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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Radiative forcing of the direct aerosol effect from AeroCom Phase II simulations" *by* G. Myhre et al.

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Response Referee2

Anonymous Referee #2 This paper is an an important timely presentation of AEROCOM radiative forcings. It updates radiative forcing estimates from Schulz et al. (2006). It presents forcing estimates for different anthropogenic aerosol changes over the industrial era. It then scales RFs to get numbers from pre-industrial to present day. The paper is very concise and because of this it is often hard to follow the discussion. It is a very good paper generally, apart from the scaling discussion which is not presented clearly enough to understand in the current draft Scaling issue: Fig 17 and the scaling discussion: I just can't work out from this what is being scaled. Is if forcing or emissions and how? I don't know what the bars are on figure 17 - the figure caption says "read

the text" but the doesn't tell me either. If these scaled numbers are going into ipcc, I think a lot more explanation should be added. I cannot judge if it is done well in the current draft. it is also not clear what time period or emissions the forcings are being scaled to. The date ranges are complicated to understand. I think the text should be clarified.

General response: We thank for the positive evaluation and useful comments. See further responses below.

Response: The following sentence has been included to make the scaling to 1750-2010 values more clear: 'Figure 17 shows a scaling of the AeroCom RF simulation for 1850-2000 to the extended time period 1750-2010. To achieve this, we first calculate the aerosol component specific ratios of OsloCTM2 RF between 2010 and 1750 (Skeie et al., 2011) to RF between 2000 and 1850 (present work). Similar ratios are extracted using the GISS values from 2000 to 2010. The ratios from these two models are combined, and applied to each of the aerosol components individually. To scale the total RF, we then take the multi-model mean from the present work and add the sum of the component scalings. BB is excluded from this analysis, due to large uncertainties in BB activity between 1750 and 1850 as well as the inhomogeneous RF (see Figure S3).'

I have a few other suggestions which I hope would improve it.

1. The albedo figure (Fig 1) is useful to aid understanding. The main other source of error discussed is the vertical profile. Can you show something similar related to this to aid the discussion? They key factor would be aerosol height related to cloud height - do you have a neat way of showing this? You may not have cloud height diagnostics from the model so it may not be possible. But your discussion left me wanting more here. And the vertical profile uncertainty seemed rather spread out in the current draft

Response: A paragraph on uncertainties has been included in the discussion: 'The reasons for the differences in burden, MEC and NRF are numerous. For differences in

NRF Randles et al. (2012) show that the radiative transfer scheme itself contributes to the diversity and Stier et al. (2012) further explores that host model differences such as surface albedo and clouds cause a substantial part of the diversity for the RF of the DAE. The differences in the aerosols vertical profile (Koffi et al., 2012; Schwarz et al., 2010) contribute to differences in NRF, especially for BC. Samset et al. (2012) show that 20-50% of the diversity in RF of BC is caused by the differences in the BC vertical profile. Further studies within AeroCom will explore other causes of the diversity in the results. Since most of the models in this study apply similar data sets for anthropogenic emissions of aerosols and their precursors, the uncertainties in this study do not include the full uncertainty in the RF of the DAE. The difference in the background aerosol concentration (pre-industrial) between the models is of small importance for the RF of the DAE since RF is relatively linearly depending on the anthropogenically perturbed concentrations at current levels of the aerosol species.' This paragraph mention vertical profiles, but in depth studies are needed to explore this issue further.

2. It would be useful to know the pre-industrial and natural emissions - can these contribute to inter model differences and how were they handled?

Response: Most models have used Dentener et al. 2006 pre-industrial emissions. However, natural dust and seasalt aerosol levels are rather different in between models, but had been kept constant for pre-industrial and present day simulations. RF is more or less linear to the small optical depths differences at current total aerosol levels (see e.g. Meerkotter et al., Ann. Geophysicae, 1080-1094, 1999) and therefore the differences in background concentration for the direct aerosol effect are of minor importance.

3. Emission error is not accounted for in the RF spread. I think this needs to be discussed. In a similar vein, observations are never really discussed. I know this is a modelling paper but, for example, if AERONET is showing models underestimate BC burden, this points to errors in emissions....

Response: Response: This issue is discussed in response to comment 1 acknowledging that mostly the same anthropogenic emissions have been used and that this underestimates the complete uncertainty.

4. Fig 14. seems really important for uncertainties in the paper but it wasn't clear. The discussion is quite good if a little concise but but I found it very hard to interpret fig 14 to check that it matched the discussion points. So I think this discussion and/or figure should be improved.

Response: More text is added to help the reader to follow the discussion of the figure and some examples are added.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 22355, 2012.