Contrasting Convective-Scale Perturbation Growth in Two Cases Over the UK

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Overview

We introduce a novel technique:

perturb model state

as the simulation progresses

at the large scale

- several storms within domain
- processes involved in *error* propagation
- general overview of model/convection response to perturbation

at the storm scale

- focus on one specific flood
- verify ensemble technique is useful in a different domain/weather regime
- accumulation within an area
- what needs to be changed: μphysics or perturbation?

Perturbation Structure

- potential temperature
- applied at fixed model level
  - 1280 m
- at regular intervals (30 mins)
  - to capture PBL transitions

- 2D Gaussian kernel applied to random numbers
- amplitude: 1, 0.1, 0.01 K
- σ: 24, 8, "0" km

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flow independent ... understandable

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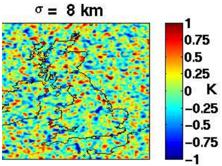

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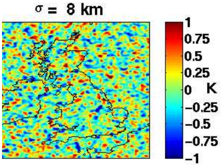

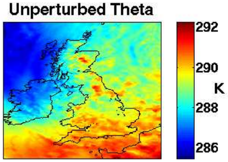

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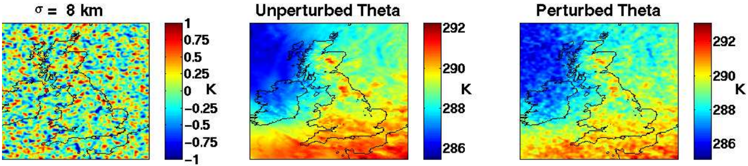
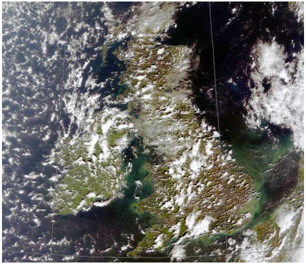


Perturbation Strategies

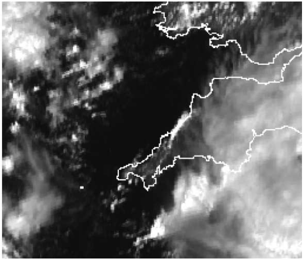
Scattered Convection



Aim: model/convection response

- 24, 8, 0 km
- 1, 0.1, 0.01 K
- MetUM, 4 km, 38 levels

Flood



Aim: perturbation v μphysics

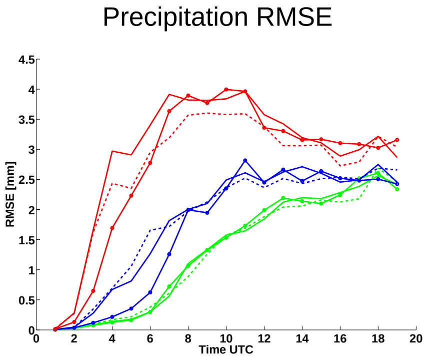
- ensembles: 0.1 K, 8 km
- change warm μphysics
- MetUM, 1 km, 76 levels

Which processes determine error growth?
Scattered Convection

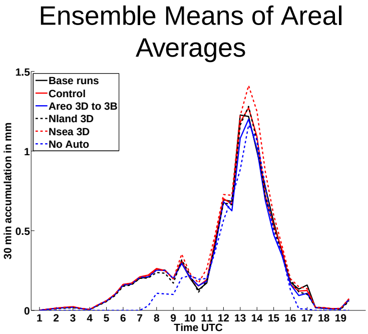
- addition/removal of a lid
- acoustic waves
- PBL parameterisation changes

Note that:

- cloud distribution not affected *directly*
- vertical motion helps



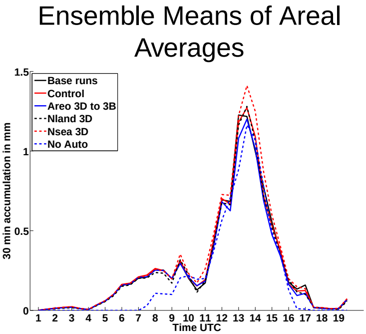
Perturbation v Parameterisation
Flood

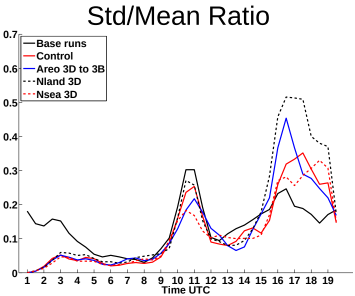


- perturbation $\sim$ parameterisation
- event is quite predictable
  - location of cells changes the most
  - number and intensity not so much
- cloud dynamics slightly affected

Perturbation v Parameterisation

Flood





Conclusions

The sequential perturbation has proven to

- generate realistic esemble members
- capture error growth due to w
- affect cloud dynamics

Scattered Convection

Strategy:

- A: 1, 0.1 and 0.01 K
- σ: 24, 8 and 0 km

We found:

- error growth due to:
  - lid
  - acoustic waves
  - BL types changes
- amplitude controls growth

Flood

Strategy:

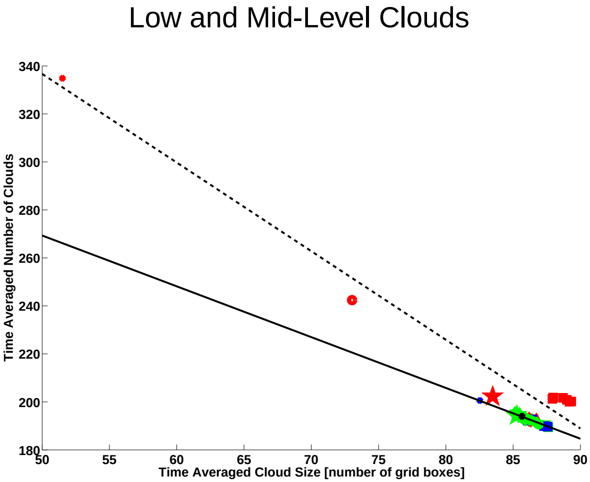
- fixed A and σ
- 0.1 K, 8 km

We found:

- accumulations are fairly predictable
- perturbation $\sim$ μphysics
- model response is sensitive to parameter values

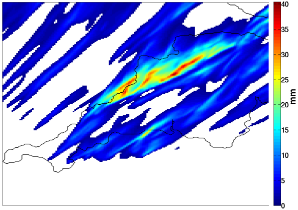
Cloud Distribution

Scattered Convection

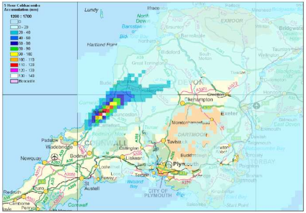


Experiments
Flood

Standard Run



Observations



Experiments

5 ensembles, 8 km, 0.1 K (8+1)

standard UM 6.1, 1 km grid spacing

2nd autoconversion model

land value for CCN

sea value for CCN

no autoconversion

Member 1