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Understanding and modelling the variability in Dissolved Organic Carbon concentrations in catchment drainage

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Our knowledge of dynamic natural habitats could be improved through the deployment of automated sensor technology. Dissolved organic carbon concentrations, [DOC], are of interest to water companies as purification removes this pool and currently in environmental science, due in part to rising DOC levels and also as respiration of this C pool can lead to an increased CO_2 efflux.

Manual sampling of catchment drainage systems has revealed seasonal patterns in DOC (Williams, P.J.L., 1995) and that hydrological events export most DOC(Raymond, P.A. and J.E. Saiers, 2010). However, manual sampling precludes detailed characterisation of the dynamic fluctuation of DOC over shorter but important time periods e.g. immediately prior to an event; the transition from base flow to a surface run-off dominated system as surface flow pathways defrost. Such insight is only gained through deployment of continuous-monitoring equipment.

Since autumn 2010 we have deployed an S::CAN Spectrolyser (which from absorbance gives a measurement of [DOC]) in a 7.5 kilometre squared peaty catchment draining Europe's largest windfarm, Whitelee. Since autumn 2011, we have an almost complete time series of [DOC] every 30. Here [DOC] has ranged from 12.2 to 58.4 mg/l C and during event flow DOC had a maximum variation of 23.5 mg/l within a single day. Simultaneously with the Spectrolyser, we have logged stage height, pH and conductivity using an In-Situ Inc MD Troll 9000. Generally there is an inverse relationship between [DOC] and both pH and conductivity, but a positive relationship (albeit with seasonal differences) with [DOC] and stage height, from which we can infer hydrological changes in the source of the DOC.

Here, in addition to presenting the time series of the data, and a more accurate export budget estimate, I will explore statistical methods for the handling of large datasets. Trends in the data of such large and dynamic data sets are challenging to model. Simple relationships with stage height or conductivity generally are not maintained over extended time periods and thus more complex statistical approaches are needed to understand trend and detail. For example wavelet analysis is being used to assess if periodicity in [DOC] occurs other than seasonally.

Raymond, P.A. and J.E. Saiers (2010), Event controlled DOC export from forested watersheds. Biogeochemistry, 100,1-3, 197-209.

Williams, P.J.L. (1995), Evidence for the seasonal accumulation of carbon-rich dissolved organic material, its scale in comparison with changes in particulate material and the consequential effect on net C/N assimilation ratios. Marine Chemistry, 51,1, 17-29.