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Atmospheric Chemistry and Physics Discussions

Interactive comment on "A pathway analysis of global aerosol processes" *by* N. A. J. Schutgens and P. Stier

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We thank the anonymous reviewer and Pete Colarco for carefully reading our manuscript and providing us with useful comments. Below you can find our responses to their questions/comments.

Answers to referee's comments

The authors are to be commended for their general thoroughness, but the paper is challenging to read. The attentive reader will need their scorecard handy (Tables 1 & 2), but even so this is a paper that will need to be viewed on a large computer monitor to make the figures at all usable. I think the color schemes for the pie chart figures are difficult to read, and so difficult to interpret without the aid of the text. I would suggest

perhaps a color scheme like those suggested at http://colorbrewer2.org for "qualitative" data as useful to people who like myself have a hard time distinguishing shading of various blues (e.g., Figure 5b).

The referee points out an issue that we struggled with ourselves. In particular our colourtables are not very accommodating to color-blind researchers. Unfortunately, we have not found a better way to represent our results. The suggested website is very illuminating in this respect (great resource, by the way!): only 2 different colour schemes are recommended for qualitative separation of data. Neither of which works for colour blind people and both of them accommodate at most 12 different classes. In contrast we are dealing with 33 different classes (see our Table 2), of which many are aggregates already.

We suppose the biggest problem is posed by the blue and green colour scales used for coagulation of resp nucleation and soluble Aitken particles. For these processes, a sequential colour scale was used and we tried Brewer scales to see if any improvement might be found. The difference between the Brewer scale and our original scale is however small and we could not decide which one is better. Finally, we considered using two colour scales instead of just one for e.g. coagulation with nucleation particles. One could use a blue scale for coagulation with soluble particles and another scale for coagulation with insoluble particles. This would allow us to add more differentiation. However, due to the use of many colours in our paper no secondary colour scale readily suggests itself (without causing conflicts or confusion in some other figure).

We also feel it is important to use a single consistent colour scheme throughout the paper. In light of the above, we suggest to stay with our original choice. Note that different shades of colour always refer to the same process but for different species or modes. Numbers of course refer to the relevant modes.

1) Please clarify in the model setup description what year was run? Were there any important events in that year (volcanoes, wildfires)?

The model was run for the year 2000. Standard AEROCOM emissions were used that contain no special events. Text of the paper has been updated.

2) For the reduced spatial resolution run I am a little surprised at the consistency of the results. Although I understand the tuning of dust and sea salt emissions mentioned, my experience has been that clouds may be quite different across changes in horizontal resolution, with possibly large effects on in-cloud sulfate production, for example. Your baseline is already relatively coarse (_2x2 degree) so maybe your cloud fields aren't so different at the coarser resolution (my experience was in moving from 2x2.5 degree grids to 0.5x0.625, for example). Could you explain a few sentences more about the nudging? Are you imposing cloud fields, or are those solved from the imposed dynamics?

The nudging is only applied to windfields (vorticity, divergence), temperature and specific humidity. Sea ice and SST are prescribed. Cloud water and number density are prognostic variables in our model. They develop freely, given atmospheric conditions. A possible explanation for the consistency of results across two different resolutions maybe that we consider only area-averages: while results maybe be very different per gridbox, they are similar over larger regions.

3) Regarding the discussion of pre-industrial emissions (p. 15062, line 10), would preindustrial meteorology matter to the results?

While aerosol will exert a feedback on the climate system and this will certainly affect meteorology which will in turn affect the aerosol, the effect of the aerosol feedback on itself tends to be smaller than natural variation in the meteorology anyway. We have shown this using an ensemble of model simulations with perturbed emissions (work in progress). See also Schwartz et al. JGR 2013.

4) Section 4.4.1, page 15064 line 2 (and throughout section):reference to Figure 6 should be to Figure 5, and reference to Fig. ?? should be to Fig. 6 (also in Section 4.4, line 14).

Agreed, corrected.

5) page 15065, line 7: I think reference to figures 8d & e should be to Figure 8 c & d.

Agreed, corrected.

6) I'm a little confused about the presentation of the aging processes for the hydrophobic Aitken mode (Section 4.4.2, esp. lines17 - 20 and Figure 9). The text talks about coagulation with nucleation particles (which is process 15 on my scorecard) which wouldn't be a loss of particles in the Aitken mode, I realize (what is plotted in Figure 9) and condensation is called out in the lower troposphere. These things all make sense, but I can't tell what they have to do with Figure 9, where the processes illustrated there aren't seemingly discussed. Please clarify the intent here

The explanation is that both processes coat hydrophobic particles with a sulfate layer, making them hydrophilic. In the model, this is done by transferring part of the hydrophobic mode to its hydrophilic counterpart (same model treatment is used for the Aitken, accumulation and coarse modes). This was discussed in Sect. 2.8. A line has been added in Sect 4.4.2 to clarify this further.

7) There doesn't seem to be any reference or discussion of Figure 17.

Actually there is but the order of the Figures and the explanation in 4.4.5 was different, possibly creating some confusion. This has been corrected.

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 15045, 2014.