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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Constraining the total aerosol indirect effect in the LMDZ and ECHAM4 GCMs using MODIS satellite data" *by* J. Quaas et al.

J. Quaas et al.

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Response to Reviewer #1

We would like to thank the Reviewer for her or his detailed and helpful comments.

1.) Uncertainty in MODIS cloud droplet radius retrievals We concur with the Reviewer that the uncertainty in the satellite-retrieval cloud droplet radius is an important source ofuncertainty for our method, and we added a brief discussion on this tothe manuscript.

2.) Figure 3 We added the information that the radiative forcing is given in Wm-2. The exponential scale has been chosen for the sake of a good readability of the variability of

the forcings, which we felt was best done with this choice of colour contour levels. The evident smaller features of variability in the LMDZ compared to the ECHAM4 model are due to the somewhat finer horizontal resolution. We clarified this in the text.

3.) Figure 4 The units are added to the figure caption. The fine-mode AOD in Figure 4 as simulated by the models may be compared to the satellite-retrieve done in Figure 1b.

4.) Figure 5 The caption now indicates the units. Thank you for spotting the mistake with the white areas, which we corrected. The scale of the colour contours has been chosen so that to our opinion the variability is best represented. The reason to show the low-level cloud cover assimulated by the two models here is not to evaluate the distributions, but rather to analyse the differences in the simulated radiative forcings. We agree that for a proper simulation of the distribution ofthe radiative forcings by the aerosol indirect effect, a detailed evaluation of the cloud distributions would be helpful. This is, however, beyond the scope of our present study.

5.) Forward and inverse simulations We clarified this phrase.

6.) Aerosol direct effect in the ECHAM4 GCM Indeed the aerosol direct effect in ECHAM4 is very small and we thus neglect its influence in the present study, which solely aims at constraining the indirect effects. However, we agree indeed that recent studies indicate that this version of then ECHAM GCM simulates a too small direct effect.

Response to Reviewer #2

The comments of the reviewer helped us to clarify central points of the manuscript, for which we would like to thank her/him.

1.) Relationship over oceans vs. relationship over continents, forcing over continents The rationale of this study is that the cloud droplet number concentration does not depend on the cloud water content or cloud geometry. We also assume here that

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the systematic difference in vertical velocity over oceans and continents do not result in systematically different relationships between CDNC and AODFM, while it certainly influences the variability. We agree that future studies need to include the influence of vertical velocity on CDNC as well. Since AODFM retrievals are not reliable over continents, the relationship could be established over oceans only, and this relationship is used to constrain the model. We added this discussion to the manuscript.

2.) Correctness of the simulated AODFM Indeed, it is only possible to use the constraint from the satellite data for the model if the aerosol distributions are not too erroneous. However, since the scale for AODFM in Fig. 2 is logarithmic, it issufficient if the order of magnitude is roughly correct, and it is notnecessary that the distributions are matched exactly (though thiscertainly would be helpful). We argue that both of our models are ableto simulate AODFM to an acceptable accuracy. Since we have chosen the AODFM bins so that each one contains the same number of measurements, the position of the points along the AODFM axis in Fig. 2 indicates the histogram of AODFM in model and satellite retrievals. Roughly, the histograms are in agreement, while, as stated by the reviewer, ECHAM4 (LMDZ) has a tendency towards smaller (larger) AODFM compared to MODIS. These statements are now clarified in the manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 9669, 2005.