Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2017-582-RC2, 2017

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Quantifying black carbon light absorption enhancement by a novel statistical approach" *by* Cheng Wu et al.

Anonymous Referee #1

Received and published: 1 September 2017

This paper proposed a new approach to characterize the light absorption enhancement of BC and reported its application to the observed results based on an aethalometer and a thermo-optical carbon analyzer in Pearl River Delta area. This manuscript includes sufficient originality, and the topic seems to fit the journal. However, there are several concerns on the accuracy of the light absorption measurements, definition of Eabs, and discussions on the observed optical properties. I believe that the points below should be addressed before considering the publication in ACP.

General comments

1) Accuracy of the aethalometer measurements Although the authors used the correction scheme reported by Weingartner et al. (2003) to correct the artifacts due to aerosol loading, filter matrix and scattering effect, it is not clear that the light absorption

for "coated-BC" can be accurately measured (or corrected), especially under "high RH" conditions. For example, Arnott et al (2003) reported that a filter-based photometer has large potential artifacts above 80% RH. The authors need to give more detailed information on accuracy of aethalometer measurements.

2) Definitions of the MAEp and Eabs The MAEp obtained by the method in this study is MAE value for primary emission source. I think that the MAEp, which was obtained in this study, includes the effects of "lensing effect" due to co-emitted OC. Therefore, the definition of Eabs values should be different with the Eabs in the previous studies, at least, using TD technique. Detailed explanation on this point should be added.

3) The effect of biomass burning

3-1) Lines 371-374: "During the rainy season when oceanic prevailing wind dominates, BC from BB emission in Southeast Asia can reach PRD through long range transport (LRT), resulting in an elevated K+/EC ratio and MAE550, which might be a combination of a thicker coating when freshly emitted from BB sources and enhanced coating during LRT."

=> If so, I think the MAEp values should be higher in summer (rainy season). Please consider about this point.

3-2) Lines 384-388: "Since the monthly average AAE in wintertime didn't exceed 1.2 (Table S3), the variations of AAE in the PRD are likely more associated with thicker coatings rather than the contribution of BrC. The results also imply that attempts on BrC absorption attribution for the PRD dataset presented in this study could be risky, considering that elevation of AAE is actually dominated by coating (Lack and Langridge, 2013)."

=> Because higher Eabs values were observe in summer, the coating would be thicker in summer. The suggestion that "the higher AAE in winter are likely more associated with thicker coatings" is not reasonable. Please consider about this point.

4) The effect of relative humidity (RH) on optical properties As mentioned above, the authors need to show some evidences suggesting that the obtained positive correlation between f(RH) (i.e., MAE) and RH is not due to the artifact of RH on aethalometer measurements. If the measurements are assumed to be accurate, the observed higher Eabs (and MAE) and lower AAE values in summer may be explained only by RH, considering that the RH may be higher in summer and RH for air masses from Southeast Asia (C2). Which one of higher OC/EC ratio and higher RH do you suggest as a main contributor for observed higher Eabs in summer?

Specific comments

1) Line 235-236 “Thus, a BrC coating (brown shell) scenario is also considered in Mie simulation following the wavelength dependent RI suggested by Lack and Cappa (2010).” => Because the results of Mie simulation should be varied depending on the RI values given here, I recommend adding the range of RI values.

2) Section 3.2.4, 1st paragraph For the brown shell scenario, I think that both of lensing effect and light absorption by BrC contribute to the Eabs values. I recommend adding the fraction of each contribution.

3) Section 4.1, 2nd paragraph The annual average MAEp value (13 m2/g) is larger than those estimated for bare BC. It may indicate that the obtained MAEp values include the effects of “lensing effect” due to co-emitted OC, as mentioned above. If so, caution on the definition of MAEp in each study should be taken during comparison with other studies. Also, it is better to add information on the wavelength used in each study.

4) Section 4.5 How did the absorption coefficients for dry conditions determine to obtained f(RH)?

5) Figure 9 What do to want to suggest from 30:1 line in Fig. 9?

(References) Arnott, W. P., Moosmuller, H., Sheridan, P. J., Ogren, J. A., Raspet, R.Slaton, W. V. 2003. Photoacoustic and Filter-Based Ambient Aerosol Light Absorp-

tion Measurements: Instrument Comparisons and the Role of Relative Humidity. J. Geophys. Res.-Atmos., 108: 4034–4045.

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2017-582, 2017.