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Interactive Comment

Interactive comment on "Standard climate models radiation codes underestimate black carbon radiative forcing" *by* G. Myhre and B. H. Samset

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Anonymous Referee #1 This paper explores the sensitivity of black carbon (BC) aerosol radiative forcing (RF) to the complexity of the radiation code (2-stream versus 4- to 16-stream). As such, it nicely extends and illustrates the conclusions of recent multi-model radiation code inter-comparisons. It is well written and should be accepted to ACP with very minor revisions, which I describe below:

1. I am somewhat confused by exactly how BC RF is calculated. It seems you use aerosol present-day (PD) and pre-industrial (PI) aerosol distributions from AeroCom Phase II? However, optical properties and meteorological data (i.e. clouds) come from OsloCTM2 and ECMWF, respectively? Perhaps some rewording could be done to

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make this a bit more clear in Section 2. Further, when calculating BC RF, you seem to imply in Section 3.2 that BC RF is calculated when other scattering aerosol types are included, and I"m not sure how this is done; some elaboration would be appreciated.

Response: The description has been clarified both connection between OsloCTM2 and AeroCom in relation to ECMWF and that other aerosol components are included. The following text is now is section 2: 'In the global simulations we used meteorological data from ECMWF, and specified aerosol optical properties (Myhre et al., 2009a) and aerosol distribution from the OsloCTM2 chemical transport model (Skeie et al., 2011). To study the impact of the radiation code on global mean RF of BC, input fields and results from OsloCTM2 part of AeroCom Phase II for several aerosol components were used.'

2. This point in Section 3.2 about how the BC RF changes much more in the presence of scattering aerosols (more so then when alone) is very interesting and could be highlighted a bit more in the abstract and conclusions.

Response: The following text is included in the conclusions: The underestimation for BC is largest in the presence of scattering components and the same applies to gases with solar absorption. However, under clear sky condition only gases in the lower levels of the troposphere with solar absorption in UV and visible region where Rayleigh scattering is strong causes underestimation of similar magnitude as for BC.

3. Did you look at other aerosol types in terms of RF at all? It would be interesting to mention the effect of the radiative transfer code complexity on other aerosol types as well.

Response: We have added the following sentence: 'For pure scattering aerosols 2-stream simulations varies with solar zenith angle (see Randles et al. (2013)) and surface albedo compared to 8-stream simulations, but on a global mean 5% stronger negative RF for anthropogenic sulphate aerosols.'

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4. Figure 1; it would be useful to print the global mean on the plot.

Response: We would like to avoid global mean of the ratio of the 2-stream and 8-stream simulations. Global mean numbers of 2-stream and 8-stream simulations are given in the text.

5. Figure 2: The legend is confusing. What is meant by “All eff”? and “BC only”? The thinnest lines are difficult to see. There are also 8 things in the legend but only 6 lines on the plot (a). Perhaps make the lines in (b) a different color to distinguish them from lines in (a).

Response: The figure and caption have been updated, and are now hopefully clearer. (There were 8 lines in the plot, as stated, however two of them are almost overlapping – as can be seen from the ratio in panel b.) The new caption reads:

Figure 2: (a) BC RF normalized by abundance, as a function of altitude. Solid lines: 8-stream simulations. Dashed lines: 2-stream simulations. Colors represent all sky and clear sky conditions, and whether a full atmospheric simulation including Rayleigh scattering, water vapour and background aerosols was performed (“Full sim.”), or if BC was the only radiatively active agent (“BC only”). (b) Ratio of 2-stream to 8-stream simulation results, for the four cases shown in panel (a).

Interactive comment on Atmos. Chem. Phys. Discuss., 14, 26173, 2014.