Light absorption of brown carbon aerosol in the PRD region of China

J.-F. Yuan*, X.-F. Huang, L.-M. Cao, J. Cui, Q. Zhu, C.-N. Huang, Z.-J. Lan, and L.-Y. He

Key Laboratory for Urban Habitat Environmental Science and Technology, School of Environment and Energy, Peking University Shenzhen Graduate School, Shenzhen, CN-518055, China
*now at: Laboratory of Atmospheric Chemistry, Paul Scherrer Institute, Villigen PSI, CH-5232, Switzerland
Keywords: Brown carbon (BrC), Black carbon (BC), Light absorption, Absorption Angstrom Exponent (AAE).
Presenting author email: jinfeng_yuan0306@163.com

The strong spectral dependence of light absorption of brown carbon (BrC) aerosol is regarded to influence aerosol's radiative forcing significantly, Alexander *et al* (2015). The Absorption Angstrom Exponent (AAE) method has been widely used in previous studies to attribute light absorption of BrC at shorter wavelengths for ambient aerosols, with a theoretical assumption that the AAE of "pure" black carbon (BC) aerosol equals to 1.0, Lack and Langridge (2013).

In this study, the AAE method was applied to both urban and rural environments in the Pearl River Delta (PRD) region of China, with an improvement of constraining the realistic AAE of "pure" BC through statistical analysis of on-line measurement data. A three-wavelength photo-acoustic soot spectrometer (PASS-3) and aerosol mass spectrometers (AMS) were used to explore the relationship between the measured AAE and the relative abundance of organic aerosol to BC ($r_{\_org/bc}$). The regression and extrapolation analysis revealed that more realistic AAE values for "pure" BC aerosol (AAE_{BC}) were 0.86, 0.82, and 1.02 between 405 and 781 nm, and 0.70, 0.71, and 0.86 between 532 and 781 nm, in the campaigns of $urban_{winter}$, $urban_{fall}$, and $rural_{fall}$, respectively, as showed inTable.1 and Figure.1. Roadway tunnel experiments were conducted and the results further confirmed the representativeness of the obtained AAE_{BC} values for the urban environment.

Finally, the average light absorption contributions of BrC (± relative uncertainties) at 405 nm were quantified to be 11.7%(±5%), 6.3%(±4%), and 12.1%(±7%) in the campaigns of $urban_{winter}$, $urban_{fall}$, and $rural_{fall}$, respectively, and those at 532 nm were 10.0%(±2%), 4.1%(±3%), and 5.5%(±5%), respectively. The relatively higher BrC absorption contribution at 405 nm in the $rural_{fall}$ campaign could be reasonably attributed to the biomass burning events nearby, which was then directly supported by the biomass burning simulation experiments performed in this study (Lan, 2013). This study indicates that the BrC contribution to total aerosol light absorption at shorter wavelengths is not negligible in the highly urbanized and industrialized PRD region

Table 1. The derived AAE_{BC} values and uncertainties in the different campaigns.

Campaign	AAE_{405_781}	AAE_{532_781}
$Urban_{winter}$	0.86±0.06	0.70±0.05
$Urban_{fall}$	0.82±0.06	0.71±0.06
$Rural_{fall}$	1.02±0.10	0.86±0.13

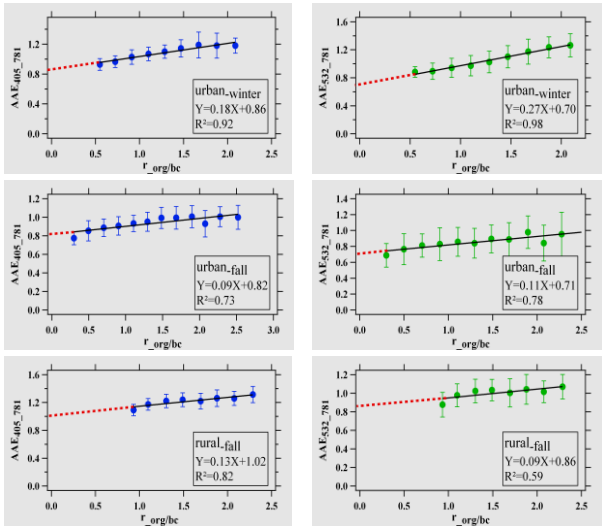

Figure 1. The linear relationship between ambient AAE and $r_{\_org/bc}$ in the different campaigns.

This work was supported by the National Natural Science Foundation of China (21277003 & U1301234), the Ministry of Science and Technology of China (2013CB228503), and the Science and Technology Plan of Shenzhen Municipality.

Alexander, L., Julia, L. and Serger, A. N. (2015) *Chemical Review, Special Issue: Chemistry in Climate*, **115**, 4335-4382.

Lack, D. A. and Langridge, J. M. (2013) *Atmos. Chem. Phys.* **13**, 5089-5101.

Lan, Z. J. (2013) *Characteristics of mixing state and light absorption of black carbon aerosol in China*, Peking University PhD dissertation.