



## Multiscale experimentation, monitoring and analysis of long term land use changes and flood risk

### Project Summary SC060092/S1

Between 2007 and 2011, the Environment Agency commissioned a study with scientists from Newcastle University, Lancaster University and Imperial College London to understand the impacts of land use changes and the effect it has on flood risk.

The Hodder catchment in north-west England was used to monitor the impact of land use changes. This catchment was selected because United Utilities had developed the Sustainable Catchment Management Plan (SCaMP), which involved major land use changes in the catchment to improve water quality.

The River Hodder, which drains an area of 261 km<sup>2</sup>, joins the River Ribble approximately 4 km south-west of the town of Clitheroe in north Lancashire. As part of the SCaMP, extensive work is being carried out in the upper part of the Hodder catchment including blocking of grips (drains) in peatland, tree planting, and reducing the stocking densities of sheep and cattle. The SCaMP's main aims are to improve the colour of water abstracted for public supply and to enhance the condition of the catchment's Sites of Special Scientific Interest.

The ultimate aim of the project was to predict the effects of upstream changes in land use/management on downstream flooding. The project focused on short-term impacts and the poorly understood problem of the effect of scale dependence and on the level of downstream flood impact.

Different types of hydrometric instruments were used that allowed monitoring of flood peaks through the catchment at meso- (~100km<sup>2</sup>), mini- (~10km<sup>2</sup>), micro- (1km<sup>2</sup>) and process- (0.01km<sup>2</sup>) scales. There were a total of 31 hydrometric instruments (new and existing), across these scales in the catchments of Sapling Clough, Brennand, Dunsop and Hodder. Rain gauges and an automatic weather station were installed to complement the flow network. Data collected from the Hodder catchment were used to develop and test models for the generation of floods.

When seeking to analyse flood generation or to predict flood levels, obtaining good hydrological data for a catchment can be a time-consuming and difficult

process. To make the Hodder and SCaMP data more available to researchers, an electronic project record was compiled that contains all the data and background information on the catchment and the SCaMP works. The record is designed to be useful to those interested in the impact of SCaMP works on downstream flooding and to those studying the links between rural land use/management and downstream flooding.

The results from this project show that:

- the Hodder response is flashy and simple that can be modelled accurately using a simple model
- if the peak discharge for a storm event is known at one gauge then good estimates can immediately be made for the peak discharges at all other gauges in the Hodder catchment at their different scales.
- there are complex time-varying spatial patterns associated with the impact of changes in land use/management on the flood response

The results imply or show that the Hodder flood response has a strong, simple sensitivity to variability in precipitation but weak, complex sensitivity to changes in land use and management.

The findings from this project have uses beyond understanding the response of the Hodder catchment. The data from this project have been used in the development and testing of new models and methods as part of the Natural Environment Research Council's Flood Risk from Extreme Events (FREE) and the Engineering and Physical Sciences Research Council's Flood Risk Management Research Consortium 2 (FRMRC2) programmes.

The Environment Agency has used the project's findings to inform the development of further evidence-based practice to bring about improved flood and coastal risk management.

This summary relates to information from project SC060092 reported in detail in the following output(s):

**Report:** SC060092/R

**Title:** Multiscale experimentation, monitoring and analysis of long-term land use changes and flood risk

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This project was commissioned by the Environment Agency's Evidence Directorate, as part of the joint Flood and Coastal Erosion Risk Management Research and Development Programme.

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