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Atmospheric Chemistry and Physics Discussions



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

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The manuscript is short, well written and presents some interesting results. The authors present a convincing explanation for the BC radiative forcing discrepancy they observe between 2-stream and multi-stream RT codes. The manuscript being short, it nevertheless raises a number of questions, which once answered by the authors, should improve the manuscript further and warrant pulication.

The authors use 8-stream and 16-stream configurations of their multi-stream RT code. However I could not find a comparison between these two versions. It seems that the 8-stream configuration is used for Figs. 1 and 2, while the 16-stream configuration is used for Fig. 3. It would be good to know the minimum number of stream that is

required to get a stable solution. In other words, does the BC RF converge and how fast at low surface albedo when the number of streams is increased.

If the authors' explanation for what they observe for BC is correct, then shouldn't that apply also to gaseous absorption in the solar spectrum? Wouldn't gaseous absorption by $O_3$, $H_2O$, $CO_2$, $CH_4$, ... also be underestimated by 2-stream RT codes? A lot of the gaseous absorption occurs in the near-infrared where scattering is less, and O3 absorbs everything where it absorbs in th UV, so the effect should be less. But H2O has many absorption bands below 1 $\mu$m. Maybe the authors should look into this or at least mention it. This could have some implications for the water vapour feedback in climate models (e.g. in polar regions, where surface albedo is large, $T$ change is amplified and $q$ change per unit of $T$ change is large).

I wonder if the effect found on an absorbing aerosol (i.e. BC) is not associated with a countereffect on scattering aerosols (e.g. sulfate). Does the radiative effect of scattering aerosols depend on the number of streams used?

Finally I wonder how general the results here are. The authors mention that most climate models use two-stream approximations with the delta-M method, but do not substantiate their findings. I would be surprised if all two-stream models use the same approximation to truncate the forward peak of the aerosol phase function. Isn't there some spread in the Stier et al. and Randles et al. papers among the two-stream models? How does the two-stream RT code used here compare with the other two-stream RT code used in Stier et al. and Randles et al.? I think the statement on lines 6–10 of page 26179 should be more substantiated or qualified.

The caption for Figure 1 needs to be revised. It looks like a ratio rather than a relative difference. Same for Figure 2b.

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