

Chemical Characterization of Ambient Fine Particulate Matter During Winter Fog Events in Delhi, India: Insights from High-Resolution Measurements

Akash Sagar Vispute

Indian Institute of Tropical Meteorology, Pashan, Pune, India, India. Department of Physics, Savitribai Phule Pune University, Pune, India, India

Author list (excluding presenting author)

Narendra Dhangar, Prasanna Lonkar, Sachin Ghude

Abstract

In Delhi, India, from December 2022 to January 2023, a detailed investigation was conducted into the chemical composition of ambient non-refractory fine particulate matter (NR-PM₁). Using high-resolution time-resolved measurements via HR-TOF-AMS, the study aimed to understand the sources and evolution of organic aerosols (OA), particularly during January's fog events. NR-PM₁ mass loading ranged from 11.2 to 318.5 $\mu\text{g}/\text{m}^3$, with OA contributing about 62%. Ammonium acted as the primary neutralizer, with an aerosol neutralization ratio (ANR) nearing unity. High-Resolution Positive Matrix Factorization (HR-PMF) identified six primary OA sources: Hydrocarbon-like OA (HOA), Nitrogen-rich Hydrocarbon Organic Aerosol (NHOA), Biomass-Burning OA (BBOA), Solid Fuel OA (SFOA), Low-volatile Oxidized OA (LV-OOA), and Semi-volatile Oxidized OA (SV-OOA). During fog events, only five factors were observed, with fog showing a higher oxidizing effect on LV-OOA than non-fog periods. The study underscored significant contributions from fresh and aged biomass burning as well as solid fuel burning OA, indicating the dominance of primary organic aerosols (POA). Back trajectory analysis revealed the influence of both local emissions and distant source regions, notably paddy residue burning during winter. OA composition varied between foggy and non-foggy periods, with higher oxygen-to-carbon (O/C) ratios in foggy conditions. Investigation into OA evolution and elemental ratios (O:C and H:C) provided insights into fog processing effects.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

ACAM: Atmospheric Chemistry and the Asian Monsoon, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality

IGAC Regional Working Groups

MANGO: Monsoon Asia and Oceania Networking Group