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The CONVEX Project - Improved Understanding of Extreme Rainfall

http://research.ncl.ac.uk/convex/

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What is CONVEX?

It is predicted that climate change will bring about changes to the intensity and frequency of climatic and hydrological extremes which will in turn have large impacts on communities through increased risk of flooding (Figure 1).

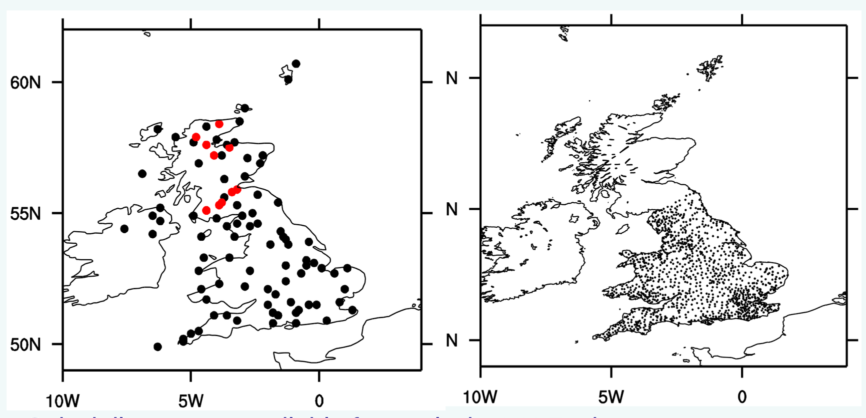
A key focus is the representation of **CONV**ective **EX**tremes that are important contributors to flood generating events. By using models operating at different scales of space and time the CONVEX project aims to improve our understanding of key atmospheric processes and their representation in climate models, and in turn improve projections of extreme rainfall. It is envisaged that this knowledge will enable better projections of future flood risk.

Figure 1: A rescue team at work during the July 2007 floods in Worcestershire[1].

Linking observations and models

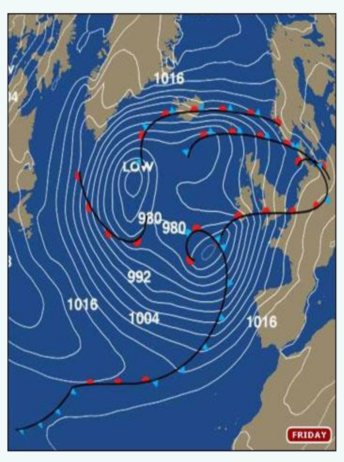
A key feature of CONVEX is to use observational evidence alongside high-resolution models to improve our understanding of atmospheric processes and better understand how model resolution relates to different types of extreme events (Figure 2).

CONVEX is combining rainfall observations from 3 sources to analyse the climatology and recent changes in sub-daily UK precipitation and to…



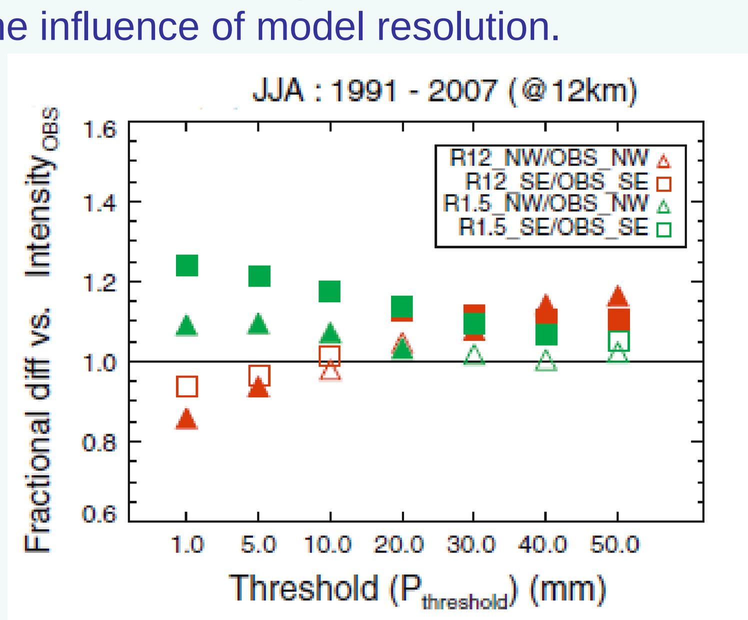
Sub-daily gauges available for analysis. UK Environment Agency data (right) subject to homogeneity and quality control checks.

…help better understand the drivers of daily and sub-daily extreme rainfall.



A key question is "what are the 'predictors' of extremes for different regions, seasons and spatial size of events?"

This will help us to assess the process deficiencies of climate and weather models and the influence of model resolution.



Here, NW and SE refer to north-west and south-east regions in the southern Britain model domain (see Figure 3).

For example, a high-resolution simulation has more realistic daily intensities for JJA extreme precipitation events. Filled symbols indicate the differences from observations (OBS) are significant at the 10% level.

Figure 2: An overview of CONVEX research

New modelling capabilities

The 1.5km regional climate model (RCM; UK Met Office UKV model) has been run for a 20-year period (1989-2008) driven by a 12 km RCM. The 12 km model is in turn driven by ERA-interim reanalysis data. The 1.5 km model (for domain see Figure 3) does not require a convective parameterisation scheme.

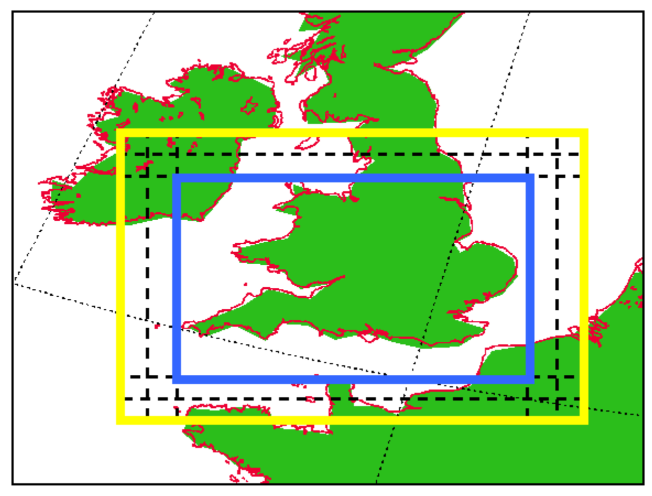


Figure 3: Domain of the 1.5 km climate model (blue rectangle).

High-resolution rainfall modelling

- The 1.5 km model more realistically represents whether it rains or not.
- There are clear improvements in occurrence of heavy precipitation (from 50 km – 12 km) but little value from increasing the resolution from 12 km - 1.5 km (Figure 4).

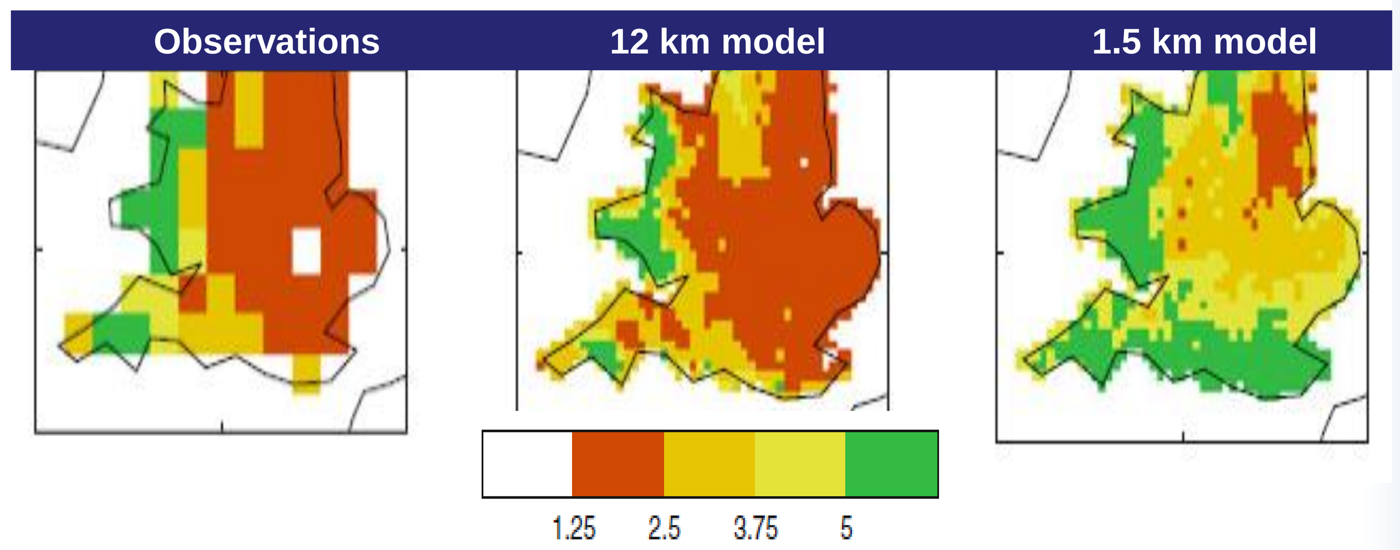


Figure 4: Average frequencies (days/year) that daily precipitation exceeds 20 mm/day (JJASON for 1991-2007).

- However, in the 1.5 km model the spatial structure of heavy rain is much more realistic (previously too persistent and widespread). Capturing spatial and temporal characteristics of rainfall is essential if we are to estimate changes in flood risk.
- Heavy rain is shorter-lived and more localised, in better agreement with radar (Figure 5) than for coarser models.

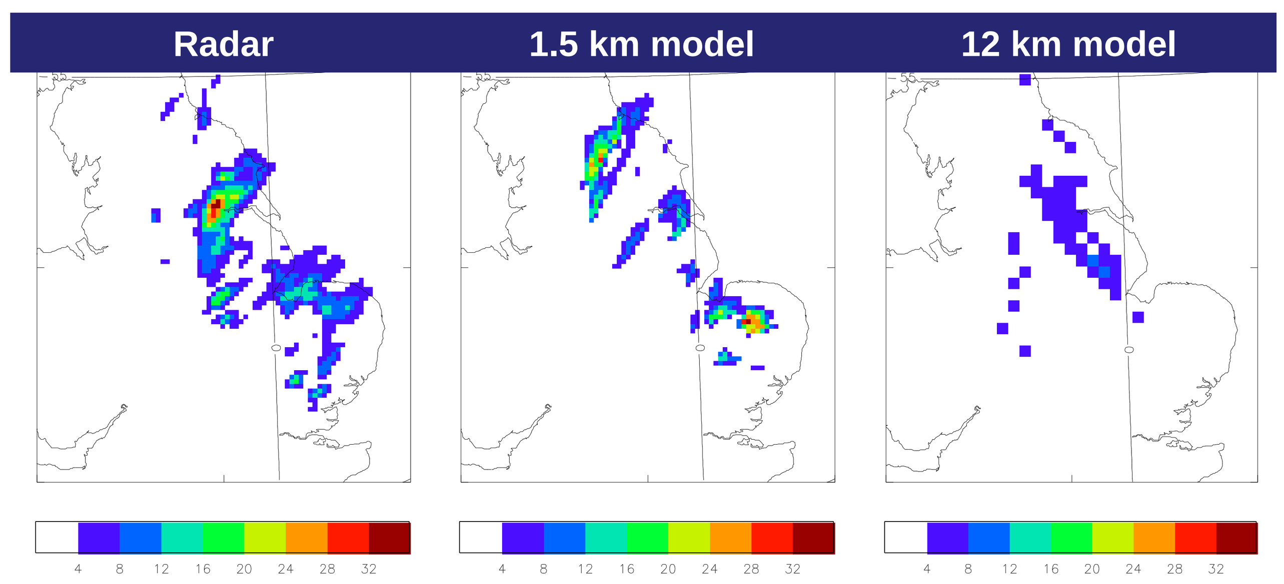


Figure 5: Improved representation of convective showers. Comparison shows 4h rainfall accumulations (mm) across a larger domain on 3 August 2011.

Ongoing work

- A ~13 year "control" run has been completed and is being followed by a future projection with estimated completion in summer 2013.
- Analysis of drivers of extremes e.g. temperature (Clausius-Clapeyron), pressure, humidity, in observations and models is being undertaken.

References

- Kendon EJ, Roberts N, Senior CA, Roberts MJ , 2012. Realism of rainfall in a very high resolution regional climate model. *Journal of Climate*, **25**, 5791-5806.
- Chan SC, Kendon EJ, Fowler HJ, Blenkinsop S, Ferro CAT, Stephenson DB, 2013. Does increasing the spatial resolution of a regional climate model improve the simulated daily precipitation? *Climate Dynamics*, in press.

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