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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of preindustrial to present-day black carbon and its albedo forcing from ACCMIP (Atmospheric Chemistry and Climate Model Intercomparison Project)" *by* Y. H. Lee et al.

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General comments

The authors have made a tremendous effort in comparing a large number of different model outputs and addressing key uncertainties regarding BC climate forcing in snow-covered areas. This paper certainly merits publication and will advance the body of scientific knowledge on this topic, however there are a few issues that need to be addressed regarding how the measurement data are presented and handled. These

issues include:

(1) Inadequate description of measurement techniques and uncertainties. Authors need to clearly separate discussion of atmospheric BC measurements versus snow or ice BC measurements and discuss techniques and uncertainties. Major points here include:

a. Air: Atmospheric BC measurements have a long history of measurement application and technique evaluation. Authors are primarily using optical filter-based datasets (PSAP, Aethalometer) for atmospheric measurements and discussion should be focused there. A critical uncertainty for those data is the selection of the mass absorption coefficient. Other uncertainties include filter-loading artifacts and misattribution of other light absorbing species as BC (e.g. brown carbon, iron oxide). Authors discuss (page 17) a variety of mass absorption coefficients applied to the data sets and only lightly touch upon the fact that a BC / EC comparison (Sharma papers) established a much higher MAC value that would significantly change the calculated BC values. A high MAC estimate comparing BC from the PSAP versus EC has also been observed at Summit, Greenland (Hagler, G.S.W., Bergin, M.H., Smith, E.A.., and Dibb, J.E., 2007. A summer time series of particulate carbon in the air and snow at Summit, Greenland, Journal of Geophysical Research-Atmospheres, 112, D21309, doi:10.1029/2007JD008993.). Authors are encouraged to take all measurements using the same model instrument (e.g., Aethalometer at 880 nm) and recalculate BC with an identical instrument-specific MAC value as another point of comparison to the model outputs.

b. Snow/Ice: The paper currently lacks a sufficient description of snow/ice measurements and vaguely implies atmospheric BC measurement evaluations are applicable. This is not the case and the snow/ice measurements need to be discussed separately. For example, the McConnell ice cores use a novel laser-induced incandenscence technique that is an actual BC mass measurement and is not replicated in the atmospheric measurements shown in this paper. This is the same tech-

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nique applied in the Kaspari et al. ice core, which the authors mentioned as reporting "unusually low" values. While this instrument is used for some atmospheric studies, the extraction of BC particles from meltwater via nebulization is a major difference for snow measurements. Other measurement techniques melt and filter snow or ice, which has potential loss of BC particles, then apply measurement techniques (thermal-optical EC, integrating sphere) that differ from the atmospheric measurements being utilized in this paper. One recent and very relevant paper to consider is: Schwarz et al., in review at AMTD - http://www.atmos-meas-tech-discuss.net/5/3771/2012/amtd-5-3771-2012.html Another basic overview the authors may find helpful is a recent summary in EPA's Report to Congress on Black Carbon, section 5.6 - http://www.epa.gov/blackcarbon/2012report/Chapter5.pdf

(2) The authors include a model (GISS-E2-R) with a 40% increase in BB emissions. This confounds the ability to compare other factors that may differentiate this model output against the others. Authors are encouraged to run a variation of the model with identical emissions inputs to improve the intercomparison.

(3) The ability to reproduce BC concentrations in surface snow (and later ice core archives) is anticipated to be heavily impacted by the accuracy of the estimated spatial variation in snow fall. How well do the models estimate snow fall rates spatially and is there variance between models for the snow estimates? How do model estimates of spatial snowfall patterns compare to observations?

Minor suggestions:

- Table 4 – Add mass absorption coefficient applied to each measurement data set.

- Table 5 – Add measurement technique for each data set.

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