



Nitrous oxide and methane in two tropical estuaries in a peat-dominated region of North-western Borneo

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Abstract. Estuaries are sources of nitrous oxide (N_2O) and methane (CH_4) to the atmosphere. However, our present knowledge of N_2O and CH_4 emissions from estuaries in the tropics is very limited because data is scarce. In this study, we present first measurements of dissolved N_2O and CH_4 from two estuaries in a peat-dominated region of north-western Borneo. Two campaigns (during the dry season in June 2013 and during the wet season in March 2014) were conducted in the estuaries of the rivers Lupar and Saribas. Median N_2O concentrations ranged between 7.2 and 12.3 nmol L^{-1} and were higher in the marine end-member ($13.0 \pm 7.0 \text{ nmol L}^{-1}$). CH_4 concentrations were low in the coastal ocean ($3.6 \pm 0.2 \text{ nmol L}^{-1}$) and higher in the estuaries (medians between 12.2 and 64.0 nmol L^{-1}). The respiration of abundant organic matter and presumably anthropogenic input caused a slight eutrophication, which did not lead to hypoxia or enhanced N_2O concentrations, however. Generally, N_2O concentrations were not related to dissolved inorganic nitrogen concentrations. Thus, the use of an emission factor for the calculation of N_2O emissions from the inorganic nitrogen load leads to an overestimation of the flux from the Lupar and Saribas estuaries. N_2O was negatively correlated with salinity during the dry season, which suggests a riverine source. In contrast, N_2O concentrations during the wet season were not correlated with salinity but locally enhanced within the estuaries, implying that there were additional estuarine sources during the wet (i.e. monsoon) season. Estuarine CH_4 distributions were not driven by freshwater input but rather by tidal variations. Both N_2O and CH_4 concentrations were more variable during the wet season. We infer that the wet season dominates the variability of the N_2O and CH_4 concentrations and subsequent emissions from tropical estuaries. Thus, we speculate that any changes the Southeast Asian monsoon system will lead to changes in the N_2O and CH_4 emissions from these systems. We also suggest that the ongoing cultivation of peat soil in Borneo is likely to increase N_2O emissions from these estuaries, while the effect on CH_4 remains uncertain.

20