Rapid Flood Inundation Modelling

FRMRC2 has produced:

- Modified rapid flood inundation model (RFIM)
- Includes a dynamic driving head for flood spreading and a new conceptual model for zonal maximum velocity prediction

Intended readership:

- Operating authority staff with responsibility for flood risk modelling
- Engineering consultants and software developers

Summary

The objectives of developing RFIM:

- Short time to run (typically < 1s)
- The RFIM will be used as an alternative to shallow water equation models (SWEMs), hence an acceptable level of comparability is required between SWEMs and RFIM predictions

Methodology

Rapid flood spreading algorithms use a simplified representation of water movement across the floodplain to provide estimates of flood inundation extent and depth. Although they represent the physics of floodplain inundation with less rigor than shallow water equation algorithms they have the advantage of very fast run times, making them appropriate to situations where multiple model realisations are necessary.

There are two stages to the RFIM calculation:

1. *Pre-calculation* - where the floodplain digital terrain model is divided into large irregularly shaped storage volumes and the linkage between these volumes
2. *Inundation* – where flood water is spread across the floodplain from storage cell to storage cell using continuity and knowledge of capacity and linkage between storage volumes

In RFIMs resistance to flow is represented by the head necessary to cause water to flow from storage volume to storage volume. Additionally, simulations from such models do not provide any information on the temporal development of the flooding.

To validate RFIM predictions we have compared predictions of final inundation extent obtained using the RFIM technique with those obtained using shallow water equation models.

Advances in methodology

These comparisons demonstrate a limitation in the application of the method when applied to similar volume floods with different rates of inflow. To account for this in the RFIM a dynamic head equation has been introduced into the methodology.

Additionally, the EU Floods Directive requires member states to undertake assessments of flood hazard in high risk flood zones. To facilitate this, a zone maximum velocity predictor has been embedded within the RFIM.

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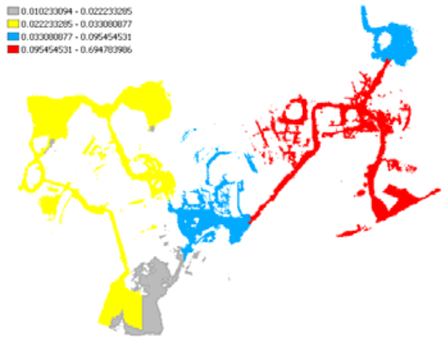
Application to Thamesmead, London.

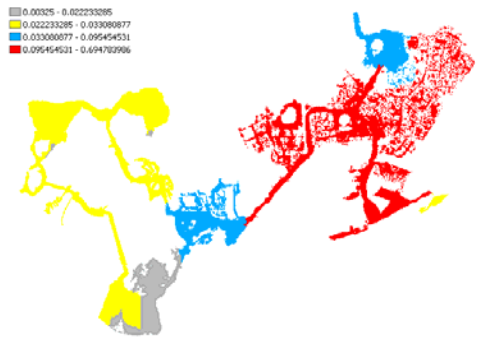
The RFIM was tested on the Thamesmead floodplain on the River Thames in London. Figures 1(a) and 1(b) show the final water depth predictions using TUFLOW model and RFIM. About 74% fit was achieved between RFIM and TUFLOW model and a consistent result of maximum velocity was obtained after calibration (Figures 1(c) and 1(d)). Details of the results and implementations can be found in a conference paper and final report.

1 (a): Final water depth RFIM

1 (b) : Final water depth TUFLOW



1 (c): Zonal maximum velocity RFIM



1 (d): Zonal maximum velocity TUFLOW

References:

- Liu Y, Pender G. (2010) “A new rapid flood inundation model”, the first IAHR European Congress, Edinburgh, UK.
- Liu Y. and Pender G., (2011) “Optimal parameters estimation of a new rapid flood spreading model using multi-objectives”, the 34th IAHR Congress, Brisbane, Australia.

Research Team

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