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

Understanding the Influence of Meteorology and Emission Sources on $PM_{2.5}$ Mass Concentrations Across India: First Results From the COALESCE Network

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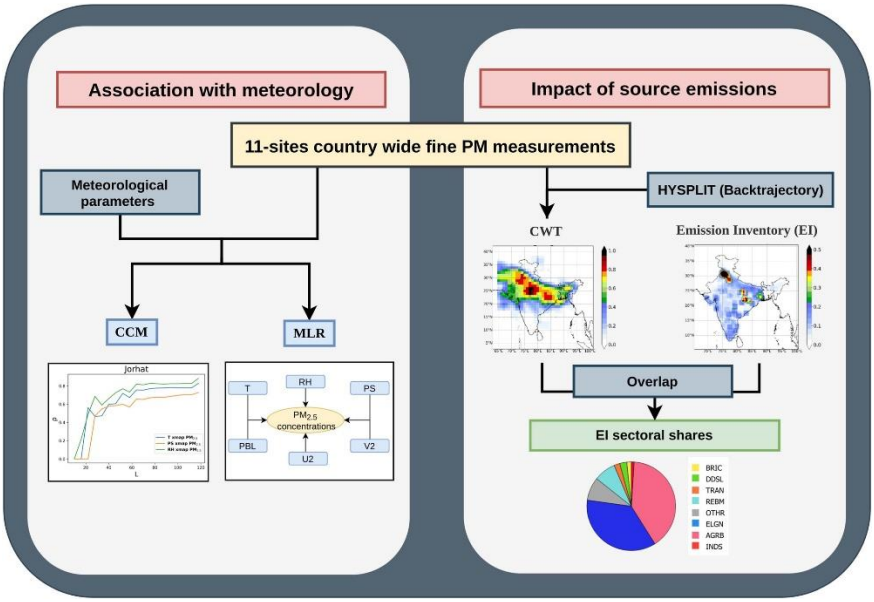

Key highlights:

- First results from time-synchronized measurements of surface $PM_{2.5}$ concentrations made during 2019 at 11 COALESCE sites in India
- Some meteorological parameters exhibit casual association with $PM_{2.5}$ but only 16%–41% mass variability explained by meteorology
- Residential biomass burning and electricity generation are important contributors to anthropogenic primary $PM_{2.5}$ in most locations in India.

Summary:

This study presents time-synchronized measurements of surface PM2.5 concentrations made during 2019 at 11 COALESCE sites across India. The network median PM2.5 concentration was 42 µg m−3 with the highest median value at Rohtak (99 µg m−3) and the lowest median value at Mysuru (26 µg m−3). The influence of six meteorological parameters on $PM_{2.5}$ was evaluated. Causality analysis suggested that temperature, surface pressure, and relative humidity were the most important factors influencing fine PM mass on an annual and seasonal scale. Further, a multivariable linear regression model showed that, on an annual

basis, meteorology could explain 16%–41% of PM2.5 variability across the network. Concentration Weighted Trajectories (CWT) and the results of causality analysis revealed common regional sources affecting $PM_{2.5}$ concentrations at multiple regional sites. Further, CWT source locations for all sites across the network correlated with the SMoG-India emissions inventory at the 95th percentile confidence. Finally, CWT maps in conjunction with emissions inventory were used to obtain quantitative estimates of anthropogenic primary $PM_{2.5}$ sectoral shares from a mass-meteorology-emissions reconciliation for all 11 pan-India network sites. These estimates can help guide immediate source reduction and mitigation actions at the national level.

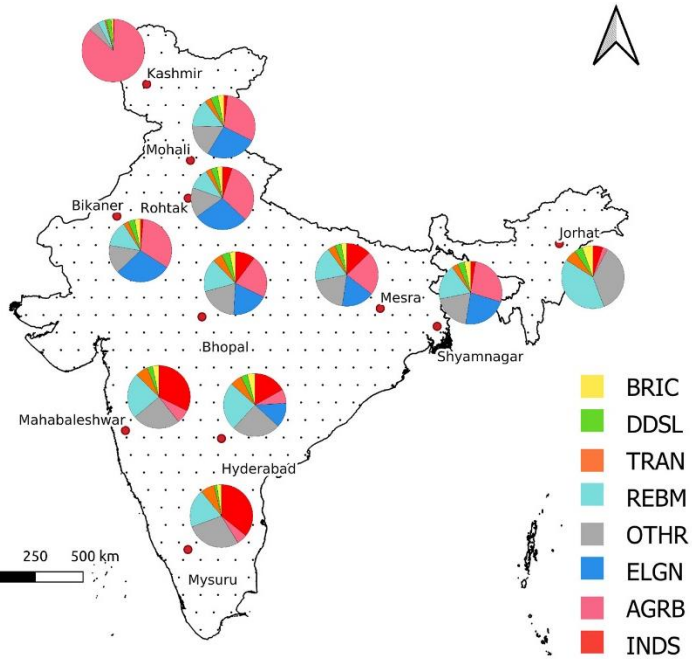

Figure 1: Annual sector-wise contribution to primary $PM_{2.5}$ mass over the 11-site COALESCE network across India for 2019.

BRIC: Brick production; DDSL: Dispersed diesel; TRAN: Transport; REBM: Residential biomass; OTHR: Others; ELGN: Electricity generation; AGRB: Agricultural residue burning; INDS: Industry).

Major findings:

- PM mass concentrations were more significantly influenced by source mix and their strengths compared to meteorology.
- Source control and mitigation of residential biomass burning across the country, together with controlling sectoral emissions such as electricity generation and agricultural crop residue burning in various regions of the country, will yield quick air quality benefits.
- This method can be retrospectively applied to all stations making only PM mass measurements across the world to aid emissions control decisions.
- The measurements reported in this study will be used in conjunction with full chemical speciation for receptor modeling at all locations.

Research Article citation

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