

National river catchment flood frequency method using continuous simulation

Technical Summary: FD2106

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

Background to R&D project

Project FD2106 deals with the quantification of river flood frequencies, that is, how often on average sites experience flood discharges of particular magnitudes. Such quantitative information provides strategic background to river flood risk management.

Current engineering practice is largely based on the 1999 Flood Estimation Handbook (and, to a degree, on its forerunner, the 1975 Flood Studies Report). Project FD2106 paves the way for a next-generation methodology, capitalising on recent data acquisition and runoff modelling advances. So, whereas the existing and past methodologies put the emphasis on statistical approaches and the use of flood event assessment, project FD2106 models continuous time series of river catchment hydrological response. It is important to note that these methodologies cover the whole of Britain, that is to say, they include ungauged or data-sparse sites in addition to those locations with river flow observations. A major challenge in the research is therefore to 'spatially generalise' the method to provide a spatially comprehensive approach.

The potential viability of this 'continuous simulation' approach was tested in a forerunner pilot (FD0404, end date 2001). The specific advances required beyond this pilot were, first, the use of a substantially larger sample (>100) of data-rich catchments on which to build the generalisation techniques; second, the development of further methods for effecting the extension to data-sparse sites; and, third, the integration of uncertainty estimation within the methodology.

Results of R&D project

Project FD2106 research has provided a new method for the quantification of expected river flood frequencies, applicable across Britain at both gauged and ungauged sites. The approach is one of modelling the continuous time series hydrological response of river catchments.

The project established a quality-controlled database of continuous flow and rainfall data, much at fine time-discretisation. Sophisticated automatic calibration procedures were developed for runoff models used in continuous-time mode for gauged sites. The model parameter values derived from these calibrations were assessed in relation to more widely-available 'catchment property' data covering the whole domain of interest, that is, including sites with no river flow observations. A major challenge of the research effort was



to use the catchment properties to enable model parameter values to be established in ungauged areas, which then allows the use of runoff modelling in those areas and hence the generation of discharge time series from which flood statistics and hydrograph characteristics can be obtained. The methods developed cover 'site-similarity' approaches (where a target ungauged site is matched as far as possible with a gauged site and weighted model parameters transposed) and varieties of regression approaches (where predictive relationships are established between runoff model parameters and catchment properties). Accompanying methods were developed to express uncertainty bands around flood frequency curves for spatially-generalised ungauged site procedures.

Principles of comparison with flood event-based procedures were given, together with next-step research directions of benefit to the continuous simulation approach to river flood frequency. Recommendations were offered for best use of this new methodology at the current state of knowledge.

R&D Outputs and their Use

Project FD2106 produced, during the course of the research, a series of reports (2002-2004) detailing the development of the science of the methodology. The final technical report (*National river catchment flood frequency method using continuous simulation, March 2005, 136 pp + 141 pp appendices*) is designed to be read as a stand-alone document and includes detail of the data, modelling, extension of method to countrywide use, uncertainty estimation and recommendations for the way the method is to be used in practice. It also includes a quick-read route through the document to obtain an overview of the method, outcomes and potential.

The emphasis of the commissioned project was research into a new hydrologically-effective methodology. This exists as research level code: it is important to recognise that this is not the same as user-friendly software. Dissemination of the work has also progressed through scientific meetings and papers.

This R&D Technical Summary relates to R&D Project FD2106 and the following R&D output:

- **R&D Technical Report FD2106 National river catchment flood frequency method using continuous simulation.** Published October 2005

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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). Copies are also available via the Environment Agency's science publications catalogue (<http://publications.environment-agency.gov.uk/epages/eapublications.storefront>) on a print-on-demand basis.

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