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Hydro-meteorological conditions associated with extremes concentrations of dissolved carbon, nitrogen and phosphorus in headwater agricultural catchment

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Agricultural intensification during the 20th century led to high disturbance of carbon and nutrient cycles entailing surface water quality deterioration. Regional climate conditions and hydrology control hydro-chemical processes. Dynamics of solute export and concentrations, such as Dissolved Organic Carbon (DOC), Nitrate (NO_3) and Phosphate (PO4) have shown partial relationships with the discharge, North Atlantic Oscillation, temperatures, water table levels. However, interactions between DOC, NO_3 and PO4 concentrations and hydro-meteorological conditions are still weakly known.
In order to better understand the ecohydrological controls on the variability of solutes concentrations, we investigated the relationships between the occurrence of daily hydro-meteorological conditions and stream concentrations of DOC, NO_3 and PO4 based on daily time series over 15 years.
This study used the long term and high frequency dataset from the Kervidy Naizin catchment (AgrHyS critical zone observatory, Brittany, France), a 5km^2 agricultural headwater catchment with oceanic temperate climate. The analyze focused on the distribution of the hydro-meteorological variables (Rainfall, temperature, wind speed, global radiations, discharge and water table level) during the extreme concentrations of DOC, NO_3 and PO4 in base flow and storm flow.
Results show that the dynamics of DOC, NO_3 and PO4 concentrations are mainly controlled by discharge, rainfall and water table level while temperature, global radiations and wind speed have low influence. DOC extreme concentrations are associated with high rainfall and storm discharge. NO_3 extreme concentrations are associated with high base flow discharge and high water table levels. PO4 extreme concentrations are associated with very high rainfall and storm discharge. These results suggest that DOC, NO_3 and PO4 sources differ. Subsurface, ground water and surface flows would provide DOC, NO_3 and PO4, respectively.
Solute exports have strong relationships with hydrological variations, but are poorly related to instantaneous meteorological conditions. Further study should investigate the solute concentration dynamics at larger (intra or inter annual) timescales.