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Connectivity of surface flow and sediments in a small upland catchment

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The study of connectivity can help understand complex systems in which different factors interact to influence water-transfer pathways across the landscape. Changes in the catchment can affect connectivity, which in turn can have significant effects on catchment processes and network structure. Furthermore, the potential negative effects of the transfer of nutrients, pollutants and sediments by water from land to water bodies make it necessary to improve our understanding of connectivity. This need is reinforced by increasing demands of legislation such as the Water Framework Directive for effective Integrated Catchment Management in which whole systems are considered rather than their individual parts separately. Thus, connectivity can potentially be a useful concept to assess more effectively the effects that changes can have in complex systems, and could provide useful knowledge for decision makers.

Field-based approaches to connectivity, needed to gain a useful understanding of real systems, need to include both the structural and functional aspects of connectivity, as the interaction between function and structure has to be understood to examine the complexity of the relationships between factors influencing pathways and transfer processes. This has to be taken into consideration, therefore, when designing and carrying studies to assess connectivity of flow networks that can provide context-specific data necessary to inform modelling approaches.

The Ingbirchworth Catchment, in the uplands of the River Don, England, is used to assess the feedbacks between the different factors influencing transfer networks and the spatial and temporal variability in dynamic and non-linear process responses across the landscape. An especial focus has been given to land-use change, as one of the variables that might have a considerable influence on runoff generation and pathways. This 8.5 km2 catchment shares many characteristics with many others in the River Don uplands, including the presence of small reservoirs that regulate the flow, a number of which have experienced pollution problems. A range of agricultural uses create a patchwork landscape in this area that is part of the Catchment Sensitive Farming programme.

Using a nested approach, a baseline structure on which to develop a context-specific field approach and to acquire the data necessary to assess connectivity in the system has been followed. An initial and then iterative description of the catchment structure and characteristics has been carried, together with a study of the catchment history and sedimentation record. These allow the definition of the relevant landscape units, identification of elements that might influence connectivity and inference of potential past changes of flow pathways. Through event monitoring at different landscape settings and scales, both structural and functional aspects are considered together and the variability and changes in the flow network are shown. The knowledge obtained is being used to assess the roles of the identified elements in relation to connectivity and to recognize the interactions and feedbacks between different system components.