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Guidelines for Good Practice in Flood Risk Mapping: The Catchment Change Network

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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 Environment Agency projects on ensemble forecasting, probabilistic flood forecasting, probabilistic flood risk mapping, probabilistic incident management (and possibly more to come)

Science into Practice…

- But…… 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)

Good Practice…and Climate Change

- Good practice implies using model predictors that a fit for purpose – **best available** model does not always imply **fit for purpose**
- **Fit for purpose** – are your climate/hydrologic/hydraulic/ecological models within **limits of acceptability** in simulating current conditions
- Testing for change is testing a hypothesis – you would not normally do so without reference to the relevant uncertainties
- Probabilities for ensemble RCM predictions are **incomplete** in representing odds of how future climate might be

Science into Practice…

from NERC: Policy into Practice

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The Catchment Change Network

NERC KT project "…..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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Structure of CCN

Three focus areas

Change and Flood Risk Management
Change and Water Scarcity
Change and Diffuse Pollution

Mechanisms

Expert facilitator
www.catchmentchange.net (with blogs)
Workshops / Training / Annual Conference

Evolving Guidelines for Good Practice as a way of operationalising uncertainty in the science

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The Catchment Change Network

Raises many questions…

- What are the critical sources of uncertainty that can be quantified (and those that cannot)?
- When are predictions informative and when not (but uncertain flood risk map should be more meaningful than a risk map without uncertainty)?
- What methods should be used in estimating uncertainty (especially when some past observations are available to constrain future uncertainty)
- How to agree (and communicate) assumptions with stakeholders?

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)……though many would prefer a "recipe"
- → Explicit agreement and record means that later review can be carried out
- → Default options, or decision tree of potential options

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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.

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*

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*

Flood Risk Mapping: Sources of Uncertainty (7)

12. *Assessing interaction between sources of uncertainty.*

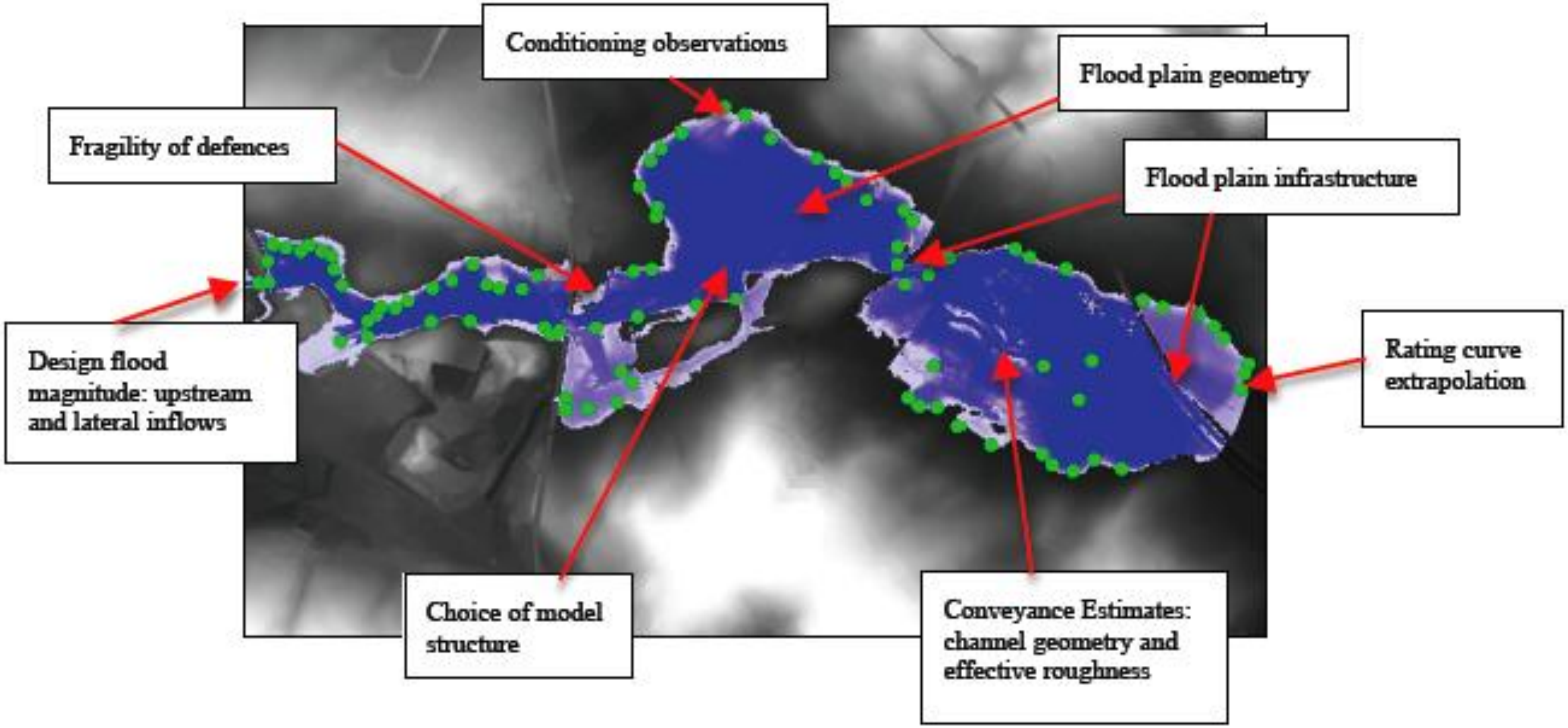
13. *Defining an uncertainty propagation process*

14. *Defining an model calibration/conditioning processing*

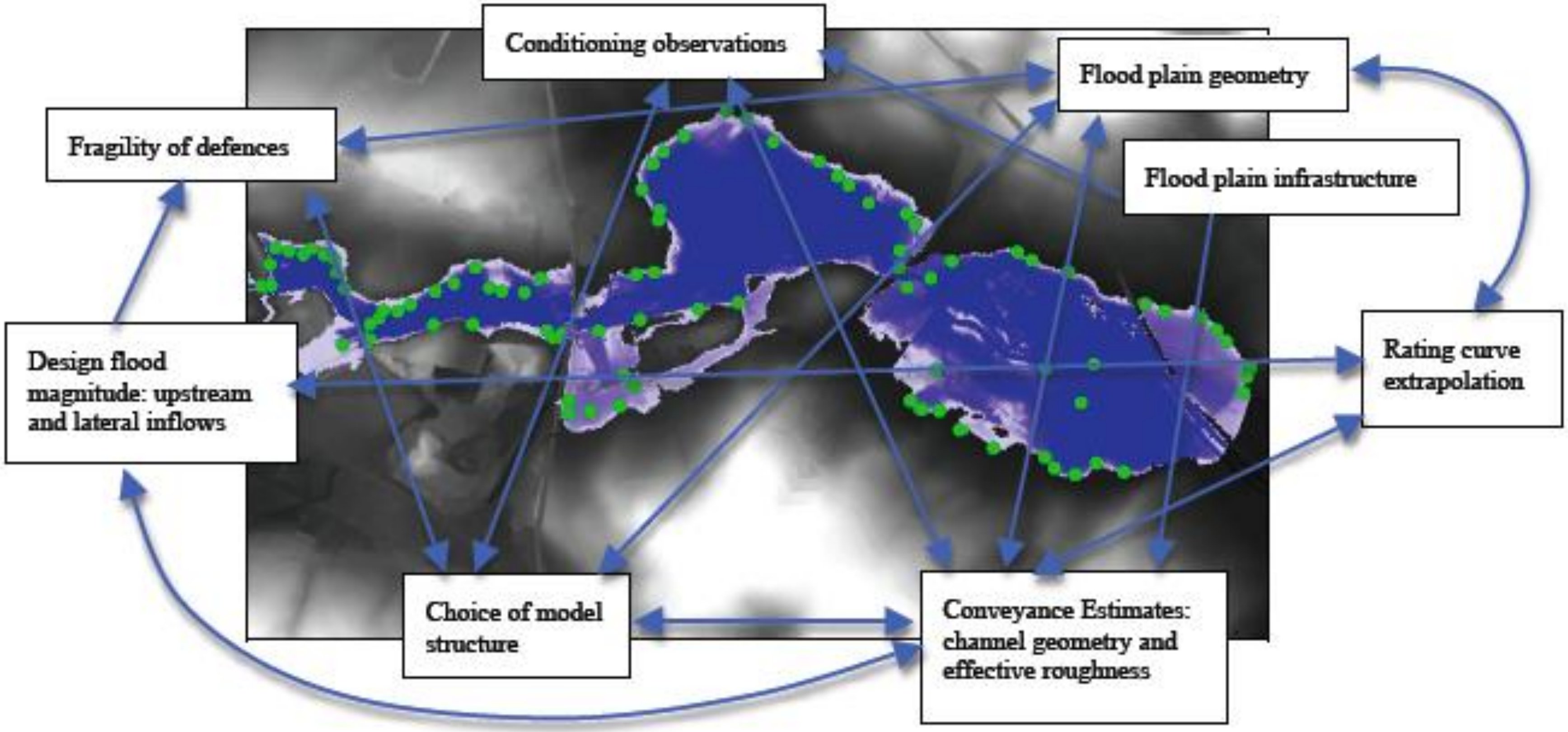
15. *Defining a presentation method*

16. *Managing and reducing uncertainty*

Sources of Uncertainty in Flood Risk Mapping



Interactions between Sources of Uncertainty

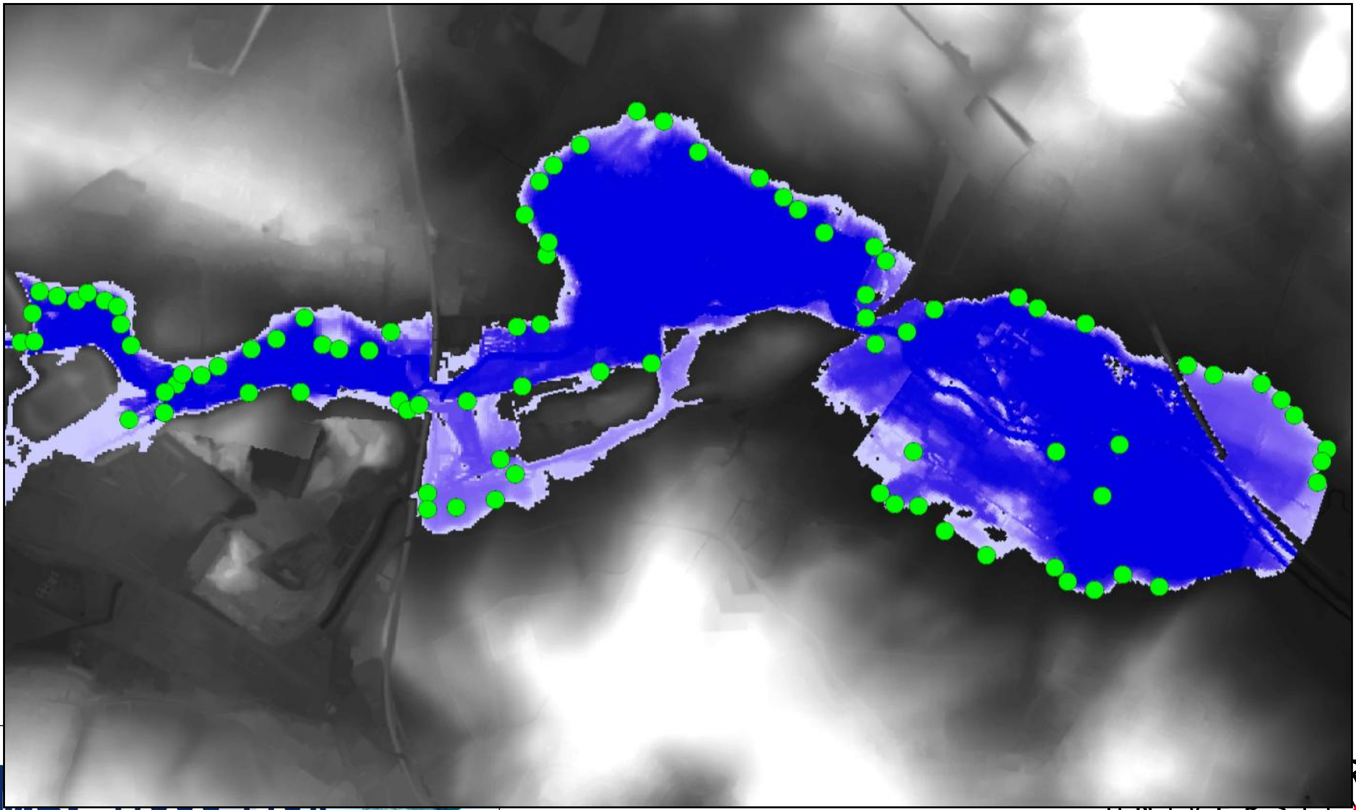


Uncertainty estimation using GLUE

1. Run Monte Carlo simulations varying upstream discharge estimate and roughness coefficients
2. Evaluate each model run in predicting maximum inundation for 2007 event to determine behavioural simulations and weights
3. Apply behavioural models to predict AEP 0.01 event
4. Map CDF for inundation depths

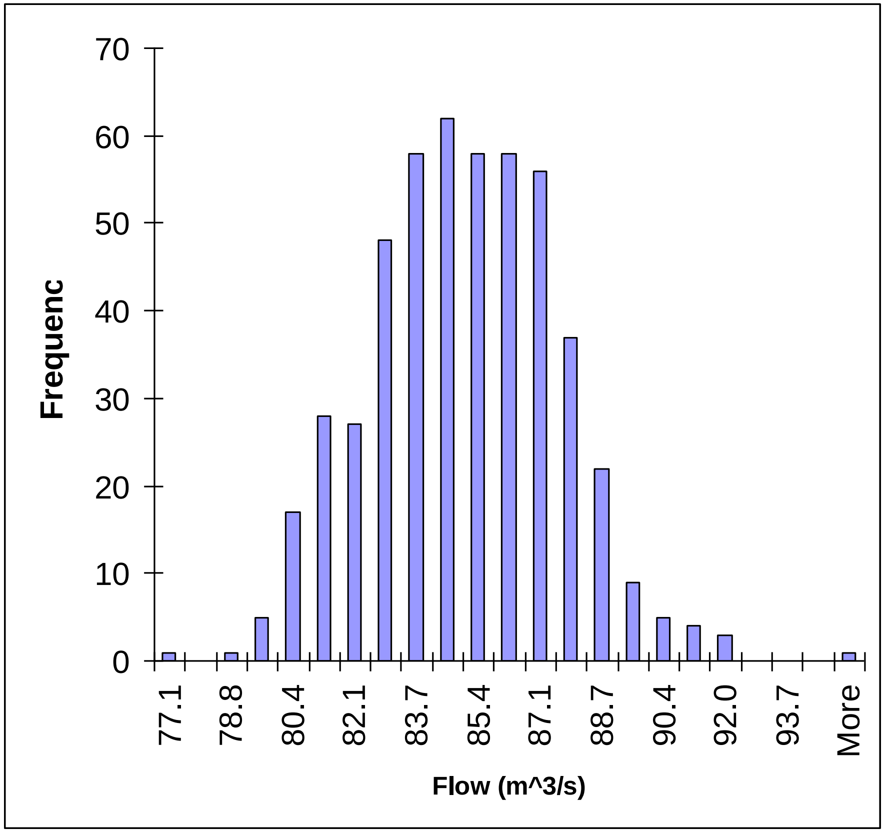
Mexborough: Summer 2007

Mapped maximum inundation and model predicted flow depths for Summer 2007 floods at Mexborough, Yorkshire using 2D JFLOW model



Mexborough Risk Mapping: Defining Input Uncertainties

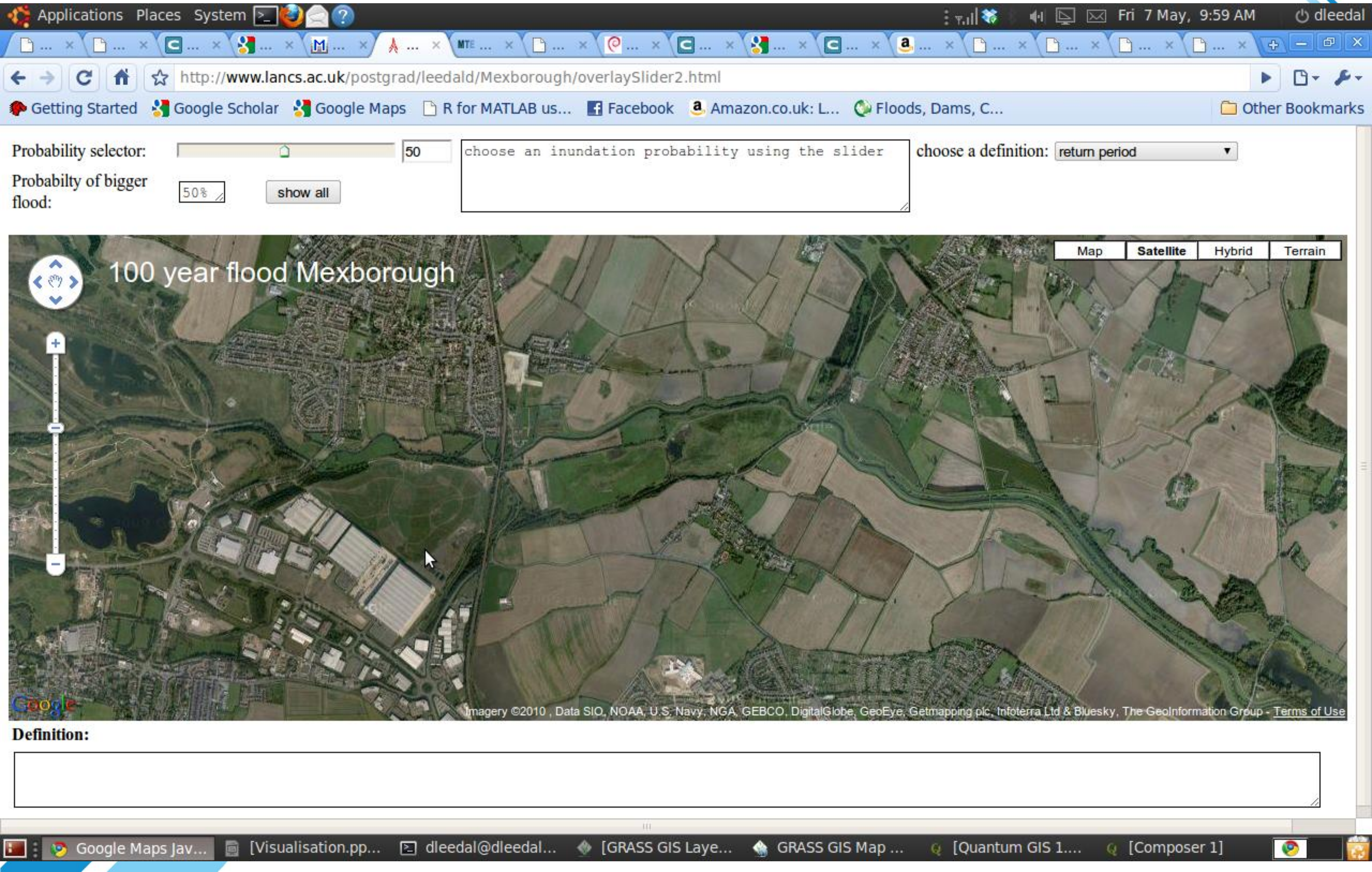
WinFAP estimate of 0.01 AEP (T100) flood peak at Adwick



Mean: 86.6 (m^3s^{-1})

Var: 6.25 (m^3s^{-1})

Google maps API



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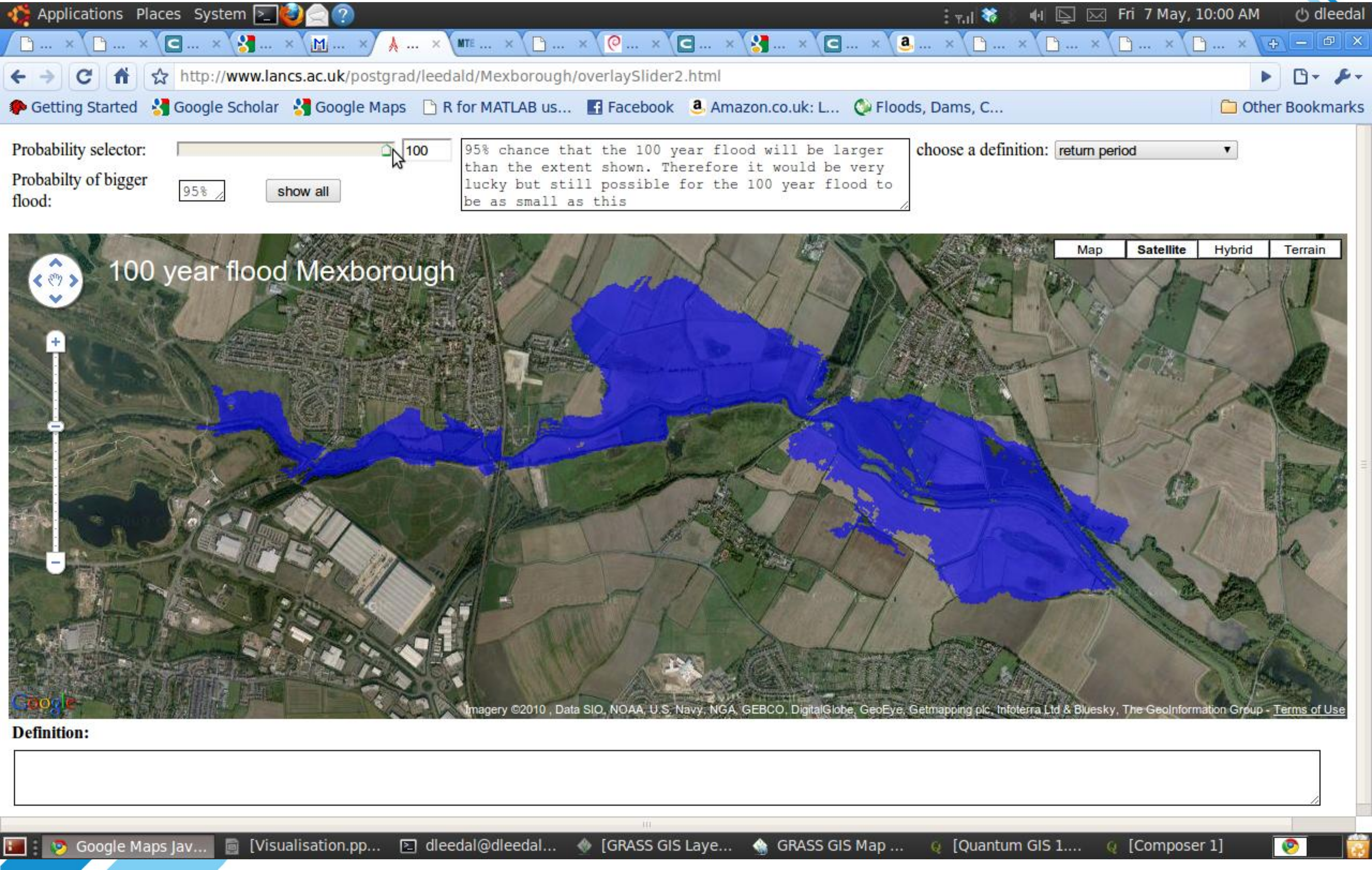
Google maps API



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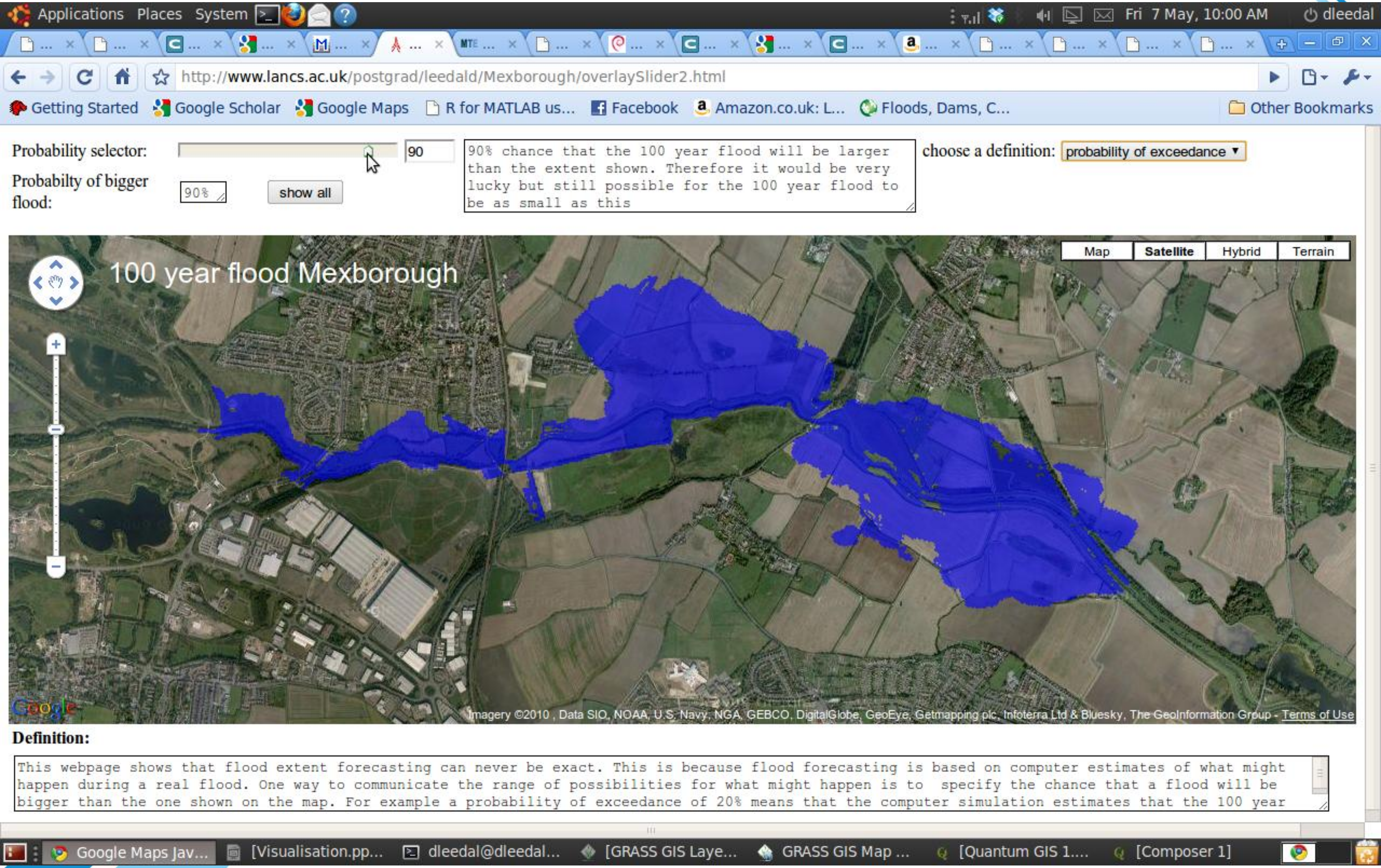

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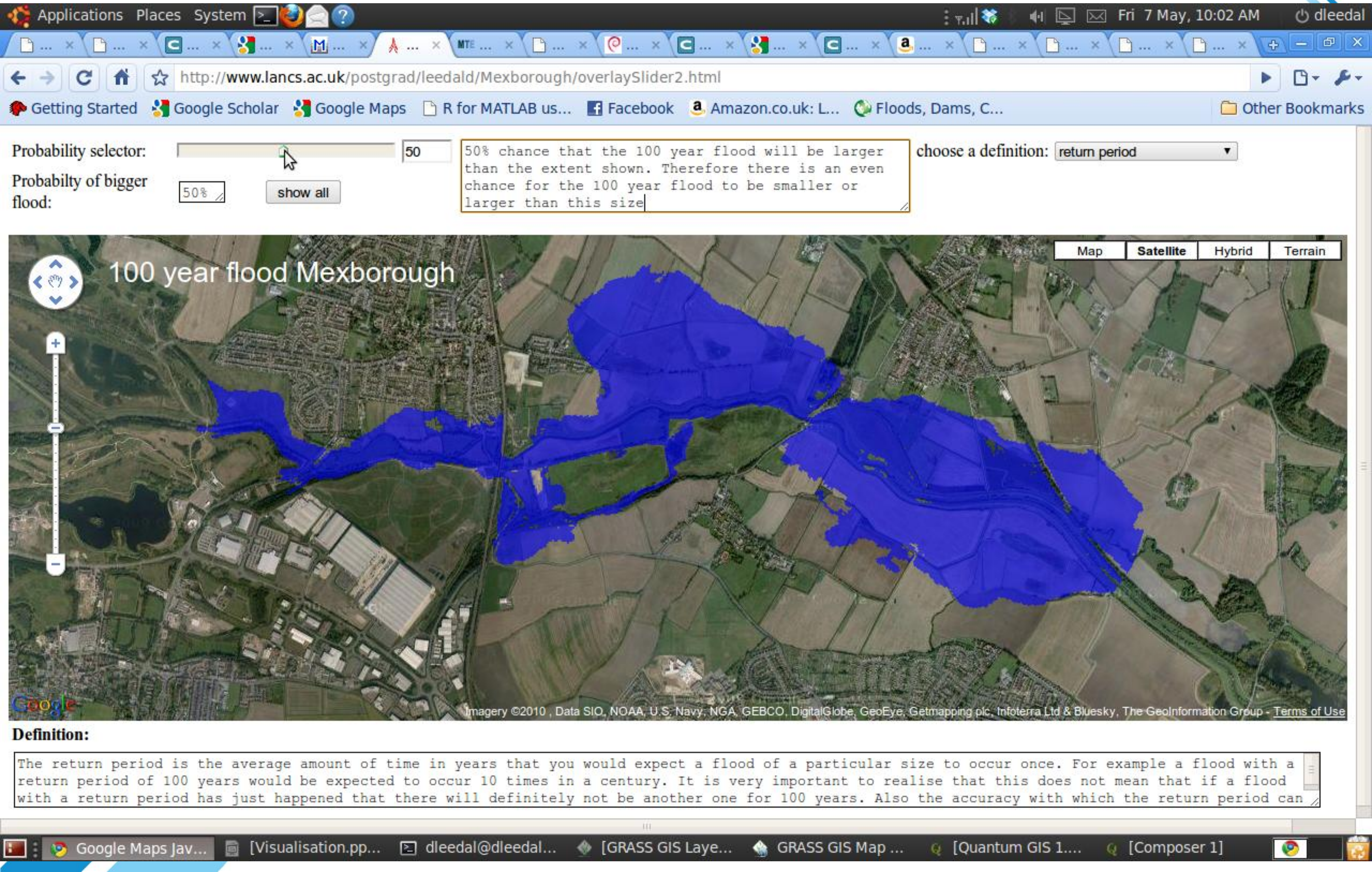

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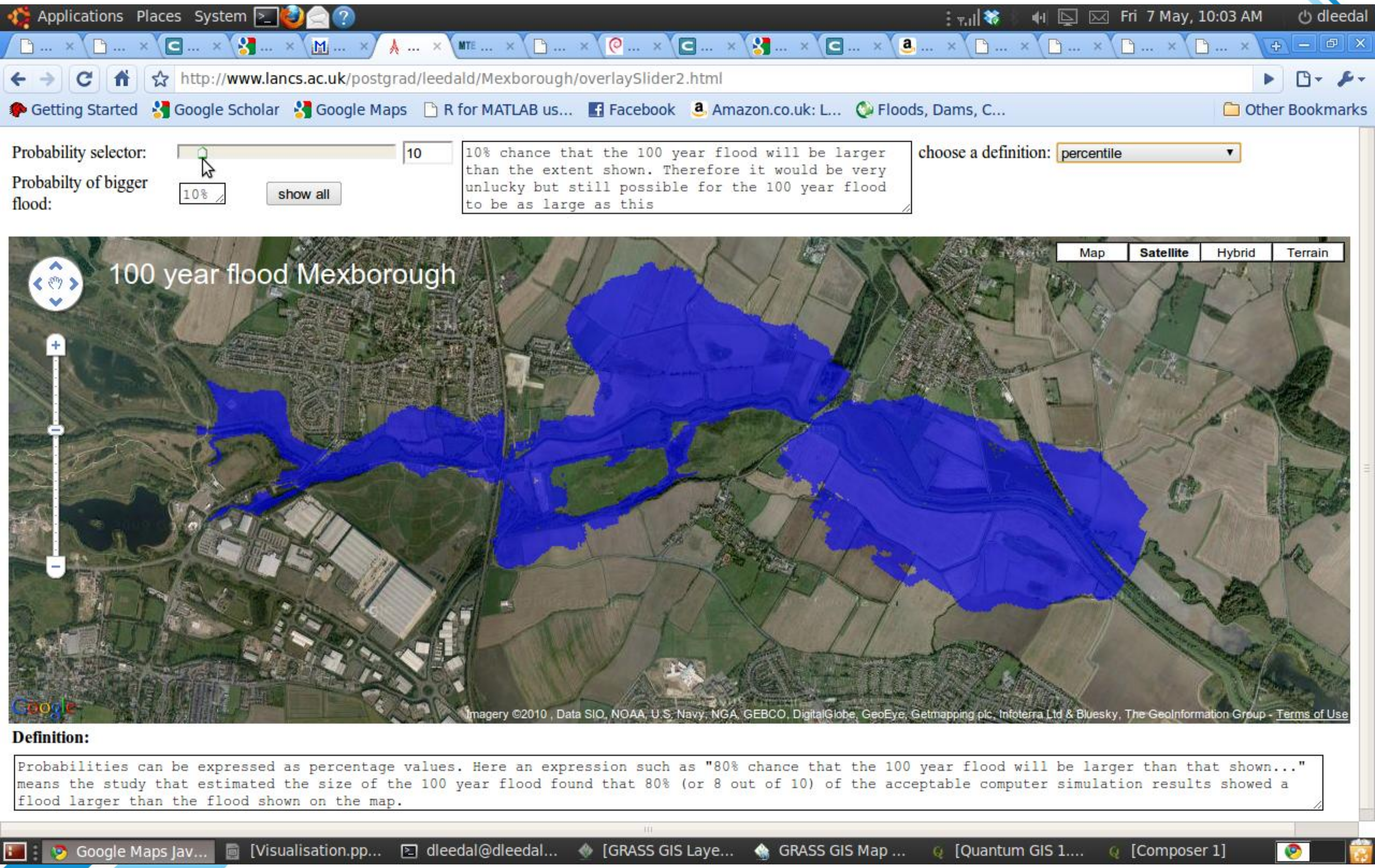

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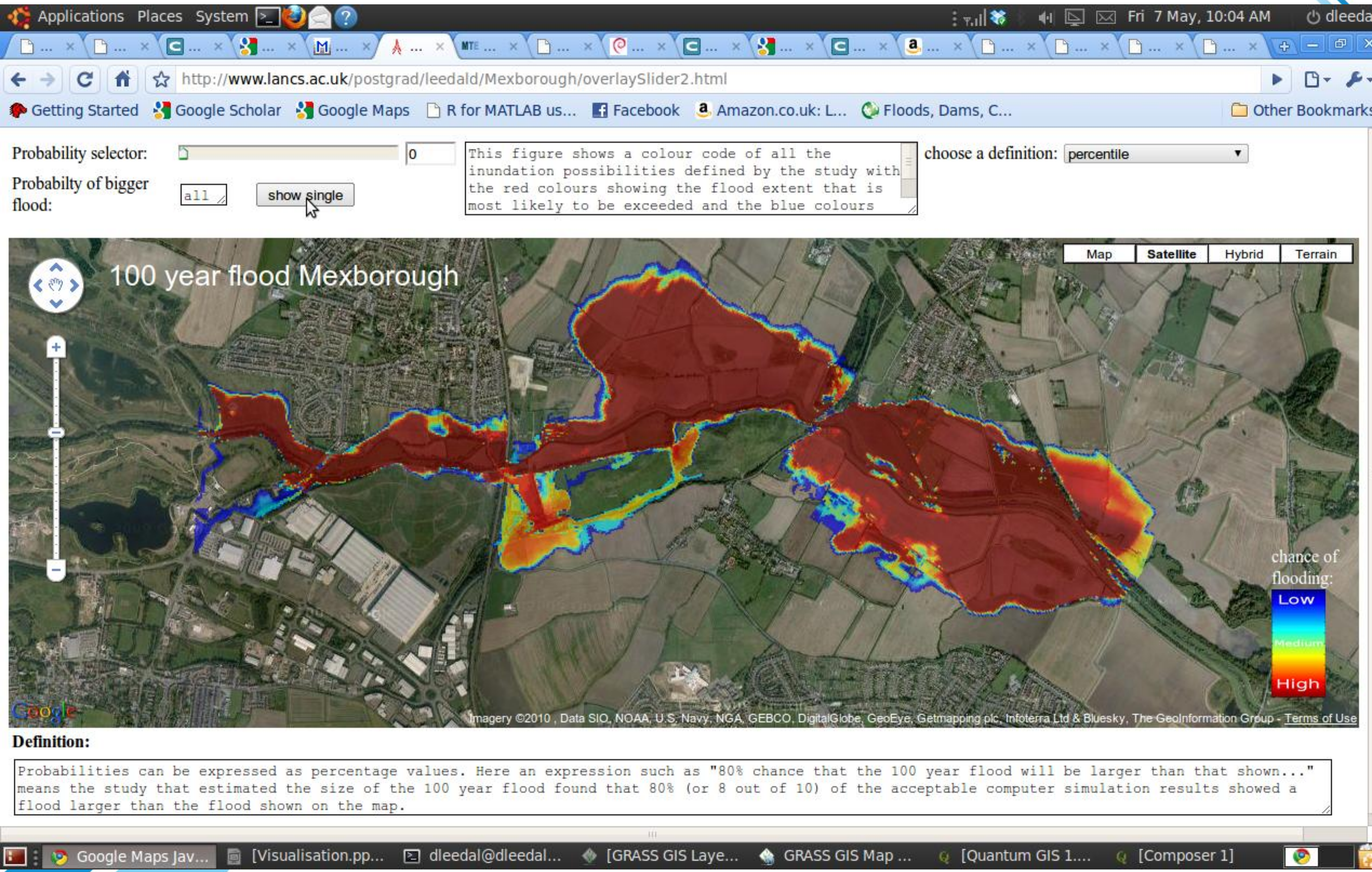

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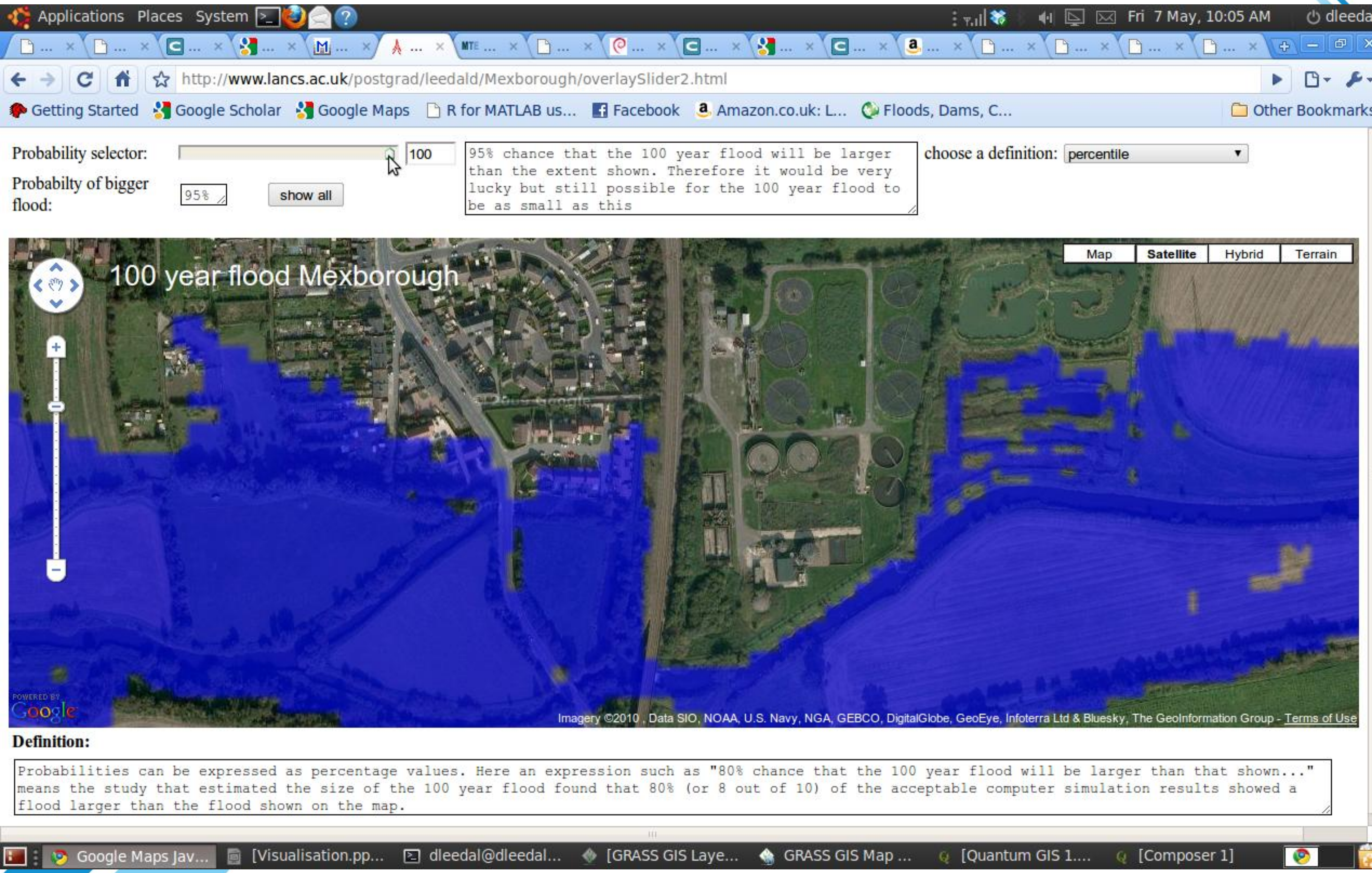

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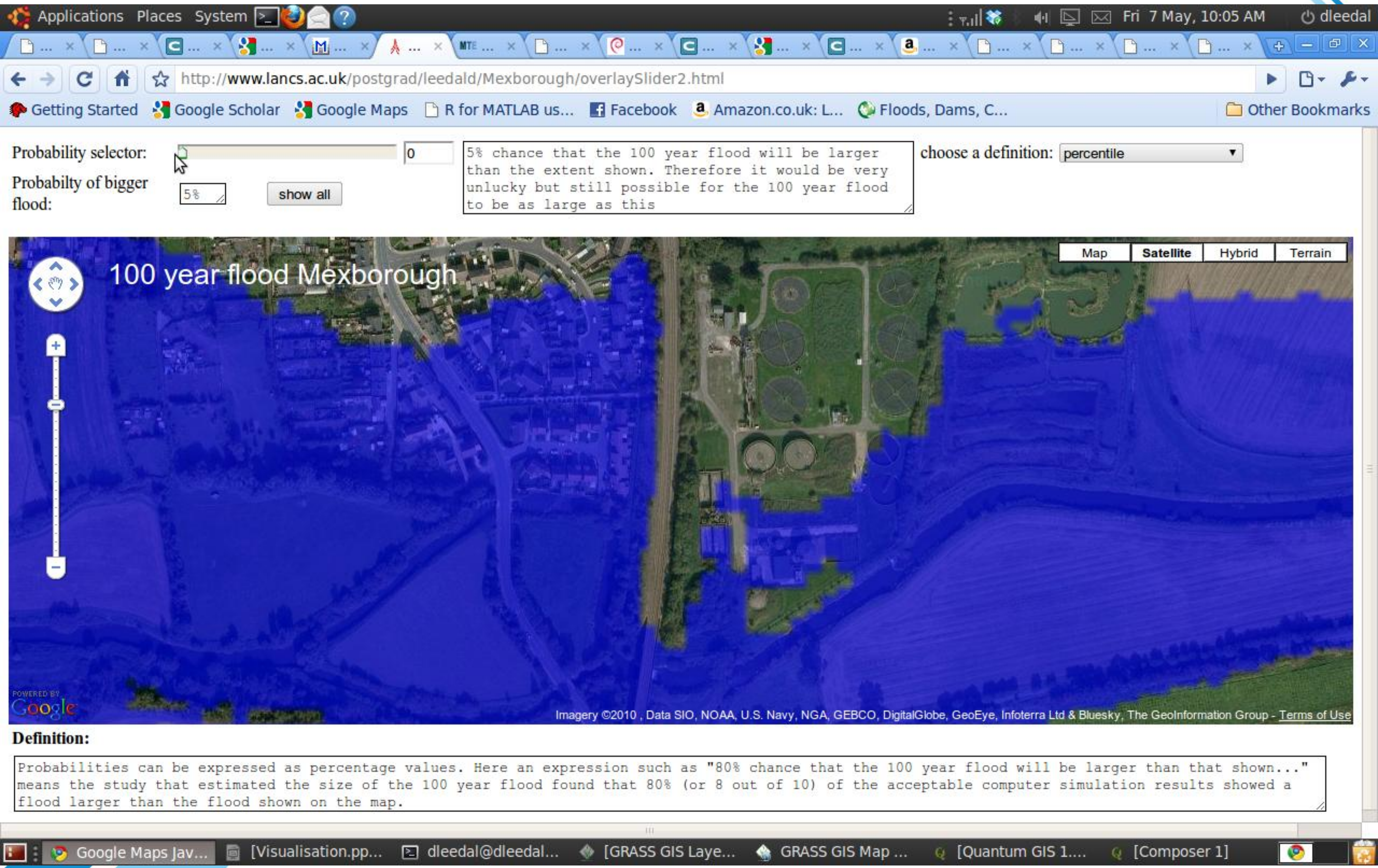

River Eden: January 2005 event

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Upstream at Appleby

Emergency Centre
at Carlisle

Public response
at Carlisle

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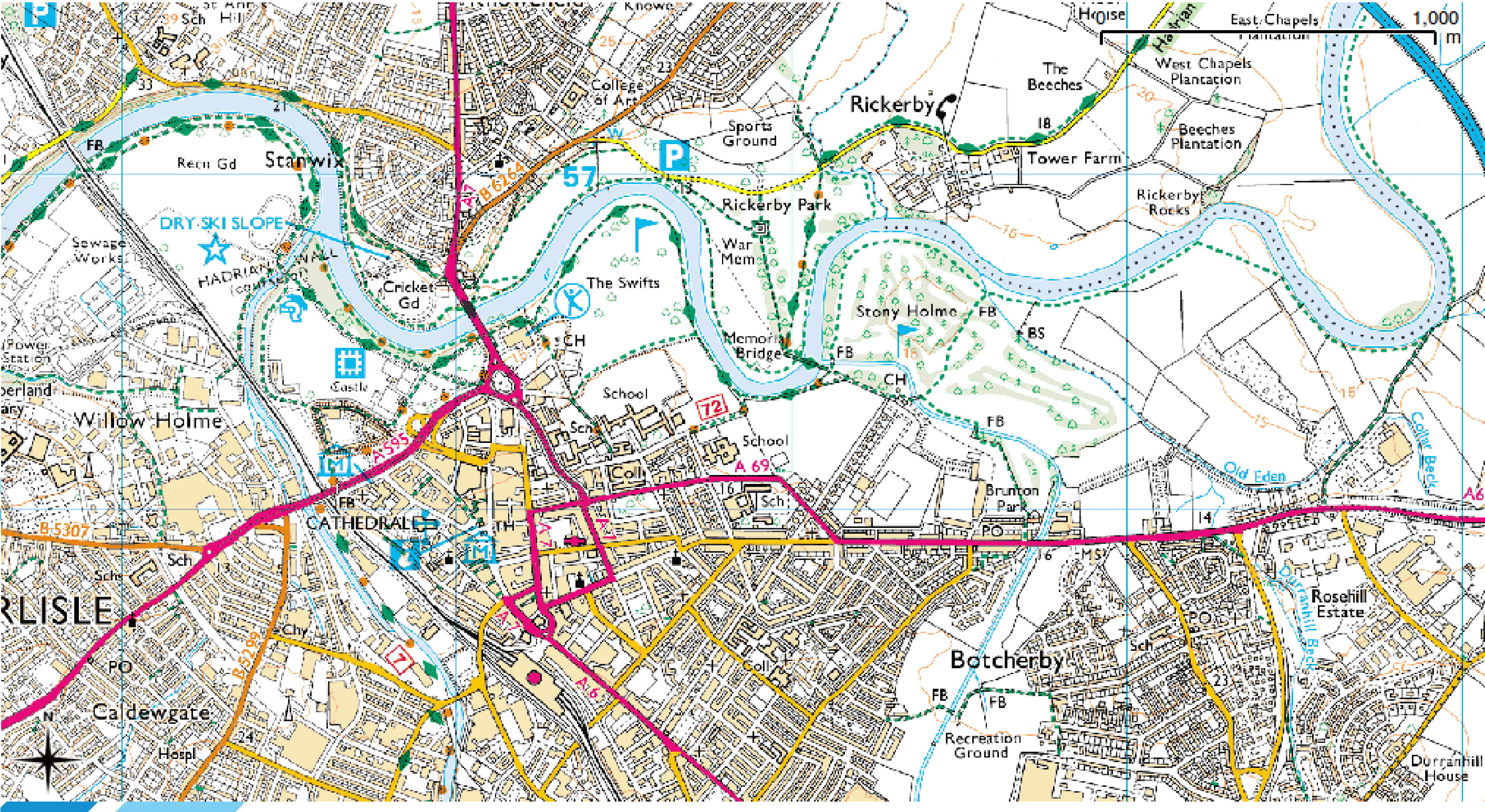
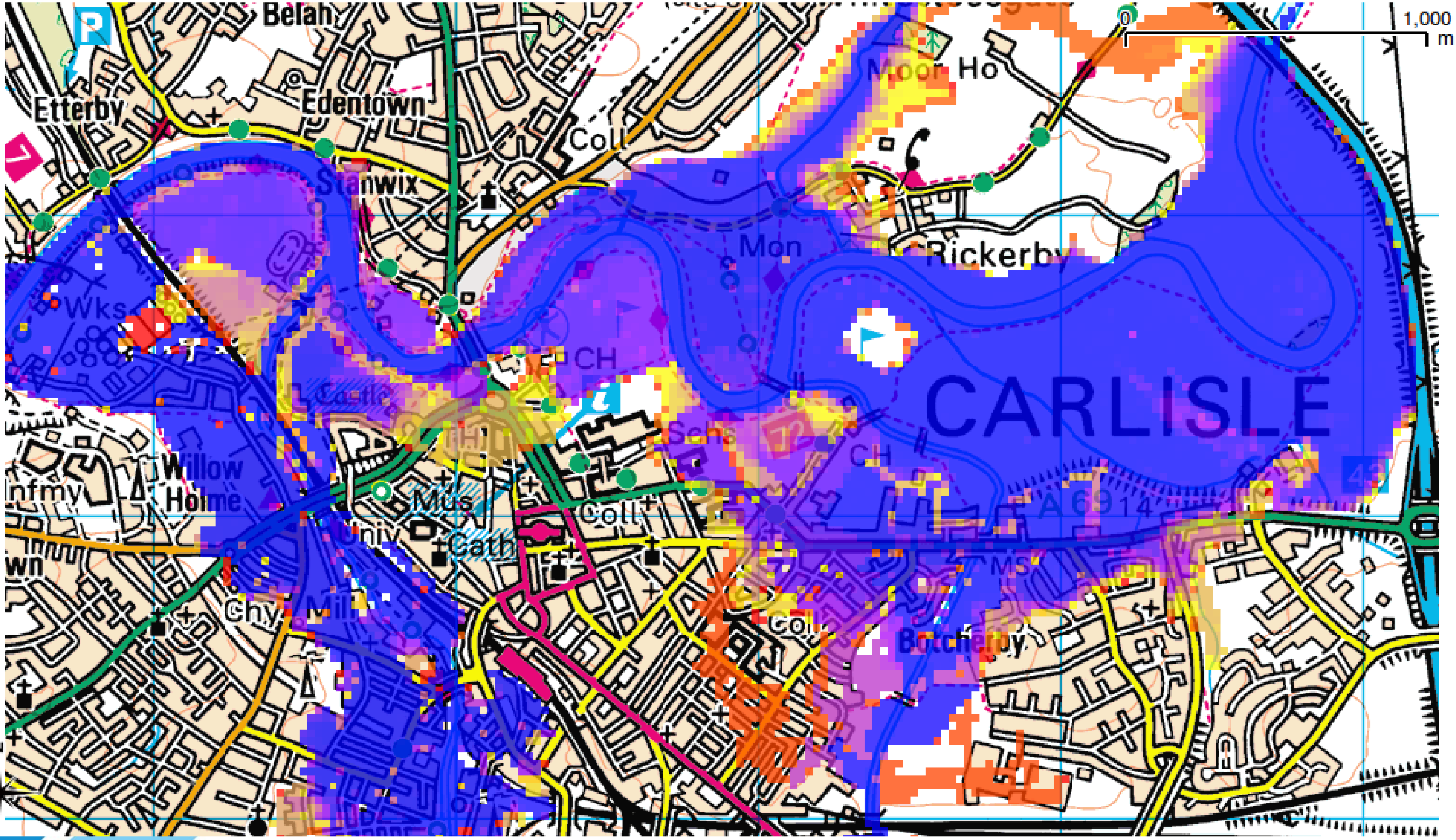
Carlisle 2005



Overlays of probabilistic flood risk



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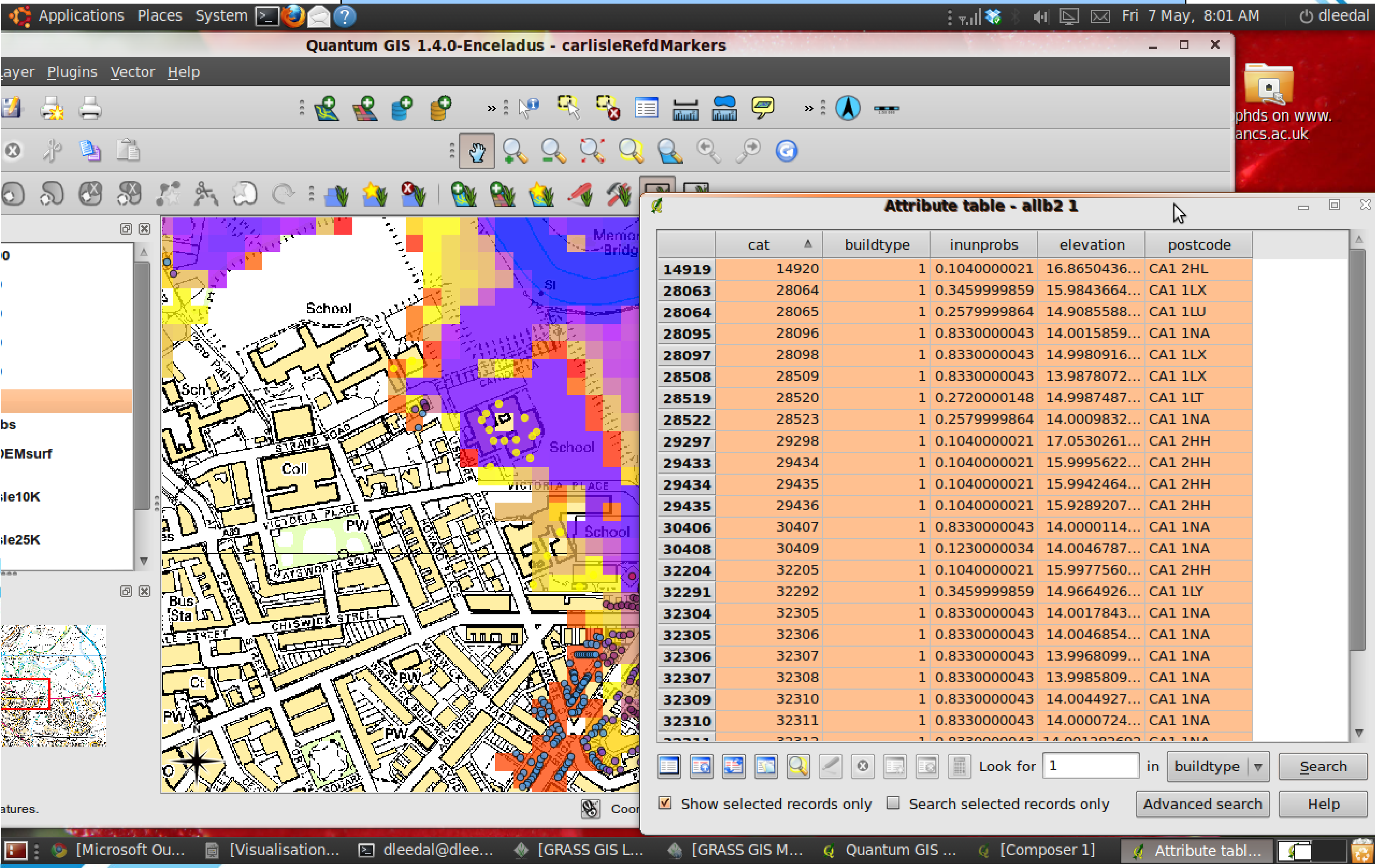
Links to database (here only centroids of building vectors)



	cat	buildtype	inunprobs	elevation	postcode
14919	14920	1	0.1040000021	16.8650436...	CA1 2HL
28063	28064	1	0.3459999859	15.9843664...	CA1 1LX
28064	28065	1	0.2579999864	14.9085588...	CA1 1LU
28095	28096	1	0.8330000043	14.0015859...	CA1 1NA
28097	28098	1	0.8330000043	14.9980916...	CA1 1LX
28508	28509	1	0.8330000043	13.9878072...	CA1 1LX
28519	28520	1	0.2720000148	14.9987487...	CA1 1LT
28522	28523	1	0.2579999864	14.0009832...	CA1 1NA
29297	29298	1	0.1040000021	17.0530261...	CA1 2HH
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32310	32311	1	0.8330000043	14.0000724...	CA1 1NA

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Concluding Comments

- 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 (perhaps with default options)

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Finally……

- Draft guideline document for flood risk mapping currently under review by Environment Agency
- 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