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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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This is a model-based study of the relative roles of anthropogenic and dust aerosol in determining the global distribution of AOD and absorbing AOD. Knowing whether the bulk of the aerosol absorption in the atmosphere is controlled by human activity is important. Knowing the distribution of the anthropogenic component of the absorbing aerosol, regionally, seasonally and vertically is a good first step in understanding the human-induced consequences to atmospheric circulations and climate.

I remain skeptical of whether models (in general, not this one specifically) are ready to do this exercise, but this skepticism should not prevent publication of such material in the open literature. I am ready to accept that given the tools available now, with the observational constraints available now, this is probably the best that can be done. I

recommend publication.

I have a few points of discussion.

1) We need more information about the data sets used to create Fig. 1. Exactly what AERONET data? Climatology? Averaging from scratch and how? There should be discussion of the uncertainties in the AERONET AAOD. These are retrievals, not observations. AAOD numbers have changed with updates to the AERONET retrieval. Which version of AERONET retrieval? Exactly what MODIS data? Level 3 daily and averaged? Level 3 monthly and averaged? Which collection of MODIS data? How were the gridded data sets matched to AERONET? The exact grid square?

There are lots of dots on these plots, especially for the monthly plot. Is there a better way to display this information? Contours for example? It is hard to see whether the model used in this study is sufficiently valid. Definitely the symbol for MODIS needs to be changed so that it can be seen. Perhaps it is not smart to put all these different things on the same plot. Perhaps the goal is to compare the results from this study against AERONET and then against MODIS and against GOCART.

The RMSE numbers are rather higher than advertised. Would showing regression lines and correlation coefficients be helpful? I just wonder if it is at all useful to have RMSE of 0.10 and above when most of the world's oceans have AOD in the 0.10 to 0.11 range? The plots suggest more skill than the RMSE values suggest, yet the only hard numbers given are these RMSEs.

2) What is meant by anthropogenic? I was taken aback by this statement on Page 6578. "Anthropogenic fraction is also high due to DMS oxidation". Huh? DMS is natural. This statement implies that the partitioning between anthropogenic and dust needs to be better defined from the beginning. What is included as 'anthropogenic'? Does it include boreal wildfires? Does it include DMS? Does it include fine mode sea salt? Terrestrial biogenics? This starts to become important. Is the reason for the dominance of anthropogenic aerosol over the oceans because of the biogenic component there?

3) We know from the AEROCOM experiments that the global aerosol transport models will all match the global AOD but have significantly different combinations of particular species and different values of extinction efficiencies. I question how robust would be the results from the present paper if two different models were employed? I'm not suggesting that the authors run multiple models. That is an AEROCOM responsibility. I just think there should be discussion.

4) In this light, I found that the model runs of 'high' and 'low', Table 1 and figure 4 to be of the most interest. The high and low runs seem to be sufficiently broad in parameter space (ie SSA for dust ranges from 0.68 to 0.94). Given this broad parameter space it is not surprising that the 'high' and 'low' scenarios show two very different worlds. The 'high' world restricts dust dominance to only the known dust source regions. The 'low' world restricts anthropogenic dominance to only the biomass burning regions and the U.S. and Chinese southeast. This implies that the greatest control that policy makers can exert on absorbing aerosol effects should be directed to tropical biomass burning.

5) It would have been very useful to do more than 'high' and 'low' and to show how the results varies due to changes in SSA versus changes to emissions. I realize that this is outside the scope of the study, but I wanted to mention it.

6) The results did not surprise me. I have never considered dust to be that absorbing in the visible. My guess is that the TOMS and then OMI global maps of 'absorbing aerosol index' in the UV accentuated the role of dust as an absorbing aerosol because the observations were made in the UV where dust absorbs strongly. This leads to a question, what is the relationship between the results calculated here for midvisible to the actual heating in the atmosphere, which should be integrated across the spectrum? Would this modify the paper's conclusions? I'm sure there must be references. I just don't know them.

Following are some typos that I noticed. Several times the article 'the' is missing.

P 6573 line 6. Lower instead of lowered.

Line 9. Ackerman with 1 'n'.

Line 11. 'on large scales' instead of 'in large scales'

Line 14 'the' Pacific, Atlantic and Indian Oceans

Line 15 'the' Indian summer monsoon

Line 18 'the' atmospheric circulation

P6577 line 13. Carbonaceous instead of carabonaceous

Line 23. 'the' tropical Atlantic Oceans; 'the' Arabian Sea; 'the' Indian subcontinent

P6580. Line 7. In the rest 'of the' seasons

Lines 9-14. How much are these statements trusted? Can ARCTAS results support the identification of dust in the arctic?

Line 23. East'ern' most

Line 24 'the' Walker circulation

Line 29. 'the' Pacific

P 6581 line 8. 'the' Indian subcontinent

Line 11. 'the' Arabian Sea

Line 12. 'the' lowermost

Line 15. 'the' high dust zone

Line 20-23, is the dust also scavenged and reduced?

Line 22. The 'centers of high' anthropogenic AAOD 'are' elevated. . .

P6582 line 2-6. Coexisting in the vertical also?

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