

# National Flood Resilience Review (NFRR)



HM Government



Professor Dame Julia Slingo  
Met Office Chief Scientist

Surprised again!  
Is this climate change?



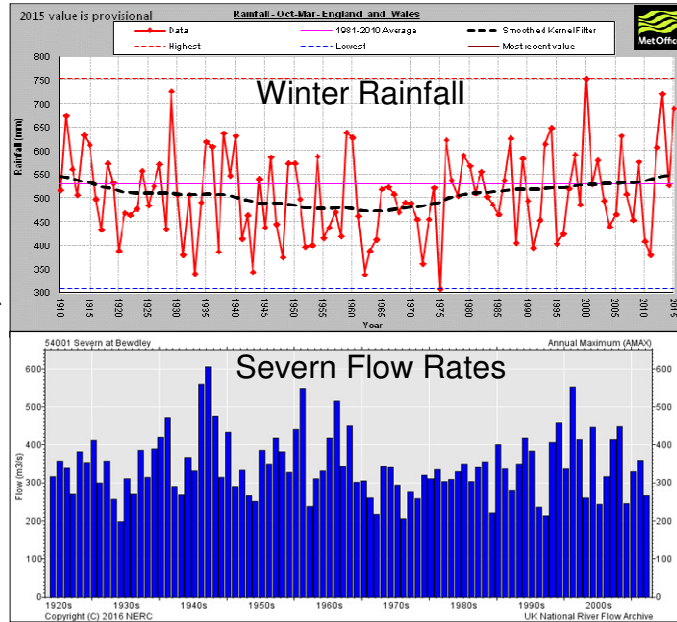
Storm Desmond 5-6 December 2015  
Rainfall record for a 24-hour period was broken, with  
341.4mm recorded at Honister Pass in the Lake District



# Evolving landscape of risk from natural variability?

Rain-rich/flood-rich,  
rain-poor/flood-poor  
periods

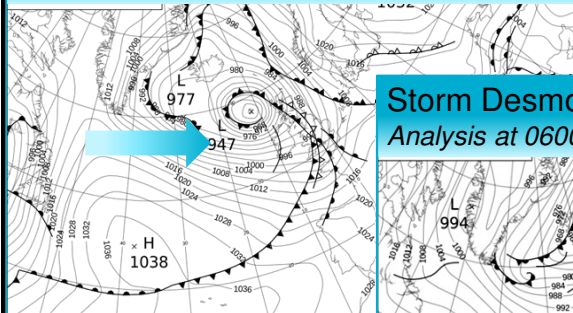
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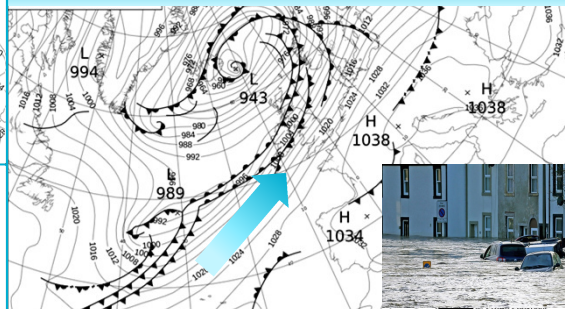
# NFRR: What is a plausible worst case for UK flooding?

Winter 2013/14  
Analysis at 1200 on 26 January 2014

It all starts with  
the weather!



Storm Desmond  
Analysis at 0600 on 5 December 2015

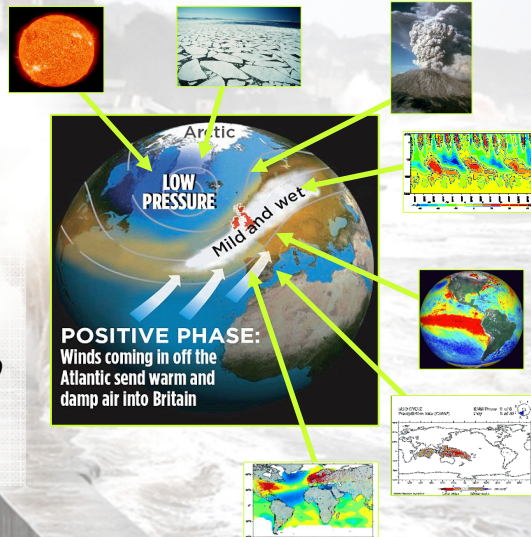


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## Climate Drivers of UK Winter Weather: North Atlantic Oscillation

October and November predictions for Winter 2015/16 noted that ***the risk of spells of windy of even stormy weather is expected to be greater than usual for the time of year***



*'One flap of a seagull's wings may forever change the course of the weather'*



Ed Lorenz and 'The Essence of Chaos'

- There are many paths that the world's weather could have taken – observations are just one plausible realisation.
- Can we use climate model simulations to find plausible alternatives with even more extreme rainfall?





## Looking for 'black swans' in a climate model event set



Weather and climate simulation essentially provides many, many synthetic realisations of the UK's weather, provided that:

- Climate model produces a plausible simulation of synoptic weather and UK rainfall.
- Simulations must sample the same forcings as the real world – but must have sufficient freedom to evolve to different regional climate and weather regimes.

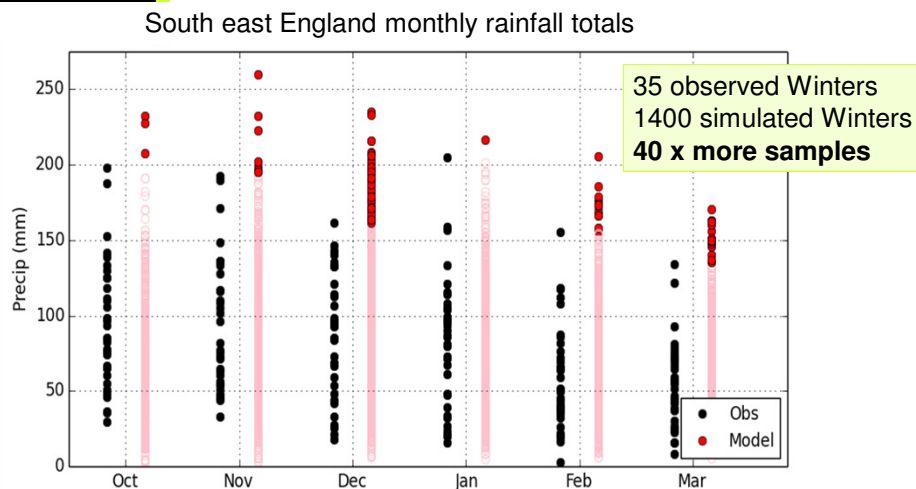
Latest Met Office Decadal Prediction System provides 1400 years of simulation representative of the period 1980 to 2015 – a rain-rich period with recent greenhouse gases.

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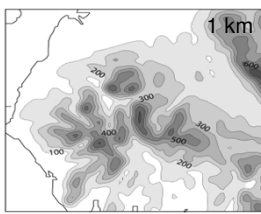
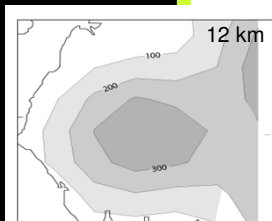
## Looking for 'black swan' events for the current climate



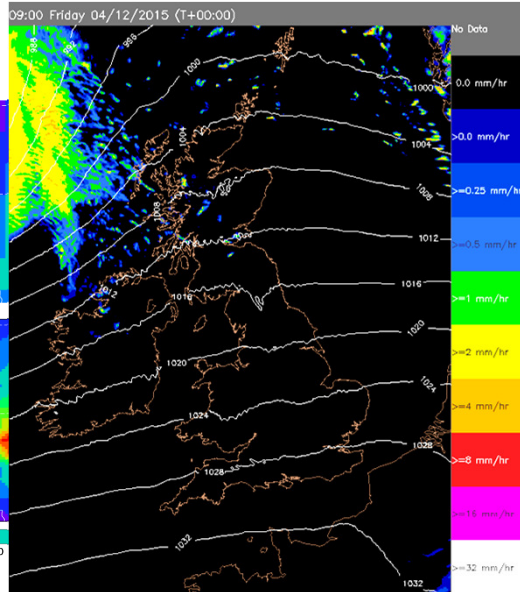
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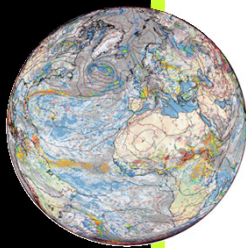
## From Regional to Local: Kilometre scale rainfall simulations



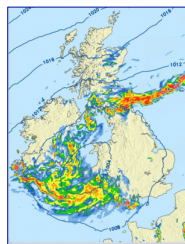
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## End-to-End Assessment of Risk: From Global Weather to Local Flooding



N x Global simulations  
at ~20km :  
**Synoptic drivers**



<N x Regional  
simulations at ~1km:  
**Local meteorology**



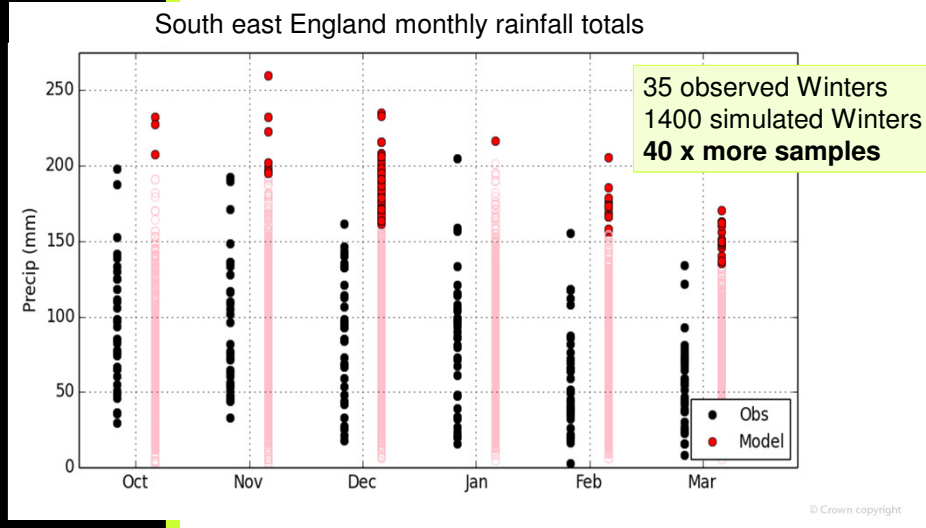
Flooding  
scenarios:  
**Impacts**

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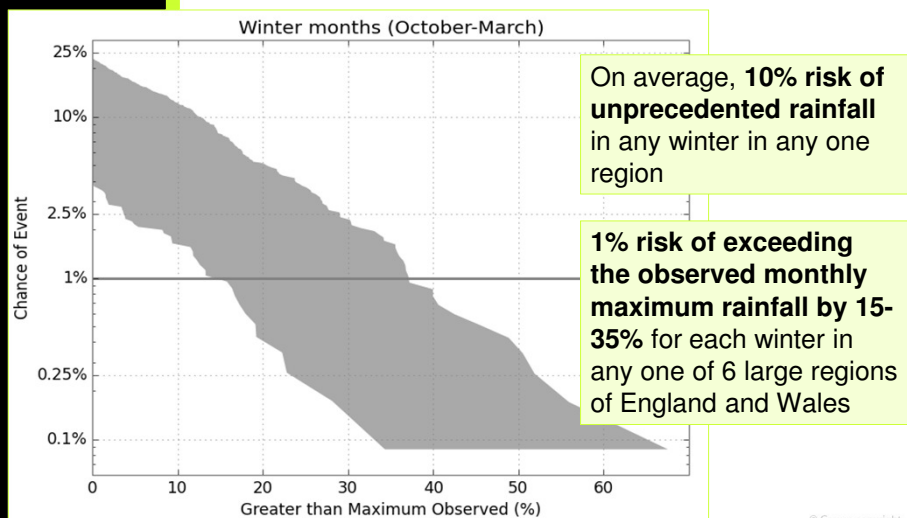
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## Looking for 'black swan' events for the current climate



## Risk of an unprecedented month of rainfall occurring during a given winter



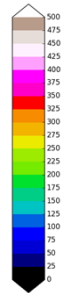
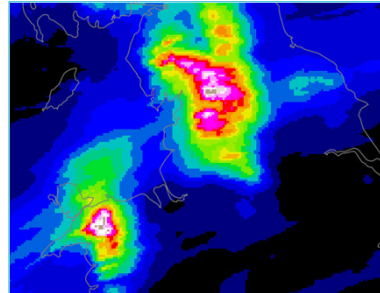
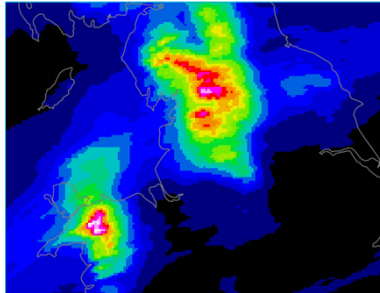


# Plausible Worst Case Scenario: Stress testing the Extreme Flood Outline using real cases

Total rainfall accumulation for Storm Desmond + Storm Eva  
December 2015

1.5km model

1.5km model + 20%



2km grid, 15 minute data provided to the EA as input to flood models

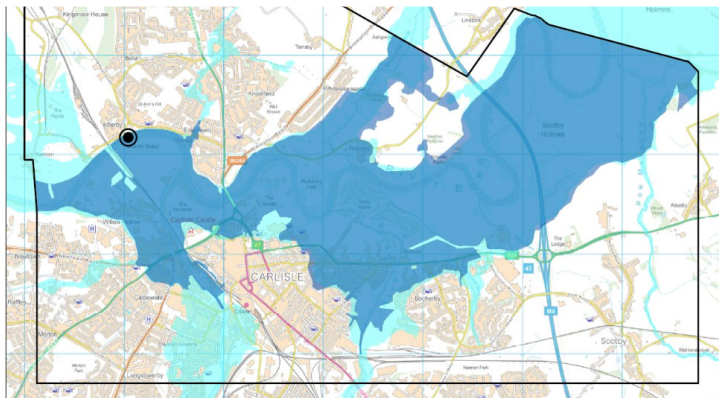
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# Plausible Worst Case Scenario: Stress testing the Extreme Flood Outline using real cases

Carlisle case study – observed December 2015 flood extent and the  
Extreme Flood Outlines



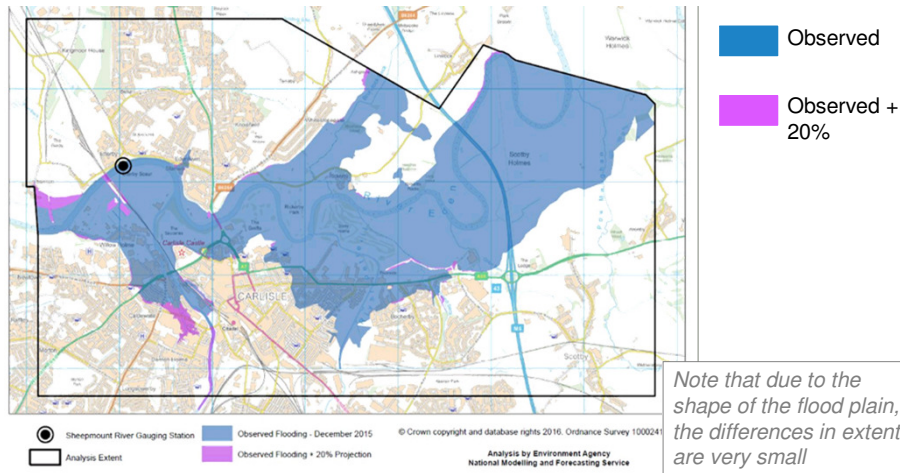
Observed  
Extreme Flood Outline

Sheepmount River Gauging Station  
Observed Flooding - December 2015  
Extreme Flood Outline  
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Analysis by Environment Agency  
National Modelling and Forecasting Service



# Plausible Worst Case Scenario: Stress testing the Extreme Flood Outline using real cases

Carlisle case study – observed December 2015 flood extent and the simulated stress test scenario.



## NFRR: A New, Integrated Approach to Flood Modelling

