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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Model intercomparison of indirect aerosol effects" *by* J. E. Penner et al.

J. E. Penner et al.

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Thank you for your review. We agree that it would be good to place our results within context. It is planned that the AEROCOM A results reported in Textor et al. (2005) will be compared and updated with those from the AEROCOM B results (Schultz, private communication, 2006). So there will be a much more thorough discussion of the differences between those results and the aerosol fields reported here (which used the AEROCOM B emissions). Nevertheless, we will add the following to the discussion section:

"It is of interest to put the predicted cloud forcing from experiment 5 into the context of other model studies for indirect forcing. The models used to provide results for the CCSR model and the LMD-z model are the same as those reported in the model intercomparison of Lohmann and Feichter (2005) (i.e. they are the models described and used in the studies of Quaas et al. (2005) and Takemura et al. (2005), while the CAM-Oslo model was updated to use the CAM2 "host" meteorology rather than the

NCAR CCM3 meteorology as described in Storelvmo et al. (2006). This change was significant since CAM2 has higher liquid water path compared to CCM3. It also uses a maximum-random cloud overlap scheme rather than a random overlap scheme. In addition, organic carbon was added to the CAM-Oslo simulation, and the CCN activation scheme was changed from prescribed supersaturations and look-up tables to the Abdul-Razzak and Ghan (2002) scheme. One further change is that all the models used here used the emissions from the AEROCOM “B” intercomparison (Dentener et al., 2005), except that dust and sea salt were prescribed in the CAM-Oslo model.

Values for cloud forcing reported for the LMD-z model and for the CCSR model in Lohmann and Feichter (2005) (about -1.2 Wm-2 and - 0.9 Wm-2, respectively) are somewhat smaller than the cloud forcing reported here for experiment 5 (-1.35 Wm-2 and -1.40 Wm-2), presumably because of the change in emissions. The range of cloud forcing values found here for experiment 5 (-0.31 Wm-2 to -1.40 Wm-2) includes one value smaller than any summarized in Lohmann and Feichter, but, since that study quoted values as large as almost -3.0 Wm-2, the largest value reported here is at least a factor of 2 less than the values in Lohmann and Feichter. While a standard deviation makes little sense for a sample of only 3 models, if we formally compute one, we get a value of 0.6 Wm-2, similar to the value quoted in Lohmann and Feichter (2005).

As noted above, one of the most important uncertainties in the model prediction of aerosol indirect effects is the model prediction of aerosols. In that sense, we can compare the lifetimes for aerosols reported in Textor et al. (2005) to those found in the CAM-Oslo, CCSR and LMD-z models. The relative standard deviation of aerosol lifetimes for sulfate, BC and POM for the models used here is 18%, 29%, and 18%, respectively, which is similar in magnitude to, but smaller than, the relative standard deviations found in all of the models examined by Textor et al. (2005) (i.e. 20%, 34% and 26%, respectively). For dust aerosols, the models used here included one with a small overall lifetime (1.6 days for the CCSR model) and whereas the lifetime in the LMD-z model is similar to that for other models (3.9 days). The small lifetime for dust

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in the CCSR model reflects its efficient dry deposition rate (Textor et al., 2005). The effect of this large difference in lifetime, however, may not impact the results reported here, because dust mass tends to reside in the larger particles with small number concentrations, and, therefore, may not significantly affect the global average aerosol indirect effect.

All of the values for cloud forcing reported here are within the range of calculations reported from inverse studies and from models used in applications (i.e. 0 to -2 Wm-2) as summarized by Anderson et al. (2003). Nevertheless, since this study only included three models, and since larger diversities in aerosol life cycles are reported in Textor et al. (2005), including diversities in aerosol sources, we think it prudent to more thoroughly examine uncertainties in model simulations of the indirect effect. "

We have also added the range of model results for experiment 5 to the abstract. In addition a few minor typos have been corrected.

Detailed comments:

1. The MODIS data plotted in Figure 1 were generated for different time periods and used different weighting schemes. We have replaced the MODIS data with data for the same time period generated from the MODIS monthly average data. This has changed the global average liquid water path for T$>$260 degrees to 93 g m-2 (panel (c) of figure) while the total cloud liquid plus ice water path for MODIS is now 193 g m-2 (panel (d) of figure).

This change has necessitated changing the text of the paper on page 20, in the Conclusions and Discussion section, as follows:

"All models show patterns of liquid or liquid plus ice water path that are similar to satellite observations, but the difference between global average liquid water path or liquid plus ice water path (for LMD-Z) and that measured by MODIS, for example, is -49%, -26%, and -0.1% for CAM-Oslo, LMD-Z, and CCSR, respectively. The comparison to

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satellite liquid water path is improved to -39% and -18% for the CAM-Oslo and LMD-Z models, respectively, when using their own aerosols and cloud microphysics schemes in Experiment 6, but is degraded to 22% in the CCSR model."

2. Figure 2b is wrong. We have replaced it.

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