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A multi-technique assessment on the flux of natural organic matter across an Australian water supply catchment

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Critical to understanding natural organic matter (NOM) flux, through both engineered treatment systems and environmental ecosystems, is the intensive application of interdisciplinary NOM characterization techniques. An increase in the frequency and occurrence of extreme precipitation events and prolonged periods of drought are believed to be driving changes in terrestrial NOM flux and aquatic in-situ carbon cycling within Australian water supply catchments. Hence there is a requirement for water treatment to adapt accordingly to increasingly variable NOM character and concentration. Given this variability in the recent decade coupled with forecasted population increases, water utilities and catchment management authorities are heading towards upgrades to existing treatment facilities. It is evident there is limited understanding of how climatological conditions drive NOM flux across environmental ecosystems, particularly under increasingly unpredictable climatic conditions. Therefore, the aim was to conduct an intensive, catchment-wide, multi-technique NOM characterization study for an Australian water supply catchment.

In addition to standard water quality parameters, NOM character was tracked both spatially and temporally using multiple NOM characterization techniques to determine a range of NOM physiochemical properties. Total NOM concentration was measured by dissolved organic carbon (DOC), whilst NOM molecular weight distribution was measured by liquid chromatography with organic carbon detection (LC-OCD). Fluorescent DOC was tracked by fluorescence spectroscopy excitation-emission matrices coupled with parallel factor analysis (FEEM/PARAFAC). NOM polarity (hydrophobicity/hydrophilicity) was evaluated with the novel polarity rapid assessment method (PRAM), encompassing polar, non-polar and anionic exchange solid phase extraction (SPE) sorbents.

Widespread application of multiple NOM characterization techniques has yielded insight into the relationship between characterization methods, as well as spatial and temporal responses to climatological events within the catchment. Distinct differences in NOM character were found in outer catchment stream-based sampling sites, to reservoir-based sites where water residence time impacts NOM concentration and character. Catchment-wide NOM character was monitored during extreme rainfall events which result in large NOM influx into the catchment system and during prolonged periods of drought which track the widespread attenuation of fluorescent DOC. Understanding NOM character change as a function of extreme climatic variance is critical to developing and preserving future treatment capacity under an increasingly variable climate.