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Chemical, microphysical and optical properties of the aerosols during foggy and nonfoggy day over a typical location in Indo-Gangetic Plain

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An extensive experimental measurement was carried out from January 16, 2010 to February 20, 2010 at Kanpur to study the chemical, microphysical and optical properties of the aerosols. A Micro-Pulse Lidar Network (MPLNET), a part of National Aeronautic Space Administration (NASA), was used for identification of fog duration. PM1 samples and fogwater were collected to examine the organic and inorganic species of aerosol and fogwater. Organic Carbon (OC), Elemental Carbon (EC) and water soluble organic carbon analysis were carried out by an EC-OC analyzer and a TOC analyzer, respectively. Trace gases and solar flux measurement were carried out by gas analyzers and a pyranometer (a part of NASA Aeronet), respectively, to identify the photo-chemical activity. Meteorological data were measured by atmospheric weather station. The microphysical properties such as aerosol size distribution were measured using a scanning mobility particle sizer (SMPS). Optical properties were measured by a photo-acoustic soot spectrometer (PASS).

Organic and inorganic species are processed by fog droplets such as production of secondary organic aerosol through aqueous mechanism (Kaul et al., 2011) and scavenging of various water soluble species. The concentrations of almost all the ionic species and organic carbon were higher in aerosols during foggy day. Presence of numerous ionic species and organic carbon in the fogwater indicates their wet scavenging and removal from the atmosphere by the fog droplets. Most of the aerosol is composed of inorganic component, $\sim$80% during foggy day and $\sim$85.5 % during clear day. Biomass burning contribution to PM1 mass concentration was considerably higher during clear days and lower during foggy days; lower concentration during foggy day could be due to wet scavenging of biomass generated aerosols. The study average higher number concentration of aerosol during foggy day during late evening and overnight was due to lower boundary layer height and subsequent accumulation of freshly emitted, previously aged particles in the atmosphere. The increase in both the number concentration and size of the aerosols as fog evaporated was caused by secondary aerosol formation. The fogwater organic and inorganic species and correlation among them indicate that organic and inorganic carbon is highly correlated with almost all the inorganic species. The higher correlation of sulfate and nitrate with organic carbon of fogwater droplets indicates presence of organo-sulfate and organo-nitrate compounds. The study average absorption and scattering coefficient of foggy day aerosols were higher. The formation of secondary organic aerosol during fog evaporation caused increase in scattering coefficient. Details of the finding on chemical, microphysical and optical properties will be presented.

Reference:

Kaul, D. S., Gupta, T., Tripathi, S. N., Tare, V., and Collett Jr., J. L.: Secondary Organic Aerosol: A comparison between foggy and non-foggy days, Environmental Science & Technology, 45, 7307-7313, 2011