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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Black carbon in the atmosphere and snow, from pre-industrial times until present" *by* R. B. Skeie et al.

Anonymous Referee #1

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This paper discusses the simulation of black carbon deposition onto snow surfaces since preindustrial times. It also examines the radiative forcing and aging time of black carbon during this period. It contains some novel information. I would recommend revisions as suggested below. If these comments are addressed with modifications in the text, I would recommend publication.

P. 7472. The authors state, "Most of these models do not include aerosol microphysics that lead to conversion of BC to a hydrophilic state where it can be scavenged by preciptitation." However, some models do account for aging by treating microphysical processes. Please identify such models.

P. 7473. The authors state they use a CTM. However, the authors do not acknowledge the disadvantage of using a CTM versus an interactive climate model-CTM– namely,

the lack of feedback of the transported pollutants in the CTM back to weather and climate, which could change results. The authors should acknowledge this limitation.

P. 7474. The authors claim that the advection scheme they use is "low-diffusive." However, this is not demonstrated here. Most global models are significantly diffusive, particularly in the vertical transport of trace species, as demonstrated by the model comparisons with vertical BC profile measurements over the Pacific ocean in Schwarz et al. Geophys. Res. Lett., 37, L18812, doi:10.1029/2010GL044372, 2010. The nearly uniform vertical profile of the modeled concentrations up to high altitude compared with the sloped profile of the data in that comparison suggests numerical diffusion. The authors have compared with some different vertical profile data here, and the results are ambiguous with respect to both numerical diffusion and accuracy. It would be helpful to compare their vertical profiles of BC with the Schwarz et al. data as well since then their results can be compared also with those from other models along with the data and a better determination of the numerical diffusivity could be obtained.

P. 7474. Aging depends not only on coagulation of BC with sulfate but also on condensation of sulfuric acid and other vapor onto BC-containing particles and heterogeneous reaction on BC-containing particle surfaces. These processes do not seem to be accounted for. The authors should state explicitly that they are excluding these additional processes. Also, the aging process varies as a function of particle size, but the authors seem to treat only bulk BC. The authors should explain how this simplification might affect results.

P. 7476. The authors assume hydrophobic BC does not obtain a coating for radiative calculations. However, sulfuric acid condenses on soot particles containing BC regardless of whether soot is hydrophobic or hydrophilic, and water will then hydrate to the sulfuric acid. The authors should discuss the potential error from not treating this process.

P. 7478. With respect to the calculated global mean BC concentration, please distin-

guish between land and ocean concentrations.

P. 7478. It is not clear how Fig. 2a shows that the modeled surface concentrations are in “good agreement with observations” as no observations are shown in that figure.

P. 7479. Figure 3 does not provide useful information. The authors should instead show a time series comparison of the model with observations at each location instead of a scatterplot. The scatterplot does not pair model with data in time so serves no real benefit.

Conclusions and abstract. The authors provide a single number rather than a range for their radiative forcing estimate of BC in air and snow. The authors should provide a range around the mean number.

Interactive comment on Atmos. Chem. Phys. Discuss., 11, 7469, 2011.