Biosphere-atmosphere Interactions Affecting the Atmospheric Methane Mixing Ratio at the Land-ocean-atmospheric Boundary of the Sundarban Mangrove, NE Coast of the Bay of Bengal, India.

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Sundarban mangrove biosphere being highly productive and the largest of its kind in the world holds a significant climatic importance at regional level, to understand the above on the dynamics of atmospheric methane the present study was conducted during 2007 to 2008. The atmospheric mixing ratio of methane expressed in dry air mole fractions showed a seasonal variability with a mean value of 1.778 ± 0.03, 1.716 ± 0.08, 1.877 ± 0.06 ppmv during pre-monsoon, monsoon and post-monsoon seasons, respectively. Annual mean of 1.79 ± 0.07 ppmv for atmospheric CH_4 over this mangrove swamp was found higher than that of world average background concentration of 1.763 and 1.788 ppmv reported in 1998 and 2008, respectively, by Earth System Research Laboratory (NOAA). The night time mean mixing ratio of CH_4 was 3.23% higher than that of the day time during this study period indicating oxidation of methane might have been induced by OH radical formed during the day time (Franz and Berresheim, 2006). Mean methane emission rate from Sundarban mangrove swamp was found to be of 1.61 ± 1.2, 1.20 ± 1.61 and 1.72 ± 0.86 μg m^{-2} s^{-1} during pre-monsoon, monsoon and post-monsoon seasons, respectively. Lower values of CH_4 mixing ratio & emission flux were obtained during monsoon period when the rainfall was the maximum. The CO mixing ratio showed a similar seasonal pattern with the CH_4 mixing ratio with 8-12% increase during the postmonsoon season. CH_4 mixing ratio during postmonsoon was found to highest due to low photochemical oxidation of methane by UV radiation during winter solstice when the net incoming solar radiation is least. Methane emission flux showed a significant negative correlation with the tidal height ($r^2 = 0.67$, N = 27, p = 0.01) and the ground heat flux ($r^2 = 0.60$, n = 24, p = 0.034). Stepwise multiple regression analysis was performed to determine the factors that regulate the atmospheric CH_4 mixing ratio in the Sundarban mangrove forest by using the dataset of 2000, 2007 and 2008. Methane flux and CO mixing ratio could explain 22.4% and 30.2% of total variability of CH_4 mixing ratio in this regional atmosphere. On the contrary rainfall data could only explain 0.9 % of explained variability for CH_4 mixing ratios in the atmosphere.

Temporal variability in the CH_4 mixing ratio and emission was calculated by comparing the reported values of Mukhopadhyay et al. (2002) with the present study.

CH_4 mixing ratio over Sundarban biosphere was estimated an annual increase of 3.6 ppb during 2000 to 2008 and is significantly higher than the global values (1.887 ppb/yr) as reported by Dlugokencky et al. (2009). Methane emission was found to increase by about 10% in the Sundarban mangrove swamp during the interval between 2000 and 2008.

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