

Improving the FEH statistical procedures for flood frequency estimation

Science Summary SC050050

Background to R&D project

For many years the Centre for Ecology & Hydrology (CEH) and the Environment Agency have funded and conducted research to develop and improve methods for flood flow estimation, which, among other things, have led to the publication of the Flood Estimation Handbook (Institute of Hydrology, 1999) and the Revitalised Rainfall Runoff Method (2005).

These procedures provide estimates of the flows that will occur in rivers on moderately rare occasions: flow values that have an exceedance probability in any given year of from 50 per cent (a 2-year return period) to 1 per cent (a 100-year return period), or even rarer. In the majority of cases where such estimates are required, the locations affected will be ungauged and too far from established river gauging stations for these to provide data records that can be immediately transferred. This highlights the need for robust methods for flood flow estimation at ungauged sites.

As part of this project, CEH was commissioned to develop improvements to several aspects of the Flood Estimation Handbook (FEH). The changes recommended arise, in part, because the HiFlows-UK project has led to the creation of a much improved database of systemically recorded flood data. Not only are the data records available now much longer than those used previously but the HiFlows-UK project put substantial effort into the quality control and assessment of the whole data-set. This means that the data available for analysis have been dramatically improved. Another influence on the changed procedures has been feedback from users of the FEH, both informal and formal. This report is largely a technical description of the studies that have led to the new recommendations.

Results of R&D project

Without substantially changing the overall framework of the existing FEH methodology, this project has updated

most technical details of the FEH method to improve the performance of the procedure. The updates include significant improvements to the theoretical statistical framework underlying the method. The key improvements are:

- A new regression model for estimating the median annual maximum flood (QMED) at ungauged catchments
- An improved procedure for the use of donor catchments for estimation of QMED at ungauged catchments
- An improved procedure for formation of pooling groups and estimation of pooled growth curves

In addition, it has been possible to consider some new descriptors of catchment topography and of local climate that have been proposed since the FEH study. In particular, a new descriptor which measures floodplain extent has been devised and it is now included in the improved procedures.

R&D Outputs and their Use

The improved procedures developed in this project will enable more accurate flood frequency estimation of in the UK. However, flood estimates produced by the new procedures can be substantially different from those produced using the FEH procedures. On taking the catchments whose data have been analysed as being typical, and treating them as if they were ungauged, the following has been noted about the ratios of the new estimates to the original FEH estimates.

The changes in QMED range from 0.55 to 2.01, with half being greater than 1.15 (25 per cent of the ratios are less than 1.00 and 25 per cent are greater than 1.24).

For floods with an annual probability of exceedance of 1 per cent (the 1% flood) the changes range from 0.48 to

2.24, with half being greater than 1.14 (25 per cent of the ratios are less than 0.97 and 25 per cent are greater than 1.32).

For both QMED and the 1% flood, the new procedure produced lower estimates than the FEH in the East of England, whereas increases in both quantities were generally observed in West England, Wales and Scotland.

This summary relates to information from Science Project SC050050, reported in detail in the following output(s):-

Science Report: SC050050

Title: Improving the FEH statistical procedures for flood frequency estimation

ISBN: 978-1-84432-920-5

June, 2008

Report Product Code: SCHO0608BOFF-E-P

Internal Status: Released to all regions

External Status: Publicly available

Project manager:

Paul Webster (Hydro-Logic)

Stefan Laeger (Environment Agency)

Research Contractor: Centre for Ecology and Hydrology, Wallingford. e-mail: enquiries@ceh.ac.uk

This project was funded by the Environment Agency's Science Group, which provides scientific knowledge, tools and techniques to enable us to protect and manage the environment as effectively as possible.

Further copies of this summary and related report(s) are available from our [publications catalogue](#) on or our National Customer Contact Centre T: 08708 506506 or E: enquiries@environment-agency.gov.uk.

© Environment Agency.