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Upscaling understanding of the hydrological and biogeochemical functioning of larger catchments

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The need to upscale hydrological understanding has become a central research theme within catchment science. At larger spatial scales ($>$1000km^2), aspects of the hydrological functioning of entire catchments can potentially be predicted using spatial data obtained from constituent sub-catchments. At these larger scales, however, other influences of landscape control - such as climate change, land use change or even topographic features - may exert an important influence on catchment hydrological dynamics and confound any relationships identified at the smaller scale.

Hydrochemical tracers have proven utility as tools that can provide insight into integrated hydrological functioning at a range of larger scales. To investigate how these relationships change when developing understanding at the larger spatial scale, and to elucidate the hydrological functioning of a large scale catchment, a two year environmental tracer study is being carried out on the 2,105km^2 catchment of the River Dee, Aberdeenshire, in Northern Scotland. Previous investigations at a number of scales (10-200km^2) have shown that soil hydrological characteristics exert a major influence on the relative importance of groundwater contributions to runoff generation and the mean residence times of catchment waters. This poster presents the first three months of data (from October 2007) collected at nested spatial scales. Data were collected from six sites along the main stem of the River Dee (288.1 km^2 to 1829.5km^2) and

six tributaries (3.4km^2 to 232.5km^2) on a weekly basis.

Oxygen-18 and chloride are used to assess mean catchment residence times. Alkalinity and Dissolved Organic Carbon (DOC) are used as hydrochemical tracers to determine spatial variation in runoff sources in terms of percentage contributions from groundwater and organic soils. In addition to this, DOC can also be used as an index for biogeochemical functioning. In these initial stages of the sampling campaign, which encompass the transition from a dry autumn to the wetter winter period, results have shown that highly variable catchment responses at the smaller to medium scale ($<$200km2) are averaged as catchment scale increases. Alkalinity and DOC values show differential levels of connectivity to different hydrological sources in the peaty soils dominating many of the sub-catchments, which attenuates further downstream and at larger spatial scales. The conservative tracers Cl^- and oxygen-18 mainly exhibit rapid responses to precipitation at all scales, implying runoff sources in headwater catchments also dominate the downstream hydrological response at the larger scale. Although these data are preliminary in nature, they provide some insights into how such information may be used to aid hydrological models.