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Carbon dynamics and weathering processes constrained by stable carbon isotopes and water chemistry in a monsoonal river

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Carbon and nutrient cycling on the Earth's surface is controlled by hydrological and biogeochemical processes, which can regulate the Earth's long-term climate though complex feedback mechanisms. Temperature and discharge are two critical expressive factors of climate variability, and changes in these factors can significantly alter flow regimes. This study investigated the effects of climate variability on CO_2 consumption fluxes and carbon dynamics in monsoonal rivers, based on high-frequency variations in dissolved solutes and d13CDIC values of riverine water in a hydrological year.

The dissolved solutes show significant temporal variations during the entire hydrological year. The concentrations of most elements decrease with increasing river discharge due to the dilution effect. However, they do not behave similar and do not follow the dilution curve closely, because of ions exchange, mineral dissolution/precipitation and biological processes. Carbonate is widely distributed in the catchment, and carbonate weathering acts as the major source for dissolved solutes. Ions from carbonate weathering showed stronger chemostatic behavior to discharge change than silicate weathering, which can be attributed to the rapid dissolution and precipitation characteristics of carbonate minerals. Based on the LoadEst program, the annual CO_2 consumption rates are calculated to be $(6.8 \pm 0.2) \times 106$ ton/yr and $(2.4 \pm 0.3) \times 106$ ton/yr for carbonate weathering and silicate weathering, respectively. The annual CO_2 consumption rates in the Xijiang River only accounted for a small fraction in the global CO_2 consumption rates, while the CO_2 consumption capacity was much higher than the global average. The discharge change is large, and the water temperature was constant in the high-flow season. So, transport control is the main driver of CO_2 consumption fluxes and FDIC. We suggest that, the sensitivity of CO_2 consumption fluxes and carbon dynamics to climate variability is significant in monsoonal rivers. More attentions should be concentrated on distinguishing the contributions of discharge change and temperature variability on CO_2 consumption fluxes and carbon dynamics in future studies.

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