

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 4:

General Comments

The demonstration of improved model skill between ECHAM5 and ECHAM4 in predicting vertical aerosol profiles seems a bit weak. The paper only shows one vertical aerosol profile over a polluted continental region (Fig. 3). Is it possible to show profiles over other regions (e.g., remote marine) and other times of year? Without further comparison with observations the statement "This results in much better agreement with observed vertical profiles of black carbon and aerosol mass mixing ratios than with the previous version ECHAM4" seems overstated. I would recommend that this statement is removed from the abstract or further evidence is included to support it. Some of the figures are quite difficult to interpret which in places makes

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the paper a little hard to follow. It should be possible to replot some of these (see specific comments below).

An in-depth comparison of aerosol mass and number concentrations with observations is given in Stier et al. (2005). We added that. We also removed the aerosol comparison from the abstract and replotted some figures.

Specific Comments

1) *I couldn't find definitions for some of the variables used in the paper. Page 4, Line 105: Define Qnucl Page 5, Line 120: define W(overbar)*

The definitions were added.

2) *Page 4, Line 106: Confirm that this is aerosol dry radius.*

No, it is actually the wet radius, we added that.

3) *Page 5, Line 123: Is there observational evidence for setting the cloud drop number concentrations to 40 cm⁻³? If so where is this from.*

Yes, there is. Quante (2004) cites typical ranges for stratocumulus and they range from 40-500 cm⁻³ for continental stratocumulus and from 45-300 cm⁻³ for marine stratocumulus. We added that.

4) *Page 5, Line 141: I do not fully understand the meaning of "in the spirit of statistically based cloud parameterizations". Is it possible to clarify this?*

We meant that the Tompkins scheme is a statistical cloud cover scheme which solves prognostic equations, we rewrote this sentence.

5) *Page 5, Line 131: Are other anthropogenic emissions (e.g., SO₂) the same between the different model runs?*

Yes, the global mean sulfur emissions are comparable, but the anthropogenic contribution is higher in the 1985 inventory. We added that.

6) Page 14: Is the main reason for improved representation of UTLS aerosol concentrations aerosol nucleation and subsequent growth? The black carbon profiles show the same behaviour (higher concentrations in the ECHAM5 compared to ECHAM4) suggesting it might be more due to changes in transport and deposition.

Yes, it is. It's true that the black carbon profile in ECHAM4 shows the same behaviour but the underestimation in the UTLS is far less pronounced than the total aerosol concentration. This suggests that aerosol nucleation and subsequent growth and differences in the scavenging ratios are the likely reason with changes in transport playing a more minor role. We clarified that. We also corrected a mistake in the calculation of the total aerosol mass so that the simulated aerosol mass now falls on the high side of the measurements in the mid troposphere but matches the observations at high and low altitudes.

7) Figure 2: Define whether it is radius or diameter $> 0.035\ 956\ \mu\text{m}$.

It's the radius, we added that.

8) Figure 4-6: These figures are a quite difficult to interpret. It might make the comparisons easier to remove the observations panel and instead plot the observations on the same panels as the model results. Or having a separate panel for TWC/LWC/IWC (for Fig 4) and plotting all model simulations and observations on the same panel.

We chose this way of representing the results to be consistent with the display of the results in the study by Korolev et al.

9) Fig 8, caption. Should it be "This diagnostic is not available from ECHAM5"?

No, the statement refers to the change in cloud-top effective radius, which has to be done online, and we cannot obtain it on hindsight from ECHAM4.

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