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Spatial and temporal variability of CO_2 diffusive fluxes from a typical valley-type reservoir on the Upper Mekong River Basin

Lin Lin

National University of Singapore, Faculty of Arts and Social Science, Geography Department , Singapore (a0109692@u.nus.edu)

Even though the greenhouse gases emission from reservoirs has been blamed for harming the green credits of hydropower, one-year observation of CO_2 effluxes in 2016 from the Gongguoqiao Reservoir located in the upper Mekong River Basin was around 623.80 mg•m-2•d-1, with a range from -43.83 to 8466.99 mg•m-2•d-1. Samples were collected at seven upstream points and one point downstream the dam. Effluxes in the studied reservoir, however, exhibited great spatial and temporal variability. The riverine zone in the upper reach was heterotrophic while the lower reach near the dam showed more lentic characteristics since autochthonous carbon was added into the carbon cycle. In the dry season, mean efflux in riverine zone with flow velocity, 2471 mg•m-2•d-1, was 4.33 times higher than that in lacustrine zone while in the rainy season the spatial heterogeneity was insignificant. Diffusion downstream the dam kept a stable areal efflux similar to the lacustrine zone through the sampled year while the emission from littoral area displayed the largest temporal variability owing to macrophytes and phytoplankton. The carbon efflux at riverine zone was sensitive to inflow as the warmer inflow with low turbidity and high alkalinity joint the reservoir as overflow in dry season and resulted in higher evasion rates. In rainy season, however, due to anti-season operation, discharging water into downstream for electricity hardly allow enough time for decomposition of allochthonous organic carbon and interrupted the vertical diffusion of CO_2, resulting in low effluxes. Lacustrine zone in the lower reach of the reservoir is more sensitive to the water temperature. The carbon dynamics in the daily-flooded littoral area was found under the control of eutrophication. Variation of pCO_2 and effluxes were dependent on the availability of nutrients and light. Diurnal observation of CO_2 emissions found that the average nocturnal emission rate was almost 3 times higher than the rate in the daytime.