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Atmospheric outflow of Nutrients to the Bay of Bengal: Impact of continental sources

Manmohan Sarin and Bikkina Srinivas

PHYSICAL RESEARCH LABORATORY, GEOSCIENCES DEPARTMENT, AHMEDABAD 380009, India
(sarin@prl.res.in)

The air-sea deposition of nutrients (N, P and Fe) to the oceanic regions located downwind of pollution sources in south Asia is gaining considerable attention in the present-day scenario of climate change. We report here a case study on the abundances of nutrients, their sources and temporal variability in the atmospheric outflow from the Indo-Gangetic Plain (IGP) to the Bay of Bengal (BoB). Air mass back trajectory analysis suggests conspicuous downwind transport of chemical constituents from the IGP to BoB during the late NE-monsoon (January-April). During rest of the year, wind-regimes do not favour the atmospheric transport from the IGP, making BoB a unique oceanic region in the global perspective. Concentrations of NO_3^-, NH_4^+, N_{Org}, PO_4^{3-} and Fe_{ws} in the atmospheric outflow from the IGP, studied during November'09 – March'10, show pronounced temporal variability. The inorganic nitrogen dominates (NH_4^+-N: $\sim$ 90 % of N_{Inorg}) the total soluble nitrogen (N_{Tot}). Although the contribution of organic nitrogen is not significant, the mass ratio of N_{Org}/N_{Tot} in the outflow varied from 0.07 to 0.40. The abundances of P_{Inorg} and Fe_{ws} varied from 0.4 to 4.8 nmol m^{-3} and 0.2 to 0.6 nmol m^{-3}, respectively. The high abundance of $K^+$and significant (P-value < 0.05) correlation with P_{Inorg} suggests their dominant contribution from biomass burning emissions. The concentration of aerosol iron (Fe_{Tot}: 60–1144 ng m^{-3}), its fractional solubility (Fe_{ws} %: 6.7 –26.5) and co-variability of Fe_{ws} (%) with nss-SO_4^{2-} suggests chemical processing of alluvial dust during atmospheric transport from the IGP. The characteristic mass ratios of nutrients (N_{Inorg}/N_{Tot}: 0.92 $\pm$ 0.13, N_{Org}/N_{Tot}: 0.21 $\pm$ 0.11, and P_{Inorg}/nss-Ca^{2+}: 0.35 $\pm$ 0.23) in the atmospheric outflow from the IGP show striking similarity with those reported over the BoB. These results have implications to further increase in the atmospheric deposition of nutrients and their impact on biogeochemistry of surface Bay of Bengal.