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Low flow estimation in the United Kingdom: from statistics to time series

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There is a considerable variation in river flow behaviour across the United Kingdom over both space and time. The flashy flow regimes of wet impermeable catchments in the north and west of the country contrast markedly with those of English lowland chalk streams, where flows show little variation over the year. At the broadest scale, natural river flow regimes are dependent on rainfall, temperature and evaporation. On a local scale, the flows will be controlled by the physical properties of a catchment, including geology, land use and the presence of surface water bodies. River flow regimes are also affected directly and indirectly by human activities such as reservoir impoundment, abstraction of water, effluent discharges and land use change. The impacts of these activities vary considerably and are dependent to a certain extent on the characteristics of the catchment.

Access to daily stream flow data, at the river reach scale is a central component of many aspects of water resource and water quality management. However, the majority of river reaches are ungauged and hence, there is an operational requirement for a quick, consistent and reliable method for estimating flow regimes within ungauged catchments. Historically within the United Kingdom, this requirement has been addressed through models and techniques that relate flow regime statistics to catchment characteristics. There is an increasing requirement for these techniques to be complimented by models for predicting flow time series within ungauged catchments. This class of model will enable both the impact of environmental change on water resources, and the relationship between water resource utilisation and ecological impacts, to be explored within such catchments.

This paper will review the current status of low flow estimation within the United Kingdom focusing on the hydrological processes that have guided the development

of conceptual models. The paper will illustrate how these conceptual models have been utilised using the development of regional models for predicting flow duration statistics within ungauged sites as an example. The paper will continue by discussing how capability for prediction within ungauged catchments has been extended through the regionalisation of continuous simulation models for application within ungauged catchments. This will discuss both the outcomes of research that has sought to develop regional relationships for prior calibrated models and new research that has led to the development of an HRU approach to the regionalisation problem. Within this latter approach model calibration and regionalisation are combined within a one step process.