

Supplementary material

Low CO₂ evasion rate from the mangrove-surrounding waters of the Sundarbans

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S1. Details of the study area

Water bodies such as estuaries, channels, and creeks comprise almost 19% of the total area of the Indian Sundarban Biosphere Reserve (9600 km²), and the remaining area encompasses an archipelago of 102 islands, 54 of which are human inhabited. At present, the Hooghly River is the only perennial freshwater input to the Sundarbans, with an annual water discharge of $8.3 \times 10^{10} \text{ m}^3$ (Samanta et al., 2015); however, it flows along the western margin of the Sundarban mangroves. The rest of the rivers – namely the Saptamukhi, Thakuran, Matla, Bidya, and Gosaba – act as arms of the sea (or tidal inlets), because the freshwater influx from the perennial flow of the Hooghly River is blocked upstream by siltation (Akhand et al., 2016; Sarkar et al., 2004).

The estuaries of the Sundarbans are categorized as meso-macro tidal (having a neap-to-spring variation in tidal amplitude of >1.5 m to <5 m) with semidiurnal tidal cycles (Chatterjee et al., 2013). Atmospheric conditions in this part of the world are mostly unstable throughout the year with high wind velocity, which in turn facilitates intensive vertical mixing of the water column (Goutam et al., 2015, Sadhuran et al., 2005). Mean current velocities range between 108 and 117 cm s⁻¹ during flood and ebb tides, respectively (De et al., 2011).

This region experiences an annual mean rainfall of 1973 mm, which acts as an additional freshwater input; however, the majority of this rainfall occurs in the monsoon season, i.e. between June and September (Ray et al., 2013). The present study was conducted in the waterways adjacent to Dhanchi Island, which shelters dense mangrove patches containing species such *Avicennia marina*, *A. alba*, and *A. officinalis* in

abundance. Species such as *Cerriops decandra*, *Excoecaria agallocha*, *Phoenix paludosa*, and *Bruguiera gymnorrhiza* are found in scattered patches.

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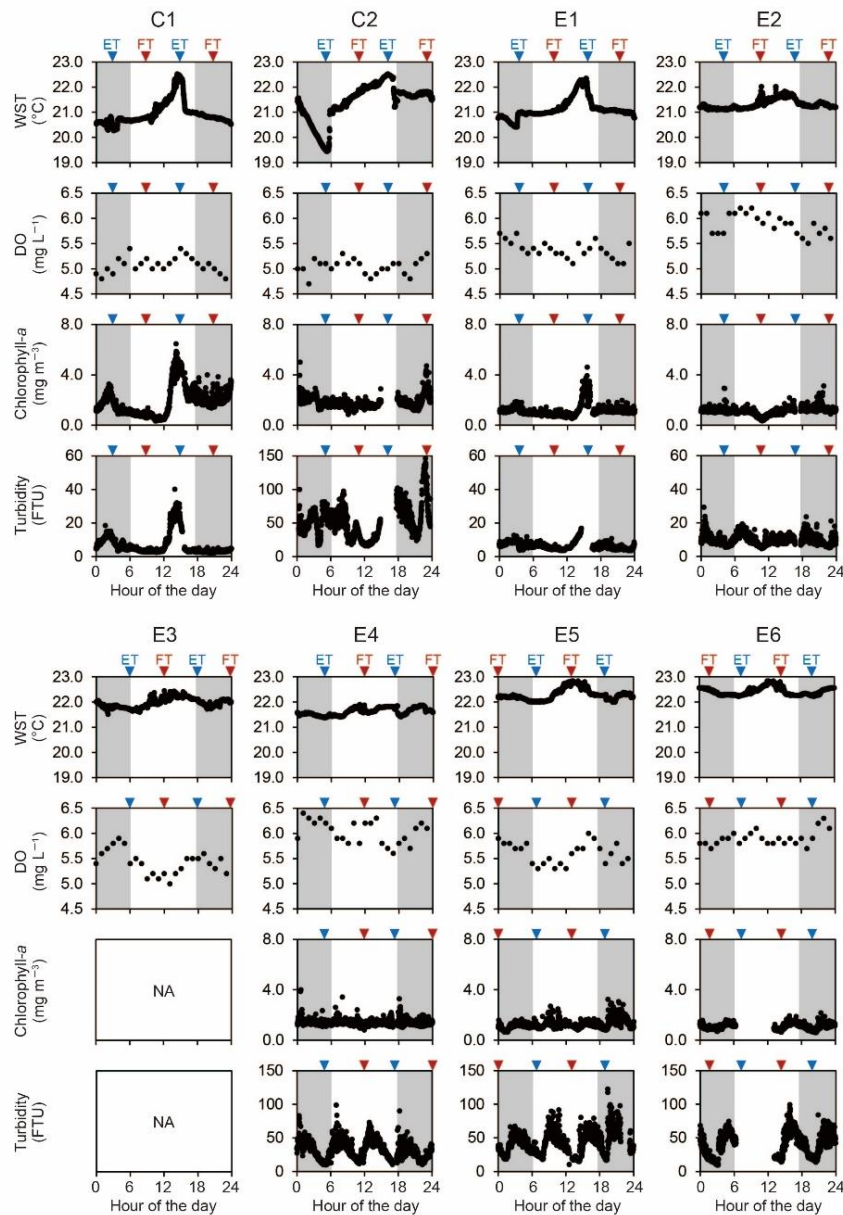


Figure S1. Time-series plot of diel variation of water surface temperature (WST, °C), dissolved oxygen (DO, mg L⁻¹), chlorophyll-*a* (Chl-*a*, mg m⁻³) and turbidity (FTU) fluorescence at the two creek stations (C1 and C2), and the six estuarine stations (E1, E2, E3, E4, E5 and E6). FT denotes flood tide and ET denotes ebb tide. FT at C1 at 09:00 and 21:15; ET at C1 at 3:30 and 15:00; FT at C2 at 11:30 and 23:15; ET at C2 at 05:30 and 17:00; FT at E1 at 10:00 and 21:30; ET at E1 at 04:00 and 15:45; FT at E2 at 10:30 and 22:00; ET at E2 at 04:00 and 16:30; FT at E3 at 00:30 and 12:00; ET at E3 at 06:30 and 18:00; FT at E4 at 10:00 and 22:30; ET at E4 at 04:30 and 16:00; FT at E5 at 00:30 and 13:00; ET at E5 at 07:00 and 18:30; FT at E6 at 00:30 and 13:00; ET at E6 at 07:00 and 18:30. All times are local time.

Table S1 Mean $\pm$ standard deviation and range (in parentheses) of nutrient concentrations (PO_4^{3-} and SiO_3^{2-}) measured at creek and estuarine stations

Parameter	Creek stations	Estuarine stations
PO_4^{3-} (μM)	0.95 ± 1.09 (0.10–3.41) $n = 11$	0.69 ± 0.82 (0.08–3.41) $n = 23$
SiO_3^{2-} (μM)	6.53 ± 2.29 (2.79–9.86) $n = 11$	7.28 ± 2.54 (2.79–12.23) $n = 23$

Table S2 Details of groundwater sampling (Akhand et al. unpublished). The depth of the ground water varied between approx. 30 and 60 metre

Name of the place	Latitude and longitude	Construction of the well	Date and time of sampling
Jharkhali	22° 1'16.57"N 88°41'6.84"E	Submersible pump operated circular well	31.01.2019 09:30 AM
Dhanchi	21°42'7.34"N 88°25'58.90"E	Submersible pump operated circular well	03.02.2019 10:00 AM
Ramganga	21°51'45.61"N 88°19'50.31"E	Manually operated tube well	05.02.2019 09:45 AM