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Sources and fates of dissolved inorganic carbon in Chinese rivers

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Rivers play an important role in global carbon cycling, but there are still large uncertainties concerning riverine carbon sources and fates. Traditionally, dissolved inorganic carbon (DIC) was considered as weathering product and its isotopes (i.e., $\delta^{13}C_{DIC}$ and $\delta^{14}C_{DIC}$) can bring the information of weathering. However, many biogeochemical processes shift the $\delta^{13}C_{DIC}$ and $\delta^{14}C_{DIC}$, masking the weathering information. In addition, the behaviors of DIC in response to short-term climate variabilities are still unclear. Herein, we investigated DIC concentrations, $\delta^{13}C_{DIC}$ and $\delta^{14}C_{DIC}$ on spatial and temporal scales in Chinese rivers to uncover the carbon dynamics to short-term climate variabilities and under the controlling factors on carbon biogeochemical processes. DIC showed strong chemostatic behaviors to hydrological changes, by which we predict the climate-carbon flux feedback is sensitive to future climate change. Carbonate weathering provides strong buffering capacity to sustain DIC concentrations and stabilize DIC dynamics in the aquatic systems. However, carbon isotopes do not support the theory of weathering, because $\delta^{14}C_{DIC}$ in carbonate-rich catchments also show high values. In contrast, we found that climate variables control the $\delta^{14}C_{DIC}$ on the spatial scale, showing the changing carbon biogeochemical processes under diverse circumstances. In addition, $\delta^{13}C_{DIC}$ had negative relationship with changing runoff, and $\delta^{14}C_{DIC}$ showed positive relationship with changing runoff, both of which indicates the influx of biological DIC in the warm and wet season. Overall, we proposed that climate-driven biological carbon activities control the carbon biogeochemical processes, and our study has great implications on understanding global carbon cycle.