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# Ionic characteristics and buffering capacity of Fog water collected over New Delhi and adjoining satellite township in North India

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North India encounters frequent foggy events during winter season which lead to significant economic loses through disruption of rail, road and air traffic. In this study, fog samples were collected from New Delhi and adjoining township of Sonipat in north India during the year 2015-16 and 2016-17. Fog water pH was found to be close to natural rainwater of 5.6 due to limited contribution of Ca2+, Mg2+ ions by virtue of low wind speed during winters, not sufficient enough to re-suspend surface dust. Despite the sources of ammonia such as livestock and agricultural emissions, NH4+ could not completely neutralize the acidity caused by sulfates and nitrates. NH4+ and Ca2+ were dominant cations present in fog samples at both sites during both sampling years. NH4+ and Ca2+ contribution were similar at New Delhi during 2015-16 but calcium on account of construction activities increased during 2016-17. NH4+ was significantly higher in comparison to calcium at Sonipat for both years. Wheat fields around Sonipat could have contributed high NH3 through fertilizer applications and animal breeding and excretion. Sulfate concentrations were amount equals to that of chlorine followed by nitrate ions. High chlorine in fog water is probably due to plastic burning in this region. The strength of neutralization decreases in the order NH4+> Ca2+ and Mg2+ for all studied fog samples at Sonipat while the trend for New Delhi samples was Ca2+ > NH4+ and Mg2+ due to more contributions of calcium carbonates on account of ongoing construction activities and limited sources of ammonia in and around the sampling site at New Delhi. Higher nitrate at New Delhi indicates high anthropogenic emissions of $NO_x$ which eventually formed nitrate. Vehicular emission at New Delhi and agriculture fields and plants at Sonipat appeared to be dominant sources of organic acids. The difference between the observed and theoretical acid buffering capacities was large and occurred over a broad pH range from 4 to 7 at New Delhi whereas the theoretical and measured buffering capacities were close to each other in Sonipat samples. Additional species such as organic species such as acetate, formate and formaldehyde and humic material and dicarboxylic acids (not identified here) could contributed to the unexplained buffering in urban fog at New Delhi. Fog water at both sites had higher level of lead than prescribed safe limits for drinking water and therefore, cannot be used for drinking purposes. Zinc was dominant metal present in fog water. Higher concentrations of metals, organic acids and soluble inorganic ions at New Delhi in comparison to Sonipat were indicators of worse state of air pollution.