

Abstract

Coastal peatlands in Southeast Asia release large amounts of organic carbon to rivers, which transport it further to the adjacent estuaries. However, little is known about the fate of this terrestrial material in the coastal ocean. Although Southeast Asia is, by area, considered a hotspot of estuarine CO₂ emissions, studies in this region are very scarce. We measured dissolved and particulate organic carbon, carbon dioxide (CO₂) partial pressure and carbon monoxide (CO) concentrations in two tropical estuaries in Sarawak, Malaysia, whose coastal area is covered by peatlands. We surveyed the estuaries of the rivers Lupar and Saribas during the wet and dry season, respectively. The spatial distribution and the carbon-to-nitrogen ratios of dissolved organic matter (DOM) suggest that peat-draining rivers convey terrestrial organic carbon to the estuaries. We found evidence that a large fraction of this carbon is respired. The median $p\text{CO}_2$ in the estuaries ranged between 618 and 5064 μatm with little seasonal variation. CO₂ fluxes were determined with a floating chamber and estimated to amount to 14–272 mol m⁻² yr⁻¹, which is high compared to other studies from tropical and subtropical sites. In contrast, CO concentrations and fluxes were relatively moderate (0.3–1.4 nmol L⁻¹ and 0.8–1.9 mmol m⁻² yr⁻¹) if compared to published data for oceanic or upwelling systems. We attributed this to the large amounts of suspended matter (4–5004 mg L⁻¹), limiting the light penetration depth. However, the diurnal variation of CO suggests that it is photochemically produced, implying that photodegradation might play a role for the removal of DOM from the estuary as well. We concluded that unlike smaller peat-draining tributaries, which tend to transport most carbon downstream, estuaries in this region function as an efficient filter for organic carbon and release large amounts of CO₂ to the atmosphere. The Lupar and Saribas mid-estuaries release $0.4 \pm 0.2 \text{ Tg C yr}^{-1}$, which corresponds to approximately 80% of the emissions from the aquatic systems in these two catchments.

CO₂ and CO emissions from Southeast Asian estuaries

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