Day-time variation in methane emission from two tropical urban wetlands in Chennai, Tamil Nadu, India

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Methane emissions from two wetland habitats in Adyar wetlands, on the East Coast were measured during August 1996. Flux data shows that each habitat is a major contributor of methane to the atmosphere. Diurnal variation in emissions was also observed at both the sites. The methane emission was found to be correlated to the soil temperature (integrated to 5 cm). Sulphate concentration and salinity are negatively correlated to the methane emission. The average emission from the Buckingham Canal, a polluted urban freshwater canal, is 30.81 ± 11.15 mg CH_4 m^{-2} h^{-1} and from Adyar Estuary, a degraded mangrove forest, is 39.1 ± 3.28 mg CH_4 m^{-2} h^{-1}.

NATURAL wetlands are estimated to contribute up to 115 Tg of methane per year, which is 21% of the total global emissions[1]. Methane emissions from wetlands show high variability spatially as well as temporally in response to environmental variables as solar radiation, rainfall, salinity, etc. Tropical and sub-tropical swamps represent ~ 30% of global wetlands and produce about 25% of total emissions[2].

A few researches have been carried out in tropics with regard to methane emissions from Wetlands[3–5]. The methane emissions from coastal wetlands of Chennai, East coast of India have been reported earlier with an annual methane emission ranging from 0.02 to 3.20 Tg of methane per year[6,7]. Day-time variation has not been studied so far.

In this work we are reporting our studies on the day-time variation in methane efflux for the same locations reported earlier[6,7]. This will help in understanding the trend of methane emission during the day from these locations. Methane flux data collected in August 1996 in two locations in Adyar wetlands are presented here. This investigation quantifies the day-time methane flux in polluted freshwater canal and an estuary.

The study site is located in Chennai, Tamil Nadu, on the southeast coast of India (Figure 1 *a*, inset). The major waterways in the city are the Cooum and the Adyar Rivers and Buckingham Canal. The Adyar River carries sludge and storm waters and wastes from industrial establishments, slaughterhouses and laundries. The mouth of the river is closed by littoral drift of sand forming a lagoon. The Buckingham Canal, was built parallel to the coast as a salt-water navigation canal. The canal links the mouth of Cooum and Adyar Rivers over a stretch of 8 km. The canal is heavily silted and carries sewage, sludge and urban garbage. One site is located in Adyar Estuary and the other in Buckingham Canal.

For the collection of material, gas samples from the sediment–water interface were collected using 'Closed Chamber' technique[8]. The gas collected was stored and transported in a number of vials and sealed immediately after collection. Triplicate for each sample was made. The perspex chamber inserted had a base of 12″ × 12″ × 3″ and chamber of 12″ × 12″ × 18″ dimensions. The perspex chamber was placed over the base inserted into the sediment column to trap the gases emitting from the sediment–water interface. The base was embedded in the sediment a few hours in advance to ensure that the ambient soil environment is maintained. The gas so collected in the chamber was transferred to the sampling bottles by displacement of water from the sampling bottle by gas from the chamber. The collected gas was stored and transported in glass vials of volume 5 ml (ref. 9). The samples were collected at regular intervals of one hour starting from the time the chamber was placed during the course of the day. The sediment temperature at 5 cm below sediment and atmospheric temperature were also continuously monitored.

The gas samples were analysed in the laboratory at Anna University within 24 h of sampling, using a Hewlett Packard gas chromatograph (GC, model: HP 5890). Column, injector and detector temperatures were maintained at 80°C, 100°C and 90°C respectively, with a flow rate of 30 ml min^{-1}, high purity argon was used as the carrier gas. The gas chromatograph was calibrated, before and after each set of measurement, using 1 ppm CH_4 in N_2 obtained from M/s Mathesons, USA, as primary standard and 2.04 ppm, 2.81 ppm and 10.9 ppm CH_4 in N_2 as secondary standards, obtained from the National Physical Laboratory, New Delhi. Under these conditions, the retention time of CH_4 was 0.65 min and minimum detectable limit was 0.5 ppm. The gas flux was calculated using the formula:

$$F = \frac{\Delta x}{10^6} \times \mathrm{BV}_{(\mathrm{STP})} \times \frac{16 \times 10^{-3}}{22400} \times \frac{1}{A} \times \frac{60}{t},$$

where,

F = efflux of methane in mg/m^2/h; Δx = change in concentration of methane in ppmv from time '0' min to 't' min;

$$\Delta x = \frac{\text{standard concentration of methane}}{\text{area obtained in G C for standard}} \times \text{area}$$

obtained in gas chromatograph for sample;

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