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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Brown carbon: a significant atmospheric absorber of solar radiation?" *by* Y. Feng et al.

Anonymous Referee #2

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This paper is a good study, but I believe Fig 4 demonstrates that the strongly absorbing BrC is too absorbing in comparison with observations. Hence, the paper needs to de-emphasize this case. There are other smaller points and points of clarification that should also be corrected (see below). i.e., the paper does not compare their derived refractive indices with those in the literature.

Page 2797: Lines 10, 11 "Although absorbing aerosols amplify the atmospheric forcing due to GHGs, their dimming effect compensates for the GHG warming at the surface." As shown in Penner et al. 2003 (JGR), whether an absorbing aerosol warms or cools depends on it's vertical placement in the atmosphere. If close to the surface, there is a negative surface forcing, but the aerosols warm the surface temperature.

Page 2799 line 3: carbonaceous aerosols above 0.63 um radius are not considered?

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How much increase in forcing would there be if these were included?

Page 2800: line 8-9: “In the IMPACT model, OC is converted to particulate organic matter at a ratio of 1 : 1.4 to account for secondary aerosol formation from volatile organic compounds.”

This sentence made me go back and find your definition of OC. On page 2798, line 7, it appears that OC is defined as “absorbing organic carbon”. So then a ratio of 1:1.4 would be the mass ratio between total organic matter (OM) and absorbing organic matter? This is unfortunate. Usually OC only refers to the carbon within organic matter. Often a ratio of 1 to 1.4 is the ratio between OC and OM. And this ratio, while partly explained by secondary aerosol formation, is not entirely due to this formation, since primary emissions of OM can be emitted with a ratio of OM to the carbon-only mass that is larger than 1. Please clarify what is meant here and on page 2798.

Line 13: state whether you refer to the primary emissions of fossil fuel here or are including secondary produced fossil fuel aerosol (I assume the former).

Line 15: is any BrC considered in the natural OM? Are these externally mixed from other aerosols?

Line 27: what is the source for the natural organic matter emissions? Are the organic emissions Tg/yr or Tg C/yr?

Page 2801: line 19: Kirchstetter et al. also derived the refractive index as did Chen and Bond. Please compare their values in Table 2. (differences may be due to different size distributions and/or densities).

Page 2802: Line 11: how is absorbing BrC and non-absorbing OC handled? Are these also a core-shell treatment, or do you do a mixing rule for the refractive indices?

Figure 4: this is an interesting figure and deserves more discussion than it is given on page 2804. In particular, are you able to say anything about whether the high-absorbing OC is too absorbing? Certainly in S. and C. America and S. Africa, the

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slope through the green full dots appears to indicate that there is too much absorption. This is the region where biomass burning is most prevalent, and thus where most of your absorbing BrC is. This might indicate that the higher estimate leads to a forcing by BrC that is too high. I cannot tell whether the slope through the open green symbols might be better. The red and blue dots (Europe, N. America) appear to have too little absorption (as does the dust regions, which you discuss).

Figure 5: It would seem that the strongly absorbing BrC should be replaced by the moderate BrC, since the former is an overestimate (see above).

Fig 6: the strongly absorbing case appears to overestimate AAE in biomass burning cases also.

Fig 7: consider also presenting the moderate BrC for this figure.

Page 2807, lin 13: Is the forcing really with and without each aerosol type? Normally one calculates the TOA flux with all aerosols minus the TOA flux with all aerosols except the aerosol type of interest. Please correct this if done incorrectly.

Interactive comment on Atmos. Chem. Phys. Discuss., 13, 2795, 2013.