

R&D Technical Summary W5C-013/6/TS

Review of Transfer Function Modelling for Fluvial Flood Forecasting

Background to R&D project

Whilst performance targets can sometimes be met by simple trigger based approaches, in many situations the required accuracy and lead time of warning can only be obtained through the use of real time forecasting models. This is particularly the case on fast response catchments where the best chance of providing accurate forecasts with sufficient lead time often lies in the real time operation of rainfall-runoff models. An earlier R&D project (reported in R&D Technical Summary WS231) looked at the choice of rainfall-runoff model for use in different river catchments for flood forecasting purposes and recommendations on possible use in each Environment Agency region were given. One of the categories considered was Transfer Function models.

Within the Agency, Transfer Function rainfall-runoff models are accepted as a valid approach to flood forecasting and have been used for more than twenty years, although against a background where (i) recent research developments have yet to find their way into Agency use and (ii) there are some known pitfalls in implementation of this type of model. Although this category of model has been used operationally in the UK for many years, within the Agency both the application and performance evaluation of these models seems to vary from region to region.

Recognising the above, this study was commissioned with the following main objectives:

- Review the state of the art in Transfer Function modelling for fluvial flood forecasting;
- Review existing Agency use of Transfer Function models for fluvial flood forecasting;
- Identify best current practice by Agency practitioners in South West, North Western, Anglian and Southern Regions;
- Provide guidance on the development (calibration and validation) of Transfer Function models; and
- Provide recommendations for future research work.

The scope of the work also included consultations with key researchers in the area of Transfer Function modelling, although excluded discussion of specific 'brands' of model from software vendors.

Results of R&D project

The project reviewed the current use of Transfer Function models within the Agency and the latest research developments in this area. The study confirmed that Transfer Function models are able to provide a robust, fast and accurate approach to flood forecasting provided that models are applied within their calibration range and that users have a good understanding of the assumptions and limitations of the approach. Results can also sometimes be extended to higher flows where models incorporate some notion of catchment response (e.g. parallel pathway models, or models using an effective rainfall preprocessor) and/or use real time updating.

The project showed that there are new developments in flood forecasting based on Transfer Function models not yet taken up by the Agency and there is the potential for increased use of such applications. The Technical Report included a section on future development plans and one particular problem

identified throughout was the need for improved software for real time use.

R&D Outputs and their Use

The Technical Report constitutes the main output from the project and covers a range of topics including current knowledge concerning model calibration and validation; modelling assumptions; updating techniques; uncertainty; and sensitivity to different model inputs. Best practice approaches are also reported where these could be identified, together with recommendations for future research and operational improvements in the way that Transfer Function models are used within the Agency. It will be of interest to all involved in operational real time flood forecasting modelling.

To meet the needs of both flood forecasting practitioners and staff involved in the development and improved application of Transfer Function models, the report is separated into two main sections:

- Section A – Operational Issues
- Section B – Technical Issues

Section A is aimed primarily at Agency staff who are involved in (or interested in) applying Transfer Function models, and provides a general overview of the techniques, a description of best practice uses of these models and a brief summary of the main findings from this study. The model application factsheets presented in Appendix B may also be of interest when reading this section.

Section B takes a more in depth look at the technical background to this category of model, and is aimed mainly at Agency staff involved in developing and improving the ‘state of the art’ application of these models within the Agency. The mathematical content, and detail provided, is therefore considerably greater in this section.

Although the project was not required to produce a guideline document for the use of Transfer Function models, the report is sufficiently comprehensive to permit this in due course.

This R&D Technical Summary relates to the R&D Project W5C-013/6 and the following R&D outputs:

- **R&D Technical Report W5C-013/6/TR - *Review of Transfer Function Modelling for Fluvial Flooding Forecasting.*** April 2004

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