

Review of Particulate absorption of solar radiation: anthropogenic aerosols vs. dust by C. Wang et al.

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1 General Remarks

This manuscript describes a model focused investigation of the contribution of anthropogenic aerosols and mineral dust to the global distribution of short wave absorption optical depth, using an aerosol scheme in the CAM climate model.

The uncertainties in current estimates of aerosol absorption remains large, making their investigation an important contribution towards the quantification of the aerosol radiative effects. However, I remain slightly puzzled by the specific focus of the manuscript on the absorption optical depth of *solar* radiation by anthropogenic aerosols and mineral dust which limits the drawn conclusions, as I will outline below. In my opinion, a number of major issues need to be addressed before publication.

2 Major Issues

Many details have already been given in the two other reviews so that I will focus on my main points.

- **Long-wave effects**

Given the large difference in the size-distributions of anthropogenic aerosols (fine) and mineral dust (coarse), I was very surprised by the limitation of this study to “*solar absorption*”. In fact, the results are entirely focusing on absorption optical depth at 550nm. However, from Mie theory it is clear that dust with its larger Mie size parameter will also have significant, if not dominant, absorption in the long-wave part of the spectrum, a fact that is neither addressed or even mentioned in this manuscript. While the climate implications of aerosol absorption are repeatedly mentioned, the impression is left throughout that AAOD at 550nm would be the representative measure of aerosol absorption. This is unfortunately not true. For a comparison of the relative importance of anthropogenic and dust radiative effects, that seems to be the focus of this manuscript, both in the title and body, it would be essential to consider SW AND LW radiative effects. I am not implying that the authors do not clearly state their

focus on solar radiation but this somewhat subtle limitation is certainly confused by a wider audience. More importantly, I am not sure what the particular science question of interest is given this limitation as it is simply not sufficient to quantify the importance of dust absorption solely through AAOD at 550nm.

- From AeroCom and other inter-comparisons we have learned that absorption optical depth, a measure of potential extinction rather than actual extinction, is not an unambiguous predictor of actual absorption as calculated by a range of models. Other factors, such as clouds seem to play an important role. Therefore, the conclusions about the relative contribution of certain aerosols to absorption are reaching too far. If absorption optical depth is shown, the discussion should focus on this parameter. Statements about the contribution to absorption should be supported by the actual results for all-sky absorption, ideally SW+LW. This has actually been done in previous work - which is largely ignored in the discussion or introduction.