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The connectivity of hydrological pathways in a peatland headwater catchment; models of dynamic catchment connectivity under wet and dry conditions

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Hydrological connectivity in peatland catchments can vary dramatically over time. Almost complete connectivity may be achieved during storm conditions due to the flashy hydrological regime of these environments. In contrast, during dry conditions baseflows are often poorly maintained, resulting in the majority of the catchment being hydrologically disconnected from the outlet. The connectivity of various different surface and subsurface flow pathways is also highly variable in peatlands, both temporally and spatially. This dynamic connectivity has implications for the source areas, timing and magnitude of the flux of water, sediments and solutes from the catchment.

This study uses a variety of sensors with the ability to detect the presence or absence of water travelling by different hydrological flow pathways, namely overland flow, subsurface pipeflow and ephemeral streamflow. Networks of the three types of sensor were installed in the Upper North Grain research catchment, a small peatland headwater catchment in the south Pennines, UK for 2 months in autumn 2009, covering a range of wet and dry conditions. The data obtained allows us to monitor changes in connectivity at high spatial and temporal resolutions.

Based on the empirical observations obtained in the study, information on the different types of flow pathway can be combined to conceptualise how connectivity varies over the course of a storm. The data suggest that the catchment response is dependent on antecedent conditions, with the timing and routing of flow generation in a ‘wet’ catchment being different to that in a ‘dry’ catchment. This gives rise to two different models of catchment connectivity, which are presented here.