Geophysical Research Abstracts
Vol. 15, EGU2013-627, 2013
EGU General Assembly 2013

Influence of hydrological connectivity on water, carbon and thermal dynamics in peat-dominated catchments

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Extended peatlands are characteristic of many upland catchments. Peaty soils in riparian zones are an important interface between subsurface, terrestrial and aquatic environments that can regulate hydrological and biogeochemical fluxes between the hillslope and stream. This buffering potential is spatially and temporally variable due to both horizontal and vertical subsurface heterogeneity within the riparian area and is linked to soil type, hydrology and biogeochemical processes. It is important to understand how this heterogeneity affects the connectivity between landscapes and the river network and how this interacts with variability in hydrology, stream water quality and ecosystem function.

Here, we present high resolution monitoring of dissolved organic carbon (DOC), dissolved oxygen concentrations (DO) and spatially distributed water temperature data from a 3.2 km2 upland watershed in the NE Scottish Highlands. This data will be coupled to understand how temporal and spatial variation in the connectivity of the riparian peat wetlands and the stream network modulates stream water chemistry and its thermal fingerprint. This potential to regulate water quality is deeply rooted in the different hydrological flow paths and stores water takes prior to entering stream flow.

Initial results indicate a seasonally varying link between runoff and DOC, with lower base flows generally having lowest concentrations. Over the course of high-flow events, concentrations are high but decrease rapidly as the soils are depleted of DOC. Replenishment by subsurface biological processes occurs at short time scales in summer. Stream water temperature profiles show distinct differences in drivers with varying flow conditions; temperatures during low flows suggest strong atmospheric controls whereas during high flows an increasing influx of groundwater is evident.

Furthermore, the dissolved oxygen data are used in modelling the stream metabolism to assess the eco-hydrological response of the catchment to hydroclimatic variability to further the understanding of how changing climate will impact upon aquatic ecosystem function in peatland dominated upland catchments.