A tool for the assessment and visualisation of flood vulnerability and risk

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FRMRC flood risk management research consortium
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Flooding in context

- *Mapping* is a cornerstone to FRM – (i.e. EU Floods Directive 2007)
- UK's Flood and Water Management Act 2010, assigns new responsibilities onto lead local authorities i.e. onto a broader base of practitioners with less formal training in flood risk science

Challenges:

i) Translate complexity of flood science into useful and useable tools for practitioners
ii) Encourage practitioners to engage and take ownership of new responsibilities in FRM
iii) Facilitate knowledge-exchange between science-practitioners

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Flood incident management in the UK

- A framework of *Integrated Emergency Management* (IEM) – 'joined-up' working.
- UK Civil Contingencies Act (2004): **Category One Responders** are core to emergency response – includes local authorities, 'blue light' services, Environment Agency and health authorities

Identifying vulnerability

- Location of key facilities (schools, hospitals, elderly care homes)
- Vulnerable people identified through Local Authorities (e.g. Adult and Social Care) and other databases with NHS and Utility companies

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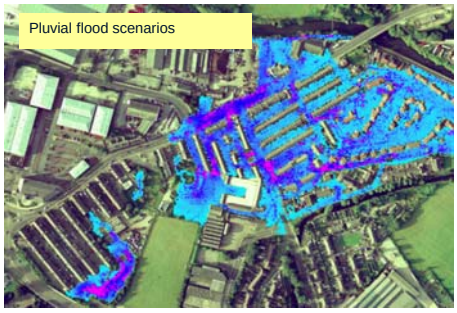
Designing the tool

Objective

Develop a GIS-based **flood risk mapping tool** + Couple with vulnerability metrics with local-scale inundation models

Tailor to emergency response professionals

Part of a UK-wide research effort: The Flood Risk Management Research Consortium (FRMRC)



Urban flood modelling developed with Phase 1 of FRMRC for **Cowes, Isle of Wight in Hampshire** and **Keighley, nr Bradford in West Yorkshire**

*** These were used as case studies for this research**

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Methods

Methods

Semi-structured interviews and questionnaires

To gauge perceptions on vulnerability (indicators and scale of assessment) and design suggestions for the tool

Tool Construction

Building on stakeholder feedback ("wish list")

Exploring ways to engage end-user; i) Interactivity and ii) incorporating user subjectivity

Tool Demonstration

Semi-structured interviews and questionnaires with sample of professionals originally interviews

Asked to rate certain features of the tool and propose ideas for future tools. Particular attention to user's views regarding vulnerability assessment.

Preliminary Feedback

- For purposes of *response*, vulnerability is defined as *... those that are less able to help themselves in the circumstances of an emergency*
- Key indicators are the elderly, long-term illness and disability
- Risk = *f* (Hazard (h), vulnerability (v))
- h and v are *not equal* in this relationship: their importance varies between responders and between phases of a flood event (preparation, response and recovery)

Tailoring the tool

End-user "Wish List"

1. Simple and user-friendly (K.I.S.S)

2. View a series of potential flood scenarios, showing extent and hazard posed.

3. Animation of flood hazard. Option to produce static maps

4. Option to view key indicators for vulnerability (with rationale), to understand the make-up of a vulnerability index

5. Option to shift between spatial scales

Constructing the tool

- Vulnerability cannot be mapped at the household scale (Data Protection Act, 1998)
- Therefore, focus on community vulnerability mapping – using existing census data: *Is there a value for integrating these form of vulnerability assessment within FIM?*
- User can add/remove layers and perform calculations on layers to produce hazard, vulnerability and risk profiles
- Promotes active end-user engagement in risk assessment and mapping and a means for integrating professional stakeholders (end-users) informed subjectivities from the day-job

* Personal geodatabase in ArcCatalogue * Written in Visual Basic for ESRI applications * Launched in ArcMap

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Constructing the tool

The Hazard Face

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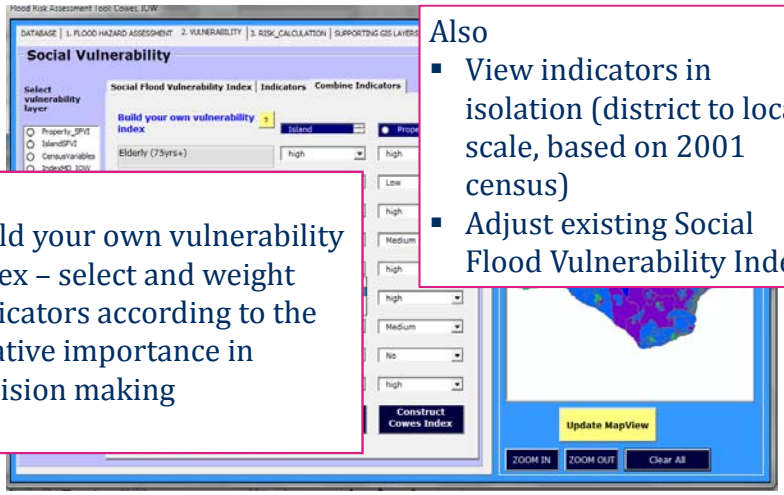
Constructing the tool

The Vulnerability Face



Also
- View indicators in isolation (district to local scale, based on 2001 census)
- Adjust existing Social Flood Vulnerability Index

Build your own vulnerability index – select and weight indicators according to the relative importance in decision making

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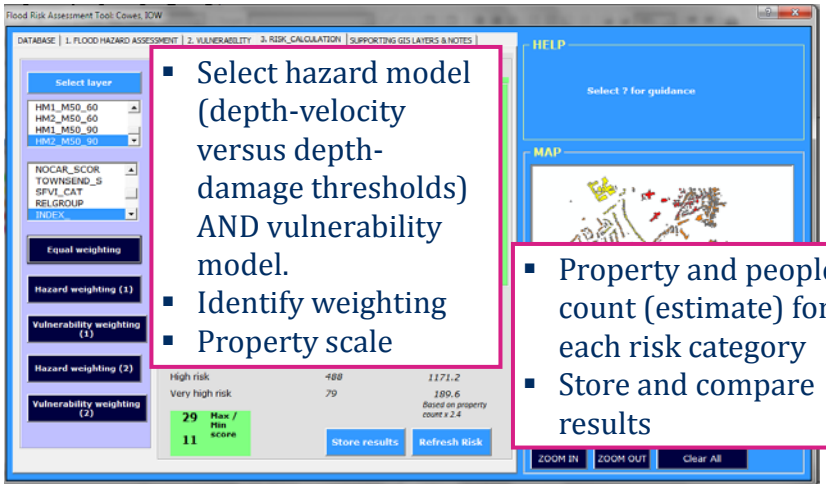
Constructing the tool

The Risk Face



- Select hazard model (depth-velocity versus depth-damage thresholds) AND vulnerability model.
- Identify weighting
- Property scale

- Property and people count (estimate) for each risk category
- Store and compare results

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Observations

- Animation: A successful tool for communicating where and when. Supporting exercising, planning and response.
  However: Gives an impression of certainty - Future challenges for visualising and integrating uncertainty in flood risk science
- Users valued options to isolate vulnerability indicators and adjust spatial scales to map relative vulnerability. Option to construct an index (influence weighting) was considered useful by most.
- Combining hazard and vulnerability created some confusion amongst users, although some could see the potential scope for weighting hazard/vulnerability details in risk estimation

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Observations

- Desire for simplicity: K.I.S.S. - *Simplistic-user-friendly* versus *simplistic-information* tools?
- A 'one stop' tool would be inappropriate – it's better to have a single, clear purpose.
- Suggestions for further tailoring:
  i) Distinguish between phases in emergency management (planning, response and recovery)
  ii) Distinguish strategic and tactical/operational decision making

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Challenges for assessing vulnerability

- Severely limited role in emergency response – issues with accuracy (decadal nature of census, area-wide rather than exact household)
- Mismatch between hazard and vulnerability assessments: Dynamic Vs static snapshot of vulnerability - therefore the two cannot be simple 'bolted' together to infer risk at the local scale
- 'Vulnerability products' are problematic
  - ➢ Not clear how they are constructed (indicators, weighting)
  - ➢ Creates a 'blind' user
  - ➢ The appropriateness of indicators will vary depending on context (application and decision maker)

Taking vulnerability assessment forward

- Census-derived data is valuable for *community* vulnerability assessments (ca. 200 households) to inform the following ...

Potential applications:

- Prioritisation tool for *broad scale* events
- Planning – indication of scale and nature of response required
- Targeting and tailoring mitigation strategies
- Exercising and training emergency professionals

- User-defined vulnerability assessments (indicators, weighting) required to...

- ➢ Engage professionals with vulnerability
- ➢ Introduce flexibility to adjust vulnerability assessments to different professional needs and applications {*interactive*}
- ➢ Integrate professional knowledge

References

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