NCAP-COALESCE
CarbOnaceous AerosoL Emissions, Source apportionment & ClimatE impacts
Understanding scientific complexities related to carbonaceous aerosols focussing on issues underlying their origin and fate, and their role as drivers of regional climate change over India.

Research BRIEFS

Origin and properties of soluble brown carbon in freshly emitted and aged ambient aerosols over an urban site in India

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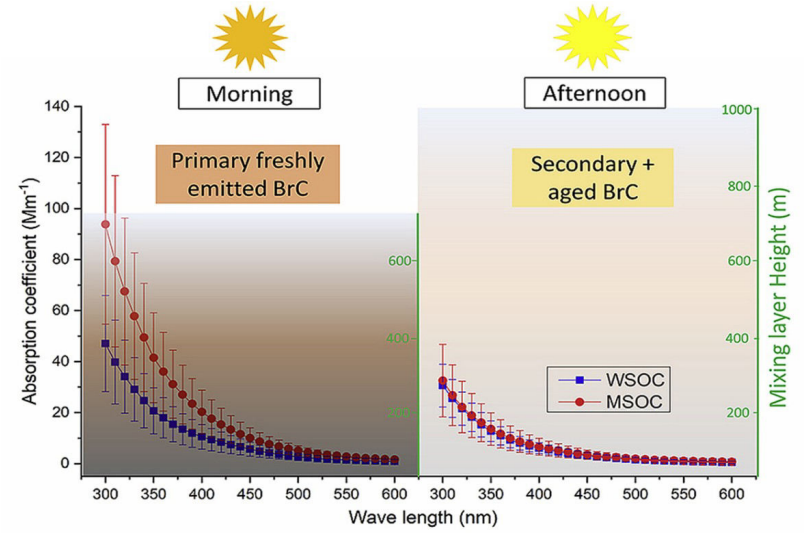

Key highlights:

- Compared with morning, BrC absorption of ambient aerosols decreased in the afternoon in Mumbai, India, with boundary layer dilution and change in emission sources being the influencing factors.
- Correlation between $b_{abs}365$ & EC/ns-K+ implies primary source contribution in morning.
- Relatively higher OC/EC, WSOC/OC ratios and ^{1}HNMR spectroscopy suggest the presence of more oxidized functional groups indicating greater aerosol aging in the afternoon.

Summary of your Research:

The present study investigated the effect of meteorology, time-varying change in source characteristics, and atmospheric aging on the chemical and optical properties of ambient BrC over an urban background site in Western India. The diurnal variability was investigated in samples collected in the morning (7–11 am) and afternoon (12–4 pm) periods. Absorption properties of BrC (in the 300–600-nm wavelength range) were measured in filter extracts of water-soluble organic carbon (WSOC) and methanol-soluble organic carbon (MSOC).

WSOC and MSOC accounted for on average 52% and 77%, respectively, of the measured OC, 30 potentially indicating unextracted BrC and rendering these values the lower bound. Compared with 31 afternoon samples, the morning samples of MSOC and WSOC had increased BrC concentrations and 32 absorption coefficients ($b_{abs}365$; 40%–65%). The decreased $babs_{365}$ in the afternoon samples was partly explained by mixing layer dilution, accompanied by a reduction in the concentrations of primary aerosol constituents.

Furthermore, in the afternoon samples, ^{1}HNMR spectroscopy revealed the presence of more oxidized functional groups and significantly higher OC/EC and WSOC/OC ratios, indicating the greater aging of afternoon aerosol. The MAC_{365} (m^2gC^{-1}) for both WSOC and MSOC extracts decreased significantly by 20%–34% in the afternoon samples compared with the morning samples, indicating degradation in the absorption properties of the particles and potentially a change in the constituent BrC chromophores.

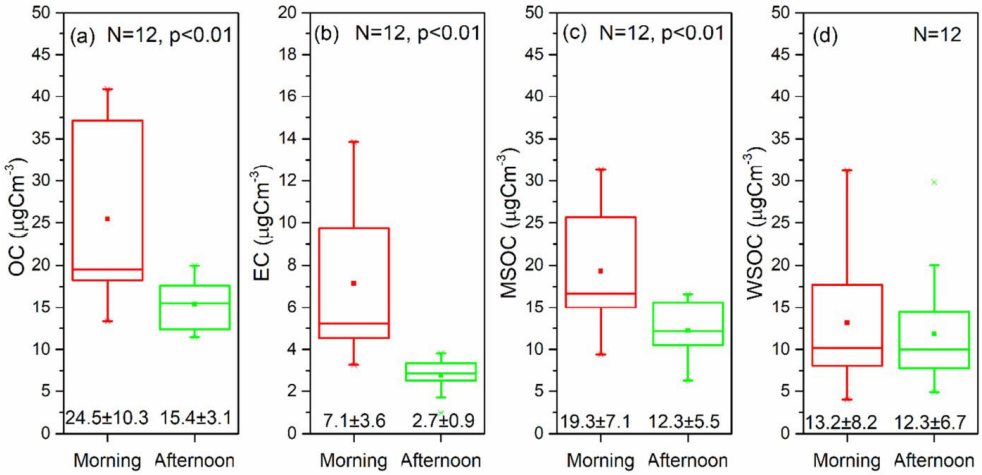

Figure: Box-Whisker plots showing morning and afternoon variability of a) OC, b) EC and c) MSOC, d) WSOC during the whole study period. The average concentration along with the standard deviation of each aerosol components, number of observation points and level of significance are shown in the respective figures.

Take away/conclusion :

- Significantly higher aerosol mass loading was observed along with higher OC, EC, MSOC, and other ionic species in the morning than in the afternoon. This is due to pollutant dilution as an effect of higher mixing layer depth in the afternoon.
- Around 52% of the OC was extracted using water, whereas 77% was soluble in methanol on average. In the afternoon, WSOC increased from 50% to 76% of total OC.
- ^{1}H-NMR analysis of WSOC indicated that morning BrC compounds were more aromatic than afternoon compounds which were more oxidized and aliphatic in nature.
- This indicates that more aromatic and unsaturated BrC compounds with high absorption efficiency were present in the morning aerosols and that less aromatic and more oxidized polar aliphatic compounds with much lower absorption efficiency were present in the afternoon aerosols.

Research Article citation

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