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What drove Dissolved Organic Carbon (DOC) concentration variability in the River Thames (UK) between 1884 and 2014?

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Climate and atmospheric circulation patterns influence the variability of basin hydrochemistry, therefore understanding their influence is essential to put short-term water quality trends into the right context and to predict future hydrochemistry responses in the face of climate change.
We investigate the drivers of DOC concentration variability in the Thames basin over 130 years. Our previous work has shown that increased urbanization since the 1880s in the Thames basin was the major driver for the increase in riverine DOC, but it does not explain DOC variability. Our current work investigates the links between hydro-climatic variability (temperature, precipitation and runoff) and teleconnections (ENSO and NAO), and the variability in DOC concentration. Moreover we compare the impact of hydro-climatic variability on riverine DOC, to the impact of land-use change and population increase.
We use singular spectrum analysis to identify and then compare the dominant oscillatory components of hydro-climatic and hydro-biogeochemical variables. We use phase-plane trajectories of the noise-free, intra-annual to inter-annual reconstructed components to elucidate the biogeochemical and hydro-climatic dynamics of the system. This allows us to elucidate the links between the variability of hydro-climatic variables and DOC. Moreover they enable the identification of points in time where the dynamics of the system have changed, e.g. due to anthropogenic influences. Further, lag-correlations between teleconnections, DOC and flow are explored, to consider the hydrological memory of the catchment due to the permeable geology present.
We show that the high seasonal to inter-annual variability in DOC concentration is linked to the variability of precipitation and runoff, rather than temperature. The dominant inter-annual modes of variability in DOC are connected to the ENSO oscillatory components. During strong El Niño and La Niña years there is statistically significant positive correlation between DOC concentration and ENSO. Moreover peaks in DOC concentration (as in the 1940s and early 1980s) are connected to very strong El Niño events. ENSO impacts riverine DOC indirectly, by influencing climate and hydrology, in turn these influence DOC export, transport and production. If El Niño events will strengthen in the future, we might expect higher DOC concentration peaks.