Atmos. Chem. Phys. Discuss., 7, S3376–S3379, 2007
www.atmos-chem-phys-discuss.net/7/S3376/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global model simulations of the impact of ocean-going ships onaerosols, clouds, and the radiation budget" *by* A. Lauer et al.

Anonymous Referee #2

Received and published: 25 July 2007

GENERAL COMMENTS:

The goal of this paper is to assess the influence of the gaseous and particulate emissions from ships on the radiative budget of the atmosphere. The authors estimate the direct and indirect forcing of aerosols due to ships. Although the results presented are new and of interest, more details are needed concerning the assumptions made in the simulations before this paper can be accepted.

In the introduction, both the first and second indirect effect are defined. I could not find in this manuscript a mention of whether both indirect effects were taken into account in the study. Moreover, in the conclusion, the authors discuss the effect of "the change in

cloud reflectivity", from which I inferred that only the 1st effect is treated. The authors should clearly state it.

Figure 10 shows that in the Southern Hemisphere the indirect aerosol forcing differs significantly for the 3 inventories A, B and C. Unfortunately, the model underestimates the observed aerosol number concentrations by several folds in the 20S to 70S region (Figure 2). For the simulated low aerosol number concentrations, a change due to shipping emissions will greatly influence the indirect effect due to the non-linearity of this effect. I would like the authors to present a sensitivity simulation that imposes aerosol number concentrations in the range of observations (circa 700 to 900 cm-3) and then add the emissions from shipping. This would allow to quantify the effect of this non-lineatiry on the results presented here. It will help constrain the amplitude of the indirect aerosol effect due to shipping.

Specific Comments:

The following result stated in the abstract: "emissions from ships significantly increase the cloud droplet number concentration of low maritime water clouds." needs to be quantified.

P 9428; lines 22-25: "In the lower troposphere of the Southern Pacific (Fig. 2, left panel), E5/M1-MADE underestimates the mean particle number concentration, which could be related to the omission of sea salt particles in the size range of the Aitken mode in the model." The incidence of the underestimation of the mean particle number concentration should be studied through a sensitivity run proposed above.

p. 9428, line 16: "For the Pacific measurement sites Coconut Island, Midway Island, and Lanai as well as for the Indian Ocean site Amsterdam Island and the Atlantic Ocean site Azores, the simulated AOT are mostly within the inter-annual variability of the Aeronet measurements, given by the standard deviation." Midway Island should not be included in this list of AERONET station since the simulated AOT does not fall within the inter-annual variability of the measurements.

ACPD

7, S3376–S3379, 2007

Page 9430: Please indicate the altitude range at which the measurements of Bennartz [2007]were made.

Page 9431, lines 6-10: “The effective cloud droplet radii derived from the satellite data lie between 11 um to 13 um. Here the model gives slightly smaller values ranging from 10 um to 11 um for the regions North America, North Africa, South America, and Southern Africa. For the region Northeast Asia, the average effective radii calculated by the model range from 8 um to 9 um, whereas the satellite data suggest 11 to 12 um." The incidence on the indirect effect of a difference of 1 to 2 um radius should be computed.

Page 9431: When comparing the GCM with ERBE data, did you use the same resolution as you sampled the two datasets?

Page 9435: If you applied equation 1 to the 3 inventories it is surprising that for clear skies you get: 0.038, 0.012, and 0.030 W/m2 for scenarios A, B and C respectively. For cloudy skies you infer values of 0.014, 0.010, and 0.009 W/m2 from equation 1, please check your numbers.

Page 9436, line 24: “In the Atlantic Ocean, for instance, the average decrease in the cloud droplet effective radius is 0.42 um (A), 0.17 um (B), and 0.25 um (C) at an altitude of 0.4 km.“ Do you have an explanation as to why this decrease in cloud droplet radius over the Atlantic is larger for scenario A compared to C or B?

Page 9436, line 10-12: “The increased reflectivity of the low marine clouds results in an increased shortwave cloud forcing, calculated as the difference between the whole sky value and the clear-sky value of the net shortwave radiation at the ToA.” Reorganize the paper with a paragraph explaining the computation of the direct radiative forcing and the indirect. This sentence indicates that you treat only the 1st indirect effect. Is it the case?

Page 9437, line 1: You should write -0.60 W m-2 and not -0.6 W m-2 (not the same

ACPD

7, S3376–S3379, 2007

precision).

Page 9437, Line 7 These values are within the range of previous model estimates (−0.9 to −2.9W/m2) (Lohmann and Feichter, 2005) of the total anthropogenic indirecteffect. In chapter 2 of the last IPCC report (http://ipcc-wg1.ucar.edu/wg1/Report/AR4WG1_Pub_Ch02.pdf) it is stated that: “Based on the results from all the modelling studies shown in Figure 2.14, compared to the TAR it is now possible to present a best estimate for the cloud albedo RF of -0.7 W m-2 as the median, with a 5 to 95% range of -0.3 to -1.8 W m-2.” This should be stated in this paper. It also allows to contrast the range you propose of -0.19 to -0.60 W m-2 with not only the papers included in Lohmann and Feichter [2005] but also a several papers that have been published since.

Finally I recommend that you improve the paragraph of conclusions in your manuscript. They seem to have been written to hastily.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 9419, 2007.