Mass absorption efficiency of light absorbing WSOC from a source region of biomass burning in the Indo-Gangetic plain

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In recent years, light absorbing water-soluble organic carbon (WSOC, also termed as brown carbon: BrC) has drawn considerable attention due to their direct and indirect effects on Earth's climate. In this study, mass absorption efficiency (MAE) of BrC in fine aerosols, collected from a source region (Patiala: 30.2 °N, 76.3 °E) of biomass burning in the Indo-Gangetic Plain (IGP), has been investigated and compared with the values documented downwind. The mass absorption coefficient of BrC at 365nm ($b_{abs-365}$), assessed from the absorption spectra of aqueous extracts, exhibits moderate (R^2 = 0.37) and strong (R^2 = 0.77) linear relationship with WSOC in day and nighttime samples, respectively, and can be attributed to primary and secondary formation/destruction pathways of light absorbing organics. Further, notable differences were observed in the slope of regression lines that corresponds to the MAE of ~0.75 $m^2\ g^{-1}$ and 1.13 $m^2\ g^{-1}$ for day and nighttime samples, respectively. A similar temporal trend was observed for $b_{abs-365}$, K^+ and WSOC for both day and nighttime samples, which indicates their common source (emissions from biomass burning). The $b_{abs-365}$ of BrC shows a power relation with wavelength ($b_{abs-\lambda} \approx \lambda^{-\alpha}$; where α = angstrom exponent), which averages ~ 5.1 ± 1.9 and 5.3 ± 2.2 M m^{-1} (where M = 10^{-6}) for the day and nighttime samples, respectively, and comparable to that documented for the Bay of Bengal and other geographical locations.

A conspicuous decrease is observed in the MAE of BrC from source region (Patiala) to the Bay of Bengal, and attributed to photobleaching of BrC and/or relative increase in the contribution of non-absorbing WSOC during long-range transport. On average, the estimated MAE of BrC at 365nm had approached as high as ~50–60% of that EC in the daytime samples compared to that observed for the nighttime samples (~46–96%), respectively. The relative radiative forcing of BrC over EC aross the solar absorption wavelengths was also estimated which accounts for ~35 and 40% for day and nighttime samples, respectively.