Spatial and temporal patterns of dissolved organic matter optical properties across large rivers in Africa

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The composition of dissolved organic matter (DOM) in aquatic ecosystems reflects the dynamic interplay between DOM sources and reactivity. As the biochemical nature of DOM defines its optical properties, optical measurements are particularly useful to assess the composition of DOM in freshwater and hence can be applied as proxies for assessments of DOM sources and its biogeochemical role. Tropical rivers have disproportionally high carbon transport and outgassing compared to their temperate or boreal counterparts, yet the cycling of DOM within these systems is still poorly studied with the exception of the Amazon basin. In this study we compared concentrations and stable isotopic signature of dissolved organic carbon (DOC) with optical properties of DOM from diverse tropical river systems across the African continent including the Congo basin, the Zambezi basin, the Ogooué basin and the Niger basin. These major rivers of the African continent were monitored for long period (from 1-2 years) at biweekly frequency. This large dataset allowed us to compare the spatial and temporal patterns of DOM quality along various environmental gradients, including hydrology, river size, terrestrial vegetation and connectivity to terrestrial inputs. The optical proxies presented and discussed in this study include absorption coefficient at 350 nm (a_{350}), the specific ultra-violet absorbance (SUVA), spectral slopes ($S_{275-295}$ and $S_{350-400}$), the spectral slope ratio (S_R=$S_{275-295}$:$S_{350-400}$) and the a_{250}:a_{365} ratio. The vegetation cover appears to be a major control on DOM composition, with DOM of lowest aromaticity in rivers draining C4-savannah dominated basin (highest a_{250}:a_{365} and S_R values and lowest SUVA values) compared to DOM exported in rivers draining C3-forested dominated basin (lowest a_{250}:a_{365} and S_R values and highest SUVA values). Moreover, temporal variability in DOM composition was higher in savannah dominated basin compared to forested dominated basin, suggesting that changes in DOM sources along the hydrograph are more pronounced in the former compared to the latter. However, DOC concentrations were higher and more variable in forested dominated basin compared to savannah dominated basin, showing that spatial and temporal variability in DOC concentration were not linked with spatial and temporal changes in DOM composition. Differences in DOM composition between C4-savannah and C3-forested dominated basins results from variations in DOM sources, and consequently suggest differences in photo- and bio-reactivity along the fluvial network as biological and photochemical processes preferentially degrade different components of DOM.