

Analysis of historical data sets to look for impacts of land use and management change on flood generation

Technical Summary: FD2120

Joint Defra / EA Flood and Coastal Erosion Risk Management R&D programme

Background to R&D project

The purpose of this study was to provide an analysis of historical data sets to ascertain whether any impacts of land use and management change on flood generation could be identified. This report presents the results of the study. Data on the nature of change in agricultural land use and management are reviewed. These data were then used to choose catchments for which change had been developed and for which hourly hydrological data were available over several decades. The change identification methodologies used were Dynamic Harmonic Regression (DHR) methods to examine longer term trends in monthly rainfalls and flows and Data Based Mechanistic (DBM) models, with a State Dependent Parameter (SPD) nonlinear filtering of rainfall inputs to examine changes in storm responses using the shorter periods of available hourly data.

Results of R&D project

In general, variability between years and inconsistencies in the rainfall and flow data appear to dominate any tendency to changes over time or with hydrological conditions. In the DHR analyses, only monthly flows could be shown to exhibit any significant trend and then only for 2 of the 9 catchments prioritised for study, the Axe and the (nearby) Isle. In the DBM analysis of modelled hydrograph characteristics most catchments showed no clear changes over time. Where tendencies for change in hydrograph characteristics with time are evident, they are masked by year to year variability. There was some tendency to reflect the hydrological conditions as represented by maximum flow in a period. This suggests that the modelling strategy has not captured all of the information content of the data.

The most promising method of change identification in the catchment dynamics was found to be to analyse groups of "similar" events classified by antecedent condition and peak flows. This analysis was applied to the Axe catchment only, but revealed some consistent changes in the DBM model parameters for some of the classes, including an apparent change in response in the pre-1980 period. This project noted that the failure to identify impacts may be in part a result of the limitations of the data available for both rainfall and discharges which highlights the need to continue support for ongoing studies of land management effects on catchment runoff. It is noted, however, that these cover only a limited range of land management strategies



R&D Outputs and their Use

The project has provided a full report with technical details of the choice of catchments, methods of analysis and full results described in 5 technical reports. A brief summary of the project was also provided in the paper: Keith Beven, Renata Romanowicz, Peter Young, Ian Holman, Helena Posthumus, Joe Morris, Steve Rose, Enda O'Connell and John Ewen, 2008, An event classification approach to the identification of hydrological change, Proceedings DEFRA Flood and Coastal Management Conference, 2008.

The policy implications of the results are considered with the following recommendations:

1. Both climate variability, particularly rainfall variability, and land use and management affect changes in flood runoff. Changes in discharge should not be analysed without consideration of changes in catchment rainfall inputs.
2. The preliminary study of catchment responses within different event classifications was the most promising form of analysis developed during this project.
3. Adequate information about past land management changes and soil conditions is not readily available but will need to be collected and made available in future for different land use categories if improved understanding of the links between runoff and land management is to be gained and used at catchment scales.
4. The results of this project show that there will be a real difficulty of estimating the benefits of such measures in respect of any reduction of flood risk.
5. The difficulty in identifying consistent change given the limitations of the available data means that land management measures cannot be relied on as alternatives to more proven flood risk management options.
6. The difficulty in identifying consistent change given the limitations of the available data should not be taken to imply a policy of doing nothing.

This R&D Technical Summary relates to R&D Project FD2120 and the following R&D output:

R&D Technical Report FD2120/TR – Analysis of historical data sets to look for impacts of land use and management change on flood generation. Published March 2009.

Publication Internal Status: Released Internally

External Status: Released to Public Domain

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The above outputs may be downloaded from the Defra/EA Joint R&D FCERM Programme website (www.defra.gov.uk/environ/fcd/research).



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