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

Wintertime aerosol refractive index in IGP

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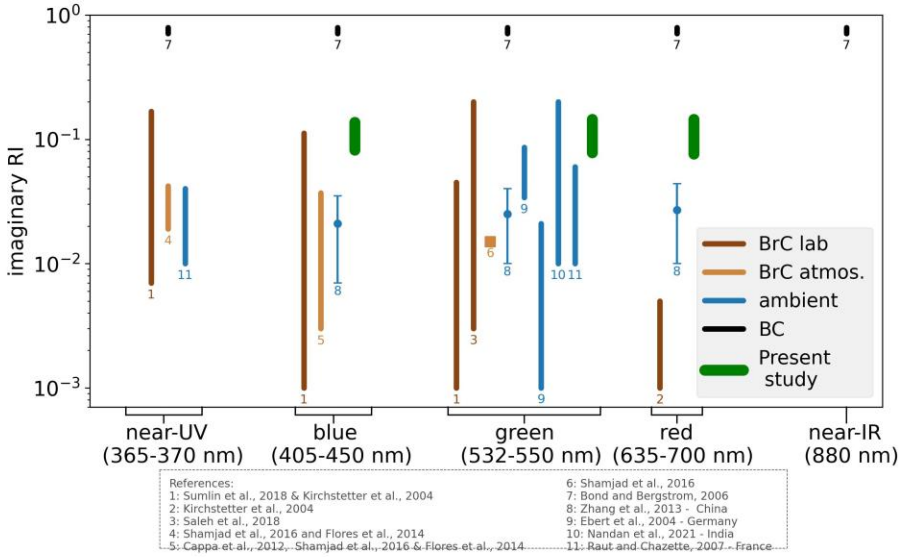


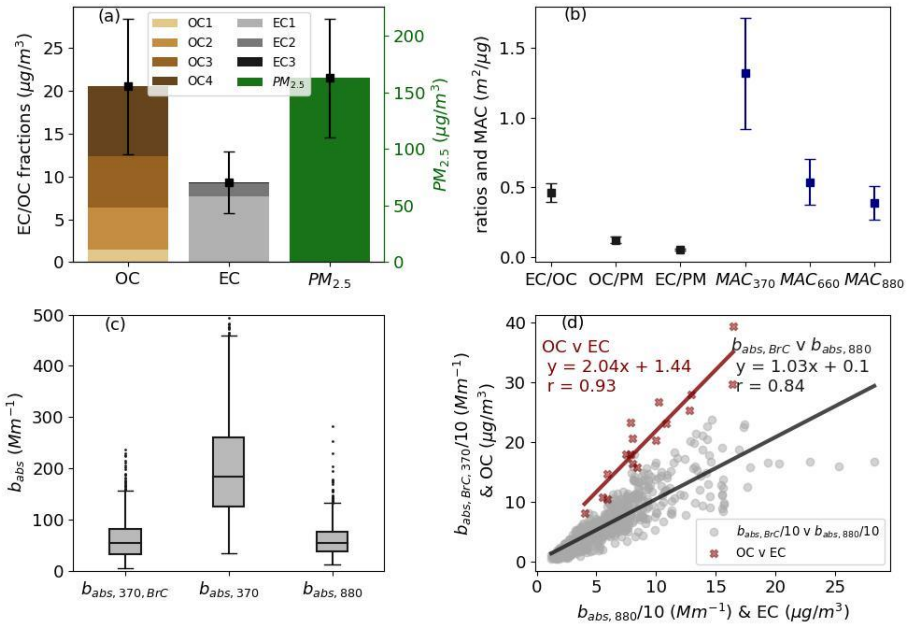
Key highlights:

- Estimate the aerosol effective refractive index (RI); imaginary RI ranges 0.076-0.145, higher than previously reported values
- A single scatter albedo of 0.7 reveals strongly absorbing components, with brown carbon absorption of 34–88 Mm^{-1}.
- Imaginary RI correlates well with near-UV absorption by brown carbon, which has low volatility and is likely emitted from combustion sources

Summary of your Research:

Estimation of aerosol radiative forcing continues to suffer from large uncertainties, partially from a lack of observations of aerosol optical properties. Limited measurements of the atmospheric aerosol imaginary refractive index (iRI) have been made, especially in some of the world's most polluted regions. In this study, we measured aerosol optical and micro-physical properties at a regional site, Rohtak, India, representative of polluted cities in the Indo-Gangetic plains in northern India. The average $PM_{2.5}$ measured during the campaign was 163 $\mu g/m^3$ with a single-scatter albedo of indicating the presence of strongly absorbing aerosol components. Measurements of aerosol absorption, scattering, and particle number size distributions were used to estimate the effective

refracticve index using an established Mie inversion technique. The calculated iRI was spectrally invariant in the visible region with values ranging between 0.076 and 0.145. Brown carbon absorption, estimated using a previously developed Mie optimization method, ranged 34–88 Mm^{-1}. Higher iRI were observed during periods with higher brown carbon absorption, which are likely directly emitted from combustion sources. Low volatility organic carbon fractions dominated during these periods with likely persistence of atmospheric absorption. The iRI values are at the upper end of the range of previously reported iRI of urban aerosol. A sensitivity analysis to measured parameters, the absorption had the dominant effect on estimated iRI. Measured single scatter albedos, were lower than those from climate model simulations over the region, demonstrating the need for intrinsic property measurements to evaluate and constrain climate models.



Take away/conclusion :

- The derived imaginary refractive index has no wavelength dependence in the visible spectrum with ranges from 0.076-0.145 with a median of ~0.1. It is on the higher end of the range reported in previous literature.
- Imaginary RI has positive correlation with the contribution of brown carbon absorption that is likely to be emitted from primary combustion sources and is dominated by compounds of low volatility.
- The present study, in one of the most polluted regions of the world – with very absorbing aerosol – likely provides the plausible higher extreme of imaginary refractive indices that can be observed in the ambient atmosphere.
- Through a comparison with climate modeled optical properties, we demonstrate the need for a comparison between modeled and observed intrinsic properties like the effective refractive index.

Research Article

Citation

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