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Dissolved organic matter dynamics in streams of intermittent flow - linkages with ecohydrologic processes from pool to catchment in northern Australia

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Changes in both the frequency and intensity of flood-drought cycles of intermittent streams, either through changing climate or anthropogenic management, may have significant impacts on stream functioning. However, little is known about how and to what extent the quantity and composition of dissolved organic matter (DOM) changes during inter-flood periods and how this relates to stream hydrology, particularly of intermittent rivers. We hypothesised that with increasing time since flooding, controls on stream biogeochemical processes transition from predominantly hydrological to more local scale environmental factors. We also argue that in strongly seasonal and oligotrophic regions, such as those of the tropical northwest of Australia, groundwater inputs of old DOC may increase the bioavailability of stream organic matter. We used δ18O and δ2H values of surface water and groundwater in the alluvium (AW) together with DOM fluorescence excitation-emission spectroscopy and radiocarbon dating to (i) characterise DOM and (ii) assess the relative importance of autochthonous versus allochthonous sources among pools according to how connected they are to groundwater. Our findings show that as streams increase in size and accumulate aromatic DOC from terrestrial plant material, percent bioavailability decreases concomitant with the modernization of the DOC pool. Therefore, rapid biotic uptake of old, bioavailable DOC originating in groundwater springs and the accumulation of modern, terrestrially derived DOC work in opposite directions affecting the dynamics of DOC along fluvial networks. The metabolism of old DOC in small streams is a direct link between terrestrial and aquatic ecosystems but also provides a biogeochemical link between non-contemporary carbon fixation and modern river productivity. Recognition of the hydrologic complexity of dryland rivers is clearly necessary for more effective catchment-scale management strategies that balance an increasing demand for groundwater extraction while preserving the long-term ecological health of riverine ecosystems.