



# Flash-flood forecasting

*Some research with the Department of  
Meteorology*

**Bob Plant**

With thanks to Giovanni Leoncini, Sue Gray and Pete Clark

Department of Meteorology, University of Reading



# Outline

---



- Issues with flash-flood forecasting
- Observations and modelling approaches
- Model resolution
- Estimating the uncertainties



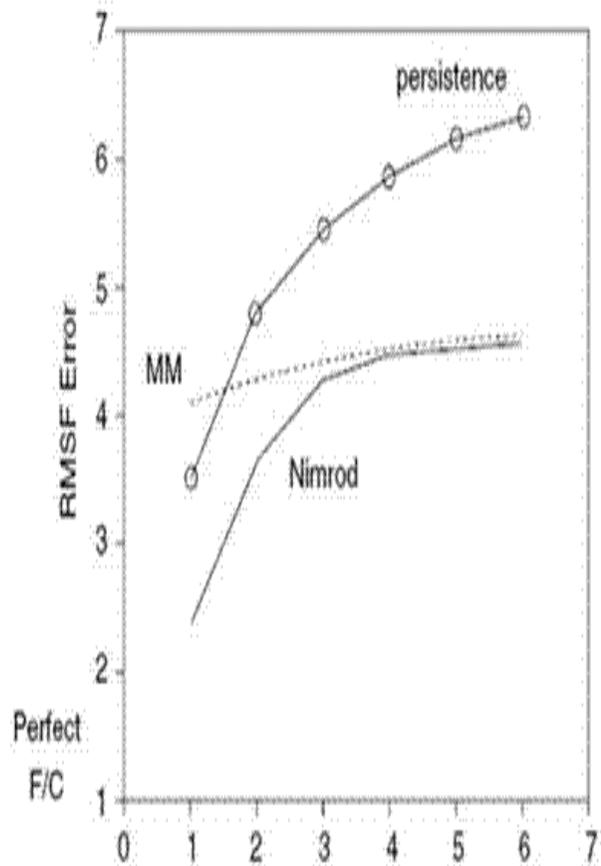
# Flash flooding



- Characterised by very intense, **very localised** precipitation and rapid response of catchment
- Limited opportunities for warnings, and hard to forecast
- Hand (2005) climatology of extreme UK rainfall
  - of 50 flash flooding events, 30 were convective
  - 20 associated with larger-scale weather fronts, but most of these due to embedded thunderstorms, so strong convective element
- Individual convective storm typically a few km across



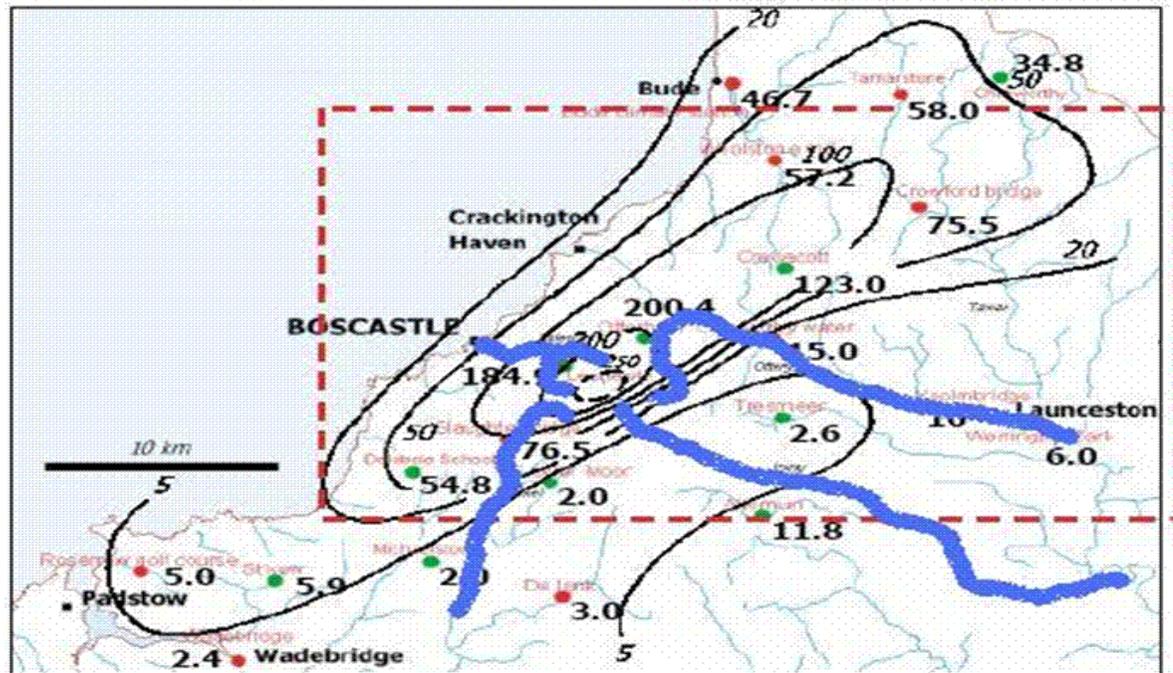
# Observations and modelling



- UK has 15 operational radar, measuring rainfall
- “Nowcasting”:  
extrapolate this data forward using estimated winds
- Useful for 1-2 hours with thunderstorms

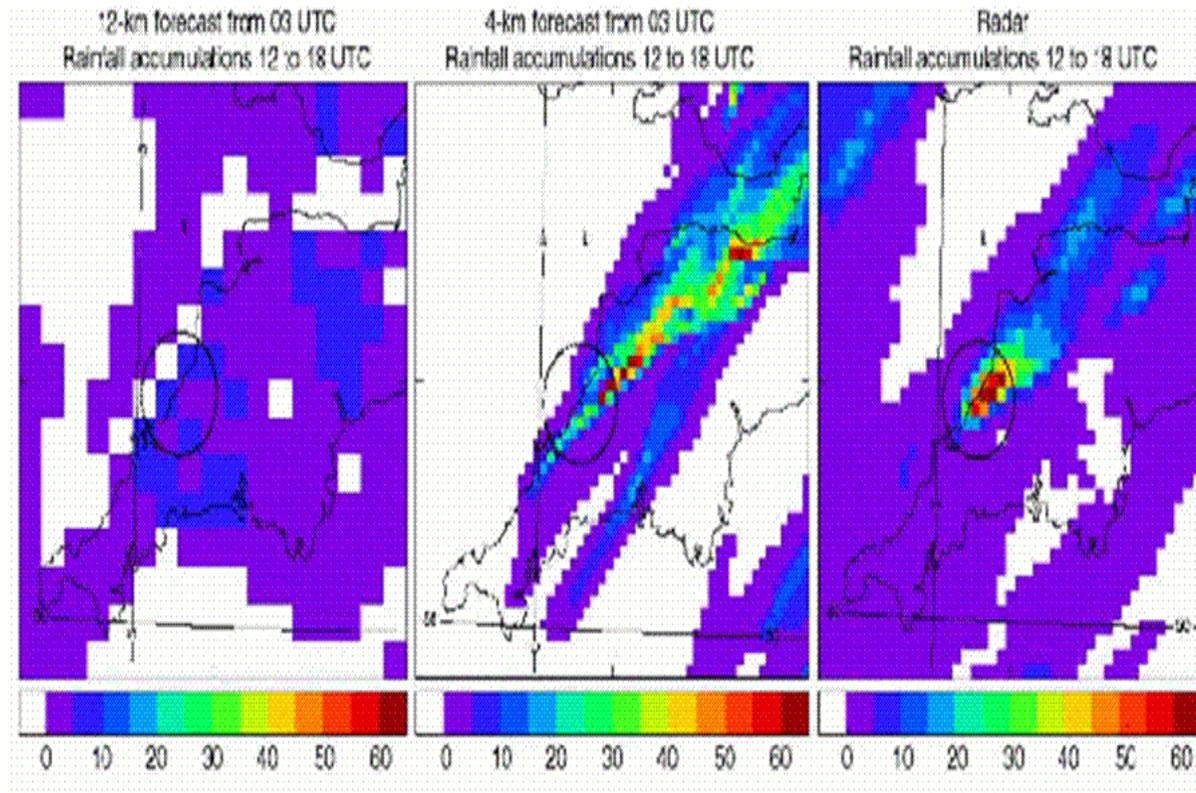
# Boscastle event

Flash flood on 16th August 2004



- Note the horizontal scale, and river locations
- Important to get intensity correct, and its precise location
- Met Office forecast model with 12km grid spacing

# Model resolution



- Forecasts with 12 and 4km grid spacings, starting at 3am, compared to radar observations
- Met Office now using 4km and 1.5km spacings routinely

# Ensemble forecasting



- High-resolution necessary to forecast flash floods
- Allows a “fighting-chance” but forecasts are not perfect
- What warnings should be issued and when?
- How believable is a model simulation / how predictable is an event?



# Model uncertainty

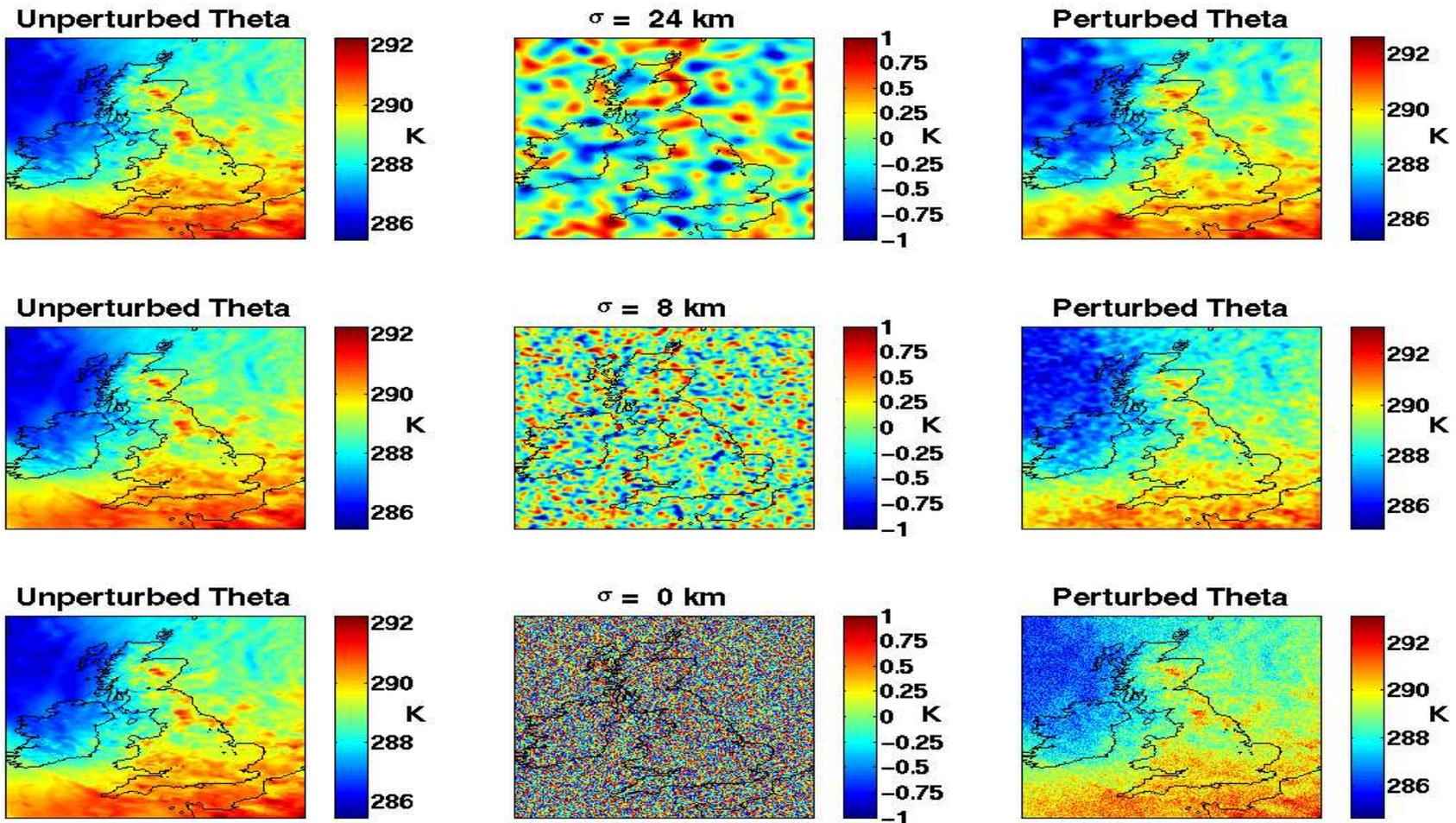


- Starting conditions for forecast are not perfectly known
  - Many issues around the best ways to exploit available data
- Boundary conditions are not perfectly known
  - These come from lower-resolution model, run over larger area
- **Model is not perfect**
  - Depends on processes that are not perfectly understood, and on factors for which there is no good data
  - e.g. “cutting the grass”

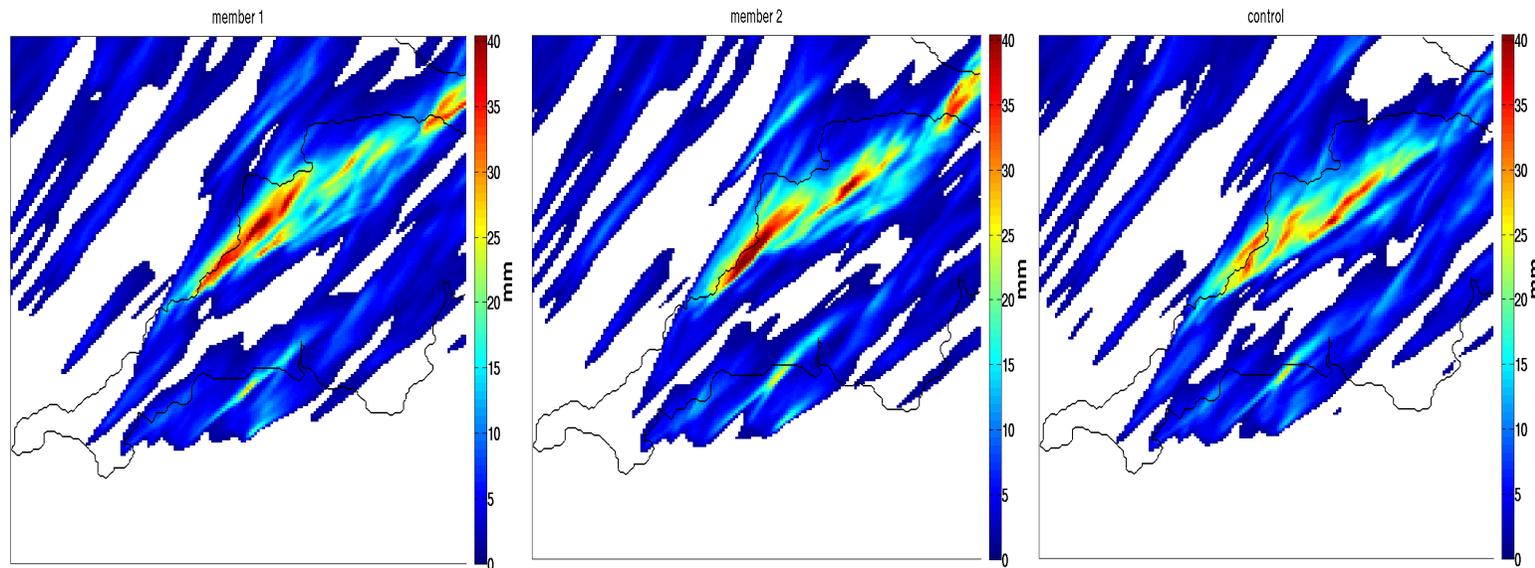


# Assessment of uncertainty

Repeat the simulations with small, but realistic changes to model



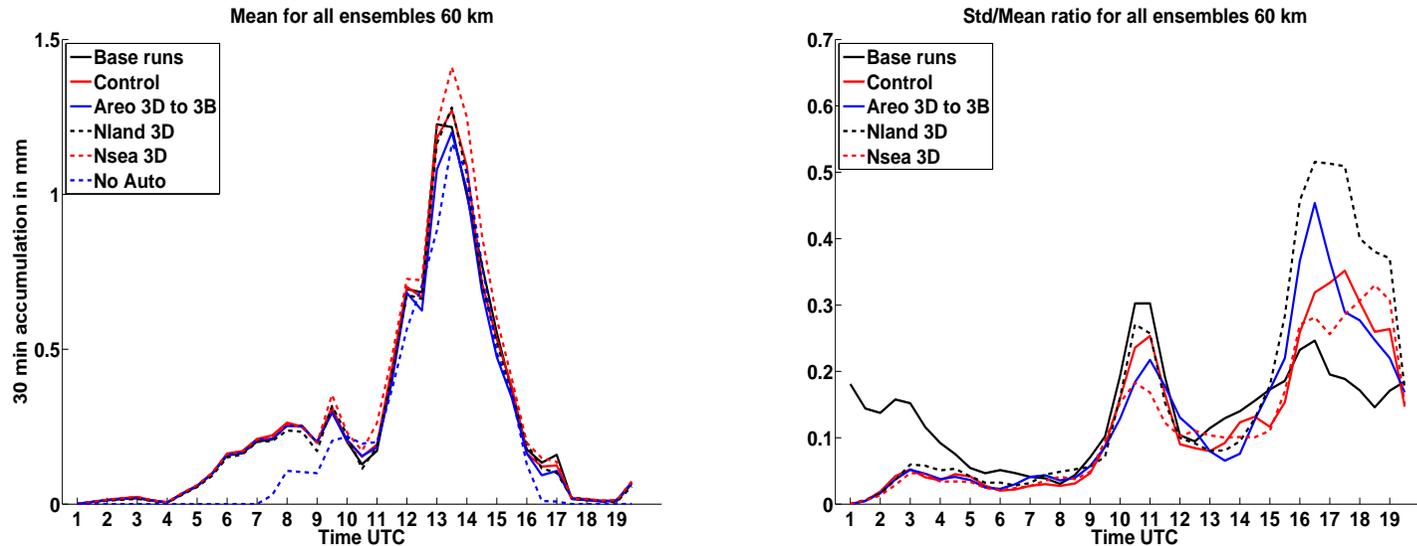
# Ensemble forecasting



Would like to do this many times, but expensive

# Uncertainty estimate

Provides estimate of uncertainty for the forecast rainfall



- Boscastle very predictable:  $\sim 30 - 40\%$  spread in rainfall forecast within 60km

# Conclusions



- Rainfall associated with flash floods is a difficult forecasting problem
- Just starting to become a practical proposition
- Need to use models with high-resolution
- Much research in department, often in collaboration with Met Office via JCMM
- A particular interest is in development of ensemble methods to determine forecast uncertainty
- Many completely-open questions:
  - how many ensemble runs are needed?
  - what model changes are the most important?

