Modelling and mapping surface water flooding

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Overview

• Context

• Different modelling methods

• Available guidance

• Scope for real-time forecasting and warning

• Conclusions and forward look
Context

• 2007-08
  – Summer 2007 floods and the subsequent Pitt Review
  – Defra Integrated Urban Drainage Pilots

• 2009-11
  – Floods Legislation (FRR 2009 / FWMA 2010)
  – Surface Water Management Plan Guidance
  – ~100 SWMPs progressed, including Drain London
  – Preliminary Flood Risk Assessments
Context

• 2012-13
  – Public demand for information (FoI)
  – Legal requirement to publish SW flood mapping
  – Need for better data to support more robust FRM, spatial and emergency planning decision making by EA and LLFAs
  – Requirement to share data with the insurance industry under new Memorandum of Understanding
Who uses SW flood mapping and how?

- **EA / NRW** – provide advice to Defra, Welsh Government and Lead Local Flood Authorities in strategic overview / oversight role

- **LLFAs** – discharge responsibilities for managing SW flooding under new legislation

- **Water Companies** – understand how assets are affected by (and contribute to) SW flooding

- **Insurance Industry** – analyse exposure and price accordingly

- **General Public** – raise awareness, proactive management, informed decision making
Different modelling methods

1. **Direct rainfall** – rainfall is applied directly to a surface and is routed overland to predict surface water flooding

2. **Drainage systems** – based around models of the underground drainage systems

3. **Fully integrated** – representing both direct rainfall, surface topography and drainage systems in an integrated manner

- Increase in costs and complexity from (1) to (3)
- Choice of approach should be proportional and appropriate to the study objectives and resources
Different scales and types of application

<table>
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<tr>
<th>Broadscale national modelling</th>
<th>Direct rainfall methods</th>
<th>Drainage system methods</th>
<th>Fully integrated methods</th>
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<td>Yes</td>
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<td>Detailed local modelling</td>
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<td>Real-time forecasting &amp; warning</td>
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- Modelling can inform and add value to other modelling
Direct rainfall methods

• Underpin all Environment Agency and JBA surface water flood map products

• Quick to apply over large areas

• Simplified representation of infiltration and urban drainage systems

• Ideally suited for analysing high magnitude, low probability storms where subsurface drainage systems are likely to be overwhelmed

• Less good where mechanisms other than rainfall-runoff contribute significantly to SW flooding
EA’s Updated Flood Map for Surface Water

- 3rd generation mapping that provides maximum flood extent, **depth**, **velocity** and **Defra hazard rating** at **2m resolution** across England and Wales for the **1 in 30**, **1 in 100** and **1 in 1,000 probabilities**

- Confidence scores that reflect the uncertainties in the input data and modelling approach

- Mapping and confidence scores were reviewed by ~95% of LLFAs

- Feedback has been overwhelmingly positive

- **Mapping will be maintained** in a similar way to the fluvial and coastal Flood Zones – i.e. updated in areas where more representative local modelling is available

- Map data is available free to all Risk Management Authorities and the insurance industry
What does the new mapping look like?

uFMfSW 1 in 1,000 Depth
What does the new mapping look like?
What does the new mapping look like?
Drainage system methods

• Based around models of the underground drainage network typically held by Water Companies

• Rainfall inputs are applied to surface sub-catchments (with loss coefficients) and surface runoff is usually routed directly underground

• When local hydraulic capacity is exceeded, pipes surcharge and flooding is generated at the surface

• Care is required – models likely to have been developed for other purposes and may not be appropriate for flood modelling
Fully integrated methods

• Provide the most accurate representation of the dynamic interaction between different components of the surface water / urban drainage system

• Enables testing of full suite of possible FRM measures – source control, drainage capacity and exceedance flow routing

• Demanding in cost and time to develop and run application must be highly selective
Examples

Multiple runoff surfaces can be used to model drainage from roofs, gardens, roads and open spaces.
Variable mesh can be used to add detail to the model and allow potential flow paths between buildings and along roads to be modelled.

Mesh zone, shown in purple, can be used to ensure that curbs are modelled.
Flow forced between buildings with some infiltration into the buildings which can be included as porous polygons to represent flow through air bricks, doors etc.

Flow channelled within the road by lowering the levels of the road.
Key issues

• Rainfall inputs

• Topography

• Representation of urban environment – e.g. buildings, roads/kerbs, pipe networks and road gullies

• Representation (or not) of key flood mechanisms – runoff generation, drainage processes, interaction with other sources of flooding

• Model proving and validation – how do we know if the model is fit for purpose?
Available guidance


AR&R – Project 15: Two Dimensional Modelling in Urban and Rural Floodplains (2013)
Scope for real-time forecasting and warning

- Currently limited warning of surface water flooding beyond Met Office Extreme Rainfall Alerts

- National scale
  - Natural Hazards Partnership (NHP) is a partnership of public sector organisations working towards improving the way natural hazards are assessed and forecast for the benefit of UK plc
  - One workstream is focussed on improving capabilities for forecasting SW flooding and its impacts through updates to the national Grid-to-Grid FF model
  - Main customer at this stage is the Flood Forecasting Centre to aid their national picture of flood risk and inform the Flood Guidance Statements.
  - May be opportunities longer term to explore using some of the capabilities more widely
Scope for real-time forecasting and warning

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- National scale

- Local scale
  - Detailed local models can be run using real-time weather data and telemetry feeds (e.g. within IWLive)
  - Can be used to manage day-to-day operations as well as respond to flood incidents
Conclusions and forward look

• Significantly increased public and professional awareness of surface water flooding since 2007

• Techniques for modelling and mapping surface water flooding have developed very rapidly (and will continue to do so)

• Demand for high quality information across many different sectors (but not necessarily the same data)

• Need to improve national and local capabilities for forecasting surface water flooding and its impacts is recognised and work is ongoing
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