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Estimating brown carbon absorption using multiple methods from long-term multi-wavelength aethalometer measurements over a Himalayan site

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Recent studies have shown that a portion of organic carbon compounds, termed Brown carbon (BrC), absorb radiation significantly in the UV-Vis wavelengths, exerting positive radiative forcing, which can alter Earth's radiation budget significantly (Feng et al., 2013). Studies deriving BrC absorption, as a difference between total and black carbon (BC) absorption, from multi-wavelength aethalometer measurements at ambient locations, have used different methods to account for black carbon absorption, which is not constant at all wavelength pairs, and can significantly depend upon the size and coating thickness on BC particles. These methods require absorption Angstrom exponent (AAE) of black carbon (BC-AAE) as an input. Different studies use either a fixed value of BC-AAE, e.g. 1 at wavelength 370-880 nm (Olson et al., 2015), or those derived from Mie theory (Wang et al., 2016, Wang et al., 2018). Recent studies showed that BC-AAE (Wang et al. 2018), increases moving from UV-Vis to IR wavelength ranges and proposed an improved BC-AAE method, based on a fixed ratio between the wavelength ranges, to derive BC-AAE at short wavelengths (e.g. 370 nm). In the present study, we use different AAE methods to calculate BrC absorption using a long term data set (2014-2017) from a high altitude station, Darjeeling (27º 01'N, 88º15'E, 2200 masl), in eastern Himalayan region in India. Using the improved BC-AAE method (Wang et al. 2018), it was calculated that the monthly average absorption coefficient of BrC (babsBrC at 370nm) varied from 3.5-13.2 Mm-1 (10-18% of the total absorption) with an average of 7.9±3.8 Mm-1 (14±2%). There were marked seasonal differences with the highest BrC absorption measured in the winter season. These results will be compared with other methods to derive BrC absorption and evaluated in terms of their applicability to this site.

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