Distribution of Trace Gases in the Godavari Estuary, India

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The coastal ocean is one of the most biogeochemically active zones at the surface of the Earth. Coastal ecosystems receive considerable amounts of materials from land, through weathering of rock, exchange with ground water and injection of contaminants, and exchange these materials with the open ocean. Despite the intense biological activity, the estuaries are typical sources of trace gases, such as carbon dioxide (pCO_2), nitrous oxide (N_2O), methane (CH_4) and dimethyl sulphide (DMS), to the atmosphere. In order to understand the distribution of traces gases and their controlling mechanisms in the Godavari estuary, systematic time series studies are being carried out in which data are being collected from upstream to coastal ocean during spring and neap tide periods. CH_4 and N_2O concentrations ranged from 4.1 to 240 nM and from 3.4 to 15 nM, respectively, in the Godavari estuary with increasing concentrations towards the mouth of the estuary. Higher concentrations, by 20-50 nM and 2-5 nM, respectively, of CH_4 and N_2O were found during spring than neap tide. In contrast, DMS (ranged from 0.03 to 2.5 nM) and pCO_2 concentrations (range:381 to 2002 μatm) and decreased towards the coast.

In addition to the estuarine sampling, ground water sampling was also carried out along the bank of the river to understand the influence of ground water seepage on the distribution of trace gases in the estuary. Abnormally high concentrations of CH_4 (maximum concentration of 910 nM), N_2O (maximum concentration of 107 nM) and pCO_2 (~1000 μatm) were found in groundwater. The CH_4 and N_2O abundances in river are similar to that of ground water strongly suggesting significant seepage into the river/estuary. The phytoplankton composition showed that upstream region was dominated by cyanobacteria/ blue green algae whereas diatoms were the major contributors in the coastal regions. Higher levels of pCO_2 in the upstream were associated with the fresh water, which has relatively low pH (~6.9-7.2) and also due to high bacterial activity. This is consistent with the higher total bacterial counts in the upstream compared to the coast. The decrease in pCO_2 towards coast was associated with high Chl-a suggesting that high primary production may be responsible decrease in pCO_2 in the coastal region. Therefore, DMS and pCO_2 were mainly controlled by the biological processes whereas ground water exchange seems to be responsible for high concentrations of N_2O and CH_4 in the Godavari estuary.