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Fog Chemistry and Sources at an Urban and a Rural Sites in Indo-Gangetic Plains

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Indo-Gangetic Plain (IGP) is among the most densely populated regions of the world, where 70% of the population still reside in the villages. Growing energy demands of such a large population have led to the increased emission of pollutants from residential, industrial and transport sectors. Due to higher biomass burning incidents, lower mixing height, temperature inversion and calm winds during winters the IGP experience severe problems associated with fog such as poor air quality, respiratory problems, visibility reduction, haze, etc. The present study aimed to quantify the bulk chemical composition of ambient air during fog forming hours through dissolution method using the re-fluxing mist chamber over the Prayag region of IGP. A total of 41 and 23 samples were collected at an urban and a rural sites, respectively from November 2016 to February 2017. Chemical composition of ambient air samples was characterized with respect to the major water soluble Inorganic ions (Na+, NH4+, K+, Ca2+, Mg2+, Cl-, NO_2-, NO_3- and SO42-). Significant variation of inorganic ions was observed between urban and rural sites with NH4+ and Ca2+ as major cations and SO42- and NO_3- as major anions at both the sites. Monthly variation of the ions has shown high concentrations in November as compared to other months due to the added emissions from crop residue burning and festival pollution. Further, the relationship of cations with anions and their aqueous chemistry is also studied to analyze the major chemical interactions and scavenging patterns in winters. Neutralization of fog acidity (NO_3-+NO_2-+SO42-) by cations occurs in the order of NH4+>Ca2+>K+>Mg2+. Subsequently, Principle Component Analysis (PCA) was used to investigate the site specific dominating sources. Apart from natural sources like soil dust, sea salts and biogenic emissions, local anthropogenic sources and meteorological conditions play an important role in the fog formation in winters. While fossil fuel, solid waste and biofuel burning were the major contributor at the urban site, biomass burning and agricultural activities were predominant sources at the rural site.