Modelling Extreme Rainfall Events

Technical Summary: FD2210

Joint Defra / EA Flood and Coastal Erosion Risk Management R&D programme

Background to R&D project

The objective of this project was to investigate the ability of a storm scale configuration of the Met Office Numerical Weather Prediction (NWP) model (the Unified Model (UM)) to predict extreme rainfall events up to 18-24 hours ahead and to determine what it is about the meteorology of these situations that the model must capture in order to produce useful predictions for flood warning. The project began in November 2005 and finished in February 2008 and was carried out by the Meteorological Office.

The project follows on from the Storm Scale Modelling project FD2207 in which it was found that the UM with a grid spacing of ~1 km has the potential to deliver significantly improved forecasts of convective rainfall events.

Results of R&D project

The project delivered several key findings about the ability of a storm-resolving NWP model to predict extreme rainfall events and the nature of the events themselves:

1. There are no differences between the physical and dynamical processes that lead to 'extreme' events compared to other heavy rainfall events. It is the coincidence and interaction of those processes that leads to extreme events and the difficulty in their prediction.
2. A storm-resolving NWP model is capable of providing useful forecasts of 'extreme' rainfall events. The use of a storm-resolving model has the potential to greatly improve on our current ability to predict such events provided that it is understood that the output must include information about forecast uncertainty (e.g. probabilities).
3. The accuracy of the forecasts may vary considerably from case to case and depends crucially on getting all the necessary meteorological components correct.
4. For many events it is vital to accurately represent the larger-scale disturbances in the flow that may originate from outside the high-resolution domain; as well as any local effects.
5. A high-resolution grid (~1 km grid spacing) is absolutely essential to be able to represent the dynamics of more localised thunderstorms and many of the important local pre-cursors to the triggering of storms.
6. Some convective situations are inherently more predictable than others, and that predictability is strongly linked to the meteorology of the situation. A classification into three types of storm has been made. Knowledge of the likely type of storm can provide information about its predictability.

Environment Agency

defra
Department for Environment Food and Rural Affairs

R&D Outputs and their Use

The project Technical Report TR/FD2210 “Modelling Extreme Rainfall Events” forms a comprehensive account of the work undertaken and the key results. This report makes recommendations that will be used to inform future research and development projects and strategies. It also describes the relationship between this project and other work in the same area within the UK and Europe.

In addition to the main report, two further reports are available which provide more detail about specific case studies.
Simulations of extreme rainfall events using the Unified Model with a grid spacing of 12, 4 and 1 km: Met Office NWP technical report 486
Meteorological components in forecasts of extreme convective rainfall using 12-km and 1-km NWP models: Met Office NWP technical report 500

This research has progressed the body of scientific knowledge about nature of extreme rainfall events in the UK, the ability of current state-of-the art Numerical Weather Prediction models to forecast them as well as new approaches for presenting and assessing the forecast output. Results were included in the government commissioned report ‘Learning lessons from the 2007 floods’ by Sir Michael Pitt.

This R&D Technical Summary relates to R&D Project FD2210 and the following R&D output:
R&D Technical Report FD2210/TR – Modelling Extreme Rainfall Events. Published September 2008.

Publication Internal Status: Released Internally External Status: Released to Public Domain

Project Manager: Robert Hatton Email: bobhatton@hattons.biz
Research Contractor: Brian Golding Email: brian.golding@metoffice.gov.uk

The above outputs may be downloaded from the Defra/EA Joint R&D FCERM Programme website (www.defra.gov.uk/environ/fcd/research).

**Defra Flood Management, Nobel House,
17 Smith Sq, London SW1P 3JR**

Tel: 020 7238 6000

**Info-fm:defra.gsi.gov.uk
www.defra.gov.uk/environ/fcd/research**

Environment Agency

defra
Department for Environment Food and Rural Affairs