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Variation in dissolved organic matter (DOM) stoichiometry in freshwaters: Assessing the influence of land cover and soil C:N ratio on DOM composition

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Dissolved organic matter (DOM) plays an important role in freshwater biogeochemistry. In addition to acting as a significant store of reduced carbon, DOM is also responsible for the delivery of significant quantities of dissolved organic nitrogen (DON) and phosphorus (DOP), which have been shown to dominate nutrient export from natural and semi-natural systems. The stoichiometry of organic matter has proved a useful tool in assessing compositional changes in the complex and dynamic pool of organic compounds that comprise DOM. What is not clear in the existing literature is whether DOM composition in streams can be reliably estimated from a knowledge of the landscape stores of DOM in soils and biota.

To investigate the influence of catchment character on the quality and quantity of DOM in freshwaters, forty-five sampling sites draining subcatchments of contrasting soil type, hydrology, and land cover within one large upland-dominated and one large lowland-dominated catchment, were sampled over a one-year period. Dominant land cover in each subcatchment included: arable and horticultural, blanket peatland, coniferous woodland, improved-, unimproved-, acid-, and calcareous-grasslands. The composition of the C, N, and P pool was determined as a function of the inorganic nutrient species (NO_3-, NO_2-, NH4+, PO43-) and dissolved organic nutrient (DOC, DON and DOP) concentrations. DOM quality was assessed by calculation of the molar DOC:DON and DOC:DOP ratios and specific ultraviolet absorbance (SUVA254).

In catchments with little anthropogenic nutrient inputs, DON and DOP typically comprised >80% of the TDN and TDP concentrations. By contrast, in heavily impacted agricultural catchments DON and DOP typically comprised 5-15% of TDN and 10-25% of TDP concentrations. Significant differences in DOC:DON and DOC:DOP ratios were observed between land cover classifications with significant correlations observed between both the DOC:DON and DOC:DOP molar ratios and SUVA254 (Spearman's rank = 0.88 and 0.84, respectively). Analysis also demonstrated a significant relationship between soil C:N ratio and instream DOC:DON and DOC:DOP (Spearman's rank = 0.79 and 0.71 respectively). We infer from this that soil properties, specifically the C:N ratio of the soil organic matter pool, has a significant influence on the composition of DOM in streams draining through these landscapes.