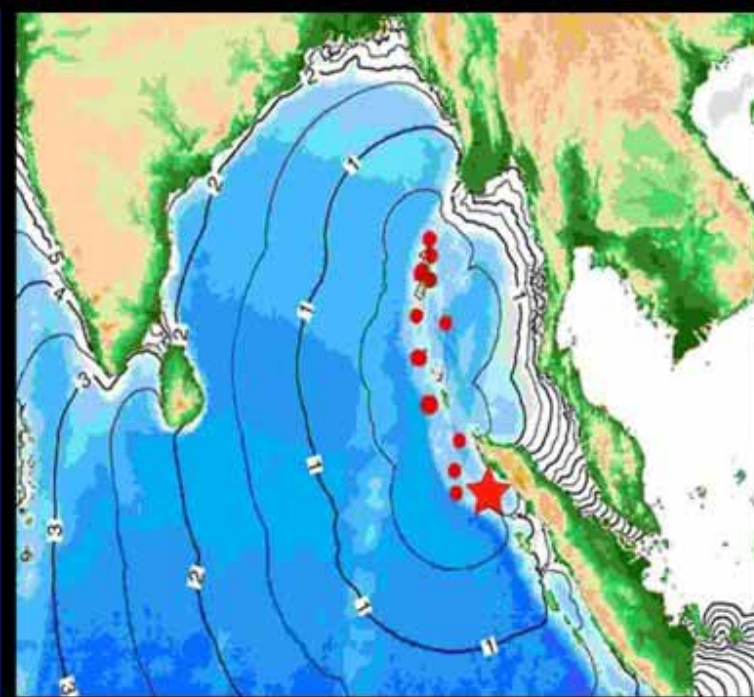


Challenges in catchment science: a Natural Hazards perspective

John Rees



Pressures - environmental

- Climate change
- Population change
- Food security
- Urbanization



Past may not be the key to the future

Pressures financial



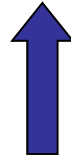
2000

2010

2020

Integrated Risk Assessment & Scientific Advice

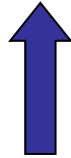
Uncertainty in forecasting and risk assessment



Hydro-meteorological					Volcanoes	Earthquakes			
Storms		Floods	Droughts, Wildfires & Heatwaves	Coastal Erosion & Flooding	Subsidence Landslides	Volcanoes		Earthquakes	Tsunami
Development of physically-based models		Development of physically-based models	Development of physically-based models	Development of physically-based models	Development of physically-based models	Development of physically-based models		Development of physically-based models	Development of physically-based models
Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey

Integrated Risk Assessment & Scientific Advice

Uncertainty in forecasting and risk assessment



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Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey	Experimental Studies	Monitoring & survey

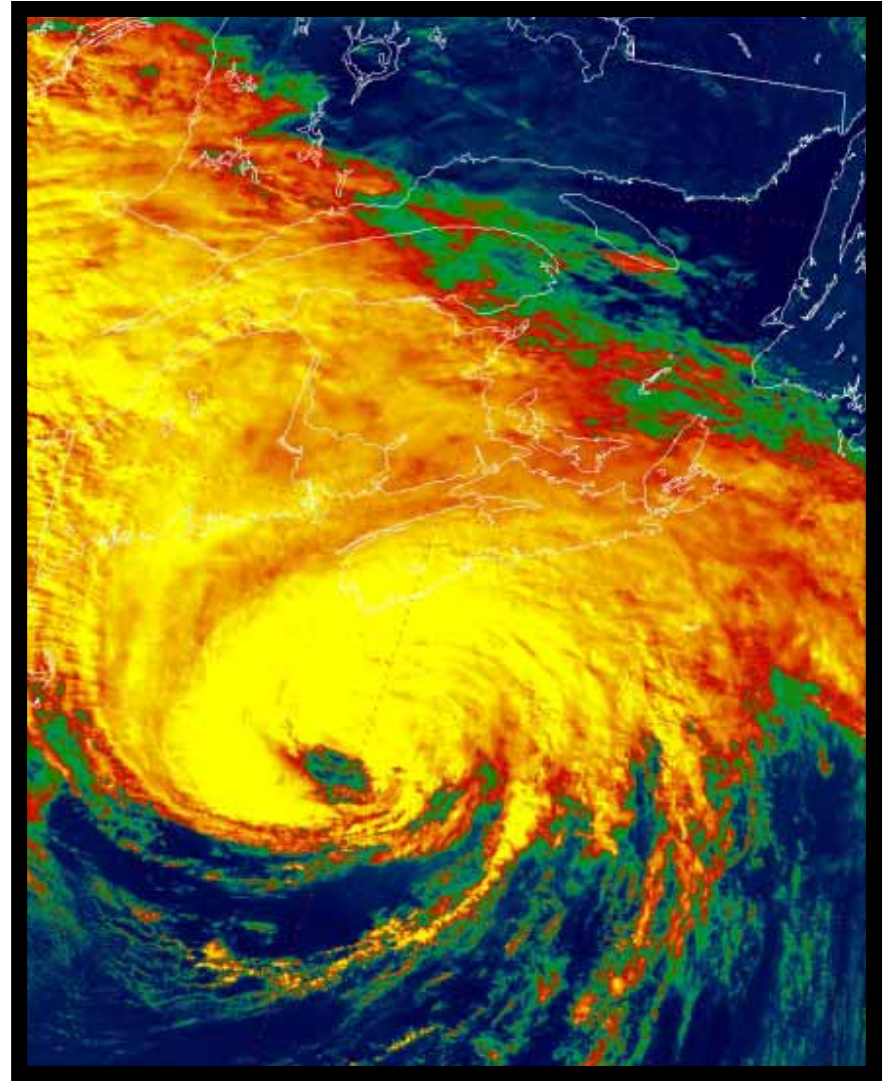
Theme Action Plan (TAP)



Hydro-meteorological focused Actions

Storms (2008)

- Increased knowledge leading to improved predictive capability of extreme wind and precipitation;
- Increased knowledge about the change in the frequency and intensity of storms under global warming conditions
- The role of storms in initiating, and enhancing the risk of, storm surges.



Changing Water Cycle (2008)



- Develop an integrated, quantitative understanding of the changes taking place in the global water cycle.
- Improve predictions for the next few decades of regional precipitation, evapotranspiration, soil moisture, hydrological storage and fluxes.
- Understand how local to regional scale hydrological and biogeochemical system properties are responding & will respond to changing climate & land use.
- Understand the consequences of the changing water cycle for water-related natural hazards, including floods and droughts, to improve their prediction and mitigation.

Analysis and communication of probability, uncertainty and risk (2010)

- Need for improved handling of probability, uncertainty and risk across NERC natural hazard research activities.



Contributing to the UK's Development of Next generation Weather and Climate Prediction Systems (2010)

- Need to maintain UK position in extreme weather research
- Severe convective storms, frontal precipitation & downslope winds all require sub-kilometre scale modelling – not possible at present
- Computational meshes and CPU time require >100,000 processors, and the UM architecture is unsuitable for appropriate parallelisation
- Joint MO-NERC-Hartree programme on the research, design and development of a new dynamical core suitable for simulation of the atmosphere on massively parallel architectures.



Coastal sediment systems (2010)

Improve understanding and prediction of sediment erosion, transport, deposition and consolidation of mixed sediment regimes, taking into consideration biological interactions.

Develop a systems-based capacity to model regional impacts of climate and human-induced change on structurally complex coasts and estuaries to inform coastal management strategies.



Forward Look

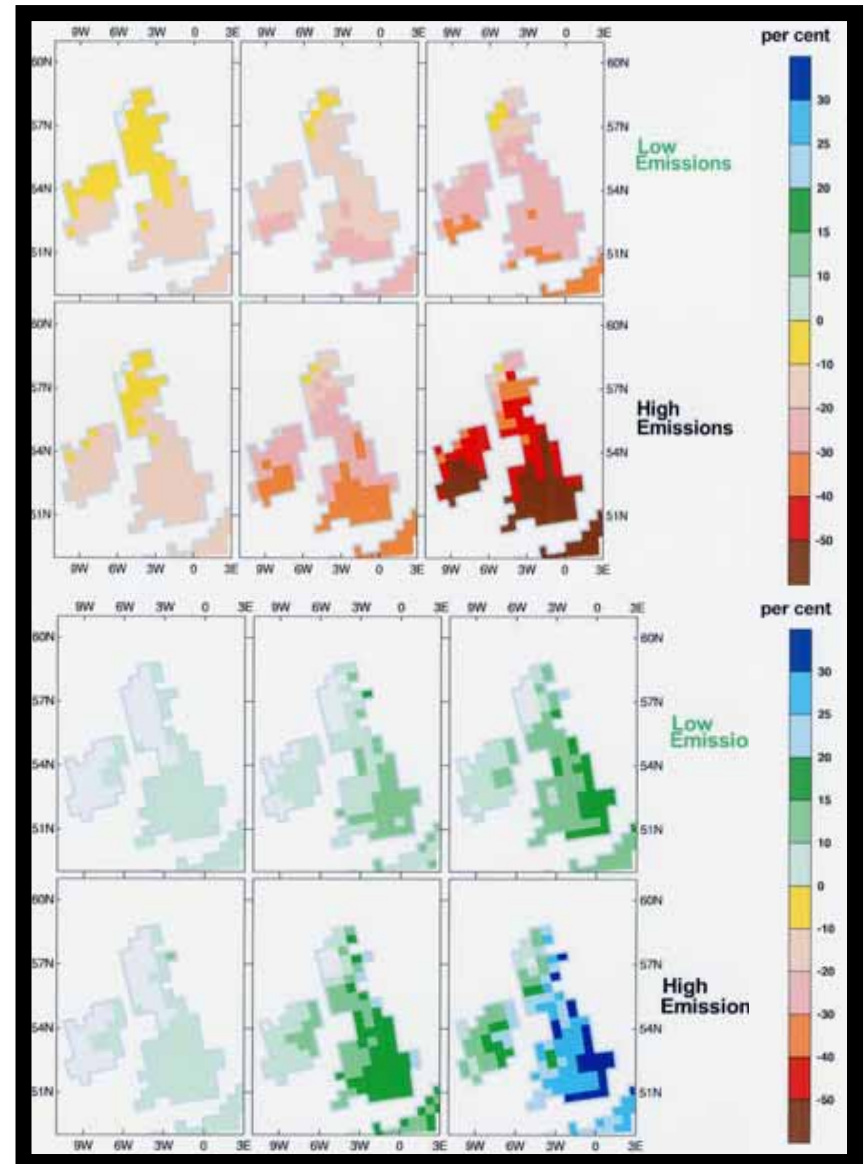
Predicting the Impacts of Climate Change on the UK

- Urgent need for improved information about the likely UK impacts of climate change.
- DEFRA leading a scoping study on a multi-partner LWEC activity on UK Impacts & adaptation.
- NERC focus on assessment and prediction of impacts.
- Developing a research programme to:
 - Develop a roadmap for the core modelling tools (addressing terrestrial, marine and atmospheric environments).
 - Support research on detection, attribution and prediction of impacts on the UK, including identifying and understanding potential non-linear responses.



Typical questions

- Flooding risk in relation to sea level rise
- Storm intensity and frequency
- *Forecasting of REALLY extreme events*
- Representation of convection
- Use of past extreme events to get a better understanding of future events
- Initialisation of convection in NWP models



Hydro-meteorological geohazards



Slope
Instability

Shrink/Swell
Clays



Collapsible
Deposits

Dissolution

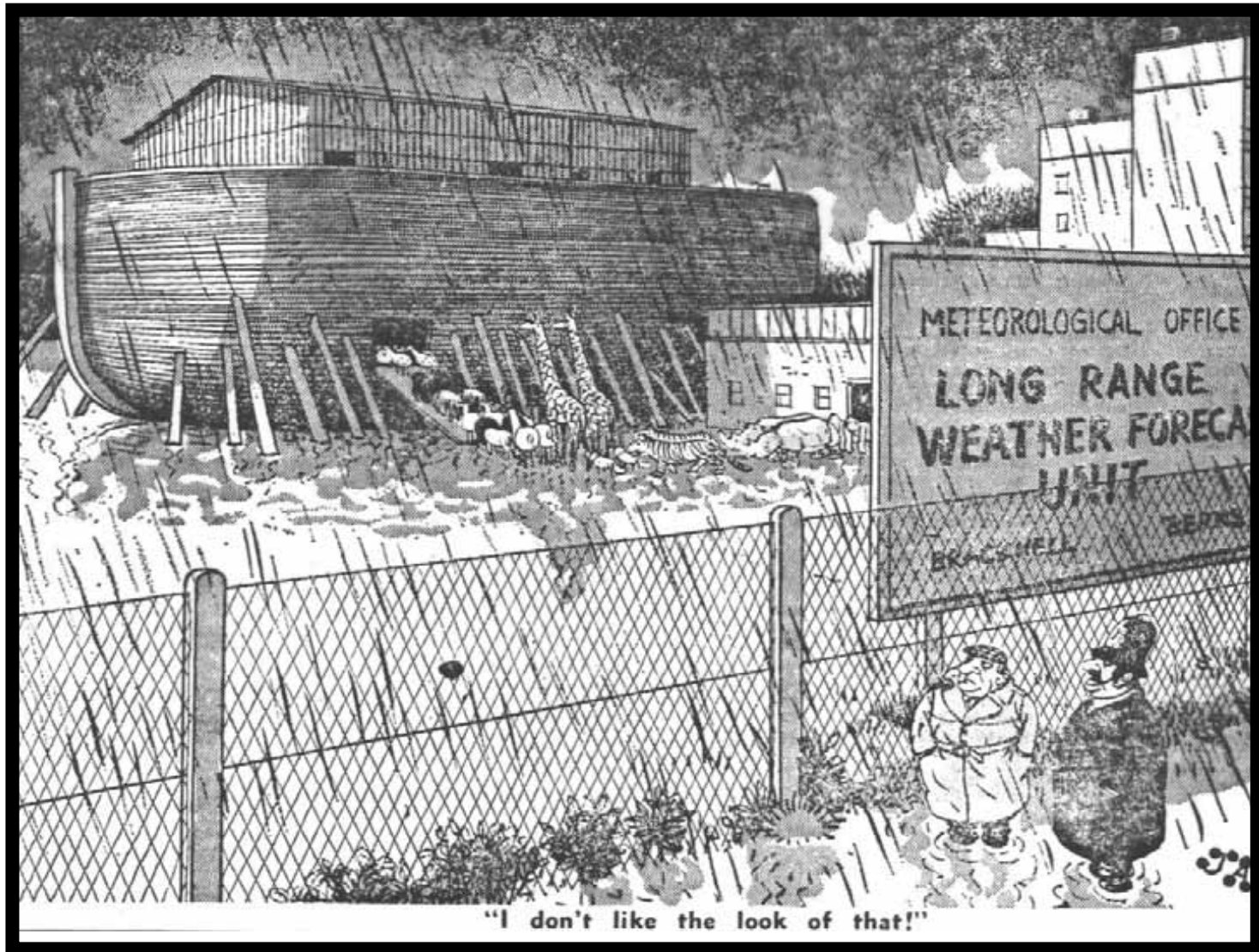


Running
Sand

Compressible
Deposits



Future flooding (2011)



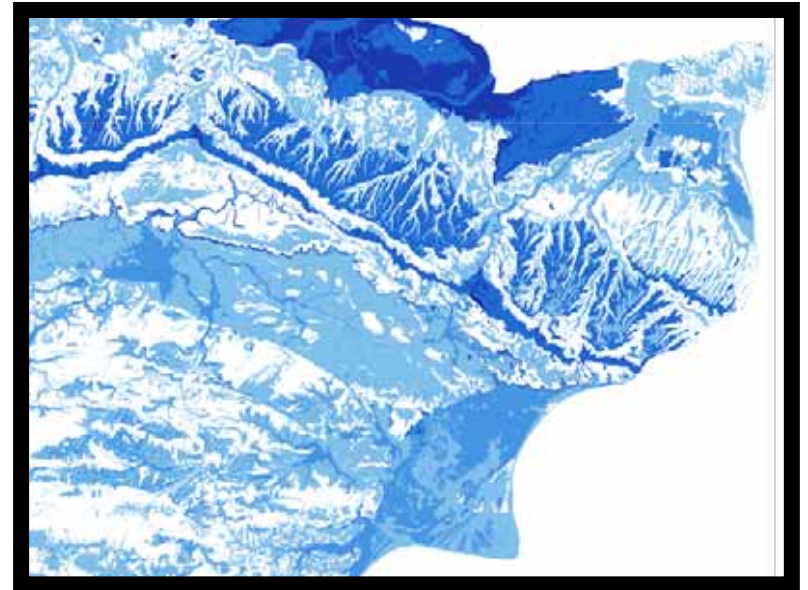
Short-term foci

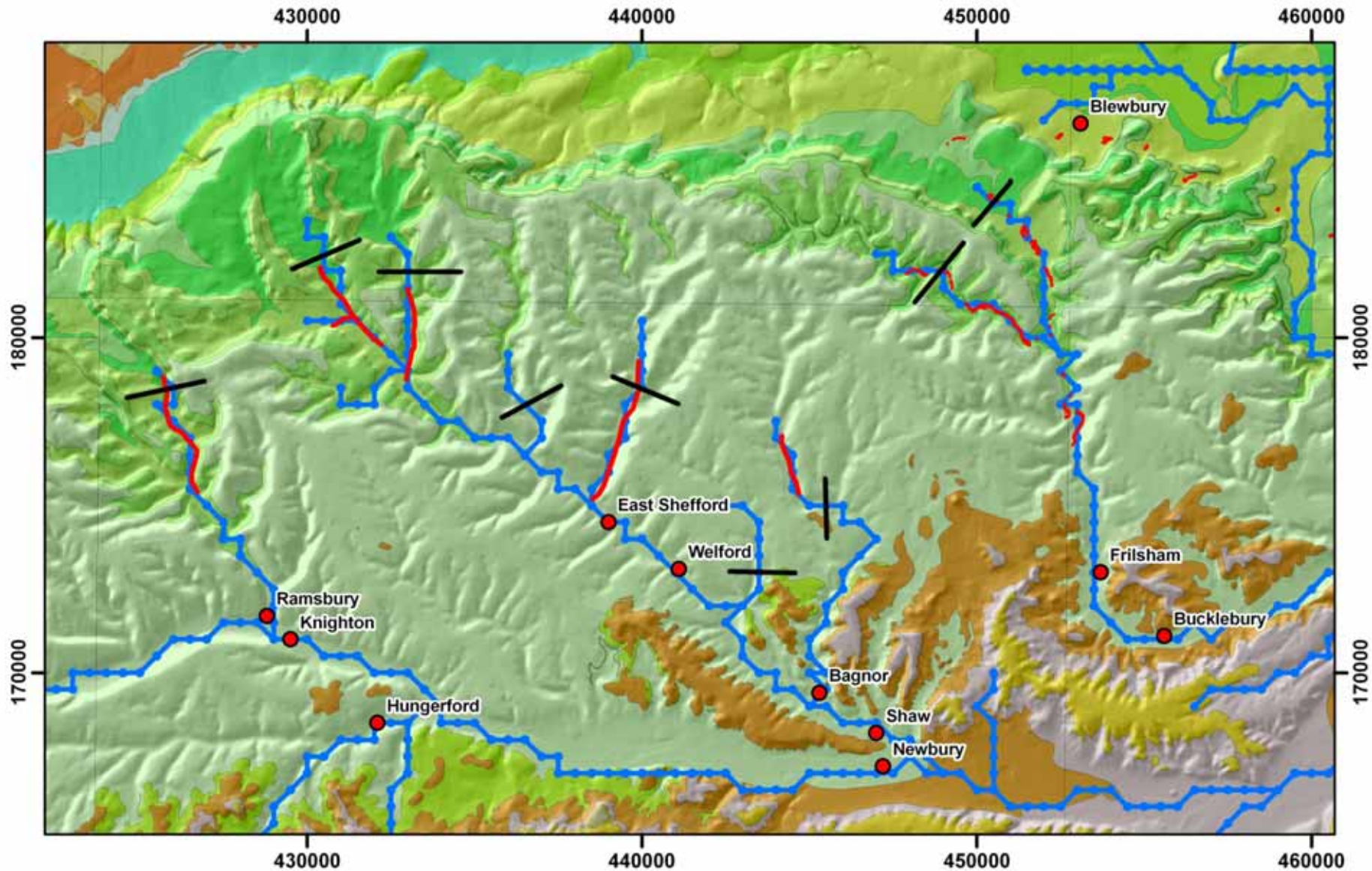
- Short term prediction of heavy rainfall
- Improve NWP representation of physics dynamics for high resolution analysis
- Use of adaptive grids
- Uncertainties & extreme events in ensembles
- Need observation to model microphysics & dynamics for prediction of storm intensity
- Need to exploit 5-minute radar observations and assimilate into NWP models
- Need observation to model microphysics & dynamics for prediction of storm intensity
- Need to exploit 5-minute radar observations and assimilate into NWP models



'Regional characterization'

- *Improved representation of soils, geology, soils, friction, topography etc. in catchments*
- Representation of urban drainage
- *Improve long-term datasets*
- Coastal modification of onshore surges
- Transfer of momentum and turbulence from atmosphere to ocean /
- *Integration of communities*
- *Improved coupling*
- Joint probability analysis of fluvial, pluvial groundwater, sewage and coastal flooding
- Risk focus

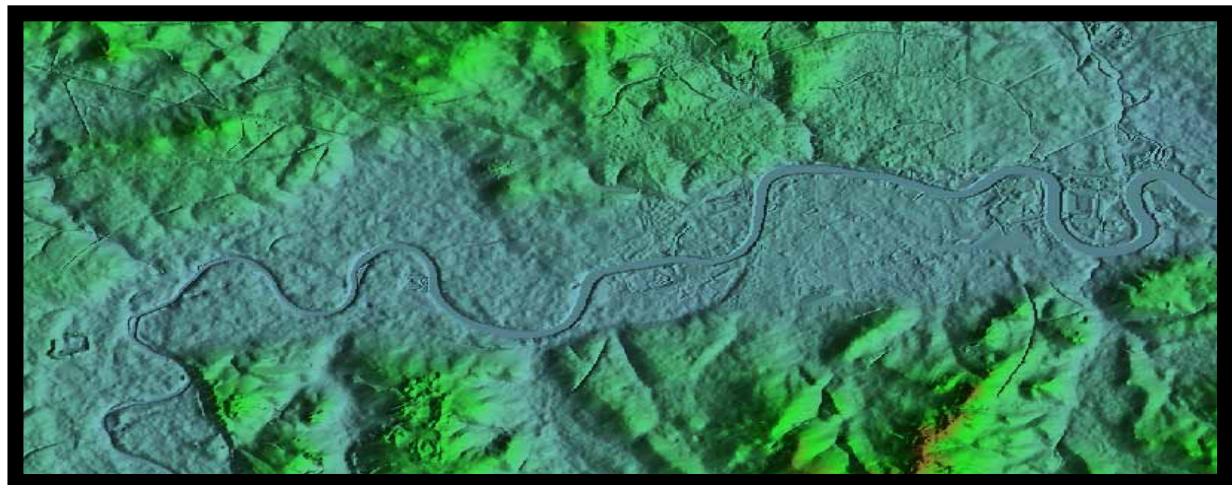




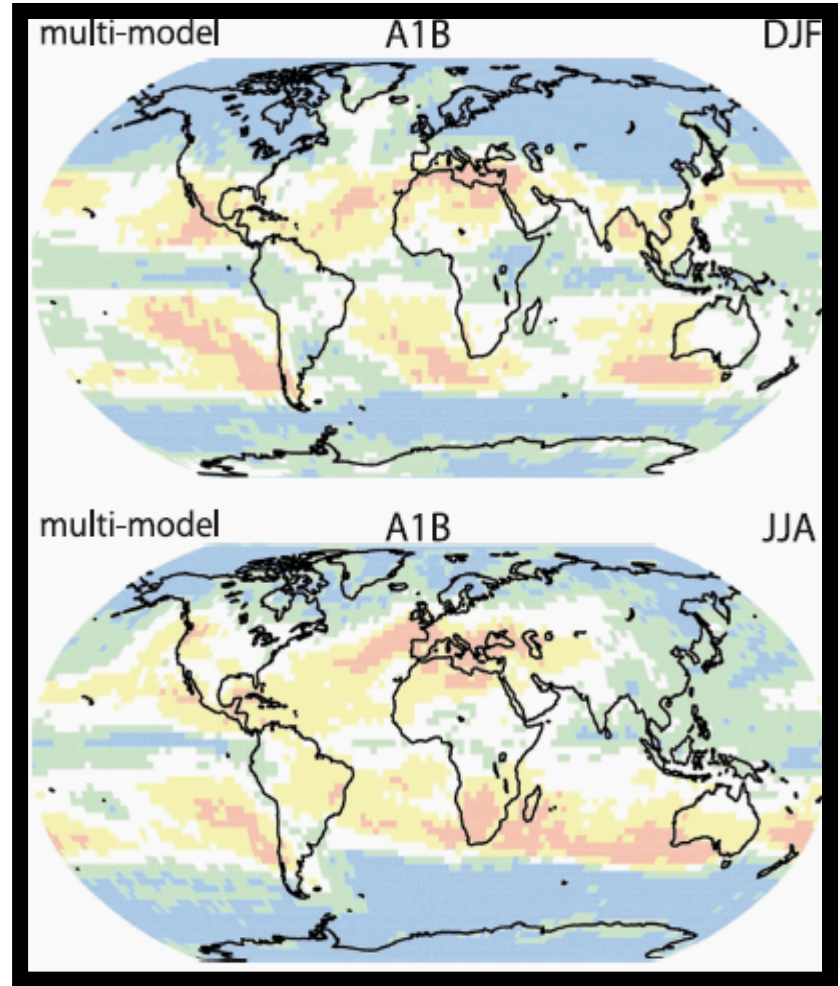
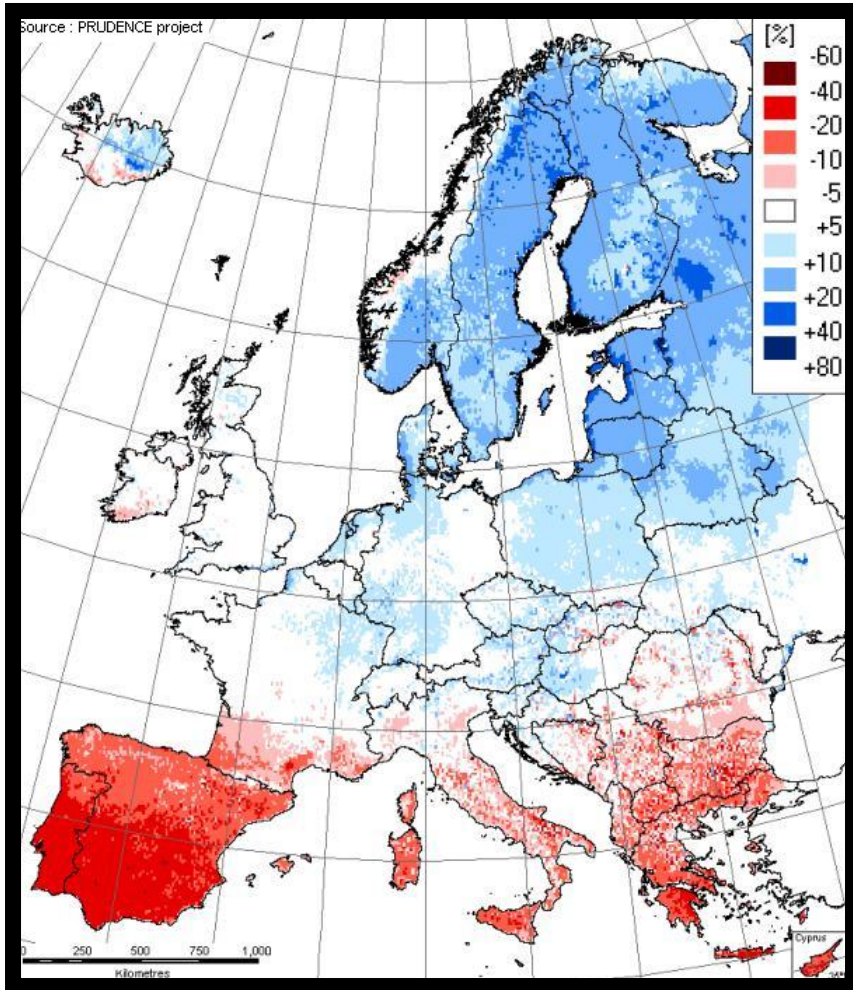
Sub-surface characterization

LWEC review of Flooding Research

- Existing run-down of many Research Council flooding programmes (e.g. FREE, FRMRC)
- Multi-partner
 - Joint strategy and objectives
 - Work to partner strengths
 - Open analysis across flooding community
- Need to address flooding needs between 5 and 10 years ahead

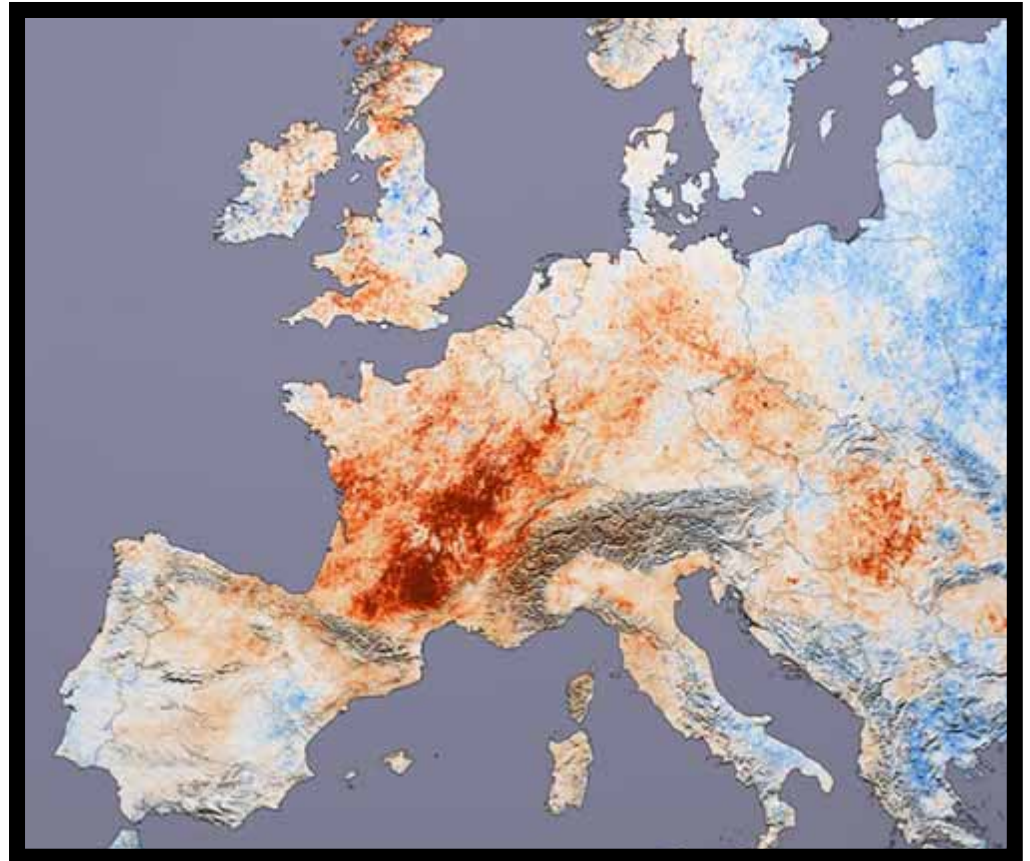


Droughts (2011)



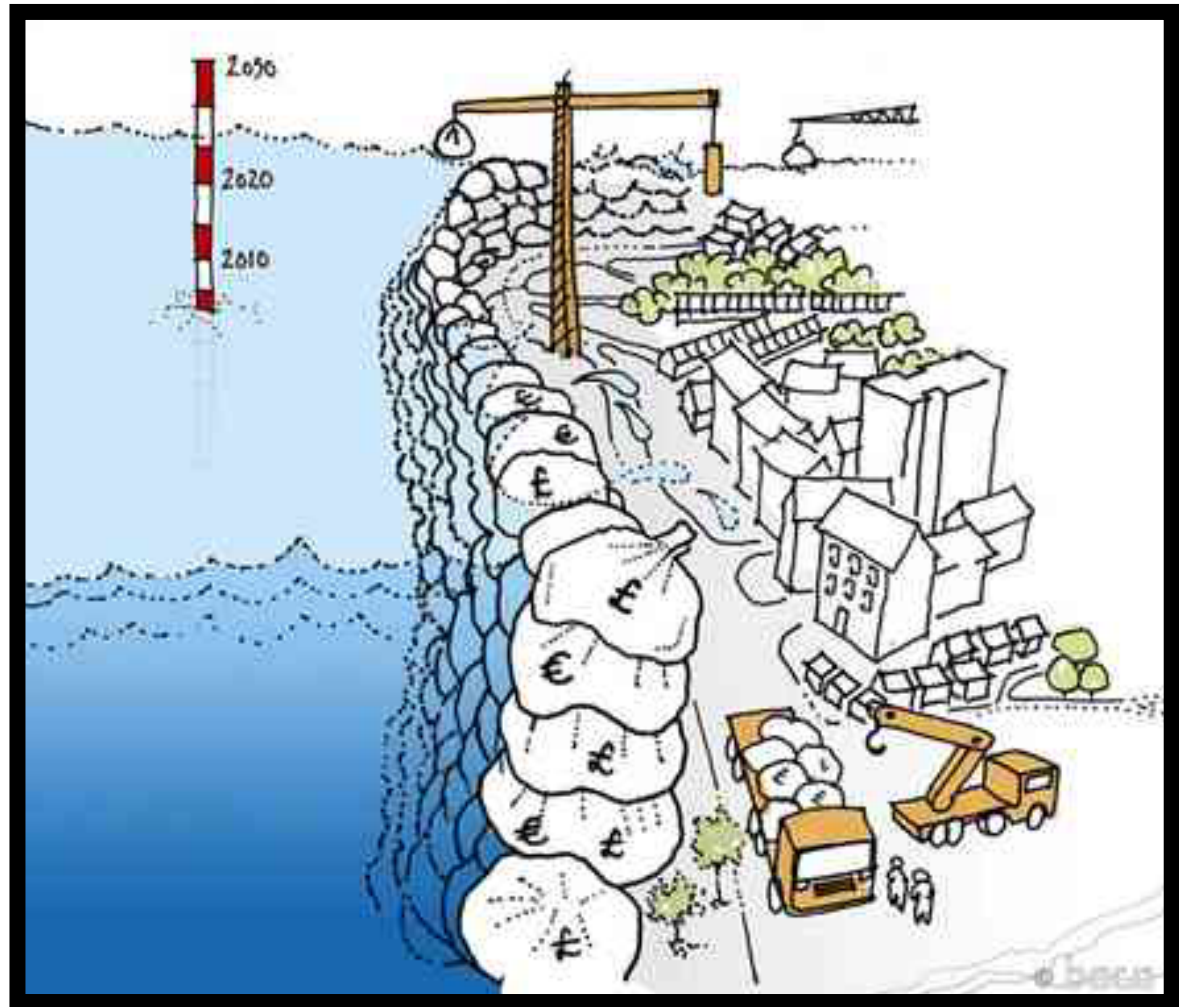
What focus on Drought?

- Geomorphological impacts?
- How to apply the science?
- The main research gaps?
- The main uncertainties?
- Future research priorities?
- Establishing socio-economic risks?



Communication

- Increased interaction with end-users
- Warnings from probabilistic forecasts
- Use of graphics in communication
- Website and open access to data and models
- Timely communication



IS THIS THE ONLY SOLUTION?

Summary

- Immediate focus on flooding, droughts
- Larger, more integrated programmes
- Increased interest in links between catchment usage (ecosystems, soils and land-use) and social & economic impacts

Questions?

