



# Visualizing Uncertainty

## Organization and communication of probabilistic flood inundation data

**FRMRC2 has produced:**

- Probabilistic flood inundation data for Carlisle and Mexborough together with tools for visualization.

**Intended readership:**

- Staff involved in flood risk management decision support and planning.

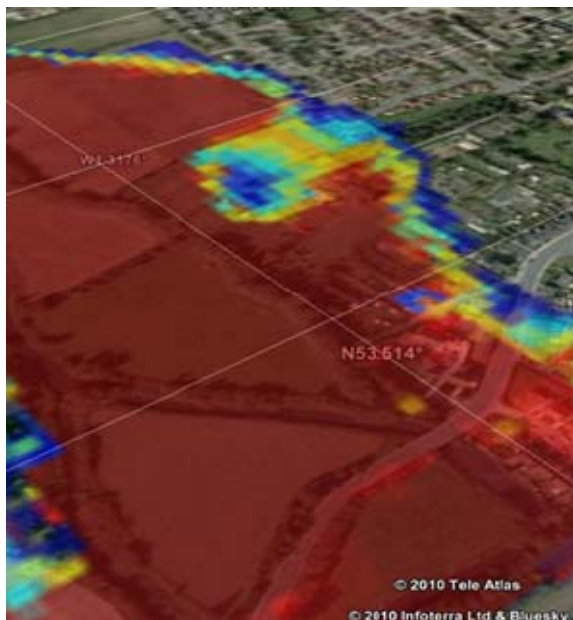
**Where to find more information:**

[www.floodrisk.org.uk](http://www.floodrisk.org.uk)

### Summary

*The commonality between science and art is in trying to see profoundly - to develop strategies of seeing and showing. (Edward Tufte)*

The above quote from Edward Tufte, pioneer of information visualization science, is appropriate here for emphasising the link between *seeing* and *showing* in flood risk management.



In the field of flood inundation mapping the *seeing* step is a realization that forecasts of flood inundation are inherently *uncertain*. Uncertainty enters the forecasting process through:

- shortcomings in hydrology models
- approximations in the hydraulic modelling process
- errors in return period statistics
- the challenge of measuring channel and floodplain geometry

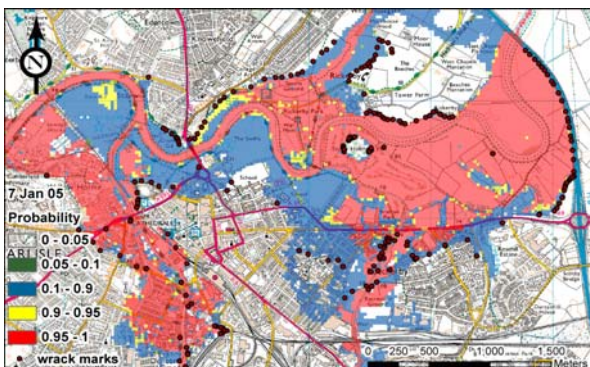
Seeing (and acknowledging) the inherent uncertainty of forecasting has motivated a probabilistic approach to inundation mapping. However, probabilistic methods generate large

quantities of data. It is essential to take this data and translate it by some means to *show* information in a clear and useful way that is sensitive to the requirements of information users. The visualisation requirements raised by the Pitt Review will only enhance the industrial relevance of this work in future.



This research was carried out in two stages:

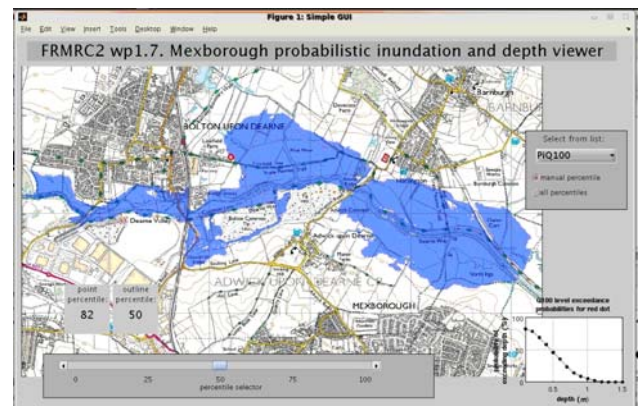
Firstly, a flood inundation modelling exercise was carried out at Carlisle (Eden catchment, Cumbria UK) and Mexborough (River Don, S. Yorkshire UK) using *LISFLOOD-FP* and *TUFLOW* model schemes respectively. The modelling was performed within a Monte Carlo (MC) framework using parallel computing methods. Ensemble members were assessed against observed inundation extents. The posterior parameters/inflow distributions were used to build forecast inundation ensembles at policy-appropriate return periods. The figure below shows example probabilistic model results plus calibration information.



Carlisle model inundation extent and wrack marks, January 2005

Secondly, given the large amounts of data generated for the Carlisle and Mexborough sites a Graphic User Interface (GUI) was programmed using Matlab(tm) to manage and serve the geospatial probabilistic data in an attractive and interactive fashion preserving information content while requiring the shallowest of learning curves on the part of the user.

The figure below shows some of the components of the Mexborough GUI: point and overall inundation probability selection, point probability of depth exceedance and pop-up scenario selectors.



Mexborough interactive flood inundation GUI incorporating uncertainty

### Other sources of information

This research is being applied in the EA's SC080030 work package: Risk-based probabilistic fluvial flood forecasting for integrated catchment models and as part of the FRMRC2's guidelines for best practice in flood risk mapping initiative.

See Journal of Flood Risk Management (online May 2010) doi: 10.1111/j.1753-318X.2010.01063.x

### Research Team

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FRMRC is an interdisciplinary research consortium made up of partners from universities, government bodies and practitioners supported by:

- Engineering and Physical Sciences Research Council
- Department of Environment, Food and Rural Affairs/Environment Agency Joint Research Programme
- United Kingdom Water Industry Research
- Office of Public Works Dublin
- Northern Ireland Rivers Agency

Data were provided by the Environment Agency and the Ordnance Survey.