

Overview of the Hooghly estuarine system and material fluxes at its land ocean boundary condition, NE coast of Bay of Bengal, India.

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The Ganges is one of the largest rivers of Asia and its Hooghly estuary, lying between 21°31' - 23°20' N and 87°45' - 88°45' E is rich in thick mangrove forests, known as the Sundarban Biosphere Reserves. This paper presents results on mass balance calculations for freshwater, salt, and C, N, P and Si at the land-ocean boundary of Hooghly estuary and also on air-sea fluxes of radiatively active gases CO₂ and CH₄ from this estuary.

The net residual flow at the estuary mouth averaged to 115 km³ yr⁻¹ of freshwater to the Bay of Bengal while the salt flux amounted to 2106×10⁶ t yr⁻¹. Annual load of sediment out of the estuary to the NE coast of Bay of Bengal was estimated to be 65.19×10⁶ t. Dissolved nutrients like inorganic nitrogen (DIN), reactive phosphate (DRP) and silicate exhibited distinct seasonal variability with maximum values in monsoon and minimum values during pre-monsoon but dissolved inorganic carbon (DIC) showed an opposite trend. The mean values of DIN (22.74 ± 2.83 μM) and DIP (1.99 ± 0.23 μM) were found to be higher than global average river water concentrations, but Si (102.91 + 13.58 μM) was lower. Based on the LOICZ biogeochemical modeling guidelines DIC, DIN, DRP and silicate budgets in the estuarine system were estimated and their fluxes at the Hooghly estuary-Bay of Bengal boundary have been calculated to be 230×10⁹ mol, 4705×10⁶ mol, 415×10⁶ mol and 15.28×10⁹ mol, respectively. Comparison was made with the estimates of nutrient fluxes of some mangrove dominated Southeast Asian estuaries.

This estuary was found to be heterotrophic in nature and light limited conditions occurs due to high turbidity suggesting regeneration of nutrients from organic matter originated from external source. Surface water remains around saturation with respect to dissolved oxygen but production of large quantities of dissolved carbon dioxide and methane take place in this estuary. The degree of saturation with respect to atmospheric CO₂ was found to be high with an annual average of 145.7±33.8 %. This turbid estuary acted as a source of CO₂ at a rate of 157.7×10³ tC yr⁻¹. The surface water of the estuary was also found to be super-saturated with CH₄ (1676 ± 641%). The annual emission of methane was calculated to be 0.26×10³ tC.

Diurnal and seasonal variations in carbon dioxide and methane fluxes between Sundarbans mangrove biosphere and atmosphere were also measured at one of the islands, namely Lothian Island using micrometeorological method. The biosphere-atmosphere flux of carbon dioxide ranged between -3.29 and 34.4 mg m⁻² s⁻¹, and that of methane, between -4.53 and 8.88 mg m⁻² s⁻¹. This estuarine mangrove ecosystem acted as a net source for carbon dioxide and methane with an overall annual flux to atmosphere estimated to be 694×10⁶ tC and 184×10³ tC, respectively.