The CONVEX project:

Using Observational Evidence and Process Understanding to Improve Predictions of Extreme Rainfall Change

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

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CONVEX progress

CONVEX has now entered its second year and the project is making considerable progress as recent months have seen the completion of a number of events and milestones:

- the first CONVEX extreme rainfall workshop was held at Reading University on 17th and 18th April. This brought together climate modellers and researchers from CONVEX and the wider academic community with users of climate information from a number of sectors. A brief summary of the event is provided in this newsletter but a more detailed summary document can be obtained from Dr. Stephen Blenkinsop (s.blenkinsop@ncl.ac.uk) or downloaded from http://research.ncl.ac.uk/convex/outputs/convex2012workshop/.

- the 1.5km resolution regional climate model (RCM) has been run for 20 years (1989-2008) driven by ERA-interim and results from this are now being analysed. A paper on the first set of results has been published online in Journal of Climate and is summarised in this newsletter;

- a 10-year "control" or baseline run of this model has commenced which will be followed by a future (climate change) run of the model, with planned completion around the summer of 2013.

CONVEX workshop – 17th & 18th April 2012

The workshop saw around 50 researchers and climate data end users gather to discuss the state-of-the-art in our understanding of extreme rainfall events and how they might change in the future and also how the scientific community might best meet the needs of users of climate information. The first day of the workshop identified what users need from climate models – highlighting the importance of quantitative outputs and a minimum requirement from many for hourly data. However, it was acknowledged that any progress on removing uncertainty over the direction of change for summer rainfall would be welcomed. As well as improved information on heavy rainfall events a strong interest was expressed in whether the high resolution model used in CONVEX might improve our model performance with respect to the persistence of dry conditions and potentially on the occurrence of drought.

The use of climate information was also addressed at the workshop and one of the key points raised was that the output and messages provided by CONVEX should be set in the context of existing tools and knowledge that users are familiar with, e.g. UKCP09, providing a link between new and existing knowledge and practice. It was also argued that users frequently want simplified, resonating messages e.g. for businesses at senior/director level, local authorities and politicians. Simple summaries of methods used, data provenance etc., should therefore be provided with research outputs which should engage users. To facilitate this, terminology must be appropriate for the audience, for example, it was suggested that for many "annual expected probability" is more readily interpretable than quoting a return period.

How will CONVEX use the information gained at the workshop?

The workshop provided us with a large range of suggested information and analysis that would be useful for end users and thoughts on who we need to engage with and disseminate results to in the user community. Some of these are outlined below:

- The issue of drought and persistence was raised several times during the course of the meeting. Therefore, we plan to investigate (time-permitting within CONVEX) whether there is a different representation of drought in the RCM at very high resolution.

- The project provides the opportunity to examine whether there is any evidence of urban influence on the initiation and evolution of convection over London. In this region we have relatively high confidence in radar data, so this can be used to validate behaviour in the 1.5km RCM. We also have several different observed rainfall datasets over this area, comprising both radar and also relatively good rainfall gauge data coverage. This provides the opportunity to compare these to gain a reliable picture of current rainfall characteristics over London.

- The Flood Estimation Handbook (FEH) was identified as a major tool widely used by practitioners in the water sector and some analysis of observed historical data used in CONVEX will be undertaken in the context of information presented in the FEH.

- We have identified a need to broaden the reach of CONVEX following suggestions that we establish links and engage with representatives from a wide range of institutions, including planning authorities, trade organisations, regulatory authorities and other water companies. The form of this engagement will need to be considered outside the framework of formal events like the Reading workshop.

- When disseminating output from CONVEX we will endeavour to identify clear narratives/messages that resonate with users in different sectors.

Potential science collaborations

The science discussion on the second day of the workshop saw presentations from Jessica Loriaux (Delft University of Technology) and Prof. Erik Kjellström (Swedish Meteorological and Hydrological Institute; SMHI). The discussion which followed identified potential areas of collaboration with other projects in the Changing Water Cycle and Storm Risk Mitigation programmes. These areas included the role of latent heat in the structure of extra-tropical cyclones, the links between convection and soil moisture, and the analysis of large-scale drivers of precipitation. It was also noted that there is wide interest in the high resolution modelling work and that international links and dissemination should be pursued. Potential collaboration with the ECLISE project, the CORDEX network and high resolution modelling being undertaken at SMHI were among initial opportunities identified.

CONVEX results published

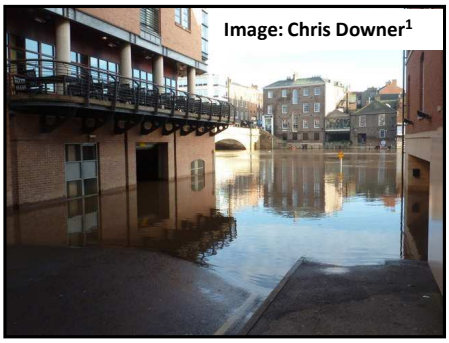
In current climate models convection occurs on scales smaller than the model grid and so needs to be represented through a parameterisation scheme. This is a key source of model deficiencies in the representation of rainfall, and in particular of local extremes. Thus there is significant interest in running climate models at a very high resolution that are able to explicitly model the process of convection, without the need for a parameterisation scheme. Such convection-permitting models are now routinely used for weather forecasting but not in climate change experiments.

These very high resolution models provide a significantly improved representation of orographic (associated with uplift over mountains) and convective rainfall. In this study, for the first time, we have run a convective-permitting model for an extended (20 year) period over a region of the UK. This has allowed us to examine the characteristics of heavy rainfall in the very high resolution (1.5km) model in a climatological sense, and compare these to a coarser resolution climate model.

The representation of daily and hourly rainfall in the 1.5km model has been compared to that in a 12km regional climate model (RCM). The key results are as follows:

- The 1.5km model gives a much better representation of rainfall occurrence compared to the 12km RCM. The tendency of coarser resolution climate models to show too much persistent light rain ("drizzle") is a longstanding problem but is considerably reduced at 1.5km.
- Whilst the 1.5km model does have a tendency for heavy rain to be too intense, it gives a much better representation of its duration and spatial extent. In the 12km RCM, heavy rain events are not heavy enough and tend to be too persistent and widespread. There are also not enough short-duration high-peak intensity events overall, which appears to be linked to deficiencies in the representation of convective rain. These biases are significantly reduced in the 1.5km model.
- The 1.5km model also shows an improved representation of the daily timing of rainfall through better simulation of the timing of peak convection.

Overall, the improved realism of rainfall in the 1.5km model gives us confidence that it is giving a better representation of the underlying physical processes, particularly in relation to the development and persistence of convection. This gives us greater confidence in its ability to project future changes in precipitation extremes, and hence supports its use in climate change studies.



Accurately predicting changes in extreme rainfall is essential if we are to estimate changes in flood risk.

Kendon, E.J., N.M. Roberts, C.A. Senior and M.J. Roberts, 2012. Realism of rainfall in a very high resolution regional climate model. *Journal of Climate*, in press. Subscribers to the journal can view the paper online at http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-11-00562.1.

How to keep in touch with what's happening in CONVEX

One of the clear messages from the workshop was the importance of continuing communication with the academic and user communities. This will not always be possible via formal events like the workshop and so we will maintain regular communication via newsletter, internet and social media and would continue to welcome comments and feedback, including views on how we can better provide you with the sort of information you need. You can find out more from our project website: http://research.ncl.ac.uk/convex/.

You can contact Dr Hayley Fowler (hayley.fowler@ncl.ac.uk) or Dr. Stephen Blenkinsop (stephen.blenkinsop@ncl.ac.uk) for more information.

You can also keep up to date with CONVEX on twitter:

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1. http://www.geograph.org.uk/profile/14700