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Brown carbon aerosol sources, composition and light absorption in central Los Angeles

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The main objective of the current study is to identify the sources and spectral properties of light-absorbing organic aerosol extracts (i.e., brown carbon (BrC)) and their correlation with chemical composition and individual particulate matter (PM) species in Los Angeles, California. Weekly $PM_{2.5}$ samples were collected on the quartz filters using personal cascade impactors (PCIS) from July 2018 to February 2019 in summer, intermediate and winter phases in central Los Angeles. UV-VIS spectrophotometry analysis was conducted on the water and methanol extracted punches of the filters to determine the absorption spectrum of the weekly samples. Water soluble organic carbon (WSOC), polycyclic aromatic hydrocarbon (PAHs), and levoglucosan concentrations of the collected samples were determined. In addition to the weekly filter collection, ambient elemental carbon (EC), total organic carbon (OC) and OC fraction (OC_x) concentrations were also concurrently measured. The result of summer campaign (July-September) revealed that light absorption of $PM_{2.5}$ water-soluble extracts at 365 nm ($Abs_{365,wsoc}$), used as the tracer for water-soluble BrC, was significantly correlated with the WSOC concentrations (R^2=0.52) implying the dominant effect of secondary organic aerosol (SOA) formation from anthropogenic emissions on BrC aerosol formation in the area in summer phase. Moreover, significant correlation of $Abs_{365,wsoc}$ with the OC_4concentration (less volatile fraction of OC with secondary origin) (R^2=0.60) supported the major effect of SOA formation on BrC concentrations. However, PAH concentrations were extremely low during the summer campaign, but significant correlation between the $Abs_{365,wsoc}$ and levoglucosan concentrations (R^2=0.52) in the visibility range could be attributed to the contribution of massive wildfires occurring during the summer (i.e., August and July) of 2018 in California to the BrC aerosol. The water-insoluble BrC was strongly correlated with the ambient EC, OC_2,and OC_3 concentrations (R^2=0.40-0.58), which are more volatile OC fractions originating mostly from fossil fuel combustion sources. This suggests that incomplete combustion from different sources is the other dominant source of BrC in the region in summer. The highest Contribution of BrC absorption relative to the EC absorption was found to be in the 300-400 nm wavelength for both Abs_{WSOC} (13.2%) and Abs_{MSOC}(17.3%). However, the corresponding ratios at higher wavelengths (300-1100 nm) decrease significantly to values as less as 4.1% and 7.1%, respectively, showing the strong wavelength-dependency of BrC. The results of intermediate and winter phase campaigns could significantly improve the discussion, as the impact of biomass burning (and traffic) on BrC absorption will become more significant in the colder seasons.