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

Rare-Earth Elements and Heavy Metals in Atmospheric Particulate Matter in an Urban Area

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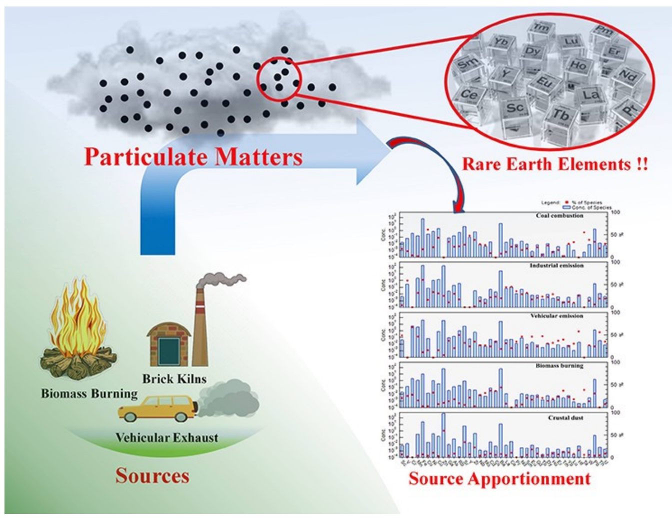

Key highlights:

- Focuses on atmospheric PM_{10} and the constituting heavy and rare-earth elements.
- Sampling of 64 8-hour samples from February to April 2019.
- Chemical speciation using HR-ICPMS to obtain 40 chemical species.
- Source apportionment method such as EPA-PMF used for identifying underlying sources.
- Most of these species were found to be emitted from local and transported fossil fuel/coal combustion, local vehicular emission.
- Other sources include local biomass burning, soil dust, and industrial emission.

Summary of your Research:

This study focuses on enhancing our fundamental understanding of atmospheric PM_{10} characteristics, rare-earth elements (REEs) and heavy metals by evaluating their sources using the positive matrix factorization (PMF) model. The PM_{10} mass concentration and elemental (REEs and heavy metals) compositions were analyzed using the gravimetric and HR-ICPMS methods. The PM_{10} concentrations are close to the CPCB limit, with an average of 72.09 ± 24.74 μg m^{-3} . The concentrations of heavy metals are below the critical levels. The rare earth elements (REEs) are found in trace quantities in PM_{10} with a total concentration (ΣREE) of 0.97 ± 0.59 ng m^{-3}.

The sampling for the study was carried out from February 2019 to April 2019 for 8 hours per day using APM460 NL, Envirotech, India sampler with a flow of 1.2 m^3 per minute. Total 64 samples were collected and speciated into 40 chemical species using HR-ICPMS instrument. PMF modeling for source apportionment reveals the contributions of five significant sources of PM_{10} mass in the urban area, mainly from coal combustion and vehicular emission followed by biomass burning, soil dust, and industrial emission. Back trajectory analysis was performed to conclude that most of the pollution is transported from the Indo-Gangetic Plain along with some local sources.

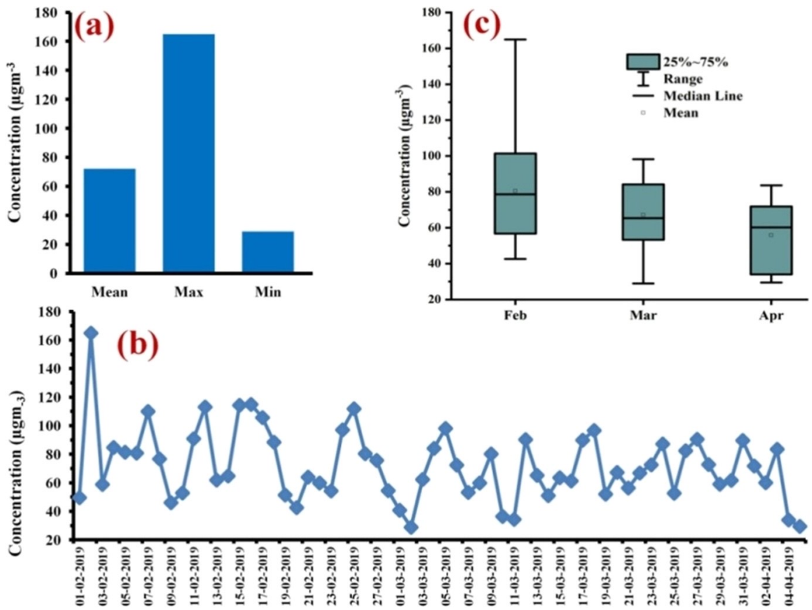

Figure: (a) Graph showing the mean, maximum, and minimum concentration level of PM_{10} in Jorhat during the sampling period. (b) Time series showing the daily concentration of PM_{10} during the sampling period. (c) Box whisker plot showing the decreasing trend of monthly PM_{10} concentration in Jorhat during February to April 2019.

Take away/conclusion :

- The atmospheric particulate matter (PM_{10}) in India, especially in the northeast region, reveals REEs in trace amounts with a total concentration (ΣREE) of 0.97 ± 0.59 ng m^{-3} and a maximum of 3.22 ng m^{-3}.
- A positive anomaly of Eu and Tm was observed, indicating the REEs' anthropogenic and natural contribution in PM_{10}.
- The concentrations of some of the heavy metals such as Fe, Zn, and Ba were considerably higher than other elements and comparable with the polluted metro-cities of India.
- PMF modeling reveals five-factor profiles suggesting that REEs and heavy metals to PM_{10} is mainly from fossil fuel/coal combustion, vehicular emission, and road dust in the region.
- The $PM_{2.5}$ sampling and analysis would be more desirable for future studies along with the studies on water-soluble ions, carbonaceous aerosol, and secondary formation of PM are also necessary for a general conclusion.

Research Article citation

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