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

Variabilities of $\delta_{13}C$ and carbonaceous components in ambient $PM_{2.5}$ in Northeast India: Insights insources and atmospheric to processes

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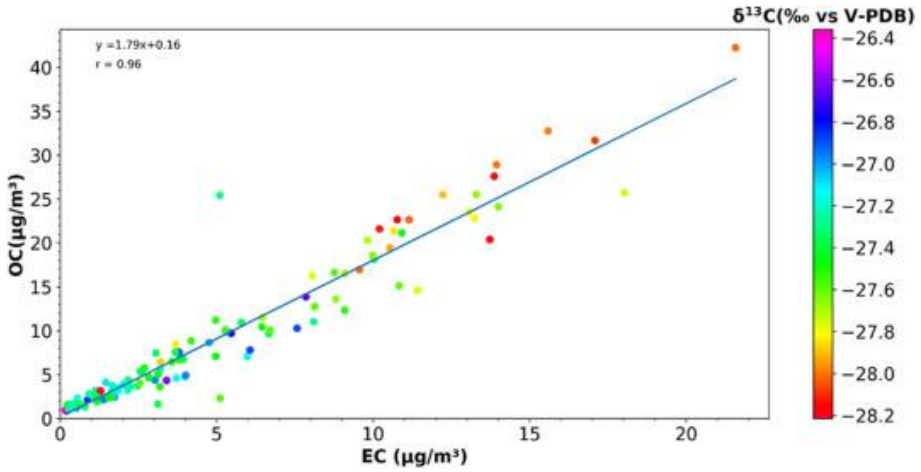


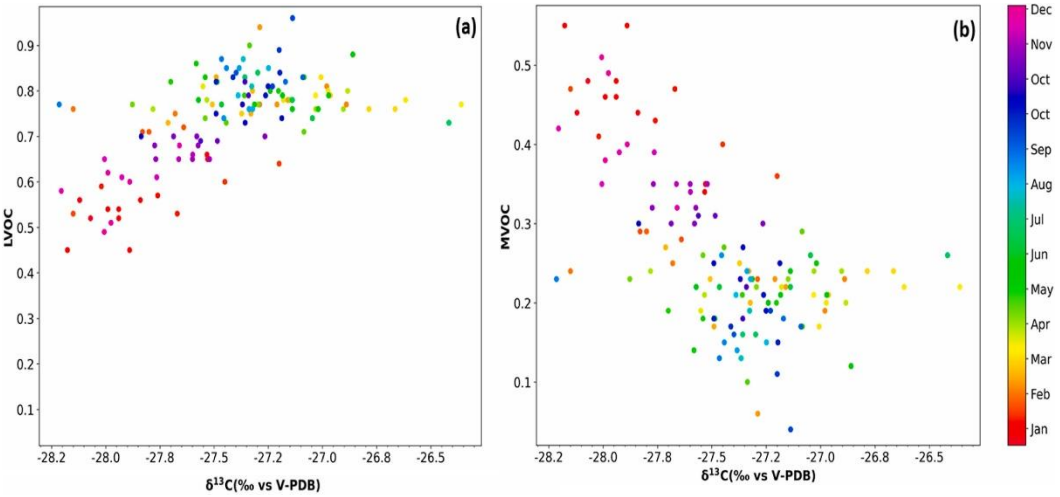
Key highlights:

- The average $PM_{2.5}$ concentrations were highest during winter (97.5 ± 35.4 µg m^{-3}).
- $\delta_{13}C$ indicated the mixing of characteristic isotopic compositions of various sources.
- Aged aerosols influenced the final $\delta_{13}C$ in pre-monsoon (−27.2 ± 0.3‰).
- $\delta_{13}C$ showed a strong negative correlation with OC in winter and post-monsoon seasons.
- Freshly generated emissions dominate aerosols in winter and post-monsoon.

Summary of your Research:

A year-long sampling campaign of ambient $PM_{2.5}$ at a regional station in the North-Eastern Region (NER) of India was performed to understand the sources and formation of carbonaceous aerosols. Mass concentration, carbon fractions (organic and elemental carbon), and stable carbon isotope ratio ($\delta_{13}C$) of $PM_{2.5}$ were measured and studied along with cluster analysis and Potential Source Contribution Function (PSCF) modeling. $PM_{2.5}$ mass concentration was highest during winter and post-monsoon seasons when the meteorological conditions were relatively stable compared to others.

Air mass data and PSCF analysis indicated that aerosols during winter and post-monsoon are dominated by freshly generated emissions from local sources, along with the influence of regional transport of polluted aerosols. On the contrary, the long-range transported air masses containing aged aerosols were dominant during pre-monsoon. During the sampled seasons, overall variability in $\delta_{13}C$ at NER is not significant as the TC and $PM_{2.5}$ mass. The $\delta_{13}C$ of aerosols indicates major Sources are the combustion of biomass/biofuels (C3 plant origin), biogenic aerosols, and secondary aerosols. The $\delta_{13}C$ variability and cluster/PSCF modeling suggest that aged aerosols (along with enhanced photo-oxidation derived secondary aerosols) influenced the final $\delta_{13}C$ during the pre-monsoon. On the other hand, lower $\delta_{13}C$ in winter and post-monsoon is attributed to the freshly emitted aerosols from biomass/biofuels. ,



Scatterplot of (a) low volatile organic carbon and (b) more volatile organic carbon fraction variabilities with δ13C.

Take away/conclusion :

- $PM_{2.5}$ aerosols collected over a year at a regional background site in NER were studied to understand the origin of carbonaceous aerosols and their subsequent modification via atmospheric processes by using stable carbon isotopic ratio ($\delta_{13}C$) and thermal fractions as tracers.
- δ13C and carbon fraction data and MODIS fire data suggest that aged aerosols mainly contributed to the receptor site with more influence of low volatile organic carbon fraction.
- These observations and the results from PSCF modeling strongly suggest that biomass and biofuel burning generated primary aerosols.
- Further, secondary organic aerosols are also a significant source of carbonaceous aerosols in the region throughout the year.
- Winter and post-monsoon periods are mainly dominated by primary sources, whereas the pre-monsoon and monsoon seasons are influenced by LRT-influenced aging and secondary formation of organics.

Research Article citation

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