Brown Carbon Aerosols over North India through Real-time Measurements

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Recent studies have documented that a certain type of organic carbon significantly absorb light at near-UV (300-400) and visible regions, and termed as "Brown Carbon (BrC)". Recent global models estimate that light absorption by BrC in different regions of the world may be 30–70% of that due to black carbon (BC). To assess the role of BrC on regional and global level, it is important to understand their sources and characteristics on temporal and spatial scale, which is lacking in literature. The major focus of present study is to fill this gap over India. The study site, Kanpur (26.5°N, 80.3°E, 142 m amsl) located in North India, receives emissions majorly from industries, vehicles, biofuel and biomass burning.

Semi-continuous measurements of water soluble organic carbon (WSOC), BrC, BC and chemical composition of organic and inorganic aerosols were performed during winter season (December, 2015-Dec to February, 2016). Diurnal variability in the absorption coefficient of BrC at 365 nm (b_{abs_365}), measured with particle-into-liquid sampler (PILS) coupled to liquid waveguide capillary cell (LWCC) and total organic carbon (TOC) analyzer, showed higher values during late evening through early morning (35±21 Mm^{-1}) and attributed to primary emissions from biomass burning and fossil fuel burning. The b_{abs_365} reduces by more than 80% as day progresses, which is ascribed to photo bleaching/dissociation of BrC. Primary BrC, assessed based on corresponding H:C ratios from high resolution-time of flight-aerosol mass spectrometer (HR-ToF-AMS), dominates the total BrC abundance with higher b_{abs_365}. Secondary BrC, assessed based on O:C ratios, was abundant in the morning and afternoon with lower b_{abs_365}. WSOC exhibited a strong correlation with b_{abs_365} (slope = 1.22±0.007, r^2 = 0.70, n =13265), suggesting a presence of significant but variable fraction of chromophores. Further, diurnal variability in ratios of b_{abs_405} and b_{abs_420} with respect to b_{abs_365} suggests that BrC composition is not uniform throughout the day.