

Interactive comment on “Radiative forcing of the direct aerosol effect using a multi-observation approach” by G. Myhre et al.

Anonymous Referee #1

Received and published: 29 July 2008

Review of "Radiative forcing of the direct aerosol effect using a multi-observation approach" by Myhre *et al.*, submitted to Atmos. Chem. Phys.

The paper presents a thorough comparison of the Oslo chemistry transport model against ground-based and satellite measurements, and gives the aerosol direct forcing estimated by that model. The model performance, demonstrated by what is certainly the most extensive comparison against observations ever achieved, is very impressive. Comparing model and satellites on an equal basis against AEROCOM is really interesting. The study also reveals the importance of anthropogenic secondary-organic carbon aerosols, which are not included in most general-circulation models. In fact, the Oslo CTM2 could very well be used as a reference for assessing the aerosol modelling in climate models. The paper is well written and organised, and I've only minor

comments. The only disappointing point is that the deficiencies identified by the comparison rarely translate into suggestions for improving specific aspects of the aerosol modelling.

Specific comments

- The title of the paper is slightly misleading, as the forcing estimate is derived from a numerical model, not observations.
- Page 12828, line 26: What is the reason for decreasing the single-scattering albedo of fresh biomass-burning aerosols? What is the new value?
- Page 12830, line 12: "EC and OC [...] challenging." I do not understand this statement.
- Page 12831, line 11: Why didn't the authors use the meteorology for each campaign? Doing so might improve the comparison, and in any case make the interpretation of results easier.
- Page 12833, section 3.2: The methodology should be given at the start of the section, rather than scattered throughout. If I understand well, the comparison is done on daily means, without trying to match satellite overpass times? Are the AERONET data level 2.0 for algorithm version 2?
- Page 12834, lines 20 and 24: A change of 10% is not really a minor difference.
- Page 12835, line 12: Figure 6 is very original. Could the authors define a threshold for correlation coefficients, below which the model/satellite performance might be deemed unsatisfactory?
- Page 12836, line 10: Forth should be written FORTH, as it is not the name of a location but stands for "Foundation for Research and Technology - Hellas".
- Page 12837, line 23: "In terms of RF, the underestimation [...] in East Asia [...] is the most important". Why is it more important than errors in the biomass-burning regions?

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- Page 12837, line 25: Note that natural aerosols can be of importance for the radiative forcing, as their direct effect modifies the radiative fluxes experienced by the anthropogenic aerosols. However, this effect is obviously only significant where both natural and anthropogenic aerosols are present at the same location.

- Page 12844, line 14: How is the anthropogenic origin defined in the model? For example, is biomass-burning considered as being entirely of anthropogenic origin?

- Page 12845, section 4: I guess that, following IPCC, the radiative forcing is defined with respect to pre-industrial conditions?

- Page 12849, line 11: Can the authors give the range of nitrate RFs?

Technical corrections

- Page 12829, line 23: "precise" should read "precisely".

- Page 12833, line 19: Should read "The model underestimate AOD in North Africa".

- Page 12836, line 15: please rephrase the "located largely influenced".

- Page 12845, line 6: "predicts" should read "suggests".

- Page 12845, line 8: "be doubled" should read "have doubled".

- Page 12849, line 16: delete "in".

- Caption of Fig. 1: "Illustrative" should read "Illustration" or "Diagram". Note that the use of the asymmetry factor to represent the aerosol phase function is not universal. Some studies and radiative transfer codes use more moments of the phase function, or even the phase function itself.

- Caption of Fig. 14: "aerosol model" should read "Oslo CTM-2 model".

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 12823, 2008.

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