Atmospheric
Chemistry
and Physics
Discussions

Interactive comment on "Radiative Effect and Climate Impacts of Brown Carbon with the Community Atmosphere Model (CAM5)" *by* Hunter Brown et al.

Anonymous Referee #2

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Review of "Radiative Effect and Climate Impacts of Brown Carbon with the Community Atmosphere Model (CAM5)" by Brown et al.

This manuscript presents an investigation into the direct and indirect radiative effect form brown carbon using the CESM model. In all, this work is well designed, executed, and of broad interest to the aerosol science community. The writing is clear and thorough. It is worthy to be published on ACP after minor revisions.

Current knowledge of both brown carbon and how aerosols interact with cloud are with large uncertain, therefore I can imagine the uncertainties in this study may be the subject of discussion. While conducting a very accurate analysis is nearly impossible

at this point, I suggest the authors to include a short discussion for the uncertainties. For example, a more reliable range of the radiative effect may be more useful than the global mean numbers. There are also a few questions need to be discussed. How large is the uncertainty? What processes contribute the uncertainty, and what are the most important? What kind of laboratory/field measurements are most useful for reducing the uncertainty?

Specific comments:

- Page 4, line 12: I guess it is 25% instead of 0.25%.

- Page 5, line 10: Could the authors give more information about the aerosol size distributions? What are the median sizes and standard deviations for each mode? Is there microphysical process changing the size in the model? Please also provide the information of BrC density here even it is discussed later.

- Page 5, line 18: does it mean the model assumes totally internal mixing everywhere? The influence of mixing assumption worth a discussion in later sections.

- Page 5, line 27: Is there any reason to use GFED3.1 instead of the current version of GFED4?

- Page 6 the first equation is not clear.

- Page 6, line 24: I cannot understand how the BC/OA ratio is used in this parameterization. Is the BC/OA ratio calculated from the emissions for every grid box at every timestep? Does this mean you assume all the BrC currently simulated in the grid box has the same absorption property as those emitted locally?

- Page 8, line 20: What version of AERONET data is used? level 1.5 or level 2? How good are the AERONET data? How many data points do you have (% per season)?

- Page 8, line 24: I cannot understand why the authors used 550nm data in their analysis. 440nm is a much better choice to evaluate BrC.

- Figure 3 is not that useful for the readers, maybe combine Figure 3 and 4 to an absorption AOD plot.

- Page 9, line 28: what wavelengths are $\lambda 1$ and $\lambda 2$?

- Before talking about the BrC effect. It may be worthy to describe the model result of BrC absorption briefly. For example, global mean absorption AOD and AAE, spatial and vertical variations of BrC absorption, contribution to total aerosol absorption, etc.

- There are a lot of measurements of BrC absorption in the literature (most at the surface). A brief comparison between model and these observations could provide useful information beyond the limited model validation by AERONET.