



From Hazards to Impact: Experiences from the Hazard Impact Modelling project

Becky Hemingway, Met Office

ECMWF UEF 2017, 14th June 2017



“[People] want to know three things:

- **What does it mean to them?**
- **What does it mean to their family?**
- **What do they need to do right now?**

And so don't speak like a meteorologist.
Tell me what we need to know.”

(television meteorologist, quoted by Demuth et al. 2012)

There is the potential for 150mm of rain in an hour



Some places will experience 60mph winds today



Temperatures today will reach 35°C



There will be a significant space weather event tomorrow



150mm of rain in an hour will cause flooding, mitigating action is required



60mph wind gusts will cause travel disruption and fallen trees



At 35°C stay in the shade and drink plenty of water



A space weather event may cause communication



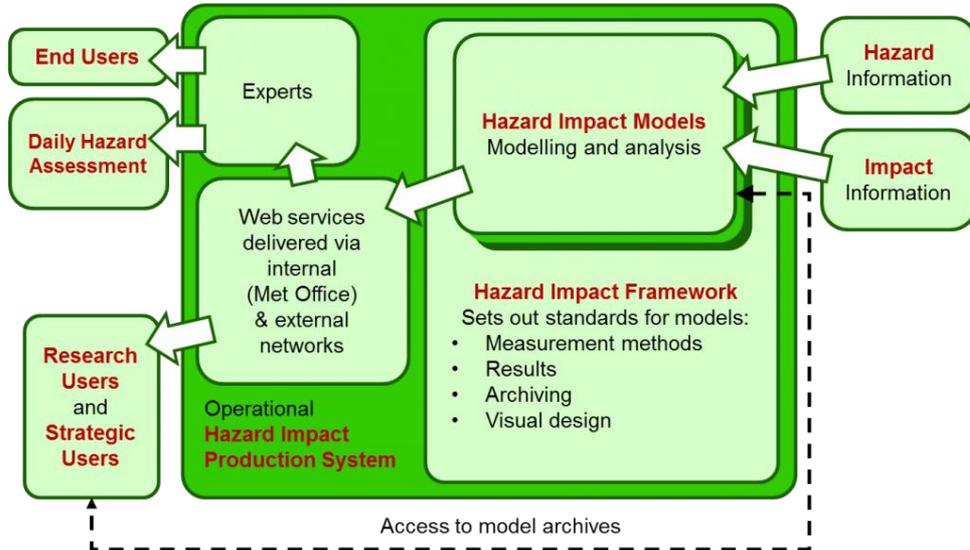
problems and power disruption



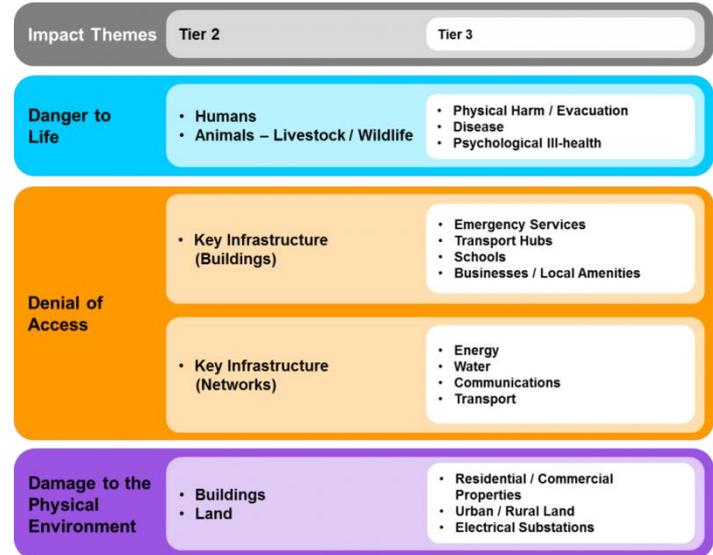
Natural Hazards Partnership



Hazard Impact Models and how they're created

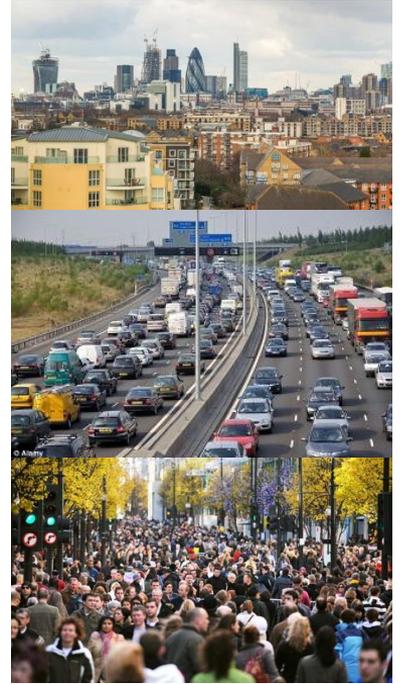
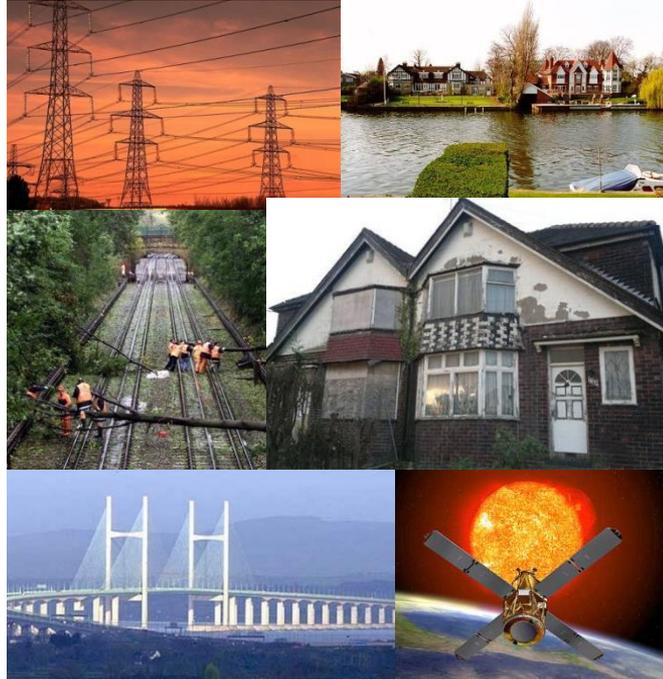


How impacts are assessed



NHP

Hazard Impact Models: Risk Algorithm



Hazard

x

Vulnerability

x

Exposure



Wind Hazard Impact Models

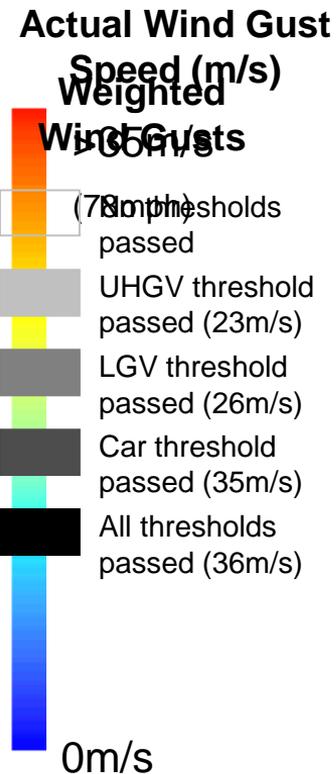
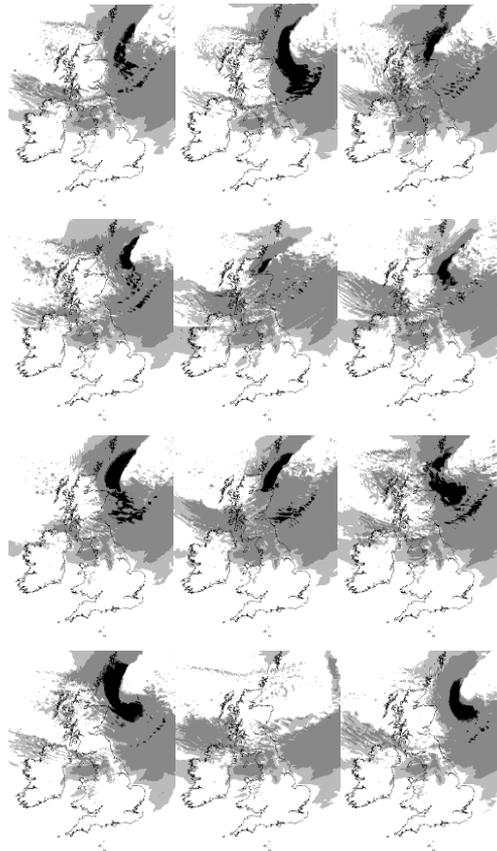
Vehicle OverTurning (VOT) model

Risk Algorithm: Vehicle OverTurning Model

MOGREPS-UK

- 2.2 km resolution
- 12 members
- 54 hours
- runs 4 times a day

Probability of max in last hour wind gusts exceeding thresholds



Risk Algorithm: Vehicle OverTurning Model

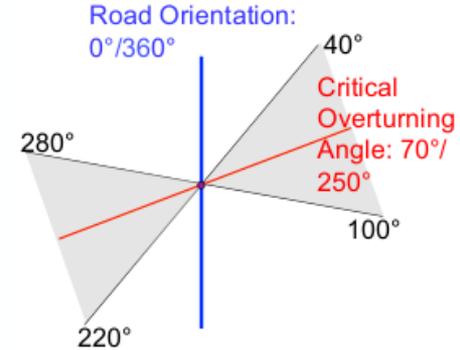
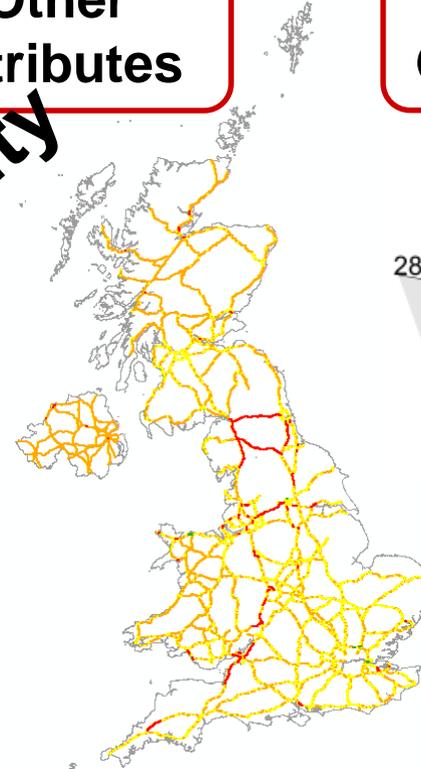
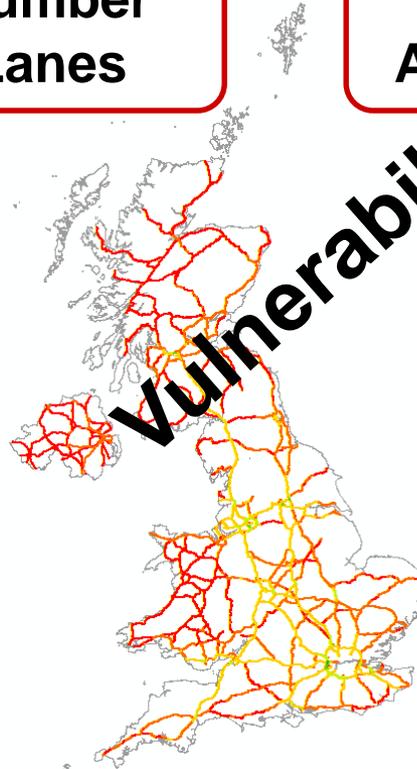
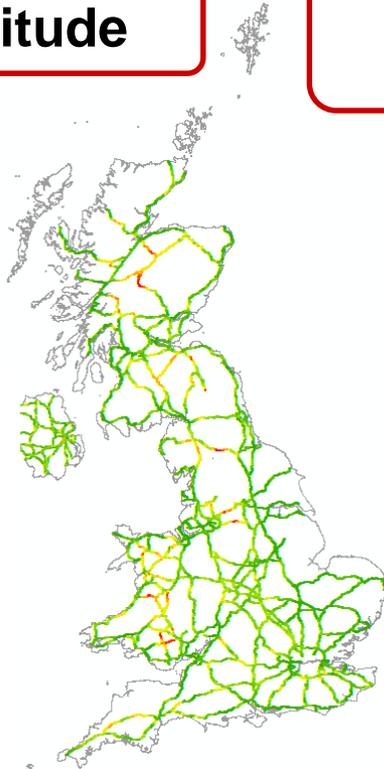
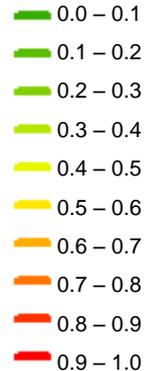
Altitude

Number
Lanes

Other
Attributes

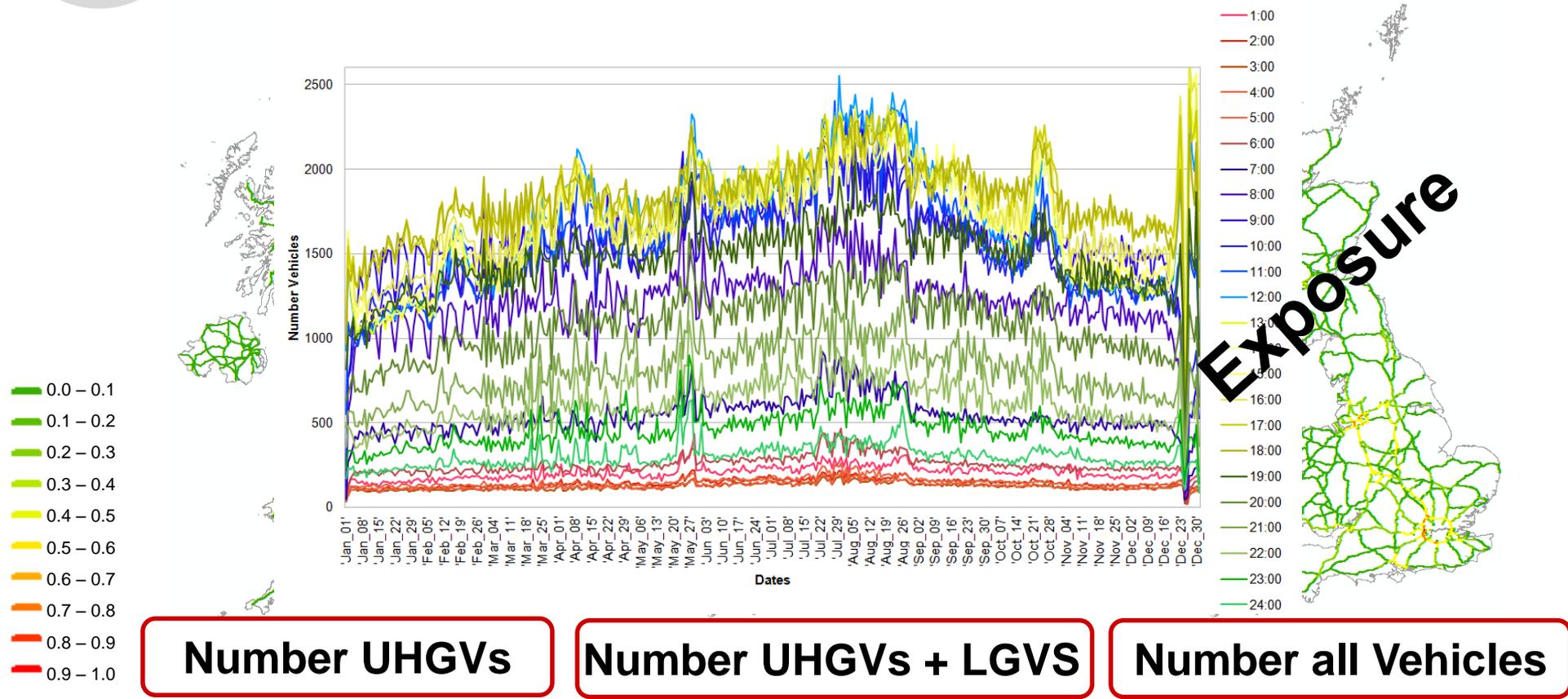
Road
Orientation

Vulnerability





Risk Algorithm: Vehicle OverTurning Model





NSWWS Wind Warnings Morning 8th January 2015

8th January 2015
19:00

Fri 9 Jan



National Severe Weather Warning Service (NSWWS) wind warning compared to the VOT model

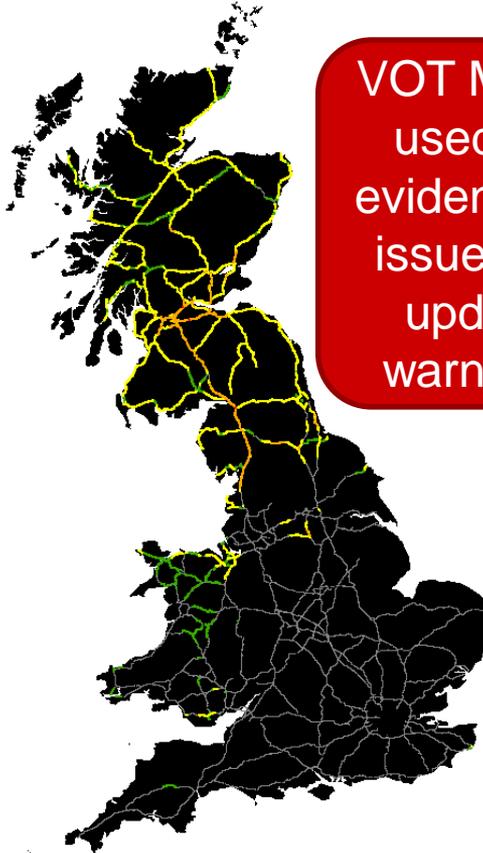
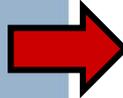
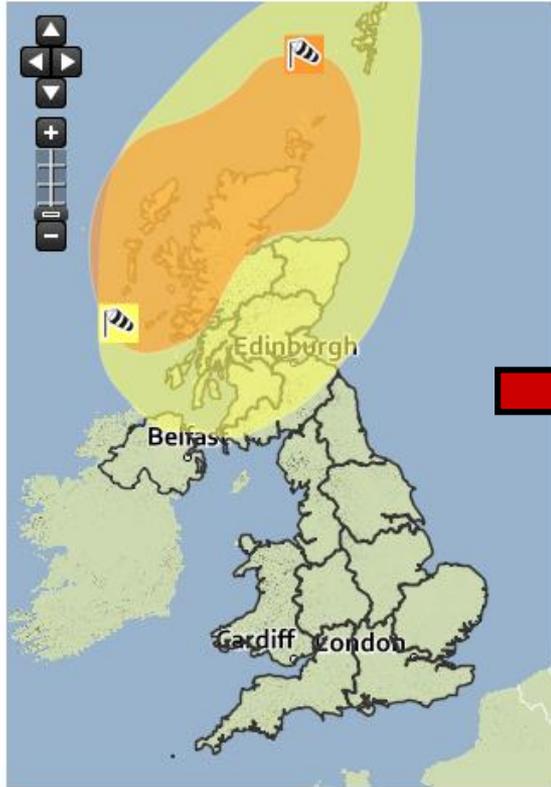
Maximum Risk of Disruption on the UK Road Network

- Low Risk
- Low - Medium Risk
- Medium - High Risk
- High Risk



T+22 Model run: 7th January 21Z

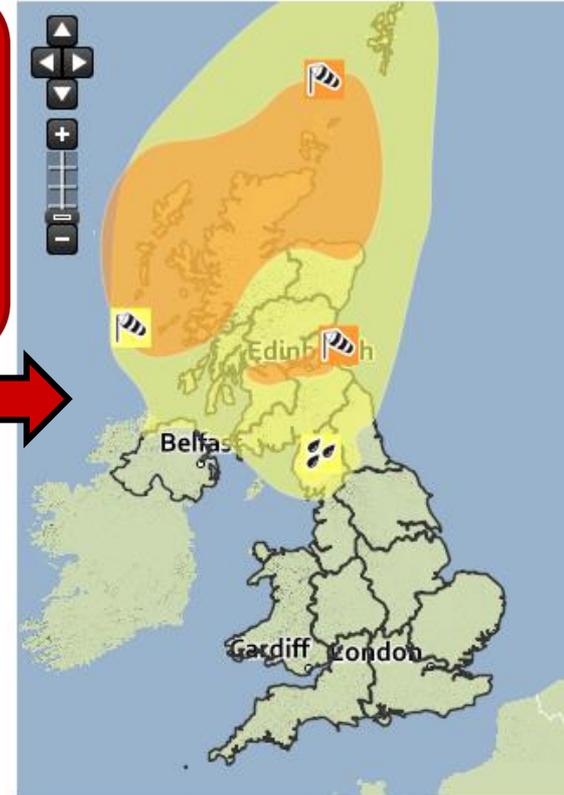
Fri 9 Jan



VOT Model
used as
evidence to
issue and
update
warnings



Fri 9 Jan



VOT Verification

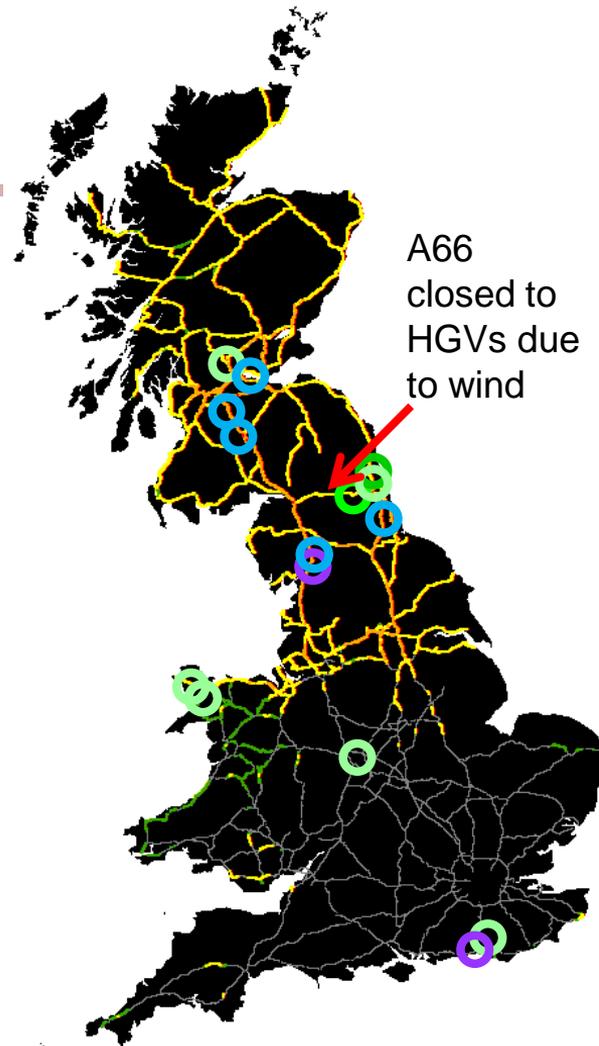
8th/9th January 2015

Multiple impact events reported including a van blown over in the amber warning in the Central Belt, Scotland.
Model verifies well



Forth Road Bridge
@forthroadbridge

Photo shows overturned van on bridge with heavy recovery vehicles alongside





83% hit rate when all warnings and 341 impacts considered, 40% hit rate for just red and amber roads

87.4% for all warnings and 55% for red and amber only when WOW impacts removed

Performs well for large storms

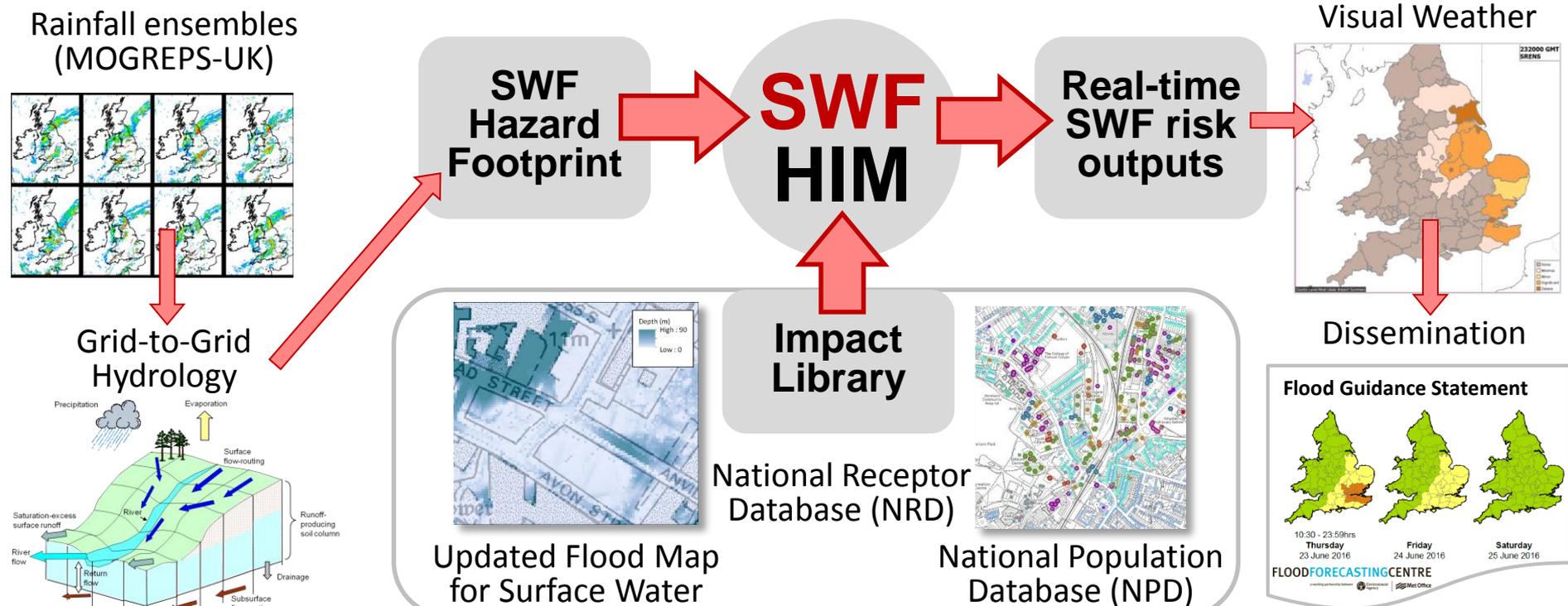
Performs less well during coastal events

Surface Water Flooding Hazard Impact Model

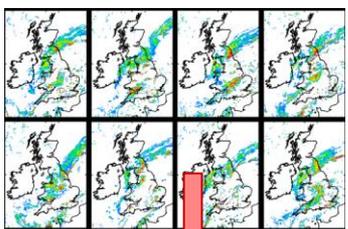


SWF HIM Overview

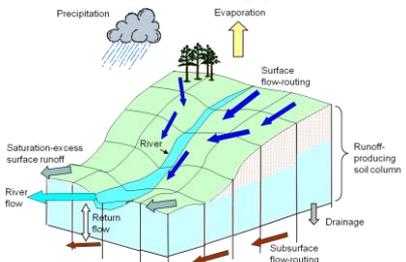
SWF HIM innovation **builds on existing** models, data and tools



Rainfall ensembles (MOGREPS-UK)



Grid-to-Grid Hydrology

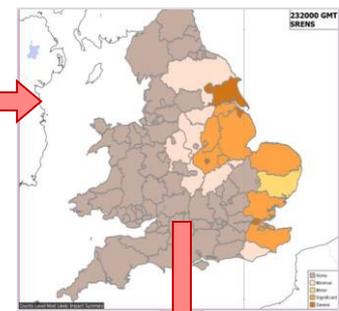


SWF Hazard Footprint

SWF HIM

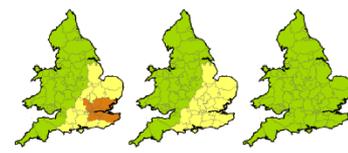
Real-time SWF risk outputs

Visual Weather

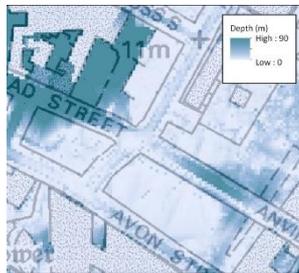


Dissemination

Flood Guidance Statement



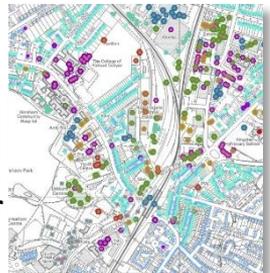
10:30 - 23:59hrs
 Thursday 23 June 2016
 Friday 24 June 2016
 Saturday 25 June 2016
 FLOODFORECASTINGCENTRE
 A partnership between the Environment Agency and Met Office



Updated Flood Map for Surface Water

Impact Library

National Receptor Database (NRD)



National Population Database (NPD)

Impact Library Construction

Hazard

EA Updated Flood Map for Surface Water (uFMfSW)

Exposure

OS MasterMap Building Information
EA National Receptor Database (NRD)

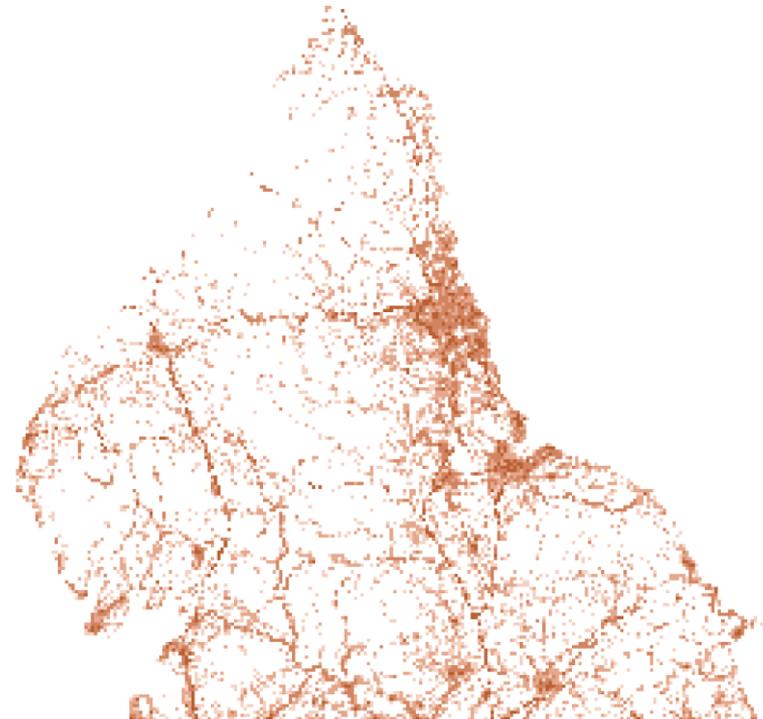


Hazard Rating	Degree of Flood Hazard	Description	Vulnerability
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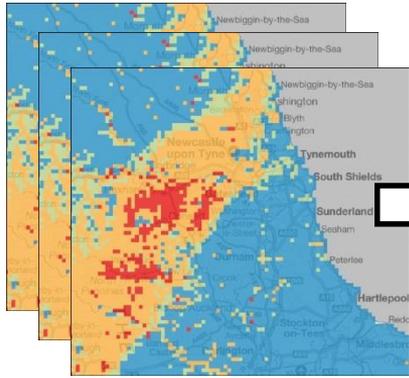
Result – SWF impact indicators for each 1km cell by criteria

Thresholds used to assign impact severity level to cell

Vulnerability



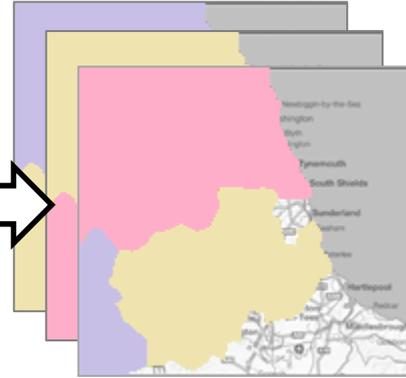
Surface Water Flooding HIM Risk Outputs



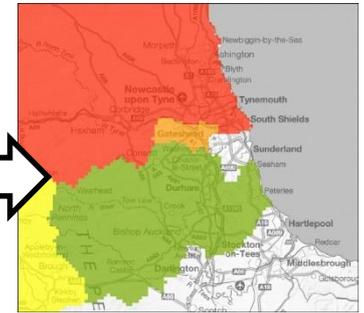
Ensemble of SWF hazard footprint



1km impacts via Impact Library

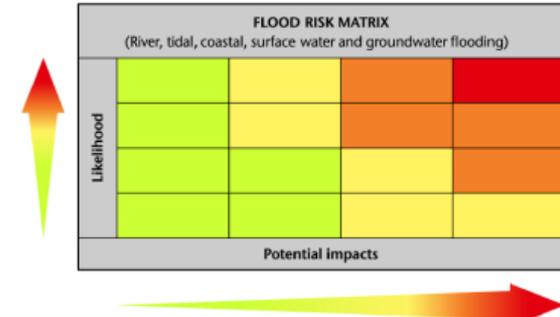


Regional Summary of SWF Impact

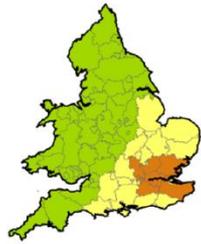


Regional Summary of SWF Risk

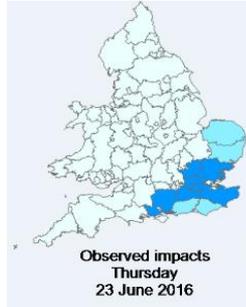
- Regional impact summary for *each* ensemble member
- Combine **impact and likelihood** to calculate **risk**
- Summarises over **time, space & uncertainty**
- Reporting by County/Authority



Trial case study: 23rd June 2016

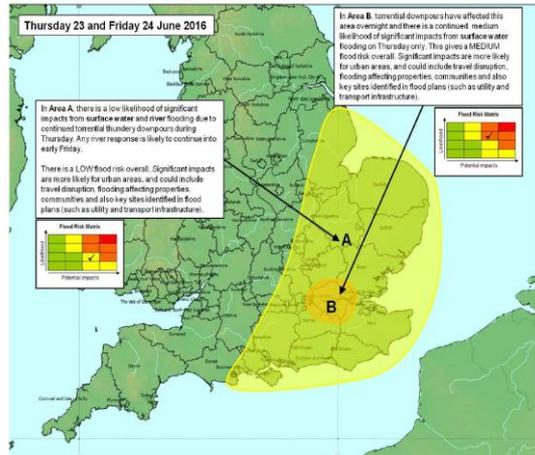


10:30 - 23:59hrs
Thursday
23 June 2016

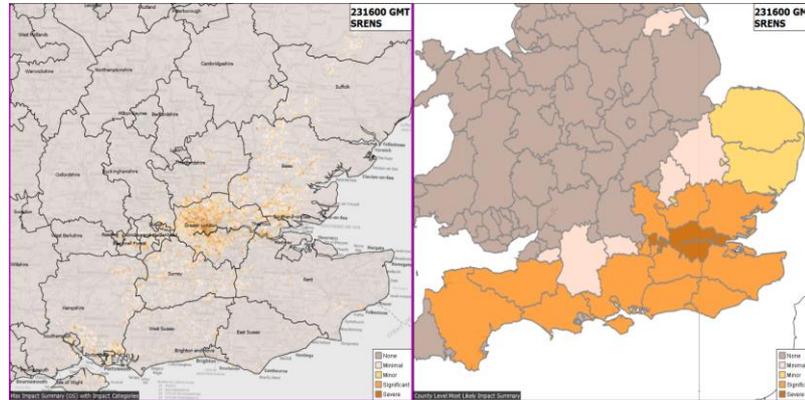


Observed impacts
Thursday
23 June 2016

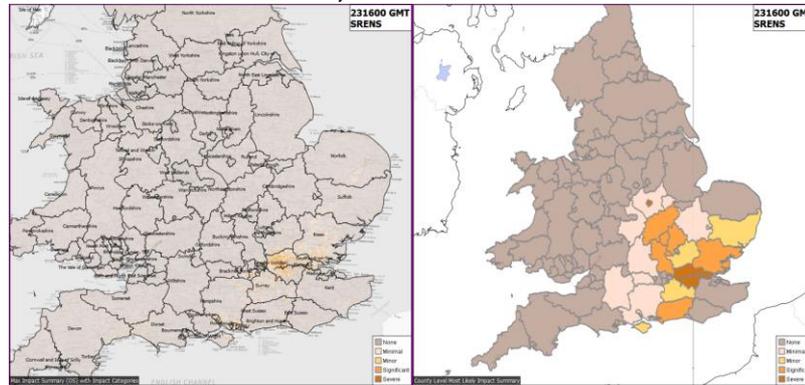
Specific areas of concern



Forecast for 1600hrs, from 0400hrs model run



Forecast for 1600hrs, from 1000hrs model run



Gtr London

23-Jun-2016 16:00:00

Threshold = 15 sq. km.

Impact	Members
None	15
Minimal	1
Minor	0
Significant	4
Severe	4

[SRE 1000_17]

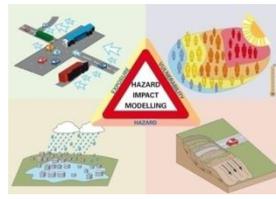
Slough

23-Jun-2016 16:00:00

Threshold = 0 sq. km.

Impact	Members
None	20
Minimal	0
Minor	0
Significant	0
Severe	4

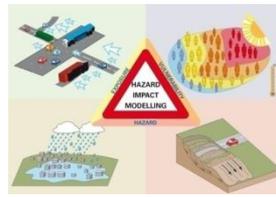
[SRE 1000_1]



Real-time tools which:

- Aid decision making for warnings/alerts
- Improved preparedness before event
- Improve understanding of natural hazard impacts
- Encourage cross-organisation collaboration to create and visualise

HIM Challenges



HIM development presents challenges that need to be addressed:

**Underpinning
Science**

Available Data

Timeliness

**Communication
of Results**



Hazard Impact Framework

www.naturalhazardspartnership.org.uk/hazard-impact-framework

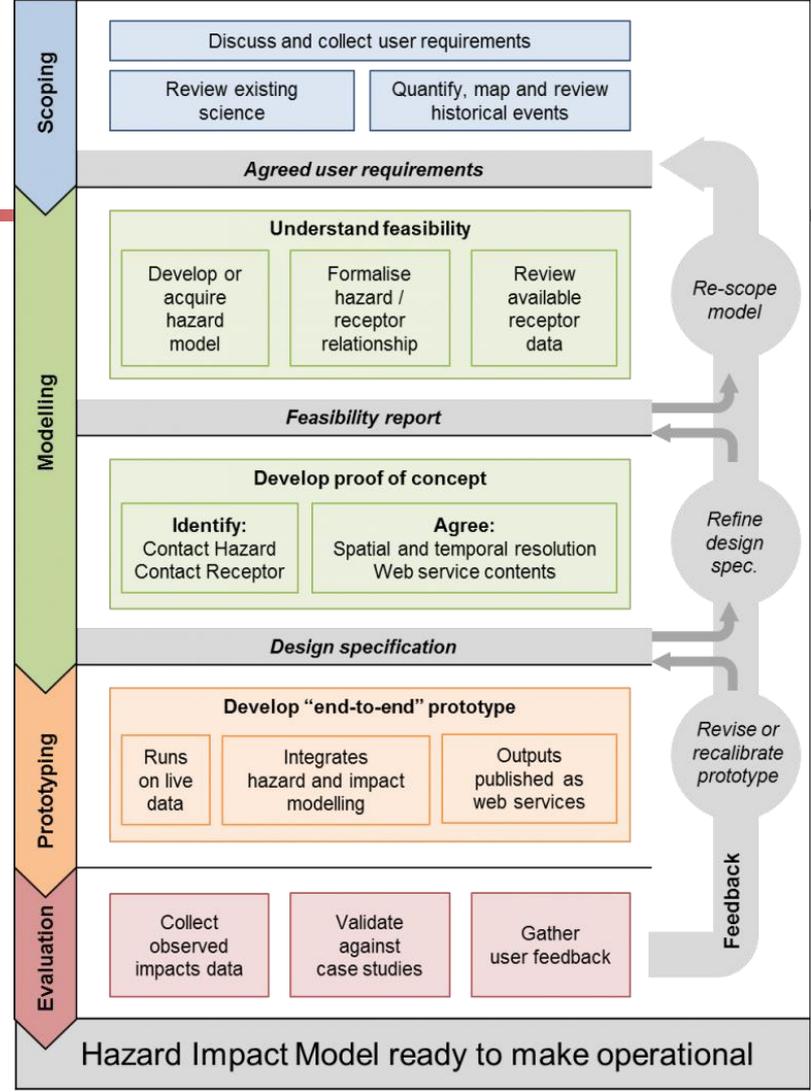


Hazard Impact Framework

The Hazard Impact Framework (HIF) provides the NHP with a **common and consistent approach** to modelling and forecasting natural hazard impacts. Specifically, the HIF is a source of **definitions** and **common concepts** in impact modelling. It provides a standard series of **guidelines** and, where necessary, stricter **protocols** for **building and developing HIMs**.



Natural Hazards Partnership Hazard Impact Framework: First Edition





Hazard Impact Framework

- Allows for model interoperability
- Multi-hazard impact assessment
- Written with the aim that it can be applied to all hazards, timescales, resolutions, assets...
- Working document which will evolve as knowledge and experience is gained

NHP - Next steps

- New NHP **Operating Plan** by end of year
- Work on **multi-hazards** including concurrent and cascading hazards using HIF
- **Longer term impacts** – month timescales
- Impact model **verification** using social media impact reports
- **New HIMs**
 - Scoping snow and ice
 - Potential future HIMs: air quality, heat and cold, groundwater, lightning

Summary

- **Hazard Impact Modelling** can be used to provide relevant information on storms and impacts providing answers to the ‘What does this mean?’ question
- **Vehicle OverTurning model** and **Surface Water Flooding HIM** are examples of short term forecast models however the same algorithm - Hazard x Vulnerability x Exposure - can be applied to longer range forecasting using the:
- **Hazard Impact Framework**, used to create HIMs in a consistent way, allowing for multi-hazard impact analysis



Hazard Impact Modelling for Storms Workshop

Ken Mylne, Becky Hemingway, Ervin Zsoter

Tomorrow, Thursday, 3.50pm-4.50pm
Don't miss it...there will be impacts!



Thank you!

Learn more on our website

www.naturalhazardspartnership.org.uk