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Exploring how land use may influence the composition and biodegradability of dissolved organic carbon in carbon-rich catchment drainage

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The terrestrial flux of dissolved organic carbon (DOC) is the largest transfer of reduced C from land to aquatic and ultimately marine ecosystems. Land use is suggested to be a local factor influencing fluvial [DOC]. Studies assessing land use impacts have focused on quantifying DOC export. However, little is known about the changes in soil-derived fluvial DOC composition and its impacts on in-stream DOC reprocessing.

This research focuses on a C-rich catchment in Scotland, UK to explore how aquatic DOC composition is influenced by wind farm-associated land uses, and how DOC biodegradation may be influenced by its composition. The monthly water monitoring from 2014-2015 in this 5.7 km2 catchment showed differences in the concentration and composition of the DOC between its two sub-catchments D-WF and D-FF. This may be attributed to the different land uses: D-WF was draining the wind farm construction areas and D-FF draining the felled forestry. The felled catchment had greater mean [DOC], however the DOC was less humified suggested by the smaller SUVA410 and larger E2/E4. This may be due to young DOC from the breakdown of residual branches, or more humification in soils in the wind farm areas.

The biodegradability of this compositionally-different DOC between D-WF and D-FF was examined through water sample biodegradation incubations in September and November of 2015, and January and May of 2016. Only 2.9-12.1% of the total DOC was biodegraded during 21 days. Weekly measurements of DOC composition and nutrients revealed that protein-like florescence component C6 and TON changed actively with biodegradable DOC (BDOC) removal. The initial SUVA254, SUVA410, C6, and concentrations of SRP and TON were good predictors for BDOC loss. SUVAs and C6 likely came out as reflecting the refractory/labile DOC pools. Spatially, larger BDOC loss was found in D-WF in January and May, which may be because in these two months the greater nutrient concentrations, smaller DOC aromaticity and more labile DOM materials in D-WF likely supported more DOC biodegradation.

This research indicates the composition of terrestrial DOC in freshwater can vary over space and time and in response to land use. In turn this inherited composition can influence the fate of DOC in aquatic continuum, which potentially impacts C export to oceans and emission to atmosphere.