

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

### **Anonymous Referee #1**

Received and published: 30 July 2007

#### General comments

The main purpose of this manuscript is a quantitative estimation of impacts of aerosol originating from ships on the radiation budget and clouds with a global model. This study should be appreciated because it is important to investigate it as one of anthropogenic climate changes. However, there are inappropriate descriptions, so that this manuscript should be published after major revisions.

1. Add global maps of the cloud droplet number concentration and cloud droplet effective radius at the boundary layer in Section 3.4. Their information is very important for readers to understand the aerosol indirect effect described in Chapter 4.

2. The method of deriving the aerosol direct forcing under the all-sky condition is inappropriate described at the last paragraph in Section 4.1. It has to be calculated from the clear-sky forcing AND cloudy-sky forcing with weighted by the cloud fraction at each time step in the simulation and then averaged. Recalculate it because estimating the aerosol radiative forcing quantitatively is meaningful for this study. The direct radiative forcing of the radiatively-absorbing aerosols, such as black carbon which is included in this study, strongly depends on relative altitude between aerosols and clouds (e.g., Haywood and Ramaswamy, *J. Geophys. Res.*, 1998; Takemura et al., *J. Climate*, 2002). The forcing even of non-absorbing aerosols, such as sulfate, depends on the liquid/ice water content as well as the cloud fraction. The estimation by Equation (1) is too rough, and the last sentence of Section 4.1 is wrong.

3. The authors have to check English. There are a lot of mistakes in grammar (some of them are mentioned in “Minor revisions”), and therefore it is illegible. Writing legible manuscript is duty of authors. Let native speakers check English.

#### Specific comments

Page 9420, Line 6: Revise “... by scattering and absorbing incoming solar radiation ...” to “... by scattering and absorbing the solar and thermal radiation ...”.

Page 9420, Line 8: Revise “... cloud microphysics, to show that ...” to “... cloud microphysics. The simulation shows that ...”.

Page 9420, Line 15: Add “on the global mean” after “in the year 2000”.

Page 9420, Line 22: Revise “... a change of the net top of the atmosphere (ToA) clear sky radiation of about ...” to “... a change in the net radiation budget at the top of the atmosphere (ToA) under the clear-sky condition of about ...”.

Page 9420, Line 24: Revise the values of all-sky forcing according to the comment 2 mentioned above.

Page 9420, Line 26: Revise “(change of the top of the atmosphere shortwave radiative

flux)” to “(a change in the atmospheric shortwave radiative flux at ToA)”.

Page 9421, Line 12: Revise “... by scattering and absorbing incoming solar radiation ...” to “by scattering and absorbing the solar and thermal radiation ...”.

Page 9421, Line 15: Delete “, known as indirect aerosol effect” because a word “indirectly” appears in the previous sentence.

Page 9421, Line 19: The authors should refer old papers on ship tracks from satellites, e.g., Nakajima and Nakajima (J. Atmos. Sci., 1995).

Page 9422, Line 4: Add “by ship emissions” after “the indirect effect”.

Page 9422, Line 22: Revise “effect” to “effects”.

Page 9423, Line 17: Revise “gas/-particle” to “gas/particle”.

1st paragraph in Section 2.2: Do the authors use an ocean model or only an atmospheric model with prescribed data of SST and sea ice? Describe clearly. If the latter, add a explanation of the prescribed data of SST and sea ice. The results largely change whether the ocean model is coupled or not.

Page 9424, Line 18: Revise “under year 2000 conditions” to “under the year 2000 condition”.

Page 9425, Line 6: Revise “with emission totals” to “with the SO<sub>2</sub> emission totals”.

Page 9425, Line 8: Add “SO<sub>2</sub>” after “9.4 Tg”.

Page 9426, Line 7: Revise “suggest” to “suggested” or “suggests”.

Page 9426, Line 23: Revise “inventory B and C” to “inventories B and C”.

Page 9432, Line 17: Add “(Table 2)” after “from shipping”. 3rd paragraph in Section 4.1: Add a table on the shortwave radiative forcing of the aerosol direct effect from shipping in the Pacific, Atlantic and global mean as same as Table 4. To show it clearly with the table is useful for other researchers.

2nd paragraph in Section 4.2: Add a table on changes and changing rates in the cloud droplet number concentrations and cloud droplet effective radius in the Pacific, Atlantic and global mean. To show it clearly with the table is useful for other researchers.

Page 9436, Line 11: Revise “whole sky” to “all-sky”.

Page 9437, Line 24: Add “(Figure 11)” after “carbon dioxide and ozone”.

Page 9438, Line 10: Explain a difference clearly in the radiative forcing between this study and “ship tracks” in Schreier et al. (2006).

Page 9438, Line 28: Add a value of RF from aircraft by Sausen et al. (2005).

Page 9439, Line 11: Revise “the general circulation model” to “the atmospheric general circulation model” if without an ocean model.

Page 9441, Line 12: Add a ratio of “from  $-0.19 \text{ W/m}^2$  to  $-0.6 \text{ W/m}^2$ ” to the total aerosol indirect effect.

---

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

[Full Screen / Esc](#)[Printer-friendly Version](#)[Interactive Discussion](#)[Discussion Paper](#)