



**British  
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL

**Gateway to the Earth**

# **Intersections between Resilience & Risk : A Geological Survey Perspective**

**Professor Katherine Royse**

**Director GeoAnalytics & Modelling**

There is no such thing as a 'natural' disaster. Environmental hazards become disasters as a result of the risk and vulnerabilities that people are exposed to

City Clusters present real opportunities for innovation and socio-economic development in the midlands and northern England but how resilient are they ?

If in the future we could mitigate 80-90% of risks in our cities would we make the population more vulnerable

Disasters are not single events but compound processes that must be understood in context





# The Impact of Geology on the built environment?

**NEWS BEDS, HERTS & BUCKS**

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15 February 2014 Last updated at 17:31

## Hemel Hempstead sinkhole causes houses to be evacuated



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## Flood risk from rising ground water in North Yorkshire

2 January 2013 | England

Parts of North Yorkshire are at risk of flooding from ground water levels, according to the Environment Agency.



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England Regions London

## Drills break through into busy London rail tunnel

8 March 2013 | London

Two construction drills broke through into a railway tunnel in east London on a busy First Capital Connect route.

Services on the Moorgate to Finsbury Park route were stopped after a driver said muddy water had poured on to his roof near Old Street Station.

An hour later, at about 11:00 GMT, two piling drills came through as a train with only a driver and Network Rail manager approached to inspect the area.



Rail staff spotted the drills which broke through into the tunnel


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England Regions York & North Yorkshire

## Ripon homes evacuated after large sinkhole opens

10 November 2016 | York & North Yorkshire



Frances O'Neill describes discovering a sink hole in the rear garden of her Ripon home

Seven homes have been evacuated after a large sinkhole opened up behind a row of houses in North Yorkshire.

One resident said she felt the ground moving beneath her as she ventured into her back garden in Magdalen's Road, Ripon.

Fire crews were called to the street at 22:30 GMT on Wednesday, where they

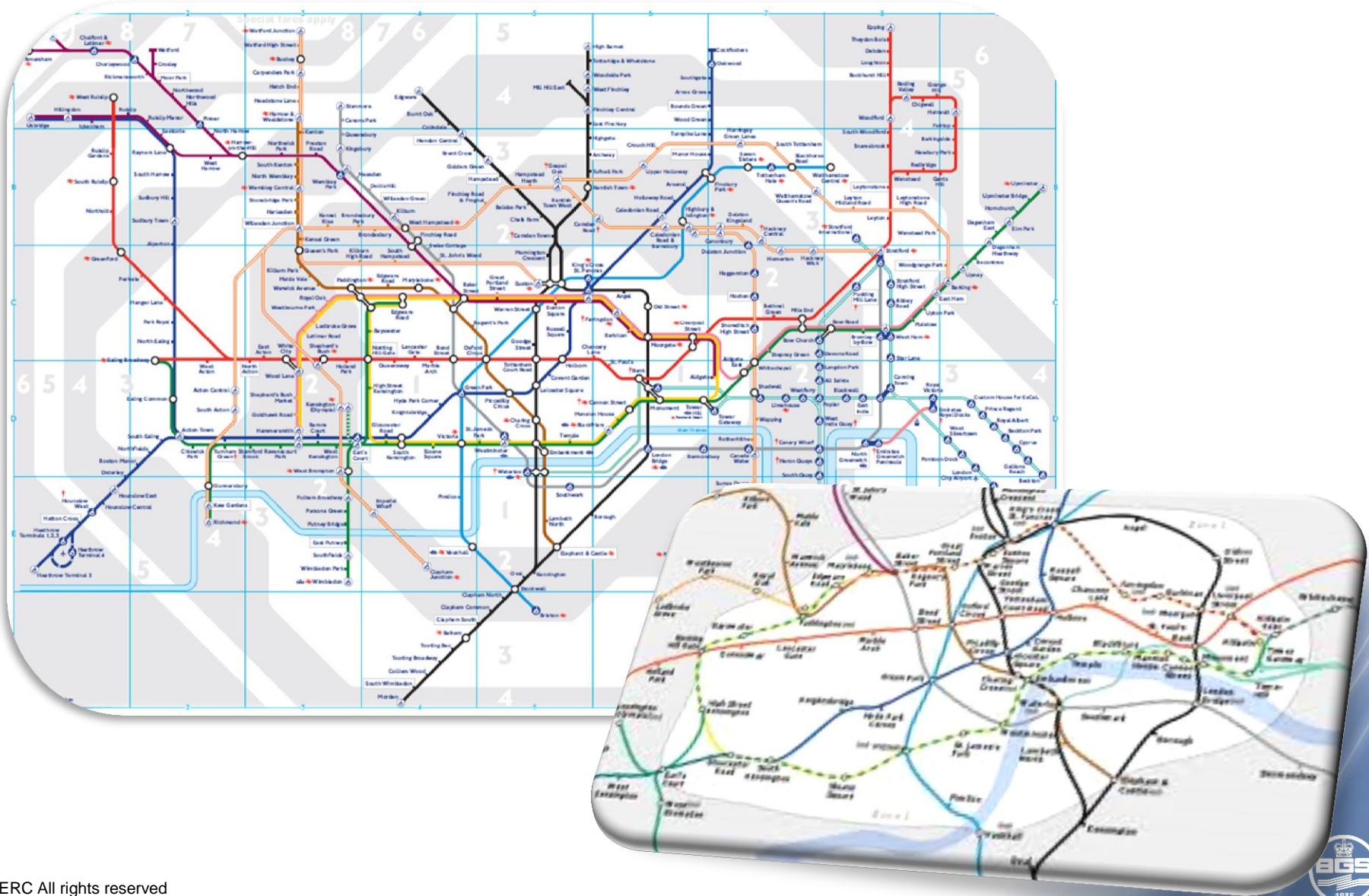
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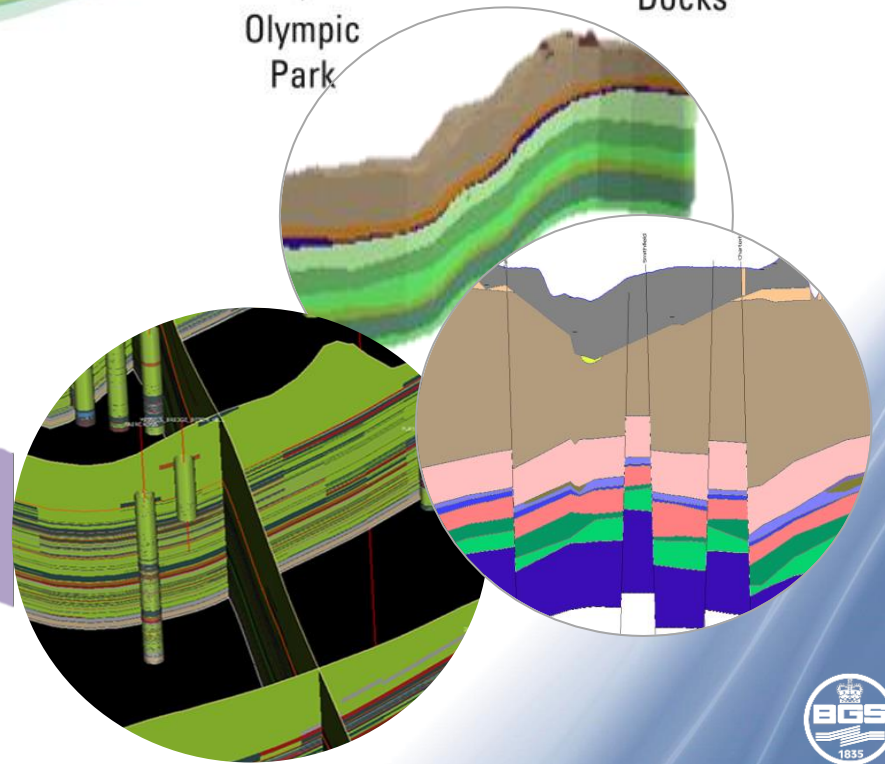
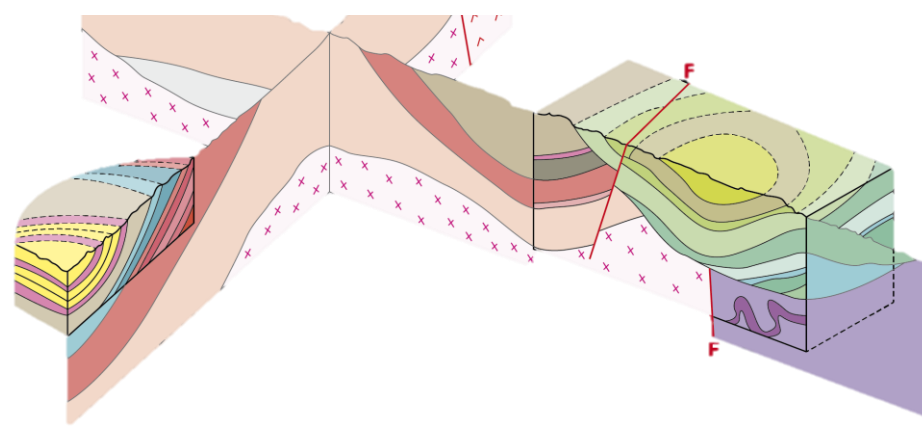
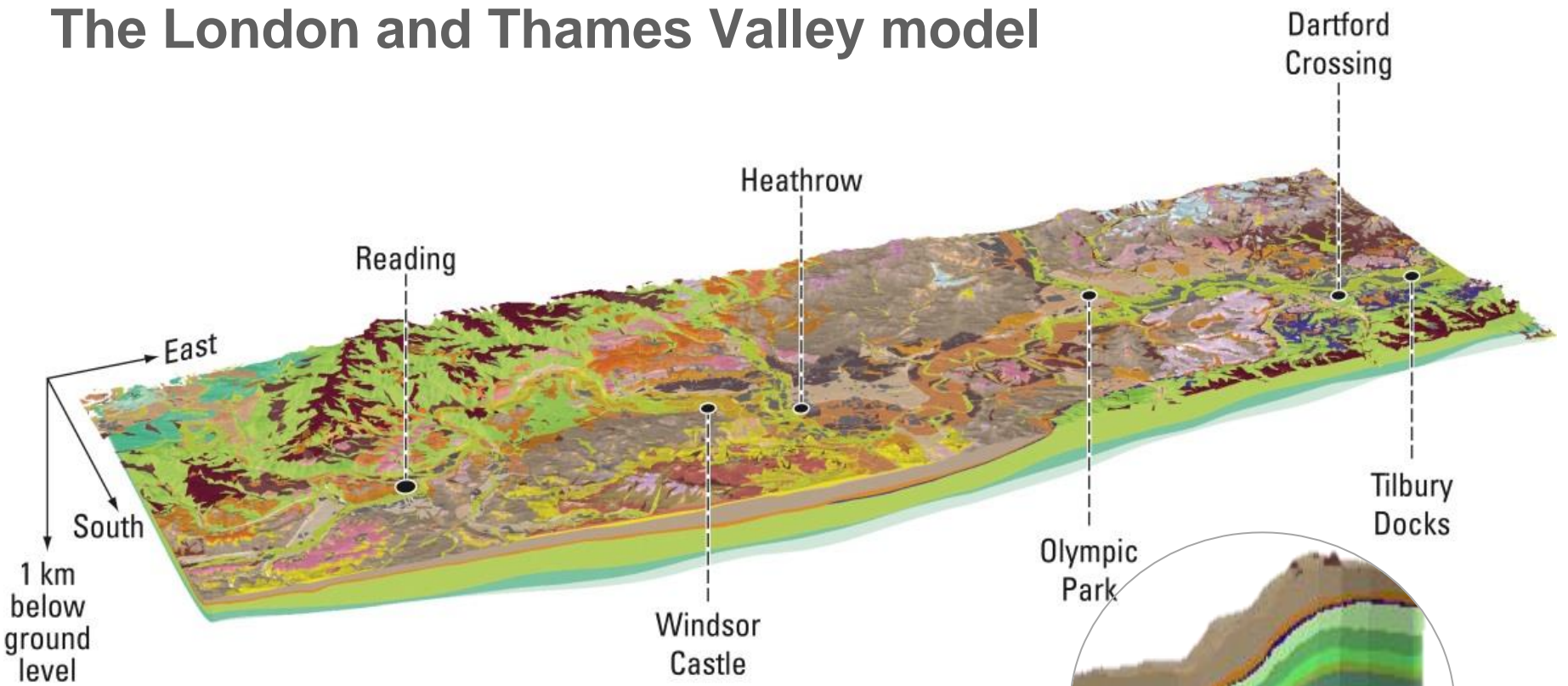
- Invisible addicts

# Geologies Influence on London's Development





# The London and Thames Valley model



Geology can be very complex

# Increasing cost in the East Midlands

Economic impact of flooding and ground instability to the cities of Derby, Nottingham & Leicester will increase from £1bn 2005 to £2.5Bn by 2025

Impact to UK infrastructure due to ground movement costs £300-500m per yr.

10-35% of all utility service disruptions are caused by natural hazards

Closure of the 1M due to flooding costs £1M per hour

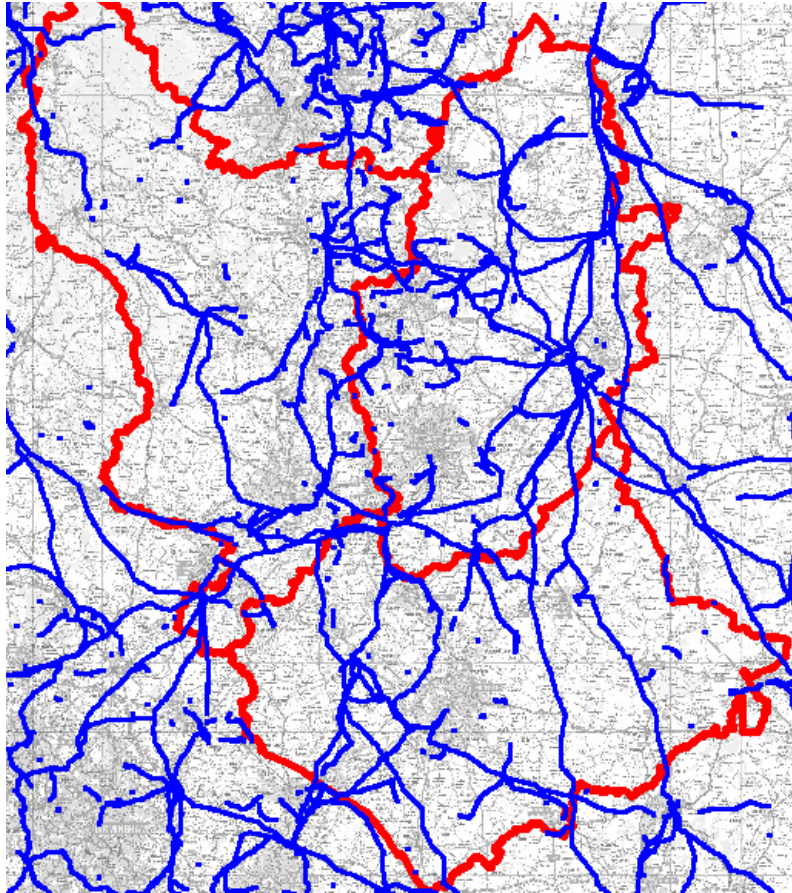
Highest levels of commuting in UK



*M1, Midlands Mainline, Radcliffe Power station & soon HS2 link @ Toton go across the Trent within 3Km of each other*



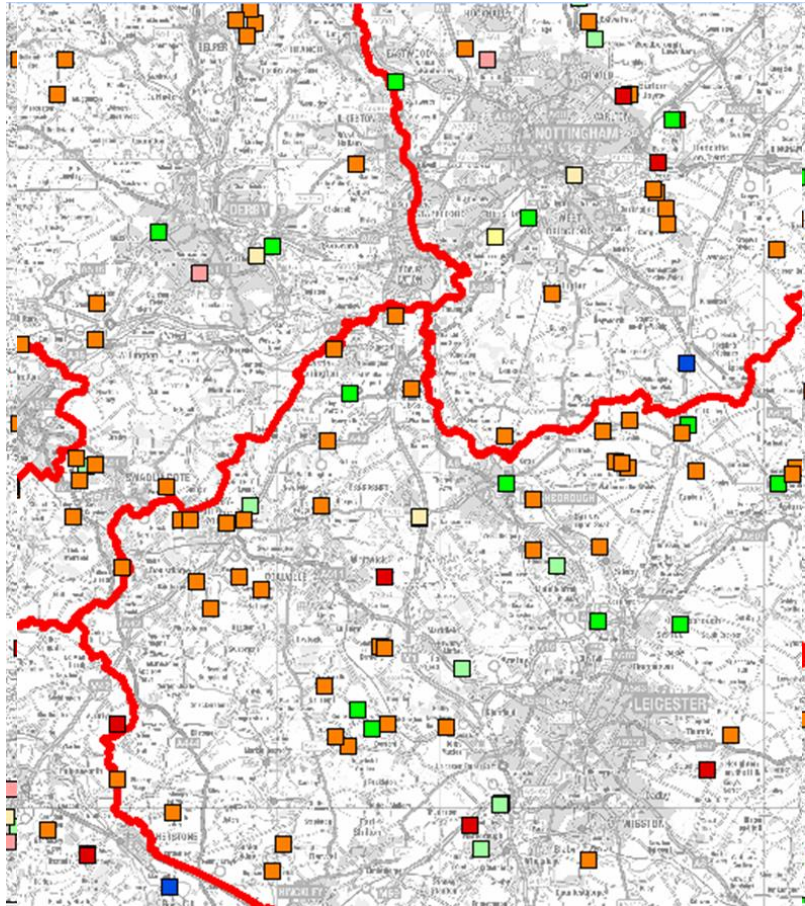
# Power Network: East Midlands



- 10000's Towers & pylons
- 1000's Substations
- 100'skm Buried cabling (lv)
- Multiple co-locations (river, exposed areas, woodland)
- All local supplies and cross network links to water/comms/transport



# Power Network: Alternatives



- 100's 'Renewables' Wind/Solar/Biomass
- Some co-locations (exposed areas, woodland)
- Resilience awareness and preparedness unknown
- What is the community reliance?
- What is the network reliance?



# Impact of Bridge Failure





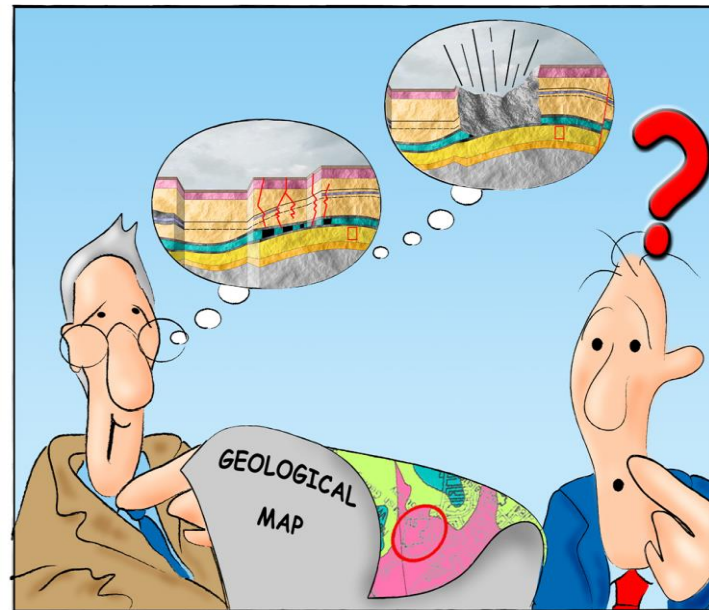
- Some 3,203 bridges in Britain are not fit to support the largest HGVs, which can weigh up to 44 tonnes, according to the RAC.
- Many of structures have weight restrictions and others are under programmes of increased monitoring or managed decline.
- The number of substandard bridges has leapt by more than 35% over the past two years, to around 4.4 % of the 72,000 bridges on the local road networks.



# KE Essential

- BGS core function is to apply our science to meet the needs of society
- **BGS** has to bridge the understanding gap
- we have to listen and be imaginative, flexible and innovative in the way we exploit our data and information technology

# #ScienceMerger

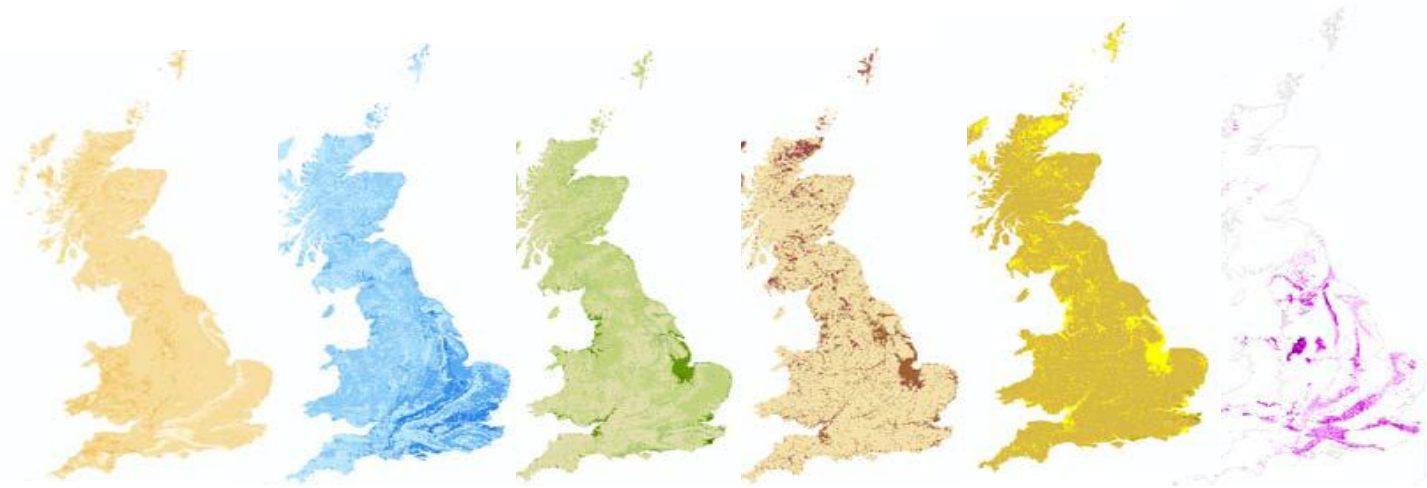


## Innovation = Problem x Solution x Execution





# Ground stability Hazards: GeoSure



- **Naturally occurring hazards**

- Subsidence (Shrink-swell; compressible, +/-dissolution)
- Landslides (domains; landslide database; debris flow; pathway analysis/run-out; falls)

- **Anthropogenic-influenced hazards**

- Running sand
- Compressible
- Collapsible



# Responding to changing Needs

- **Stern Review 2007** *'economic benefits of strong early action on climate change outweigh the costs'*
- **Pitt Review 2010** *'all organisations have a duty to share information, better visualisation tools; improve modelling and forecasting'*
- **Eyjafjallajokull 2010** *'better understanding of the hazard is needed, thresholds for safe flying should be defined on the basis of evidence, risk aversion should not be a strategy for any future eruption scenario'*
- **TE2100 Plan 2012** *'we must either invest more in flood and coastal management or learn to live with increased flooding'*



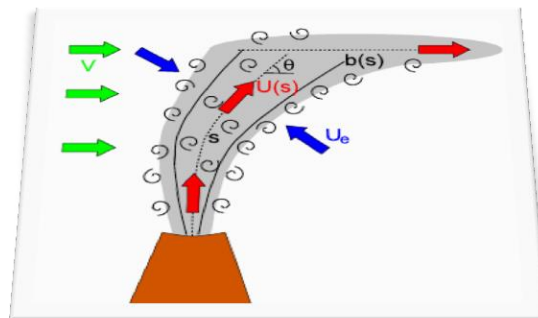
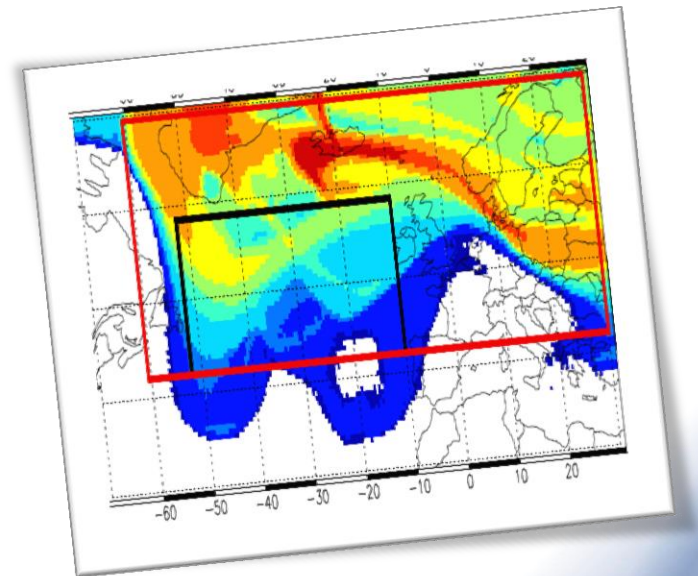
# Lessons learned

- Manage risks not avoid
- Governments and responders need access to all the scientific data and information in one place in a form that can be easily and quickly interpreted
- We need to be able to improve our modelling of hazards so that we can improve our forecasting and scenario planning tools
- Cost-benefit can't protect everything...what is its value?
- Scientist need to be able to communicate complex scientific concepts to the non-scientist

It's only a  
failure  
if you don't  
learn  
something

# Volcanic and Atmospheric Near- to far-field Analysis of plumes Helping Interpretation and Modelling

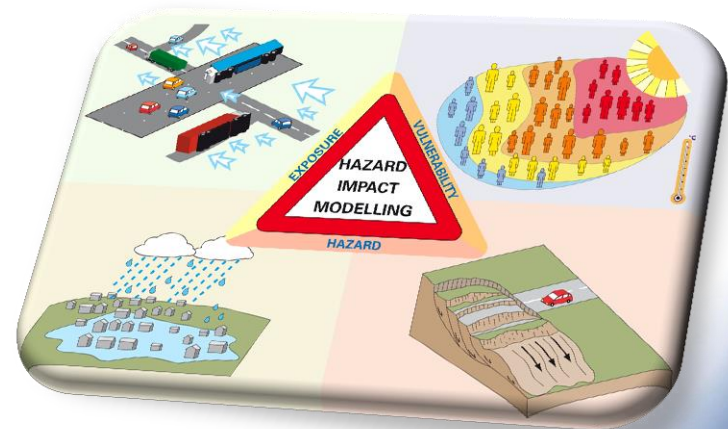
- Lead by NCAS, BGS and 7 other institutions
- Response to 2010 Eyjafjallajokull eruption
- Improve information provided to the aviation community by developing better dispersion models
- Dispersion models can be improved through better characterisation of plume dynamics and the physical properties of the ash and gases in the plume





# National Hazard Partnership

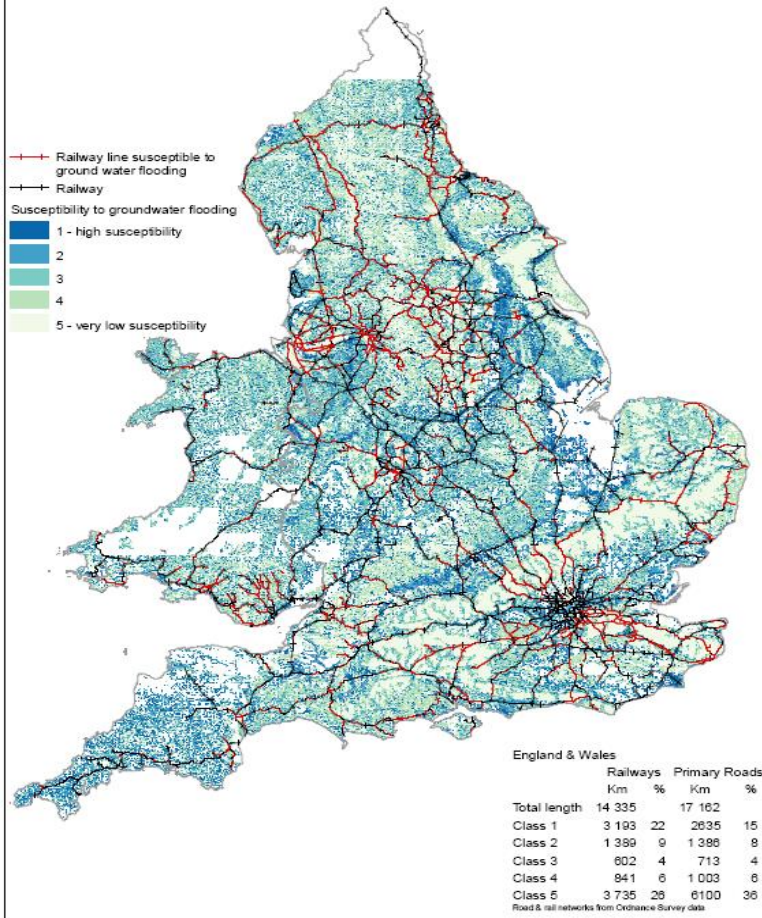
- Setup in 2011
- Consortium of public bodies
- Exchanges knowledge, ideas, expertise, intelligence & best practice
- Provides a timely and consistent source of advice to government & emergency responders for civil contingencies & disaster response
- Creates an environment for the development of new services to assist in disaster response



# Groundwater Flooding



Effect of Groundwater Flooding on Primary Roads and Rail networks



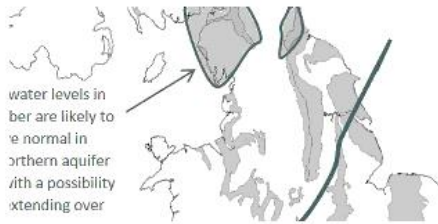
Visit [www.hydoutuk.net](http://www.hydoutuk.net) for the latest Hydrological Outlook map







## Latest Outlook



water levels in  
ber are likely to  
e normal in  
rthern aquifer  
with a possibility  
xtending over

The Hydrological Outlook UK is published monthly.  
The latest can be viewed here.

[Read more](#)

## Methods



Do you wish to know more about the methods used to  
produce the Hydrological Outlook UK?

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## Supporting outputs



Further information on the research that underpins the  
Hydrological Outlook UK is available.

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# ResilienceDirect



Cabinet Office



Department for  
Communities and  
Local Government

## Welcome

A COMMON INFORMATION PLATFORM FOR CENTRAL AND LOCAL RESILIENCE

This is for you to make it easier to do your job.

The future service will be designed and built with you.

ResilienceDirect is by you, the Resilience Community.

## About ResilienceDirect



Commissioned by the Cabinet Office and supported by Ordnance Survey, ResilienceDirect is a service that was launched in March 2014.

[Learn more](#)

## Communities prepared



The Communities Prepared website is a new, free resource to help you build the resilience of communities and groups that you work with.

[New free resource](#)

 **UKResilience** [Follow](#)  
@UKResilience

Goodbye from @UKResilience @OrdnanceSurvey @CommunitiesUK at stand P19. Thanks for a great show @emergencyukahow #ESS2014 #ResilienceDirect  
5:44PM - 25 Sep 2014 from London

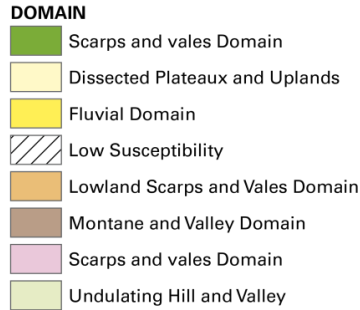
There's still time to visit P19 and trial the #ResilienceDirect mapping tool, brought to you in collaboration with @OrdnanceSurvey #ESS2014  
2:07PM - 25 Sep 2014 from London

Proud winners of the EPS Resilience Awards 2014 Most Innovative Product of the Year, thank you #ResilienceDirect <http://t.co/BJHKSIMlJU>  
12:34PM - 25 Sep 2014 from London

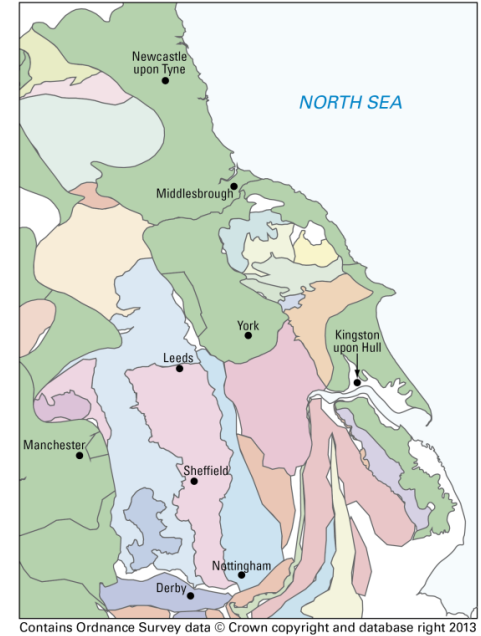
Good morning and welcome to day 2 #ESS2014. Visit us on stand P19 with @OrdnanceSurvey & @CommunitiesUK to see our system #ResilienceDirect  
9:40AM - 25 Sep 2014 from London

Great day with @emergencyukahow @OrdnanceSurvey & @CommunitiesUK. At #ESS2014 tomorrow? Visit P19 #ResilienceDirect <http://t.co/xVHz5Vpvu9>  
9:40AM - 25 Sep 2014 from London

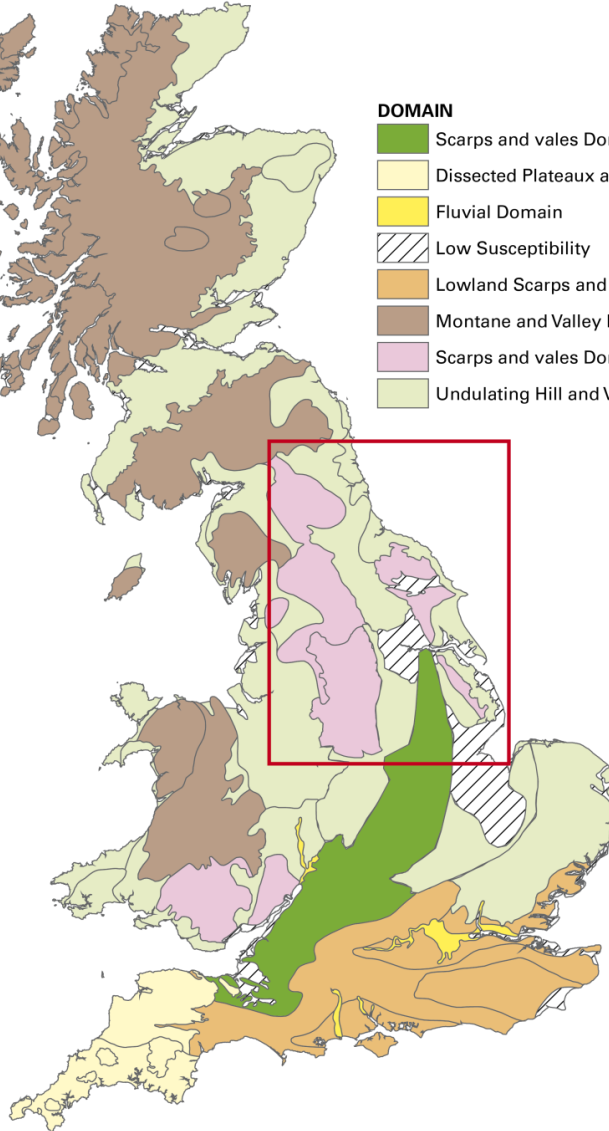
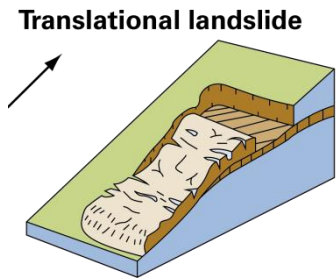
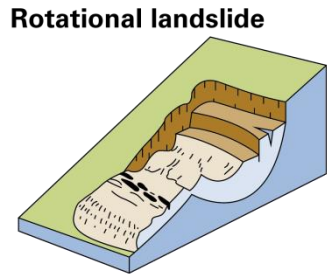
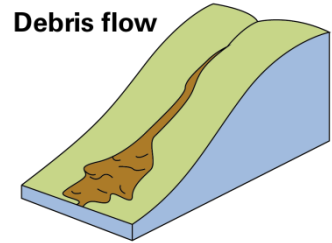
# Landslides (domains)



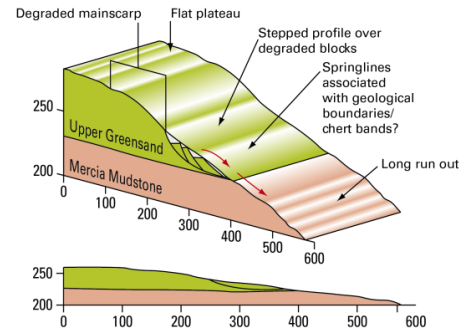
## Sub Domains



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### Blackdown Common (NLDN 10812, NGR 311440, 116663)



**Geology:**

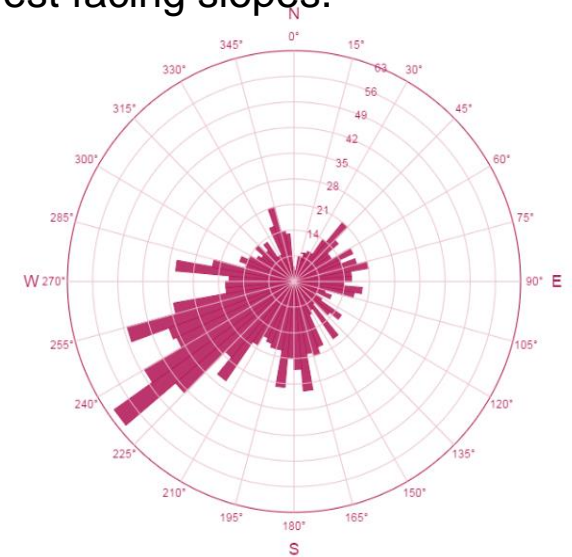
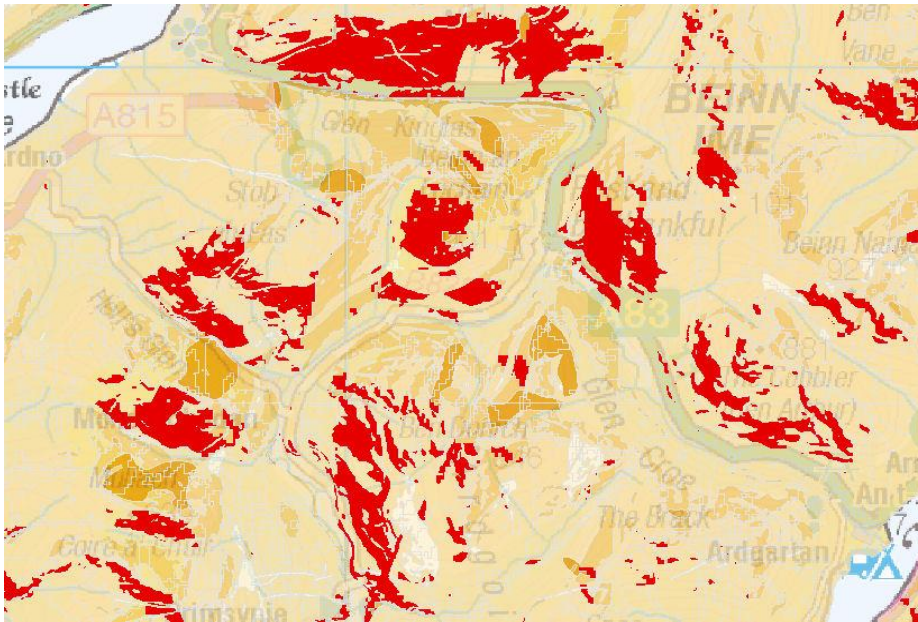
- Permeable Upper Greensand Formation overlying relatively impermeable Mercia Mudstone Group

**Geomorphology:**

- Markedly non-circular rotational failures
- Very degraded transitional blocks
- Long run out of toe in degraded Upper Greensand up to 1400 m
- Failure is most likely to occur at locations where water pressure is enhanced by impaired drainage (at chert or clay bands) or greater water flow (along fault zones).

# Temporal services: Forecasting heighten susceptibility

- This dataset can then be used to highlight potential areas that might be susceptible to heightened landslide hazard due to its slope aspect.
- Debris flows might be more susceptible on the south – west facing slopes.
- These can be highlighted in the data as shown below

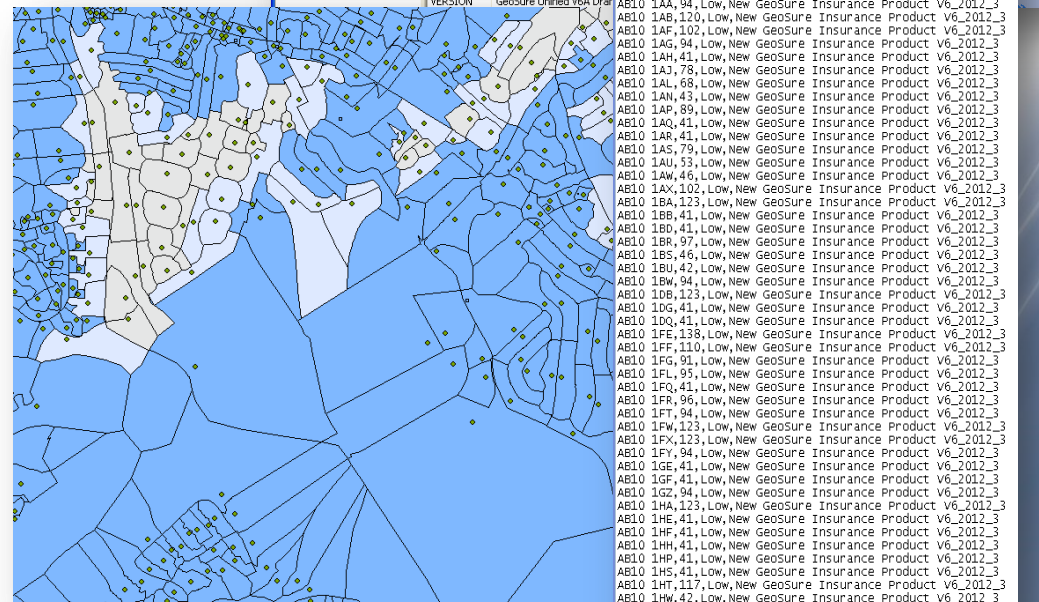
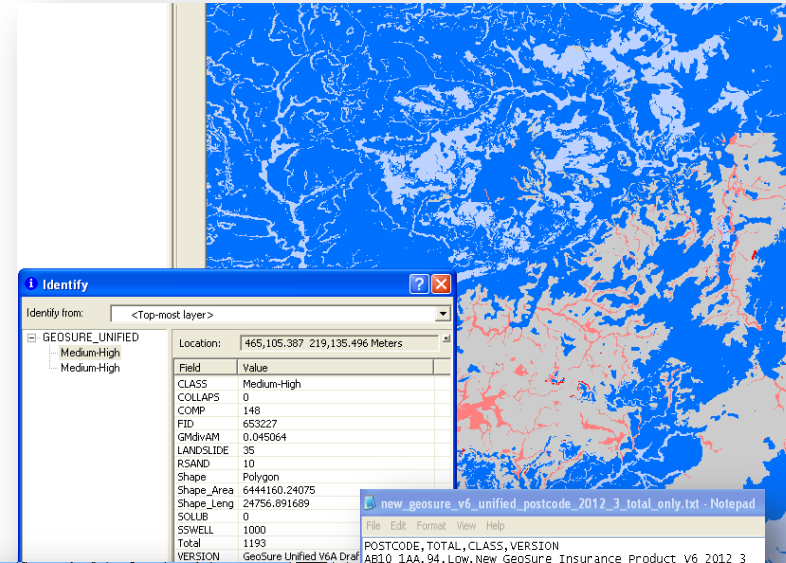


*Areas of moderate (Geosure C) to high (Geosure D and E) susceptibility on south – west facing slopes are highlighted in red.*



# GeoSure Insurance Product

- Provides information specifically for the insurance industry
- Indicates the potential insurance risk for natural ground instability to be active at a site
- Provides an analysis of all potential hazards present but delivered in a simple valorised format
- Uses Sheffield Elicitation Framework to derive the probability of occurrence and impact



# Communication



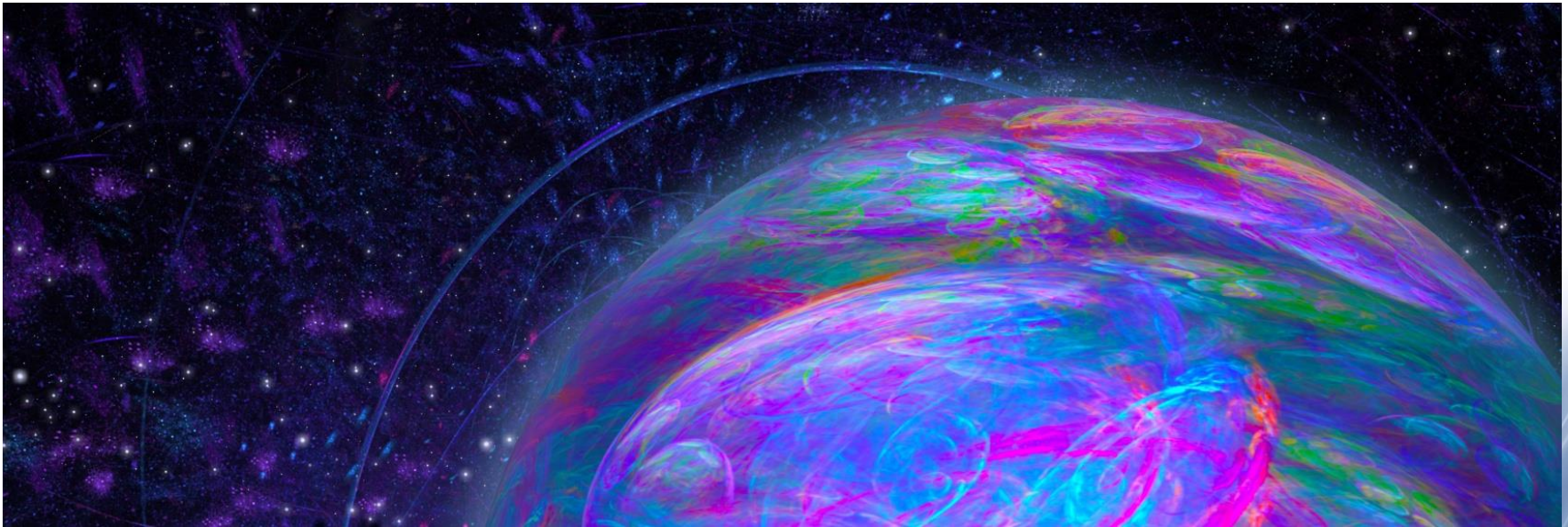
- Critically Important to communicate risk well, saying enough to be helpful while avoiding blanket statements
- Use of models and forecasting means that we have to be able to communicate the uncertainties..... Just using words without numerical reference points can be misleading
- Speaking a common language
- Sound bite communication



L'Aquila earthquake  
2009 ....6 scientists  
prosecuted for  
involuntary  
manslaughter

# IS UNCERTAINTY A BAD THING?

Uncertainty is *not* a weakness of science. It is inevitable when finding out about how the world works – there will always be uncertainty when we push back new frontiers.





# Conclusions

- Data isn't useful unless it is interpreted, assessable and provided in a useable format
- There has been a change from static attributed map provision to complex models that can be used for forecasting and scenario planning
- Communication is key

