-22. The whole section about the diurnal cycle is removed.

23. This statements were made due to the model results. An additional figure is included to show the changes in wind speed. The figure showing the decrease in GCCN ratio as a model result was already in the manuscript.

24. See reply to “General Comments”.

Reply to “Technical corrections”: The technical corrections has been included.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 14767, 2007.