
FLOODFORECASTINGCENTRE
a working partnership between
Environment Agency
Met Office
"Surface water flood forecasting and guidance in the UK: theory, performance and outlook"
RainGain National Observers Group (NOG) Meeting
16 April 2013
Dr Andy Lane
Senior Hydrometeorologist

# Overview

- Flood Forecasting Centre
- Developing our surface water flood forecasting capabilities
- Outlook

# Flood Forecasting Centre


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a working partnership between Environment Agency | Met Office

## What is the FFC?

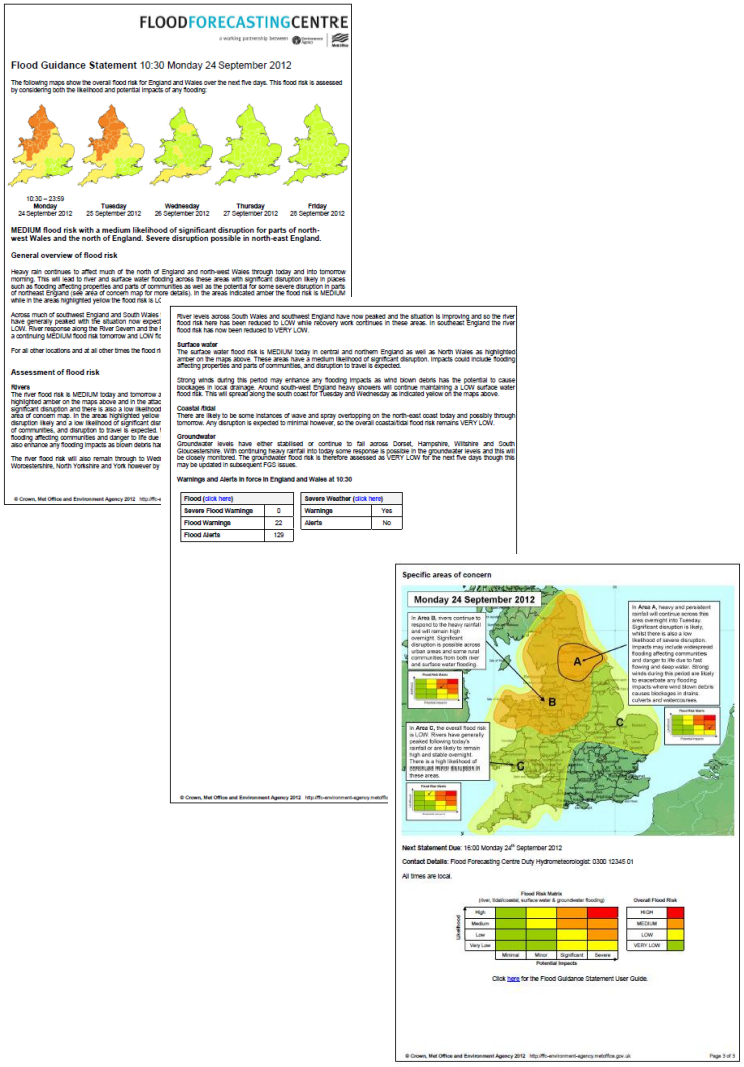
- Successful **partnership** between the Met Office and Environment Agency;
- Remit to forecast for **all sources** of flooding;
- **Operational** since April 2009 delivering 24/7 services;
- **Combine staff expertise** in hydrometeorology to provide improved and new services
- Agreed outcomes with three year delivery plan
- Permanent base in MO Exeter
- DEFRA funded inc. national contributions

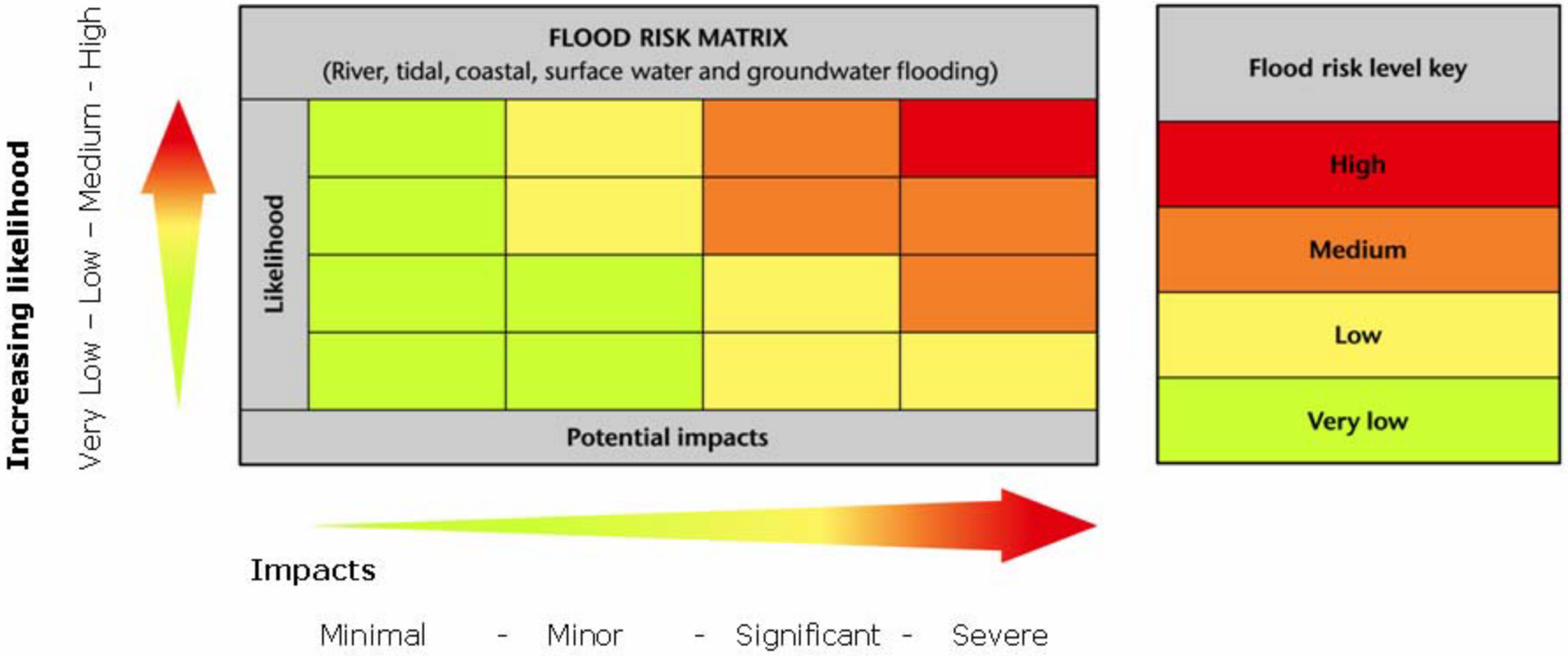
# Our Services

- **Government Services**
  England, Wales & Local Flood Advisory Services
- **Cat 1 and 2 Services**
  Flood Guidance Statements, Hazard Manager, Consultancy, materials and training
- **Environment Agency English Regions and Wales**
  Hydromet Services: Guidance, Heavy Rainfall Alerts & Forecast Met Data
- **UKCMF Services**
  Outlooks, alerts and consultancy for the UK coast inc Scotland & NI
- **Public Services**
  Public Flood Risk Forecast

# Flood Guidance Statement (FGS)

- Five day national, county level forecast of flood risk for England & Wales
- Issued daily, and more frequently at times of higher risk
- Risk (colour) determined using a flood risk matrix, combining **likelihood <u>and</u> impact** of flooding
- Email and Fax to 2500+ government and emergency responders




Increasing likelihood
Very Low – Low – Medium - High
FLOOD RISK MATRIX
(River, tidal, coastal, surface water and groundwater flooding)
Likelihood
Potential impacts
Impacts
Minimal - Minor - Significant - Severe
Flood risk level key
High
Medium
Low
Very low

# Our Delivery Plan Priorities

1. 24/7 hydrometeorological service enabling all our partners to be better prepared for flooding.

2. Understand our customers, lead in the integration of flood services and help them to understand how they can best use our products and services.

3. **Develop our forecasting capabilities further**

4. Develop and promote the FFC as a centre of expertise in hydrometeorology

# Developing our surface water flood forecasting capabilities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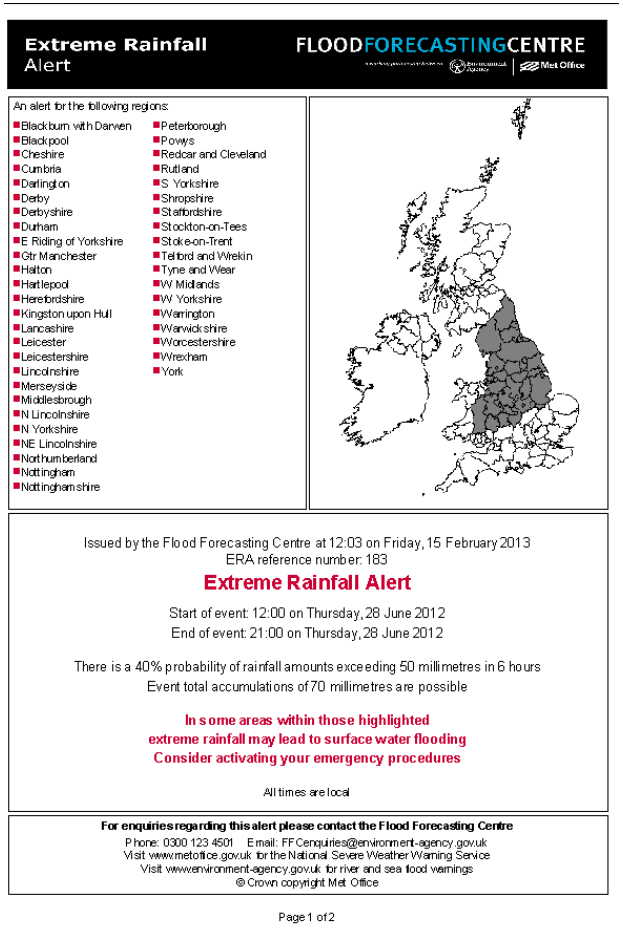
# 1st Generation Extreme Rainfall Alerts 2008 - 2011

- 1 in 30 year return period rainfall depth-duration thresholds
- 30mm/hour, 40mm/3hours and 50mm/6hours
- Issued at county level to alert for extreme rainfall that could lead to severe surface water flooding in urban areas
- Issued on 20% probability of meeting the thresholds



**Extreme Rainfall Alert**

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An alert for the following regions:

- Blackburn with Darwen
- Blackpool
- Cheshire
- Cumbria
- Darlington
- Derby
- Derbyshire
- Durham
- E Riding of Yorkshire
- Gtr Manchester
- Halton
- Hartlepool
- Herefordshire
- Kingston upon Hull
- Lancashire
- Leicester
- Leicestershire
- Lincolnshire
- Merseyside
- Middlesbrough
- N Lincolnshire
- N Yorkshire
- NE Lincolnshire
- Northumberland
- Nottingham
- Nottinghamshire
- Peterborough
- Powys
- Redcar and Cleveland
- Rutland
- S Yorkshire
- Shropshire
- Staffordshire
- Stockton-on-Tees
- Stoke-on-Trent
- Telford and Wrekin
- Tyne and Wear
- W Midlands
- W Yorkshire
- Warrington
- Warwickshire
- Worcestershire
- Wrexham
- York

Issued by the Flood Forecasting Centre at 12:03 on Friday, 15 February 2013
ERA reference number: 183

**Extreme Rainfall Alert**

Start of event: 12:00 on Thursday, 28 June 2012
End of event: 21:00 on Thursday, 28 June 2012

There is a 40% probability of rainfall amounts exceeding 50 millimetres in 6 hours
Event total accumulations of 70 millimetres are possible

**In some areas within those highlighted**
**extreme rainfall may lead to surface water flooding**
**Consider activating your emergency procedures**

All times are local

**For enquiries regarding this alert please contact the Flood Forecasting Centre**
Phone: 0300 123 4501 Email: FFCenquiries@environment-agency.gov.uk
Visit www.metoffice.gov.uk for the National Severe Weather Warning Service
Visit www.environment-agency.gov.uk for river and sea flood warnings


Page 1 of 2

# 2nd Generation – Surface Water Flooding Decision Support Tool (SWFDST) 2011 – present

- Project with Halcrow (2010 – 2011)
- Examined rainfall and other criteria (SMD, API, Urban Extent etc) that exacerbate SWF
- Shortlisted main ones where data available
- Tested these criteria against flood and non-flood events (surface water)
- Iterative process to find ‘best’ weightings of these criteria using POD/FAR/CSI
- Developed an operational tool

# 2nd Generation – Initial UK4 SWFDST

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County ID and County/Unitary Authority

Blue Square % per county/unitary authority. Each 1km 'blue square' indicates where at least 200 people, 20 businesses or 1 critical service might be flooded to a depth of 0.3m by a 1 in 200 year rainfall event (using the EA's Flood Map for Surface Water)

Experienced based assessment of likely impact of meteorological hazard. For example, fast moving, single cell thunderstorms generally have less flood impact than slow moving, back building thunderstorms.

Extreme Rainfall Alert probabilities from 4km NWP model. Thresholds used are 40mm/3hr and 50mm/6hr.

Weighted Score equivalent to flood risk level for 3 categories of blue square % – calibrated with event data

## Surface Water Decision Support Tool

| ID | County / Unitary Authority | Blue Square (%) | Blue Sq. Category | Meteorological Hazard Weight 0.25 Data | Score | Prob. Excd. 3Hr30 Weight 0.375 Column F Data | Score | Prob. Excd. 6Hr30 Weight 0.375 Column G Data | Score | Total weighted score | Risk Category |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 50 | Kingston upon Hull | 7.36 | 1 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | Very Low |
| 51 | E Riding of Yorkshire | 2.20 | 1 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | Very Low |
| 52 | NE Lincolnshire | 3.93 | 1 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | Very Low |
| 53 | N Lincolnshire | 3.31 | 1 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | Very Low |
| 54 | York | 2.21 | 1 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | Very Low |

## Winter 2011/12
## 2nd Generation – Updated UK4 SWFDST

- Recalibrated with summer 2011 rainfall and flood impact data

## Winter 2012/13
## 2nd Generation – UKV SWFDST

- Parameters that can exacerbate SWF re-assessed using rainfall and flood impact data collected over summer 2012 and previous years.
- Spreadsheet re-weighted based upon this new parameter set.
- Re-calibrated to use UKV 1.5km (not UK4 4km) Extreme Rainfall Alert probability data.

# 2nd Generation – UKV SWFDST

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County ID and County/Unitary Authority

Blue Square % per county/unitary authority. Each 1km 'blue square' indicates where at least 200 people, 20 businesses or 1 critical service might be flooded to a depth of 0.3m by a 1 in 200 year rainfall event (using the EA's Flood Map for Surface Water)

Experienced based assessment of likely impact of meteorological hazard. For example, fast moving, single cell thunderstorms generally have less flood impact than slow moving, back building thunderstorms.

Maximum probability value from all three 1 in 10 and all three 1 in 30 year return period UKV (1.5km NWP model) Extreme Rainfall Alert Probabilities.

Soil Moisture Deficit value. <=6mm the catchment is considered wet and assigned a SMD score of 100%. >6mm SMD score decreases inversely (score = 6mm/SMD(mm))

| 10 year return periods | 30 year return periods |
|---|---|
| 20 mm / hour | 30 mm / hour |
| 30 mm / 3 hours | 40 mm / 3 hours |
| 40mm / 6 hours | 50mm / 6 hours |

Weighted Score equivalent to flood risk level for 3 categories of blue square % – calibrated with flood event data

## Surface Water Flooding Decision Support Tool

| ID | County / Unitary Authority | Blue Square (%) | Blue Sq. Category | Met Hazard Guidelines Weight 0.333 Data | Score | Prob. Exed. 10Yr Max Weight 0.278 Column H Data | Score | Prob. Exed. 30Yr Max Weight 0.222 Column I Data | Score | SMD Weight 0.167 Column J Data | Score | Total weighted score | Risk Category |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | Merseyside | 17.64 | 3 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | 1 | 0.50 | Very Low |
| 1 | S Yorkshire | 10.63 | 2 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | 1 | 0.50 | Very Low |
| 2 | Tyne and Wear | 19.60 | 3 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | 1 | 0.50 | Very Low |
| 3 | W Midlands | 44.47 | 3 | no rainfall | 0 | 0 | 0 | 0 | 0 | 0.00 | 1 | 0.50 | Very Low |

## Surface Water Flood Forecasting process

**SWFDST –** Initial assessment

**Consultation**

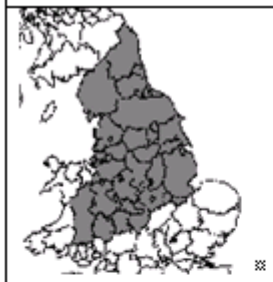
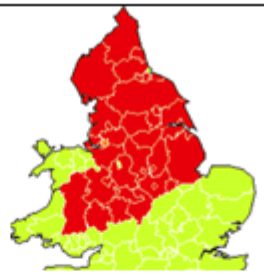
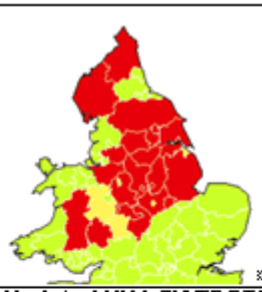
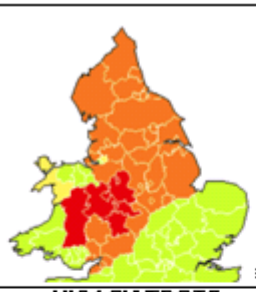
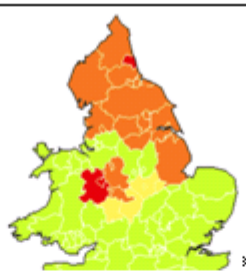
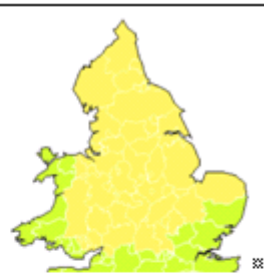
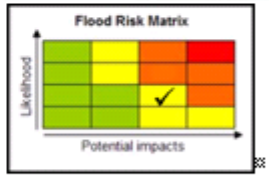
- Environment Agency regional flood forecasting teams
- Met Office Civil Contingency Advisors
- Met Office Chief Forecaster

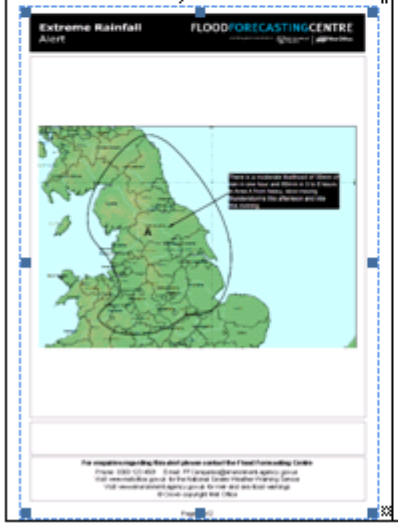
**Look at other NWP models**

- MOGREPS-UK
- ECMWF

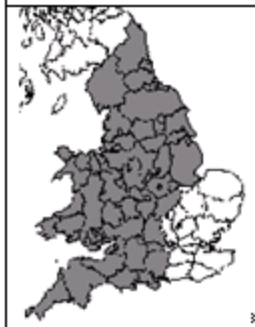
...etc

**Produce Flood Guidance Statement**

| 28 June 2012 | | | | | |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| **ERA** | **Initial UK4 SWFDST** | **Updated UK4 SWFDST** | **UKV SWFDST** | **Actual Impacts** | **FGS issued** |
| 40% Probability of 50mm/6 hours | Few calibration events | More calibration events from summer 2011 | Input data changed<br>Few calibration events | That we know about and assuming a high likelihood.<br>Sometimes difficult to know what actually happened. |  <br>  |

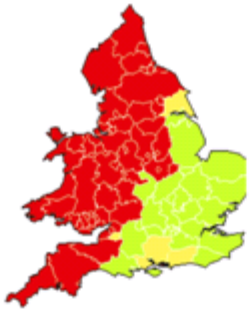


## 4 August 2012



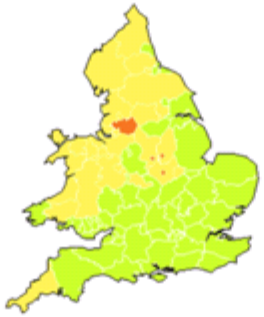
**ERA**

30% Probability of 50mm/6 hours



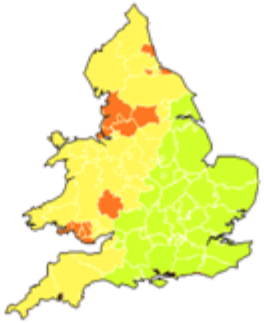
**Initial UK4 SWFDST**

Few calibration events



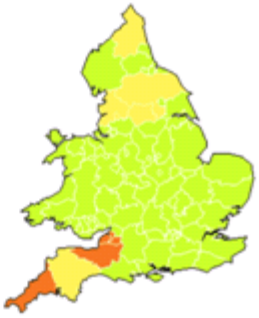
**Updated UK4 SWFDST**

More calibration events from summer 2011.



**UKV SWFDST**

Input data changed
Few calibration events



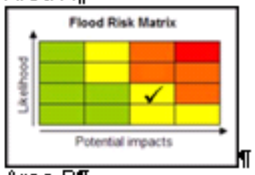
**Actual Impacts**

That we know about and assuming a high likelihood

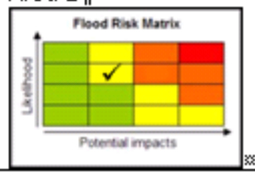
Sometimes difficult to know what actually happened.


**FGS issued**

Area A




Area B



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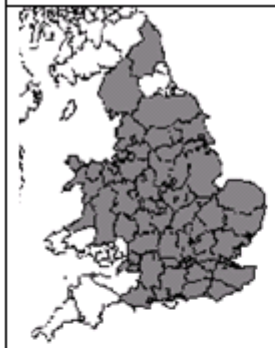
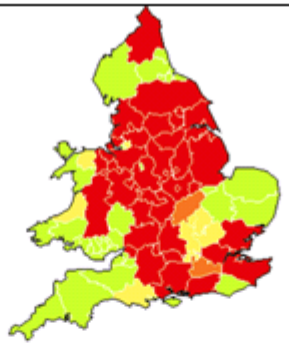
## 25 August 2012



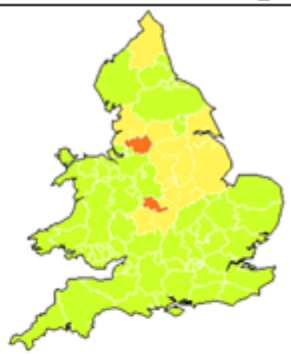
**ERA**

30% Probability of 50mm/6 hours

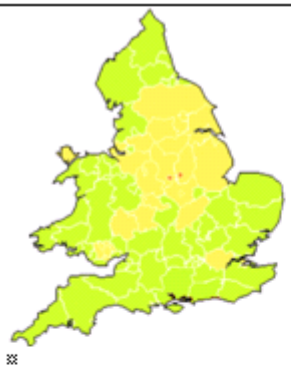
**Initial UK4 SWFDST**

Few calibration events



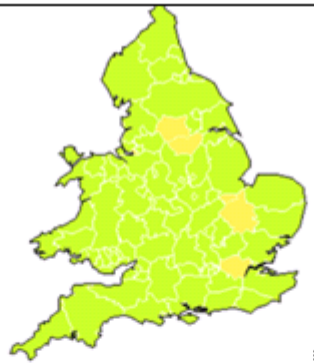
**Updated UK4 SWFDST**

More calibration events from summer 2011.



**UKV SWFDST**

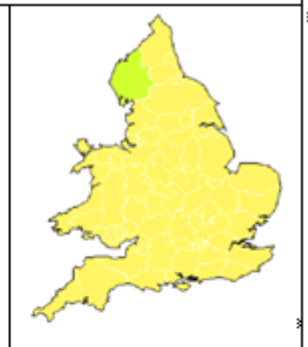
Input data changed
Few calibration events



**Actual Impacts**

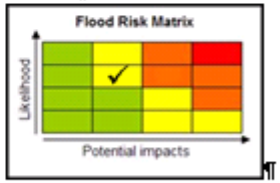
That we know about and assuming a high likelihood

Sometimes difficult to know what actually happened.



**FGS issued**


Area A

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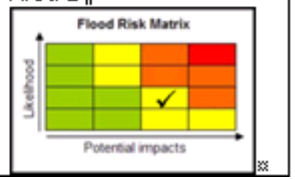

# Outlook


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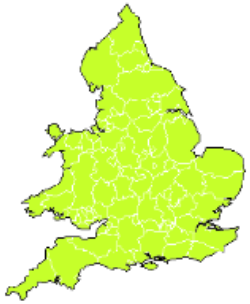
- FFC Targets to ‘reliably’ forecast at county scale:

Amber - Day 2 – 2013



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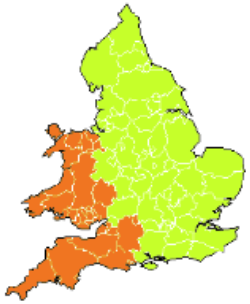
Tuesday
13 November 2012



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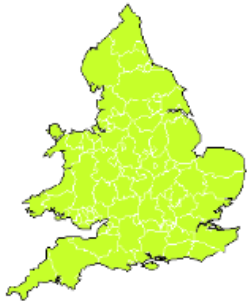
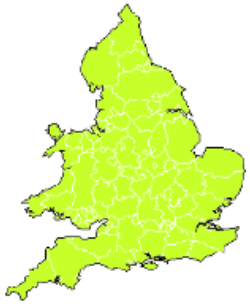
Wednesday
14 November 2012



00:00 - 23:59hrs
Thursday
15 November 2012



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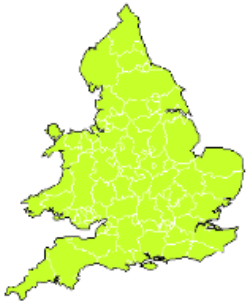
Friday
16 November 2012



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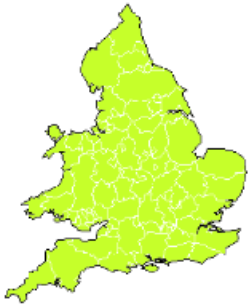
Saturday
17 November 2012

Red - Day 2 – 2015



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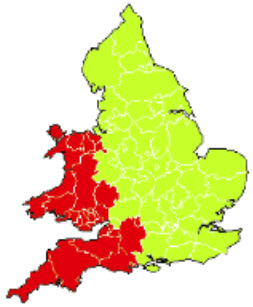

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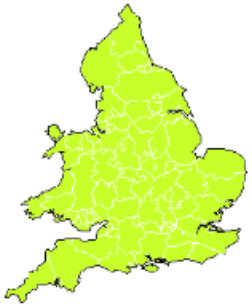
14 November 2012



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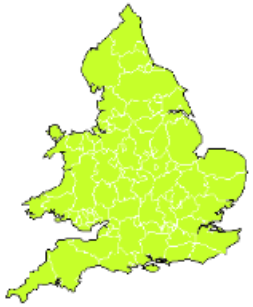

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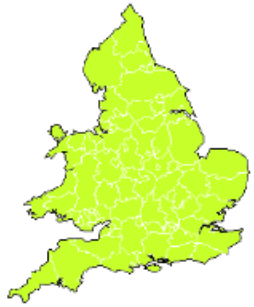
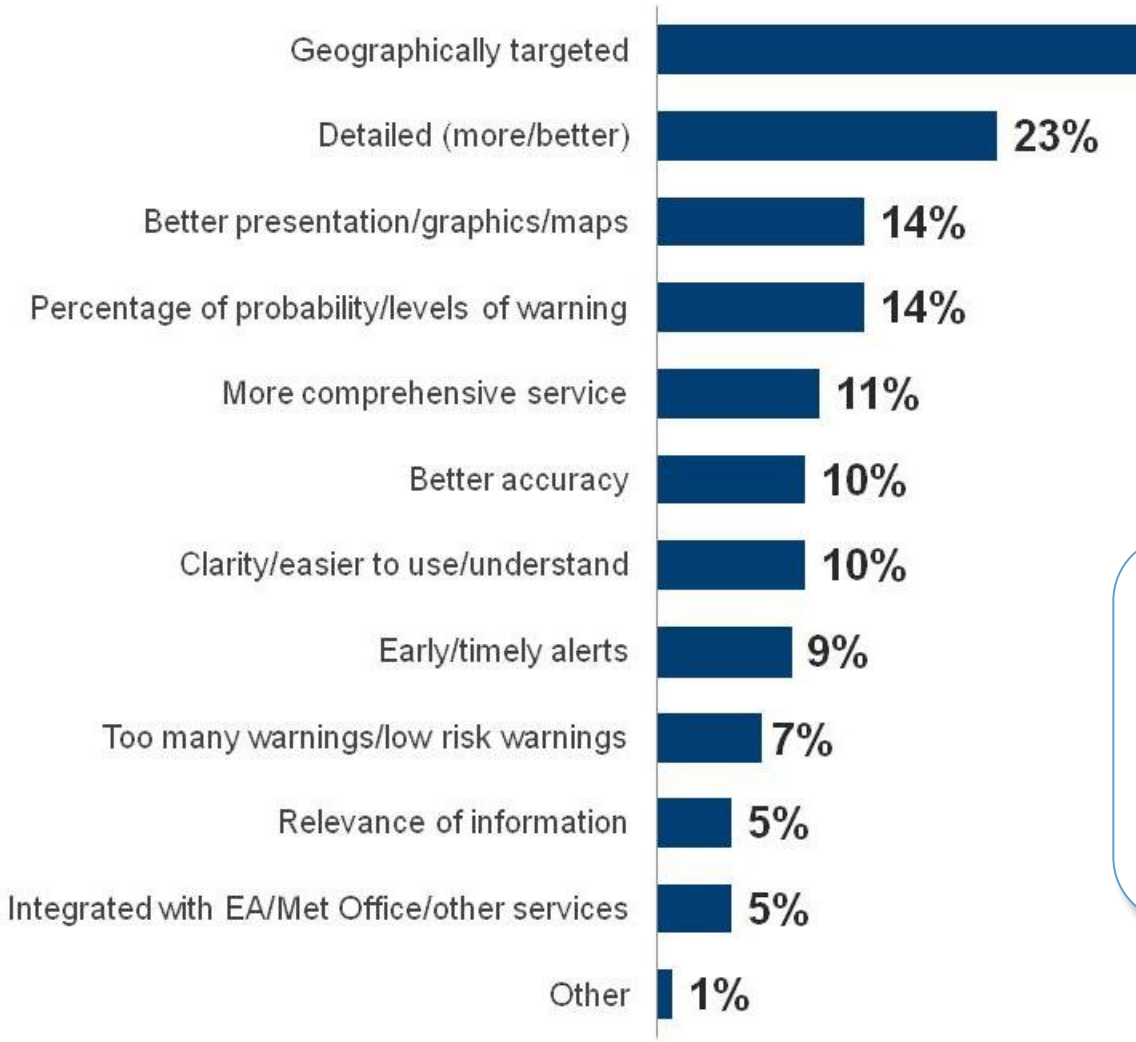


00:00 - 23:59hrs
Saturday
17 November 2012

# How could FGS be improved?




*There could be more regional based when Amber alerts or above are issued. e.g. West Mids very large area more detailed maps of the expected locations likely to receive the impacts would be useful*

*Improve the visual representation of the UK. Some of the smaller geographical representations of counties are not easy to distinguish against neighbouring counties. i.e. North Somerset*

# 3rd Generation – Hazard Impact Modelling

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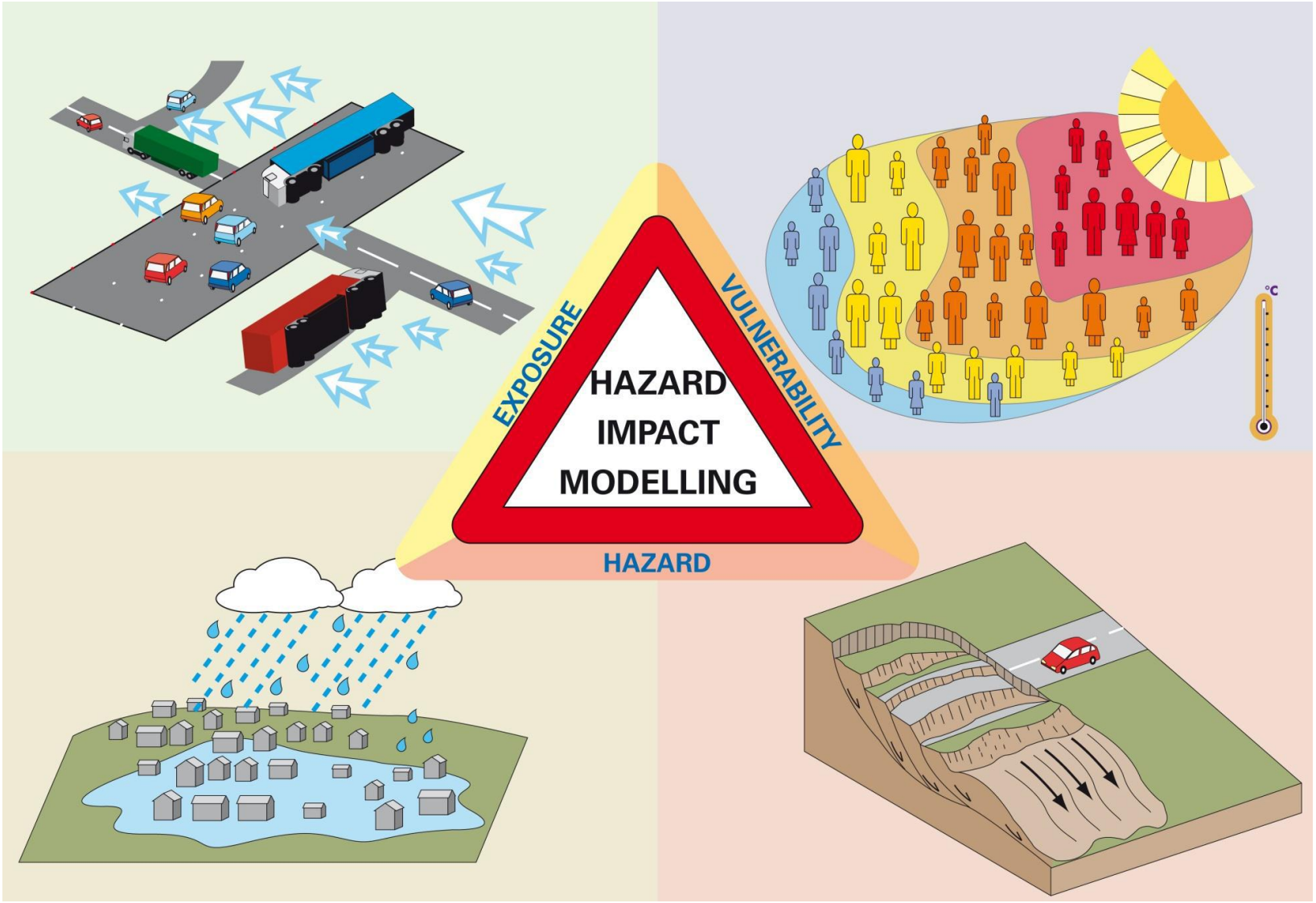

# Natural Hazards Partnership

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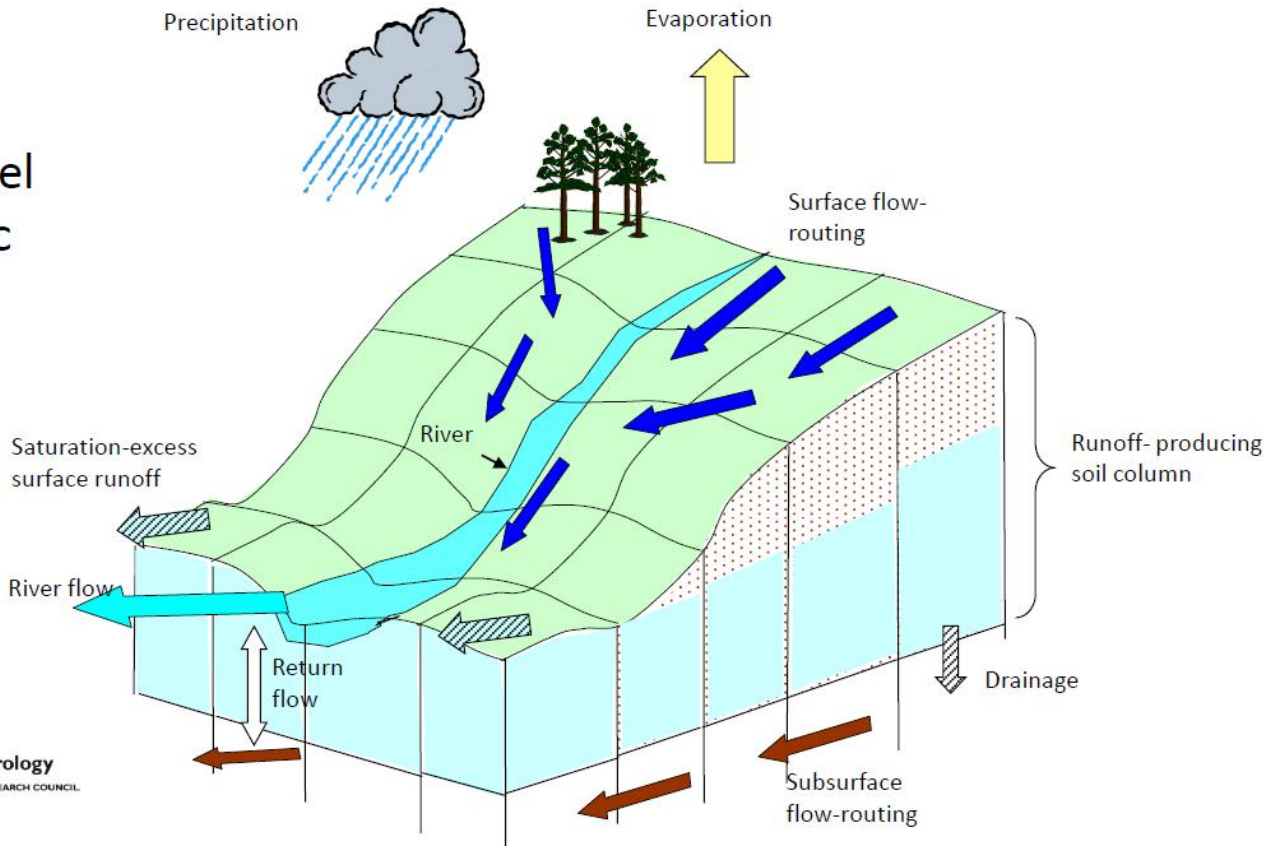
# Grid-to-Grid Distributed Hydrological Model

- Uses spatial datasets on terrain, soil, geology, land-cover
- Responds to spatial variation of rainfall input

G2G Model Schematic

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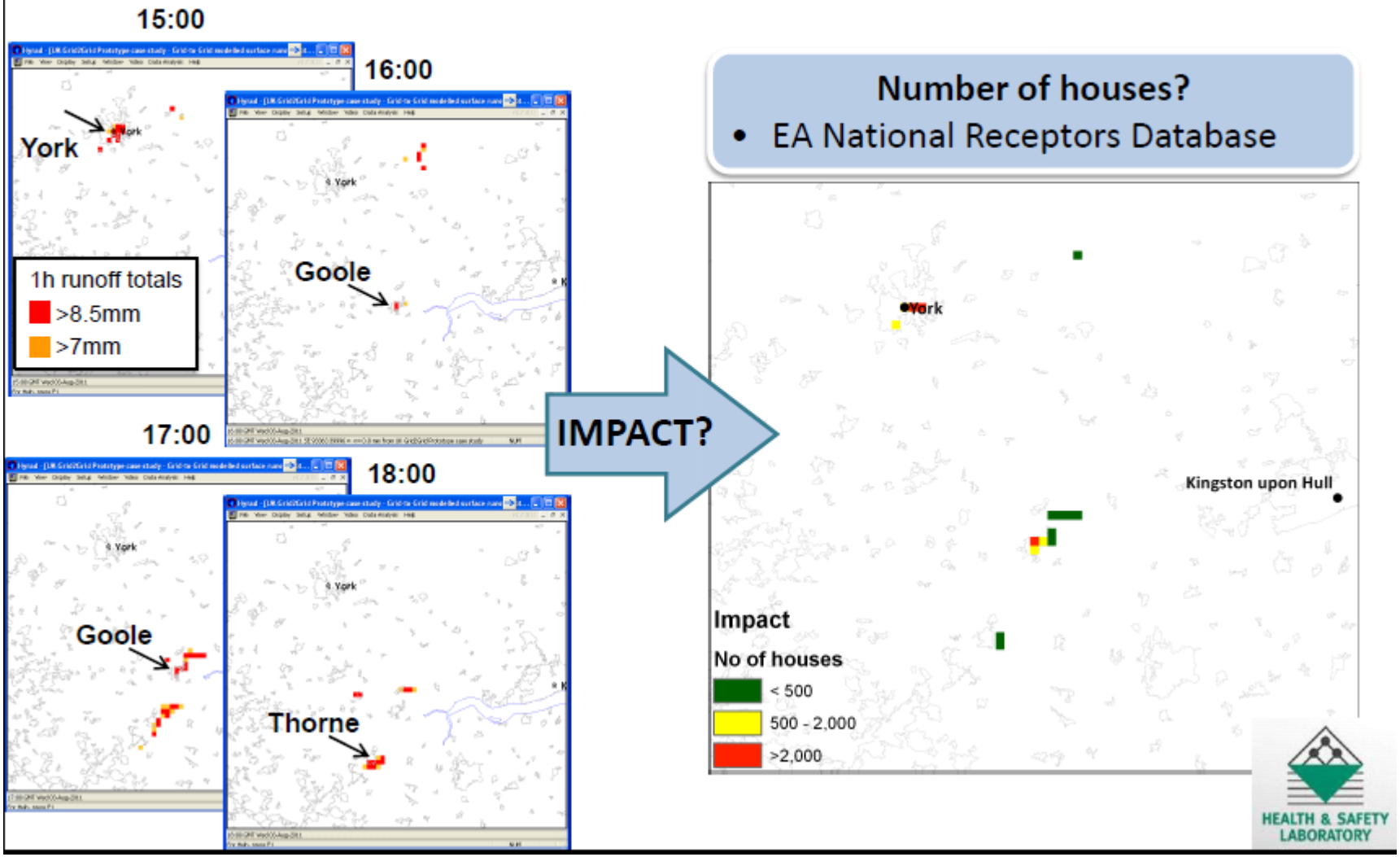
## How to map from G2G "Hazard Footprint" to "Impact"?



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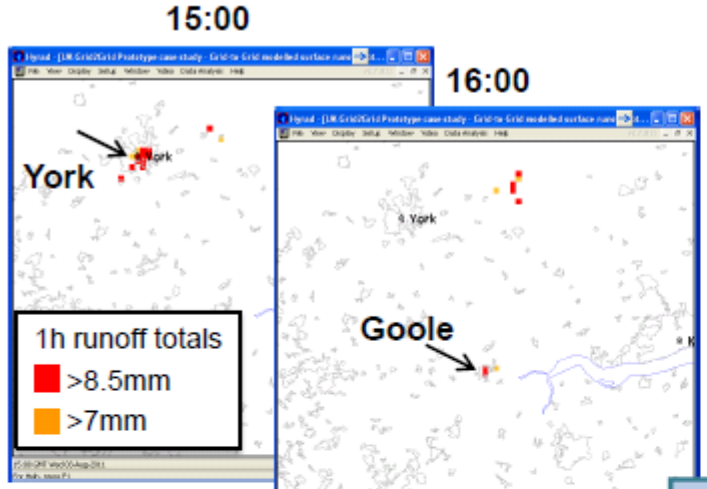
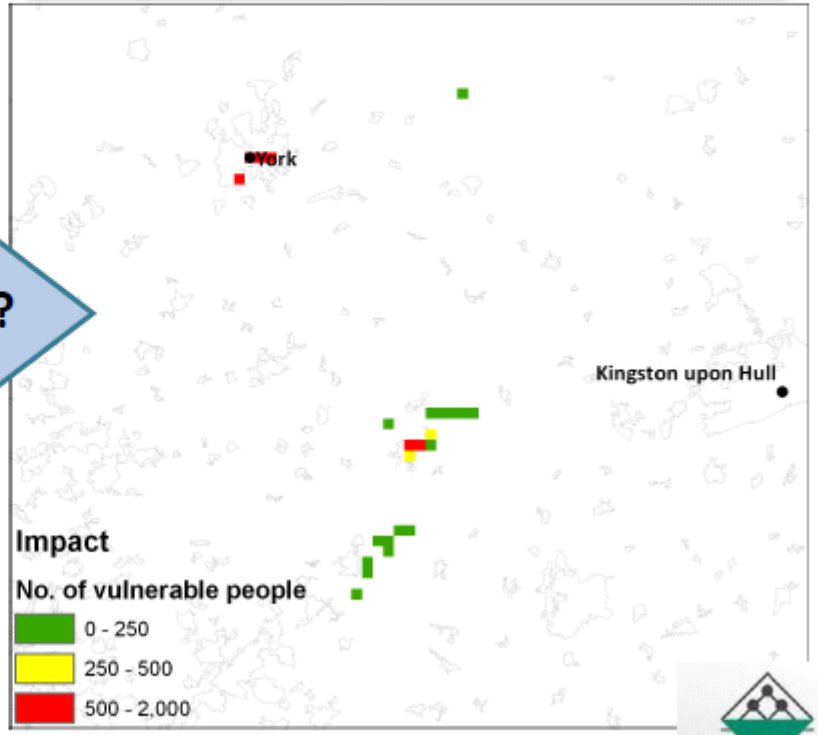
## How to map from G2G "Hazard Footprint" to "Impact"?




IMPACT?

**Number of vulnerable people?**

- HSL National Population Database




HEALTH & SAFETY LABORATORY


Questions?
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