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High Anthropogenic Contribution in Fog Water at a Coastal Island Bhola, Bangladesh

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A comprehensive study on the chemical composition and source characterization of fog water (18 samples) was carried out at an outflow location of the Indo-gangetic plain to the Bay of Bengal (Coastal Bhola Island, Bangladesh) during the winter season (December 2017 to February 2018). Different physical properties of fog water including color, odor, pH, electrical conductivity (EC), total dissolved solids (TDS), total organic carbon (TOC) were measured. Concentrations of different water-soluble ions (F-, Cl-, SO42-, NO_3-, HCO_3-, Na+, K+, NH4+, Ca2+, and Mg2+) and trace metals (Zn, Fe, Mn, Cu, Cr, Pb, and Ni) were determined in fog water. Source characterization was conducted with a combination of correlation analysis, enrichment factor analysis, % source contribution calculation, and air mass trajectory analysis. The average pH, EC, TDS, TOC of the collected fog water were 7.03±0.2, 371.2±63 μS cm-1, 235.8±128 ppm, and 15.8±5.8 ppm, respectively. The average concentration of (F-, Cl-, SO42-, NO_3-, HCO_3-, Na+, K+, NH4+, Ca2+, and Mg2+ were 77.7±38.5, 937±416.5, 725.24±383.9, 1002.4±562.2, 70±48.2, 733.8±205.3, 338.6±188.7, 562.5±402.9, 1147.4±616.2, 350±125.5 μeqL-1, respectively. The concentration of the determined ions followed the sequence: Ca2+> NO_3->Cl-> Na+> SO42- >NH4+>Mg2+> K+> F-> HCO_3-. The average concentration of Zn, Mn, Fe, Cu were 336±150, 272±123, 50±30, 23±15 μgL-1 while the concentrations of Cr, Pb and Ni were very low. The order of concentration of trace metals was Zn>Mn>Fe>Cu>Ni>Cr>Pb. The ratio of Σcation to Σanion was 1.07, indicating that alkaline constituents neutralize acidity. The recorded pH (on average pH=7.03±0.2) also confirm the ratio of Σcation to Σanion was neutral. The concentration of K+ and NO_3- were higher than many countries of the world but lower than China. Neutralization factor analysis showed that Ca and NH4+ were the major neutralization constituents of the fog water. Correlation analysis between different chemical species showed a significant correlation among sea, soil and anthropogenic species. High enrichment factors of SO42-, NO_3-, Zn, Mn, and Cu were a good indication of anthropogenic sources. % source contribution of different species showed a significant anthropogenic contribution of Cl- (8.30%), SO42- (84.02%) and NO_3- (99.74%). The results suggested that fog water chemistry is strongly influenced by anthropogenic sources rather than natural and marine sources.
Keywords: Fog water; chemical composition, enrichment Factors; % Source Contribution