



## **Sources of baseflow in larger catchments - using tracers to develop a holistic understanding of runoff generation across multiple scales**

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Despite increased awareness about the importance for low flow and drought prediction, spatial and temporal variations in the processes sustaining baseflow in larger catchments are still poorly understood. Here, tracers were used in conjunction with hydrometric analysis to assess the sources of baseflow in the 22 main tributaries of the 1849km<sup>2</sup> catchment of the Dee in Scotland. Geochemical tracers showed that the chemical composition of baseflow evolved downstream, but mainly reflected the dominance of hydrological sources in headwater tributaries in the upper catchment. This was corroborated by hydrometric monitoring which showed that the upper 54% of the catchment contributed 71% of baseflow in the lower river. Baseflows in small headwater sub-catchments also exhibited the most variable hydrochemical characteristics. This variability was averaged at larger scales as new patterns emerged. In addition, isotopic analysis of delta18O suggests similarly mixed groundwater sources dominated baseflow generation in different parts of the catchment. Groundwater in the lower slopes of the sub-catchments appears to be the main source of baseflow. Baseflow periods were found to be dynamic; despite the river system being in overall recession, the channel network exhibited contrasting responses to relatively small (<5mm) rainfall events in different parts of the catchment. Moreover, diurnal variation in flows in sub-catchments with a high proportion of coverage by peat soils is apparent, which may reflect the daily variation of evapotranspiration as a control on baseflow generation and DOC concentrations. This study showed clearly that far from being a static period in the hydrological year, baseflows in larger catchments result from a complex suite of hydrological processes, which requires further research to understanding how

baseflows sustain water supplies and aquatic ecosystems, to be able to protect these services from environmental change.