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Developing Guidelines for Managing Uncertainty in Flood Risk

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National Significance and Impact of CCN

Summer 2007 floods economic cost £3.2 billion with 200,000 insurance claims *(Environment Agency 2010)*

The Pitt Review
- a need for improved local flood risk management
- need to take account of uncertainties

Increasing probability of flooding and droughts in the future - a need for better decision-making capacity and ensuring planning incorporates adaptation
and resilience

Flooding at Newby Bridge, Windermere November 2009

Guidance needed to define best practice across all stakeholder groups

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Science into Practice…

Pitt Review following 2007 floods – 94 recommendations including taking more account of uncertainties in the flood risk management process

- Suddenly a host of new EA projects on ensemble forecasting, probabilistic flood forecasting, probabilistic flood risk mapping, probabilistic incident management (and possibly more to come)
- But……not all uncertainties are statistical – importance of epistemic uncertainties
- So what are appropriate assumptions and what do results mean to users – what should "Good Practice" mean in informing decisions?
- Need for a *translatory discourse* between scientist and practitioners about nature and meaning of uncertainties (Faulkner et al., *Ambio*, 2007)

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Aims of CCN

"…..to enable the exchange of knowledge between the NERC research base and science user community to understand and manage uncertainty and risk related to water scarcity, flood risk and diffuse pollution management"

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Evolving the Guidelines

Science/Practitioner Translationary Discourse

- Defining and framing the type of application
- Communication of sources of uncertainty considered
- Communication of assumptions used in assessing sources of uncertainty
- Communication of how uncertainties combined
- Communication of meaning of probabilistic or possibilistic information

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Risk Mapping: Defining and framing the type of application

- Planning decisions
- Emergency planning
- Flood damage assessments and defence design
- Insurance
- Generating householder resilience
- ……

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Evolving the Guidelines

Guidelines as a set of decisions

- Assumptions to be agreed between analyst and stakeholder(s).....provides framework for discussing and handling epistemic uncertainties
- Explicit agreement and record means that later evaluation and review can be carried out
- Default options, or decision tree of potential options

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Evolving the Guidelines

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See CCN/FRMRC Draft Guidelines for Probabilistic Flood Risk Mapping document

Comments requested by end of July

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Flood Risk Mapping: Sources of Uncertainty (1)

1. Uncertainty in Design Flood Magnitude

D1.1 Are gauge data available?

D1.2 If yes: what is an appropriate frequency distribution to fit (Default: use of WinFAP to fit GL or GP distributions)?

D1.3 If no: what method of extrapolating to ungauged site to be used?

D1.4 Do multiple inputs to flood risk site need to be considered?

D1.5 If yes: generate correlated samples for design event AEP (using methods of Keef et al., 2009)

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Flood Risk Mapping: Sources of Uncertainty (2)

2. Uncertainty in Conveyance Estimates

D2.1 Are observations available to allow the calibration of channel and/or flood plain roughness values (if yes: go to section 7)?

D 2.2. If not: decide on a range of roughness values for channel and flood plain units (if possible obtain a credible range from the CES).

D2.2 Decide on a (probabilistic) interpretation of the estimated range.

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Flood Risk Mapping: Sources of Uncertainty (3)

3. ***Uncertainty in rating curve extrapolation***
4. ***Uncertainty in flood plain topography***
5. ***Uncertainty in model structure***
6. ***Uncertainty in flood plain infrastructure***
7. ***Uncertainty in observations used in model conditioning***

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Flood Risk Mapping: Sources of Uncertainty (4)

8. Uncertainty in assessing effects of future catchment change

9. Uncertainty in assessing effects of future climate change

10. Uncertainty in fragility of defences

11. Uncertainty in consequences/vulnerability

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Flood Risk Mapping: Sources of Uncertainty (5)

12. Assessing interaction between sources of uncertainty.

13. Defining an uncertainty propagation process

14. Defining an model calibration/conditioning processing

15. Defining a presentation method

16. Managing and reducing uncertainty

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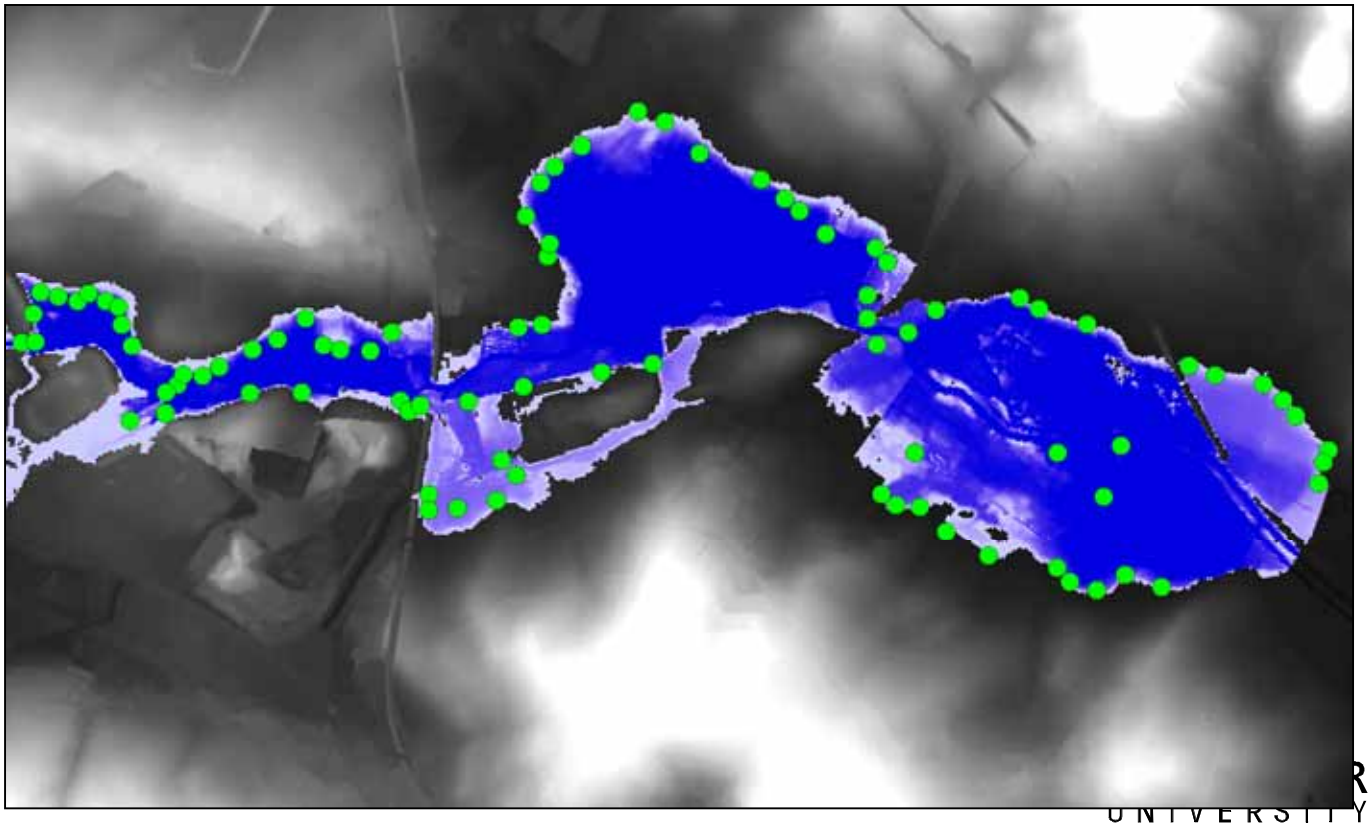
Case Study

Mapped maximum inundation and model predicted flow depths for Summer 2007 floods at Mexborough, Yorkshire



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Google maps Flood Risk API

Applications Places System Fri 7 May, 9:59 AM dleedal

http://www.lancs.ac.uk/postgrad/leedald/Mexborough/overlaySlider2.html

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Probability selector: 50

choose an inundation probability using the slider

choose a definition: return period

Probabilty of bigger flood: 50% show all

Definition:

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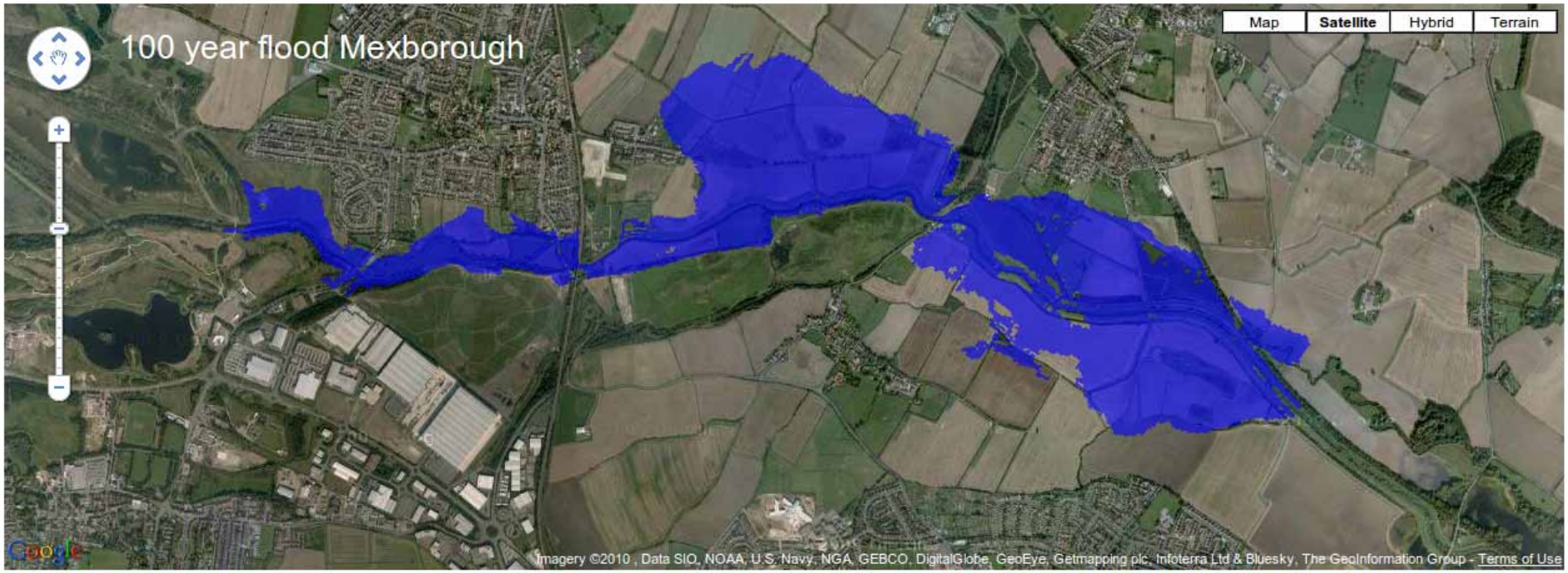
Probability selector: 100

Probabilty of bigger flood: 95% show all

95% chance that the 100 year flood will be larger than the extent shown. Therefore it would be very lucky but still possible for the 100 year flood to be as small as this

choose a definition: return period



Definition:

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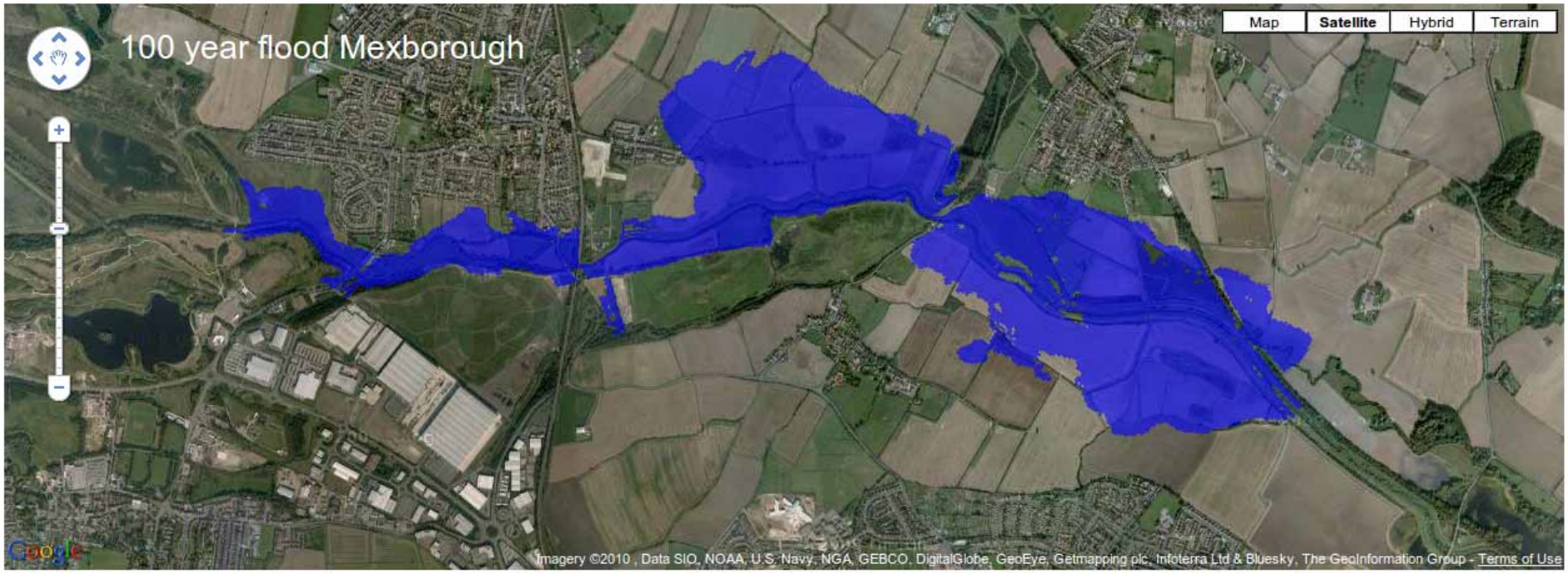
Probability selector: 90

Probabilty of bigger flood: 90% show all

90% chance that the 100 year flood will be larger than the extent shown. Therefore it would be very lucky but still possible for the 100 year flood to be as small as this

choose a definition: probability of exceedance



Definition:

This webpage shows that flood extent forecasting can never be exact. This is because flood forecasting is based on computer estimates of what might happen during a real flood. One way to communicate the range of possibilities for what might happen is to specify the chance that a flood will be bigger than the one shown on the map. For example a probability of exceedance of 20% means that the computer simulation estimates that the 100 year

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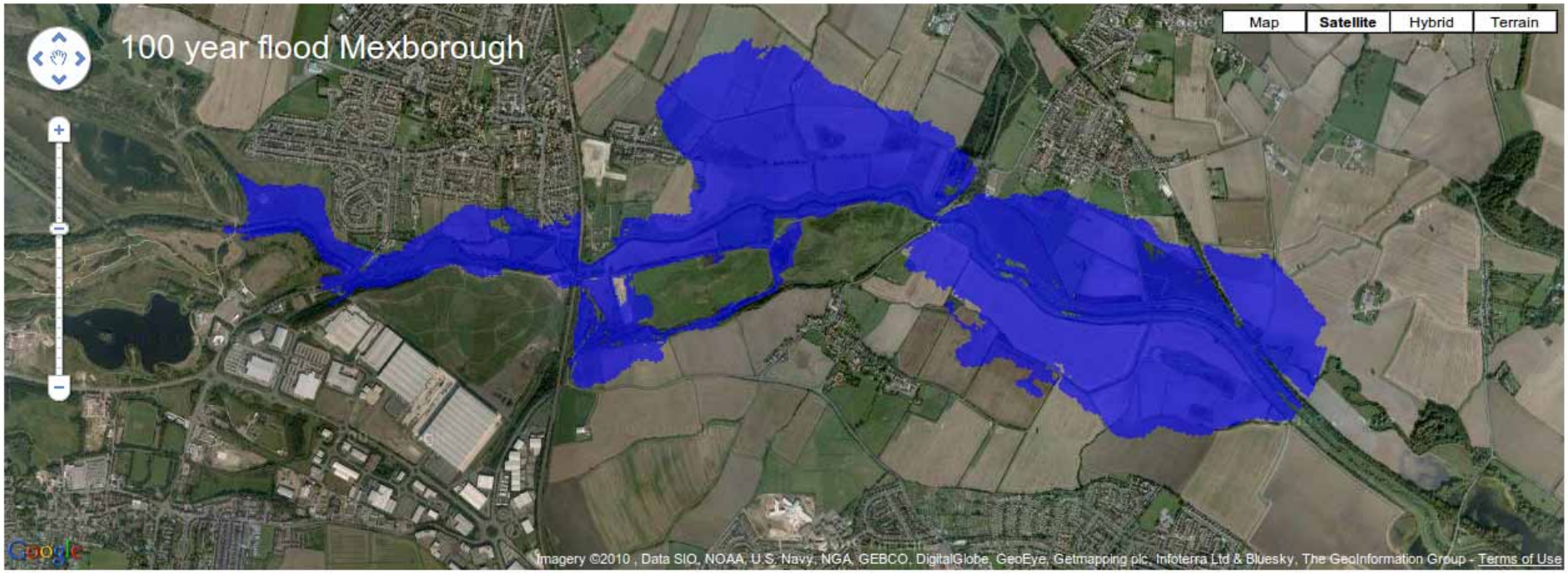
Probability selector: 50

Probabilty of bigger flood: 50% show all

50% chance that the 100 year flood will be larger than the extent shown. Therefore there is an even chance for the 100 year flood to be smaller or larger than this size

choose a definition: return period



Definition:

The return period is the average amount of time in years that you would expect a flood of a particular size to occur once. For example a flood with a return period of 100 years would be expected to occur 10 times in a century. It is very important to realise that this does not mean that if a flood with a return period has just happened that there will definitely not be another one for 100 years. Also the accuracy with which the return period can

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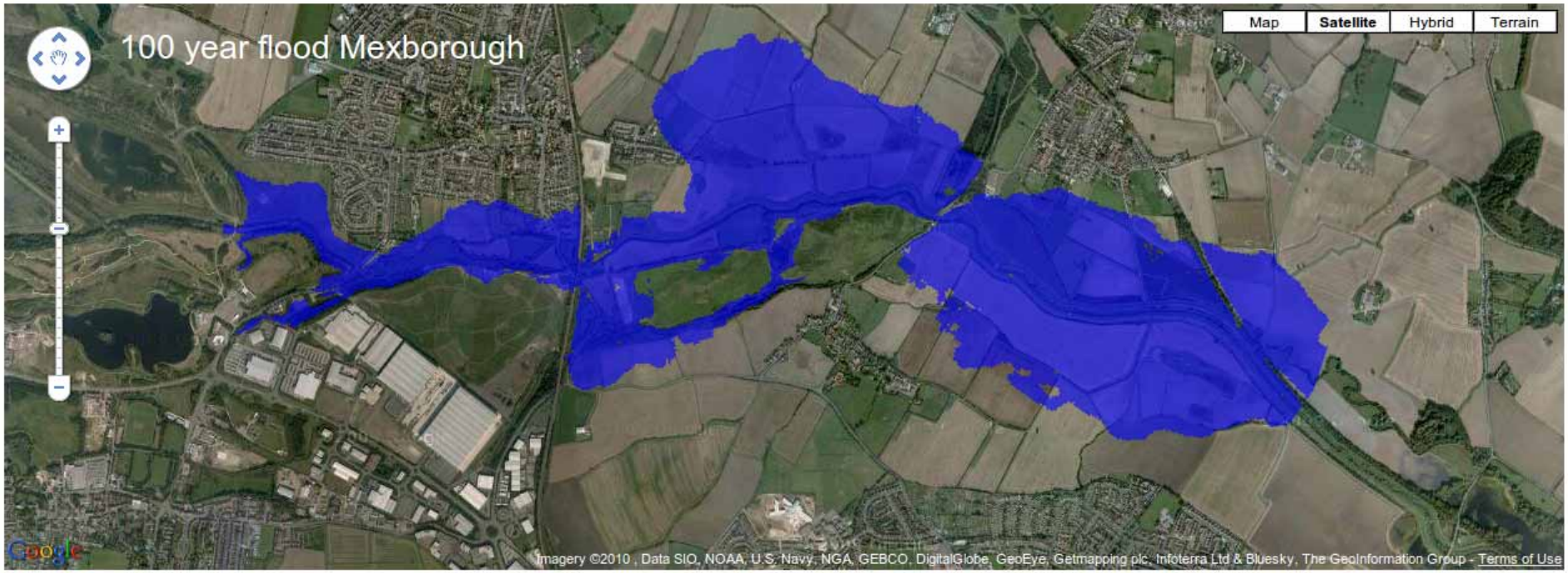
Probability selector: 10

Probabilty of bigger flood: 10% show all

10% chance that the 100 year flood will be larger than the extent shown. Therefore it would be very unlucky but still possible for the 100 year flood to be as large as this

choose a definition: percentile



Definition:

Probabilities can be expressed as percentage values. Here an expression such as "80% chance that the 100 year flood will be larger than that shown..." means the study that estimated the size of the 100 year flood found that 80% (or 8 out of 10) of the acceptable computer simulation results showed a flood larger than the flood shown on the map.

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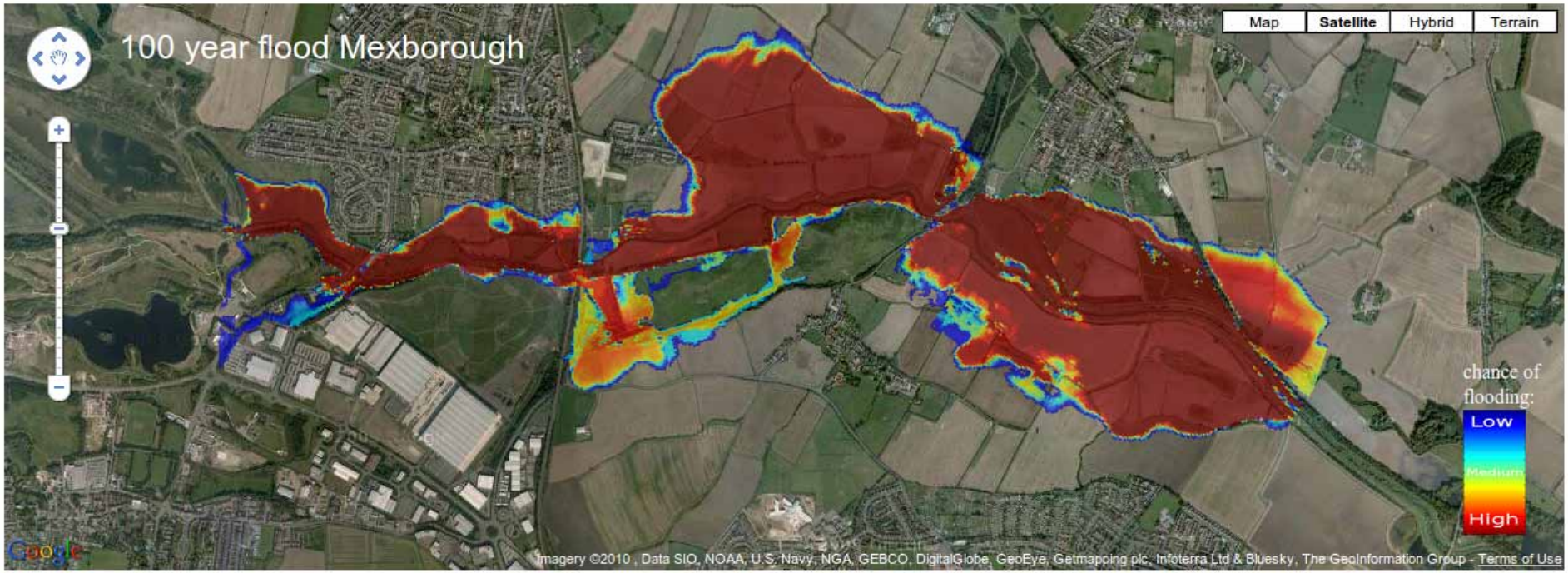
Probability selector: 0

Probabilty of bigger flood: all

show single

This figure shows a colour code of all the inundation possibilities defined by the study with the red colours showing the flood extent that is most likely to be exceeded and the blue colours

choose a definition: percentile



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Probability selector: 100

Probabilty of bigger flood: 95%

show all

95% chance that the 100 year flood will be larger than the extent shown. Therefore it would be very lucky but still possible for the 100 year flood to be as small as this

choose a definition: percentile

Definition:

Probabilities can be expressed as percentage values. Here an expression such as "80% chance that the 100 year flood will be larger than that shown..." means the study that estimated the size of the 100 year flood found that 80% (or 8 out of 10) of the acceptable computer simulation results showed a flood larger than the flood shown on the map.

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Probability selector: 0

Probabilty of bigger flood: 5% show all

5% chance that the 100 year flood will be larger than the extent shown. Therefore it would be very unlucky but still possible for the 100 year flood to be as large as this

choose a definition: percentile

Definition:

Probabilities can be expressed as percentage values. Here an expression such as "80% chance that the 100 year flood will be larger than that shown..." means the study that estimated the size of the 100 year flood found that 80% (or 8 out of 10) of the acceptable computer simulation results showed a flood larger than the flood shown on the map.

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Summary……

- Uncertainty estimation as a means of maintaining integrity (and avoiding being wrong)
- But needs a translationary discourse between science and stakeholders
- One framework for doing so is to evolve Guidelines for Good Practice within which assumptions and means of communication/visualisation must be agreed (and recorded for later evaluation)
- Guidelines as a decision framework (with default options)

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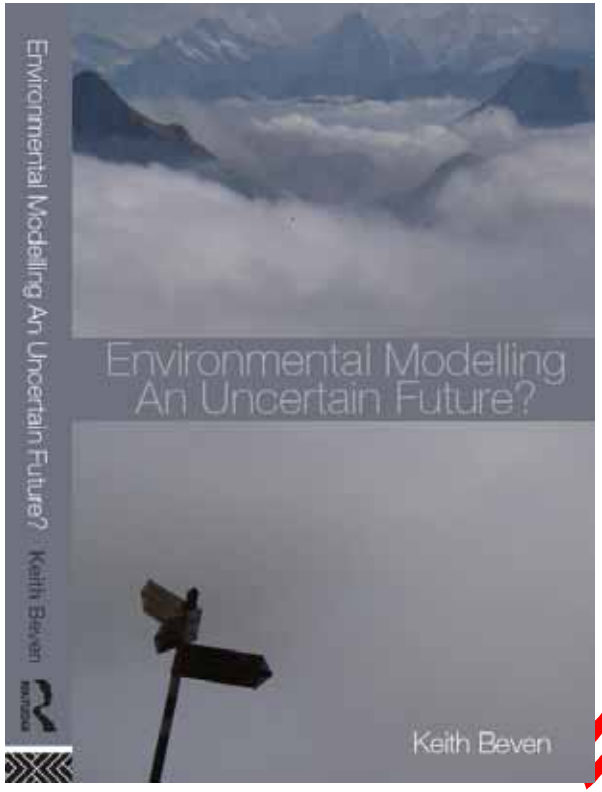
Finally.....

- Draft guideline document for flood risk mapping just released for consultation (copy provided on meeting USB)
- Intended initially to be a dynamic (wiki-type) document in which decisions, defaults and case studies evolve over time.
- More on uncertainty estimation methods at www.uncertain-future.org.uk



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