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Temporal variability and spatial distribution of suspended matter and organic C pool in the Zambezi River

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It is increasingly recognized that rivers are active components of global carbon (C) cycling, able of processing, emitting into atmosphere, and transporting to the oceans large quantities of both organic and inorganic carbon derived from the surrounding terrestrial landscape. Although tropical rivers contribute with more than half to the global freshwater discharge to the oceans, there is surprisingly little information on biogeochemistry and C cycling of those systems, especially for Africa. As part of a broader study on the biogeochemistry of large African river basins, we present here data on temporal and spatial variability of total suspended matter (TSM), particulate (POC) and dissolved organic C (DOC) in the Zambezi River (length = 2900 km, catchment area $>$ 1.4 million km^2, annual discharge $\sim$ 4150 m^3/s) in relation to physico-chemical proprieties (conductivity, oxygen, pH, total alkalinity), bacterial respiration, primary production and net aquatic metabolism. Data were collected along the entire river stretch during 2012 and 2013, and over 2 climatic (dry and wet) seasons to constrain the interannual variability, seasonality and spatial heterogeneity of the investigated parameters, and at two monitoring stations: one on the Zambezi mainstream, and one on the Kafue River (major tributary of the Zambezi; total length $\sim$ 1900 km, catchment $\sim$ 156, 000 km^2, annual discharge = 350 m^3/s), both located several km upstream their confluence. During the two sampled years, TSM concentrations varied from 1.6 mg/L to 110 mg/L (mean 17 in 2012 and 29 mg/L in 2013) and were systematically higher in the river mainstream (mean 21 mg/L and 36 mg/L in 2012 and 2013, respectively) compared to both reservoirs (the Kariba and the Cahora Bassa) where TSM concentrations average 2.5 mg/L. Despite the disturbance along the aquatic continuum caused by the presence of the two man-made reservoirs, a distinct longitudinal pattern was observed during both years, with TSM increasing downstream, and pH, conductivity and total alkalinity decreasing gradually. A good and negative correlation exists between the relative contribution of both POC and particulate nitrogen (PN) and the total suspended load (higher organic fraction in low suspended load) accounting for approximately 13% and 1.5%, respectively, of the TSM. Higher contribution of both POC and PN was observed systematically in reservoirs (30% and 4%, respectively), which together with the isotopic signature (δ^{13}C-POC of -28.3 ‰ and δ^{15}N-P of 0.8‰) suggests the dominance of aquatic produced organic matter in reservoirs compared to the river mainstream (8% and 1%, respectively) of mostly terrestrial origin (δ^{13}C-POC: -25‰ and δ^{15}N-PN: 2.8‰). Less clear distinction between mainstream river (3.2 mg/L) and reservoir (2.5 mg/L) was observed for DOC (mean 3.1 mg/L) which showed generally an increasing trend downstream. The comparison between the two monitoring stations indicate an overall higher sediment load in the Kafue River (21 mg/L) compared to the Zambezi (7 mg/L), but lower contribution of particulate organic fraction (9% POC and 1% PN, respectively) and higher DOC (4.2 mg/L) versus 17% POC, 2.5% PN and 2.5mg/L DOC in the Zambezi.