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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Particulate absorption of solar radiation: anthropogenic aerosols vs. dust" *by* C. Wang et al.

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We appreciate the constructive comments of the reviewer on our paper. We have revised the manuscript based the comments and suggestions from both reviewers. The following are our point-to-point responses to this reviewer's comments (listed with bold and Italic font).

1 Main comments.
The quality of the aerosol modelling is assessed by comparing against AERONET, MODIS, and GOCART. CAM3 seems to do ok, although the logarithmic scale used in Figure 1 is forgiving. However, we are not given enough information to know where the modelled aerosol distributions stand compared to other models. Publishing the global-averaged aerosol optical depths and bur-

dens for each aerosol species included, and comparing those values against AeroCom estimates (Schulz et al., ACP, 2006) would place the authors' model in context. Of course, being outside the AeroCom range on a given variable is not a bad thing, but it helps considering whether results would be reproduced in other models. This is particularly important for the mineral dust aerosol, which seems to have quite a large contribution in this study. This is also important for the black carbon. The total black carbon emissions of 14.7 Tg per year used in the baseline estimate are on the high side. More generally, AeroCom publications are of interest here. Kinne et al. (ACP, 2006) discussed the distributions of aerosol absorption in participating models. Results are now slightly dated, as aerosol modelling has since evolved, but remain relevant.

We have revised Figure 1 by adding a comparison of our modeled AAOD with the median of AeroCOM models as listed in Figure A6 of Kinne et al. (2006). We also discussed the result by indicating the differences in both emissions and aerosol physiochemical processes between our model and AeroCOM models.

Sea-salt should not be left out of the calculation of the anthropogenic fraction of total aerosol optical depth. Neglecting such an important natural aerosol yields large anthropogenic fractions that are difficult to compare against other estimates (it will not impact the anthropogenic fraction of the absorption aerosol optical depth). In addition, considering sulphate aerosols produced by DMS oxidation as "anthropogenic" is not a good move. This is a natural process.

The reviewer's point is well taken. Our emphasis of the paper is on AAOD. The AOD fractions are discussed only for the purpose to describe how different the result would be when not considering the absorption but total extinction. We believe the current comparison between anthropogenic fractions of AAOD and AOD that only include dust, carbonaceous and sulfate serves the purpose. Actually, we indicated in the text about the potential outcome if sea salt was included. Note that in all places where the total modeled AOD is compared with observed one, our results actually include sea salt as

described in the Method section.

The "DMS" statement has been revised to: "Note an artifact over the remote oceans where the anthropogenic fraction is high due to sulfate aerosols largely from DMS oxidation that should be separated from anthropogenic fraction."

We also added a sentence P6575, L16: "There are, however, particularly in the AOD calculation, rather small contributions from natural sources such as DMS in sulfate production and secondary particulate organic carbon in OC that have not been separated from anthropogenic fraction owing to the complexity of such a procedure."

Showing that mineral dust absorption can be as large as black carbon absorption over India is an interesting result (provided that mineral dust fields are not overestimated). However, from a climate change perspective, anthropogenic absorption remains more important, as it can be controlled to some extent.

We agree with the reviewer. The current discussion of the potential role of dust is to provide an overview to the reader of other hypotheses. New citations are also added.

2 Minor comments.
Lines 11-12, page 6575: "except for events influenced by episodic pollutants". What does that mean? Hopefully those episodic pollutants are not aerosols...

We have revised the sentence to: "A good agreement between modeled and observed data is seen in most of these comparisons except for events clearly under influences of episodic heavy pollution plumes in subgrid scale that could not be well represented by the model". Here the pollution plumes contain particulate matters.

Lines 16-18, page 6576: It would be worth indicating that the scaling of the refractive index results in a less absorbing mineral dust aerosol. Giving the resulting single-scattering albedo at selected wavelengths would be helpful.

The sentence has been revised as: "These estimates are based on satellite and surface based field observations, which actually results in less absorbing dust aerosols,

and may still be susceptible to biases due to measurement errors and contaminations".

Pages 6575-6576: Different aerosol species seem to come from different sources. To make it clearer: Were the mineral dust and sea-salt models run independently of the rest of the model? If so, are climate and atmospheric circulation consistent across all models?

The climate driving the derivation of anthropogenic, dust, and sea salt aerosols might not be exactly the same but should be consistent. This is because that all the simulations were forced by the observed sea surface temperature of "current climate".

3 Typos.

All typos indicated by the reviewer were corrected.

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