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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud microphysics and aerosol indirect effects in the global climate model ECHAM5-HAM" *by* U. Lohmann et al.

U. Lohmann et al.

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Response to reviewer 2:

Major concern: The changes between simulations ECHAM4 and ECHAM5-REF are so numerous that it makes difficult to believe the authors in their attribution to the sole difference in microphysics the difference between the two simulations. When reading carefully along the text, it appears that the simulations have been run over different periods (10 yr vs. 5 yr), with differences in spatial resolution (T30 vs. T42), advection scheme, radiative scheme, aerosol scavenging, diagnostic of effective ice crystal radius, etc. For example, p3732, l11, the increased frequency of deep convection is attributed to the changes in the radiative scheme. But it might be also due to the increased spatial resolution, the decrease in the aerosol content, a cloud feedback, etc. In order to "focus only on those differences between ECHAM4 and ECHAM5 that are related to the different treatment of aerosols and cloud microphysics", as it is stated in

the introduction, I strongly suggest to redo a simulation by including the ECHAM4 aerosols and cloud microphysics into the ECHAM5 model using the same set-up as for ECHAM5 simulations. Otherwise, the paper should focus on the sensitivity differences between the ECHAM5 simulations (and the comparison between ECHAM4 and ECHAM5-REF should be cited for reference only).

Unfortunately, it is not possible to include the aerosol scheme of ECHAM4 into ECHAM5. In principle we agree that we could focus on the differences between the different ECHAM5 simulations, but we published quite a bit on the aerosol indirect effect with ECHAM4. Thus we feel that it is our obligation to explain why the indirect aerosol effect is larger in ECHAM5 than in ECHAM4.

Specific comments

1) p3723, section 2.1. The radiative properties for aerosols have to be described. Is there any difference between those of ECHAM4 and of ECHAM5?

Indeed the aerosol radiative properties between the ECHAM4 and ECHAM5 aerosol models differ, as much of the aerosol representation itself. In ECHAM4, employing a bulk aerosol scheme, aerosol radiative properties were based on the OPAC database (Hess et al., 1998), implicitly assuming size-distributions and aerosol properties, such as the complex refractive indices. In ECHAM5-HAM, that is the focus of this study, aerosol radiative properties are explicitly calculated for the prognostic aerosol size-distributions, compositions, and mixing-states, as described in detail in Stier et al., ACP, (2005) and Stier et al., ACPD, (2007). We have extended the manuscript by a brief description of this approach with references to the full model description:

"The aerosol radiative properties of ECHAM5-HAM are calculated in the framework of Mie theory (see Stier et al., 2005,2007). For each aerosol mode, effective refractive indices are calculated by volume-averaging the refractive indices of all components, including the prognostic aerosol water. The effective complex refractive indices and the Mie size-parameters for each mode serve as input to look-up tables for the aerosol

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radiative properties, providing extinction cross-section, single scattering albedo, and asymmetry parameter to the ECHAM5 radiation scheme."

2) p3724, l15. I suppose that TKE is diagnosed. This should be described.

No, TKE is predicted, we added that.

3) p3728, l11. Table 1 should be introduced in the first paragraph of section 2, before the presentations on the aerosol and cloud schemes that refer to the different simulations.

Done

4) p3728, l16. The time step should be given.

Done

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 3719, 2007.