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Advancing understanding of the fluvial export of organic matter through high-resolution profiling of dissolved organic carbon.

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Quantifying the natural variation (complexity) of a system remains an enduring scientific challenge in better understanding controls on surface water quality. This characterisation is needed in order to reveal controlling processes, such as dilution, and also to identify unusual load profiles. In trying to capture that natural variation we still rely largely on concentration time series (and associated export budgets) generated from manual spot sampling, or from samples collected by autosamplers - approaches which are unlikely to provide the high temporal resolution of parameter concentration required. Now however, advances in sensor technology are helping us address this challenge.

Here we present detailed dissolved organic carbon (DOC) export profiles from a small upland river (9.4 km sq.), generated since June 2011 by semi-continuous logging of UV-vis absorption (200-750 nm, every 2.5 nm) every 30 minutes. Observed increases in the concentration of the DOC, [DOC], in freshwaters have prompted significant research to understand the cause and consequences of increased export: higher levels of DOC require additional water purification of potable sources; increased aquatic export may represent a reduction in terrestrial C-soil sequestration; changes in light penetration can affect the heterotrophic / autotrophic balance in surface waters and this has consequences for the food web structure; increased aquatic export may also result in increased carbon dioxide evasion. Additionally, C export is often linked to nutrient export: we have observed statistically significant stoichiometric relationships between DOC and soluble reactive phosphorus (SRP) concentrations, thus understanding better this parameters offers insight into export of other nutrient and the source of material from which these dissolved compounds are produced; this may be particulate.

Our Scottish study site is interesting because there are multiple processes that can contribute to DOC and other nutrient exports. Whilst the river drains pastureland the headwaters are predominantly a peatland undergoing restoration as part of a habitat management plan implemented in response to the nearby construction of a wind farm.

The DOC time series we present reveals new details of DOC export responses to both hydrological controls such as rainfall-induced event flow, and terrestrial controls such as seasonal changes in terrestrial DOC production. Additionally, we compare this profile of absorption-estimated DOC export to one generated from statistically significant relationships between [DOC] from manual water sampling with water chemistry time series (e.g. conductivity) generated from sondes deployed at the same site. Finally, both approaches support the calculation of a C export budget, and we compare the export budget generated by these two semi-continuous profiles with that derived from manual spot sampling.