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Distribution and flux of dissolved iron in the peatland-draining rivers and estuaries of Sarawak, Malaysian Borneo

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Abstract. Dissolved iron (dFe) is essential for multiple biogeochemical reactions in oceans, such as photosynthesis, respiration and nitrogen fixation. Currently, large uncertainties remain regarding the input of riverine dFe into coastal oceans, especially in tropical rivers in southeastern Asia. In the present study, the concentrations of dFe and distribution patterns of dFe were determined along the salinity gradient in the Rajang River and three blackwater rivers that drain from peatlands, including the Maludam River, the Sebuyau River and the Simunjan River. In the Rajang River, the dFe concentration in freshwater samples (salinity < 1 PSU – practical salinity units) in the wet season (March 2017) was higher than that in the dry season (August 2016), which might be related to the resuspension of sediment particles and soil erosion from cropland. In the Rajang estuary, an intense removal of dFe in low-salinity waters (salinity < 15 PSU) was observed, which was likely due to salt-induced flocculation and absorption of dFe onto suspended particulate matter (SPM). However, increases in the dFe concentration in the wet season were also found, which may be related to dFe desorption from SPM and the influences of agricultural activities. In the blackwater rivers, the dFe concentration reached 44.2 $\mu mol\,L^{-1}$, indicating a strong contribution to the dFe budget from peatland leaching. The dFe flux derived from the Rajang estuary to the South China Sea was estimated to be $6.4 \pm 2.3 \times 10^5$ $kg\,yr^{-1}$. For blackwater rivers, the dFe flux was approximately $1.1 \pm 0.5 \times 10^5$ $kg\,yr^{-1}$ in the Maludam River. Anthropogenic activities may play an important role in the dFe yield, such as in the Serendeng tributary of the Rajang River and Simunjan River, where intensive oil palm plantations were observed.

1 Introduction

Iron (Fe) is an essential element for enzymes and is deemed to be responsible for photosynthesis, respiration and nitrogen fixation (Moore et al., 2009; Raven, 1988; Williams, 1981). Over the past 4 decades, Fe has been identified as a micronutrient that significantly supports primary productivity in oceans (Brand and Sunda, 1983; Moore et al., 2009; Tagliabue et al., 2017). In particular, after a series of in situ fertilization experiments, researchers have verified the occurrence of Fe limitation on the growth of phytoplankton and its critical effect on CO_2 fixation (Boyd et al., 2007; Martin, 1990).

At the global scale, the amount of riverine dissolved iron (dFe) transported to coastal oceans is estimated to be 1.5×10^9 $mol\,yr^{-1}$ (Boyd and Ellwood, 2010; de Baar and de Jong, 2001; Jickells et al., 2005; Milliman and Farnsworth, 2011; Saitoh et al., 2008). Tropical rivers might contribute a significant quantity of dFe based on studies of the Amazon River (Bergquist and Boyle, 2006; Gaillardet et al., 1997) and the Congo River (Coynel et al., 2005; Dupré et al., 1996). However, few studies have assessed the dFe concentrations and transport patterns of tropical rivers in southeastern Asia, even

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