Characterization of light absorbing organic aerosols in Pearl River Delta region, China

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Keywords: light absorption, brown carbon, AAE.
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While the dominant light-absorbing aerosol species is thought to be BC, other light absorbing species are also present in atmospheric aerosols, which were recently revealed to be of potentially important in the absorption of near-UV light, and thus the radiative forcing (Bahadur et al., 2012; Moosmüller et al., 2011). High contribution of brown carbon (BrC) to light absorption at near-UV wavelength is reported worldwide from satellite and ground observations, and modeling studies (e.g., Bahadur et al., 2012; Feng et al., 2013).

Understanding light absorption properties of atmospheric aerosols is a necessity for evaluating the climate impact, however, little is known about the optical significance of BrC, despite of the importance relative to black carbon (BC) and influence on direct radiative forcing by aerosols.

Method

In the present study, a multi-wavelength (370–950 nm) Aethalometer was used to measure the wavelength-dependent light absorption properties of ambient aerosols with and without heating (250 °C) in Pearl River Delta (PRD) region for 25 days. Based on the collected data, an alternative method was developed to evaluate the contribution of light absorption from BrC at wavelength of 370 nm, based on their wave-dependent light absorption properties. The method applied real-time (in 1h resolution) obtained value of Absorption Angström exponent ($AAE_{590-950}$) in the wavelength range of 590–950 nm, rather than a constant value (AAE = 1) assumed by previous studies.

Results

The temporal profile of the estimated contribution of light absorption from BrC to total light abortion at 370 nm is shown in Fig. 1. The majority of the value distributed in a range of 0-20% (~77%), with an average value at 11.7%. Contribution to total light absorption at 370 nm by the BrC was also estimated by comparing the wavelength dependent of the absorption coefficients with and without heating (Cappa et al., 2012), and was compared to our results. The results indicate that conversion of secondary organic aerosols to BrC occurs during the heating process, and thus the reported BrC based on the latter method may be substantially underestimated. This work indicates a potentially important contribution of light absorption from BrC at UV wavelength in the PRD region, which should not be neglected in the climate model.

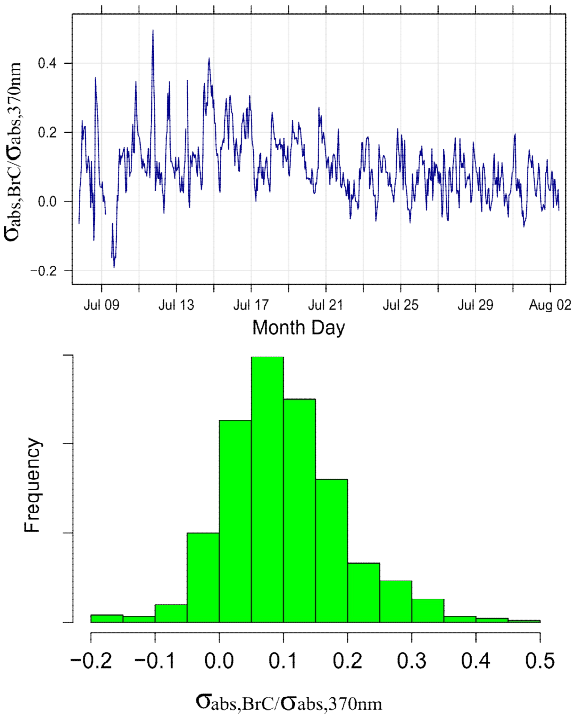

Figure 1. Temporal profiles for the contribution of BrC to the total light absorption ($\sigma_{abs,BrC}/\sigma_{abs,370nm}$) at wavelength of 370 nm (upper), and the histogram summarizing of the $\sigma_{abs,BrC}/\sigma_{abs,370nm}$ (bottom) over the study.

This work was supported by the the "Strategic Priority Research Program (B)" of the Chinese Academy of Sciences (XDB05020205) and National Nature Science Foundation of China (No. 41405131).

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