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Damming effect on carbon processing in a subtropical valley-type reservoir in the upper Mekong Basin

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Damming rivers has been identified as one of the most intense artificial perturbations on carbon transportation along the river continuum. To quantify the damming effect on the riverine carbon flux in the upper Mekong River, seasonal carbon fluxes were monitored in a subtropical valley-type reservoir (the Gongguoqiao Reservoir) in 2016. Annually, around 20% of the incoming carbon was sequestered within the reservoir with most of the carbon retention occurring in the rainy season. Since higher rainfalls and water discharge brought large amounts of terrestrial carbon into the reservoir in summer, the concentrations of dissolved organic carbon (DIC), particulate inorganic carbon (PIC) and particulate organic carbon (POC) in the topwater show significant decreasing trends from the river inlet to the outlet ($p<0.01$). During the cooler dry season (winter), however, the damming effect was much weaker. Precipitation of PIC owing to the alkaline environment and decelerated flow velocity contributed over half of the carbon retention in the reservoir. Correlation between suspended sediment concentration and carbon concentrations reveals that heavy sedimentation also resulted in the sequestration of particulate carbon. Yet the damming impact on the flux of dissolved organic carbon (DOC) was relatively weak due to the short water retention time and refractory nature of allochthonous carbon. The anti-season operation of the dam allowed little time for the decomposition of the incoming DOC in the rainy season. The differentiation processing of the carbon flow significantly increased the dissolved carbon proportion in the outflow. The dams could be acting as filters and the effect might be exacerbated in the cascading system. Accumulation of dissolved organic carbon possibly can accelerate eutrophication processes in the downstream reservoirs and thus altered the aquatic carbon dynamics in the downstream river channels.

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