

Interactive comment on “Relative Importance of Black Carbon, Brown Carbon and Absorption Enhancement from Clear Coatings in Biomass Burning Emissions” by Rudra P. Pokhrel et al.

Anonymous Referee #3

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This paper reports the relative contributions of light absorption of BC, lensing effect, and BrC for biomass burning aerosol from several types of fuels. The experiments were carefully conducted and manuscript is clearly written. Especially, the comparison of three different approaches to estimate the relative contributions of light absorption of BC, lensing effect, and BrC should be valuable for atmospheric science community. However, some descriptions in the experimental section and discussion on the points below are not enough. I recommend publication to ACP after the points below have been addressed.

Major comments:

- 1) For the correlation analyses between Eabs and AAE, EC/OC ratio, or MCE and C1

between the fraction of BrC absorption and AAE, EC/OC ratio, or MCE, the authors sometimes use logarithm but not in some other cases. For example, the author reported that the $\log(\text{Eabs_Den_405})$ linearly correlates with AAE (Fig. 4), and the “% of absorption of BrC” linearly correlates with $\log(\text{AAE})$ (not AAE itself) (Fig. 7). In contrast, the log-log plot was used for both of Eabs vs. EC/OC and % of absorption of BrC vs. EC/OC. The authors need to add detailed explanation on these choices. For the discussion of these correlations, the term “logarithm of” should be added in the text, if the correlation analysis was conducted for the logarithm.

- 2) This paper reported the small lensing effect for all fuels and burning conditions. Is the magnitude of the lensing effect reasonable, if you assume all OC is used for the coating with the core-shell structure?

- 3) The main findings of the paper “The fraction of absorption from BrC shows reasonably good correlation with AAE and EC/OC at both 405 and 532 nm.” are not surprising, because the relative contribution of BrC is expected to increase with increasing OC concentration and that the AAE is expected to increase with increasing BrC (OC). The results imply that the light absorbing properties (such as mass absorption cross section and imaginary part of refractive index) of OC do not largely change with EC/OC ratio, fuel types, and burning conditions. If so, the results obtained in this work may be inconsistent with the results of Saleh et al. (2014). I think that the discussion on this point and the more detailed descriptions on the evidence leading to the conclusion below should be added. “This result is distinct but not inconsistent with Saleh et al. (2014) who found that the imaginary index of refraction increases with increasing BC/OA ratio. These two results can be understood with the idea that brown carbon grows darker as emissions have a higher fraction of black carbon relative to non-refractory organic mass, but the fraction of total absorption caused by brown carbon increases as the amount of organic mass increases and the black carbon to organic carbon mass ratio decreases.”

Specific comments:

1) Page 3, 2 Material and Methods If a part of the data (fuel) used in this work is same with that used in Pokhrel (ACP2016), it is better to add the information on that and how the authors chose the data (fuel) used in this work.

2) Page 4, 2.1 Inlet system

a) Have you estimate the particle losses in the Nafion dryer and the activated carbon monolith?

b) Did you check the possible contribution of removal of semi-volatile organic compounds to the amount and optical properties of BrC through the change in the gas/particle partitioning?

c) Line 17: How often did you insert the filter for the baseline measurements?

3) Page 5, 2.4 Particle loss in Thermal denuder

a) How did you measure the particle size dependence of particle loss? Did you use two SMPS system and place them upstream and downstream of thermal denuder?

b) In Fig. 1, the particle transmittance only above 100 nm were given. How was the transmittance for smaller particles? If the particles with a diameter less than 100 nm are negligible, I recommend to the authors to give some information on this point.

4) Page 6, lines 22-24 "The calibration of the dry 405 nm channel determined without the high ozone points (what was done for most of the project) was consistently closer to the slope determined using all ozone concentrations (including the high ozone points) than the calibration of the denuded 405 nm channel without the high-ozone points." => I recommend to adding more qualitative information on this point.

5) Page 7, line 31 "For fires without backup filters or those that were below the detection limit, the average OC correction for that fuel type was applied: rice straw (2.0 ± 0.4 %), ponderosa pine (1.2 %), black spruce (2.9 ± 1.6 %), and peat (3.1 ± 0.8 %). For fuel types without backup filters collected, the study average OC artifact (2.4 ± 1.2 %) was

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subtracted." => It seems that the authors assume the amount of carbonaceous gas adsorption is proportional to the mass concentration of OC. The assumption may not be reasonable if the filter is saturated.

6) Page 9, line 24 Are the particle sizes (100 and 200 nm) given here volume-based average diameters or number based average diameters?

7) Page 14, line 2 "Figure 5" may be "Figure 7"

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