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How the regional economy and associated emissions are affecting the aerosol acidity and its intrinsic property (oxidative potential) over a pristine island of a tropical mangrove ecosystem

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A three-year (2018-2020) winter-time campaign was conducted over a human-habitant-free remote island (21.35°N, 88.32°E) of the Sundarbans mangrove ecosystem to investigate the effect of regional and long-distance pollution plumes on the aerosol chemistry and its intrinsic chemical properties. The average PM_{10} concentration over the island was found to be 98.3 ± 22.2 μg m^{-3} for the entire study period, with a high fraction of non-sea SO_4^{2-} and water-soluble organic carbons (WSOC). Literature surveys and bureaucratic reports have revealed high usage of domestic solid fuel in the mangrove biosphere, which in turn could be responsible for high SO_2 emissions and consequently a high concentration of non-sea SO_4^{2-}. Metal concentration over the island was found to be higher than in many urban atmospheres of the Indo-Gangetic Plain (IGP) and mostly associated with the emission from the local boat services that use old engines. Aerosols were found to be acidic, as estimated with the thermodynamic E-AIM IV model, with an average pH of 2.4± 0.6 and mainly governed by non-sea-SO_4^{2-}. The mass normalized oxidative potential (OP) of PM_{10} was found to be 18.4 ± 6.1 pmol DTT min^{-1} μg^{-1} which was surprisingly higher than in several urban atmospheres. It was found that with the decrease in pH, the transition metals (Cu, Mn) tend to get more water soluble and increase the OP of the aerosols. WSOC originated from biomass/solid fuel burning and are primary in origin, with a significant contribution to the aerosol mass normalized OP. The study revealed that the advection of regional solid fuel burning plume and associated non-sea SO_4^{2-} is enhancing aerosol acidity and oxidative stress, which in turn could be extremely hazardous for such marine ecosystems rich in ecology and bio-geochemistry.