Urban Air Quality Dynamics: Seasonal Trends, Meteorological Influences, and Aerosol (PM_{10}, $PM_{2.5}$, $PM_{1.0}$, BC) Characterization by FE-SEM-EDX

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Abstract

The air quality decrease, especially in urban areas, is related to local-scale conditions and to dispersion of air pollutants (regional and long-range) as well. This study investigates the physicochemical characterization of PM_{10}, $PM_{2.5}$, $PM_{1.0}$, and their relationship with black carbon (BC), alongside the influence of meteorological parameters. Weekly monitoring data for mass concentrations of PM_{10}, $PM_{2.5}$, $PM_{1.0}$, and BC were analyzed over period of April 2023 to March 2024 in Agra, an urban city over Indo-Gangetic Basin (IGB). Mean mass concentration of PM_{10} was 165.8 ± 82.7 and $PM_{2.5}$ was 110.7 ± 85.2 and for $PM_{1.0}$ was 83.0 ± 63.9 and BC concentration was 9.0 μg m^{-3}. Statistical methods were employed to elucidate seasonal variations and potential correlations between air pollutants and meteorological variables. A strong correlation was observed between $PM_{1.0}$and $PM_{2.5}$, suggesting that ultrafine particles play a significant role in $PM_{2.5}$ composition. Additionally, seasonal variations in PM and BC concentrations were influenced by factors such as topography and temperature, with better correlations observed in summer and autumn. Diurnal variations highlighted the impact of traffic emissions and atmospheric stability on pollution levels. Seasonal variations in PM and BC concentrations were attributed to biomass burning and atmospheric stability, with peak concentrations recorded during post-monsoon and winter. Trajectory cluster analysis revealed dominant transport pathways, with regional flows significantly contributing to PM levels. Moreover, concentration-weighted trajectory methods identified strong seasonal variations and differences between weekdays and weekends, indicating the influence of both regional and local factors on pollution levels. Furthermore, Field-Emission Scanning Electron Microscopy (FESEM) is used for characterizing aerosol composition and elemental analysis with high spatial resolution. By providing detailed imaging and elemental mapping, FESEM enables the identification and quantification of individual aerosol particles, aiding in understanding their chemical composition and morphological characteristics.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality, ACAM: Atmospheric Chemistry and the Asian Monsoon, AMIGO: Analysis of eMIssions usinG Observations, CCMi: Chemistry Climate

Model Initiative, GEIA: Global Emissions Initiative, BBURNED: Biomass Burning Uncertainty: ReactioNs, Emissions and Dynamics

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group