Met Office convection-permitting ensemble MOGREPS-UK

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MOGREPS-UK

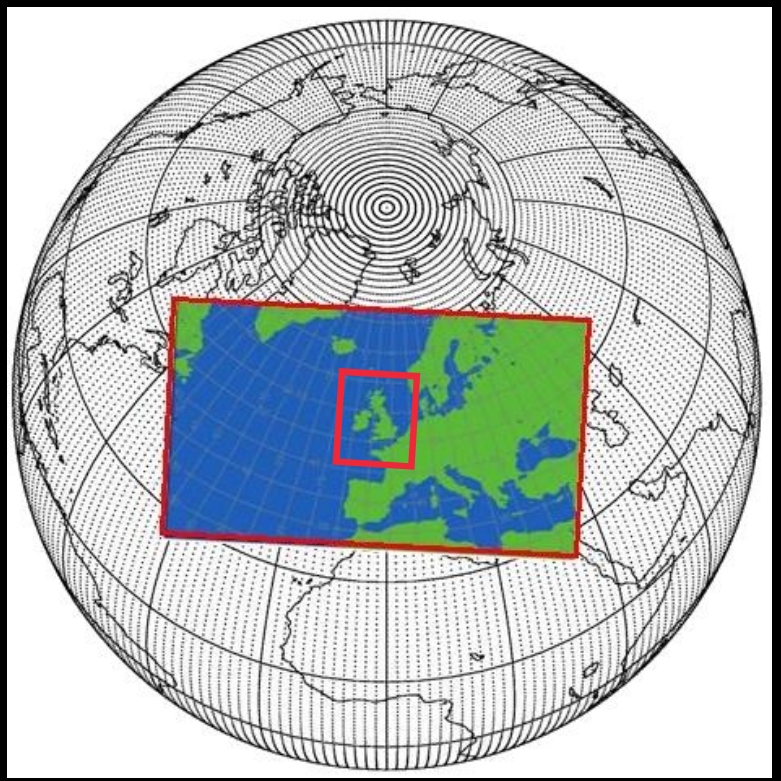
Convection-permitting 2.2 km ensemble now running routinely

Embedded within MOGREPS-R ensemble members (18 km)

Now used by forecasters – good feedback so far

Demonstration probabilistic products for the London Olympics (Clive Wilson)

Impressive for recent high-impact flood events



Why this approach?

Natural extension to MOGREPS global and regional ensembles

Case studies looked very promising

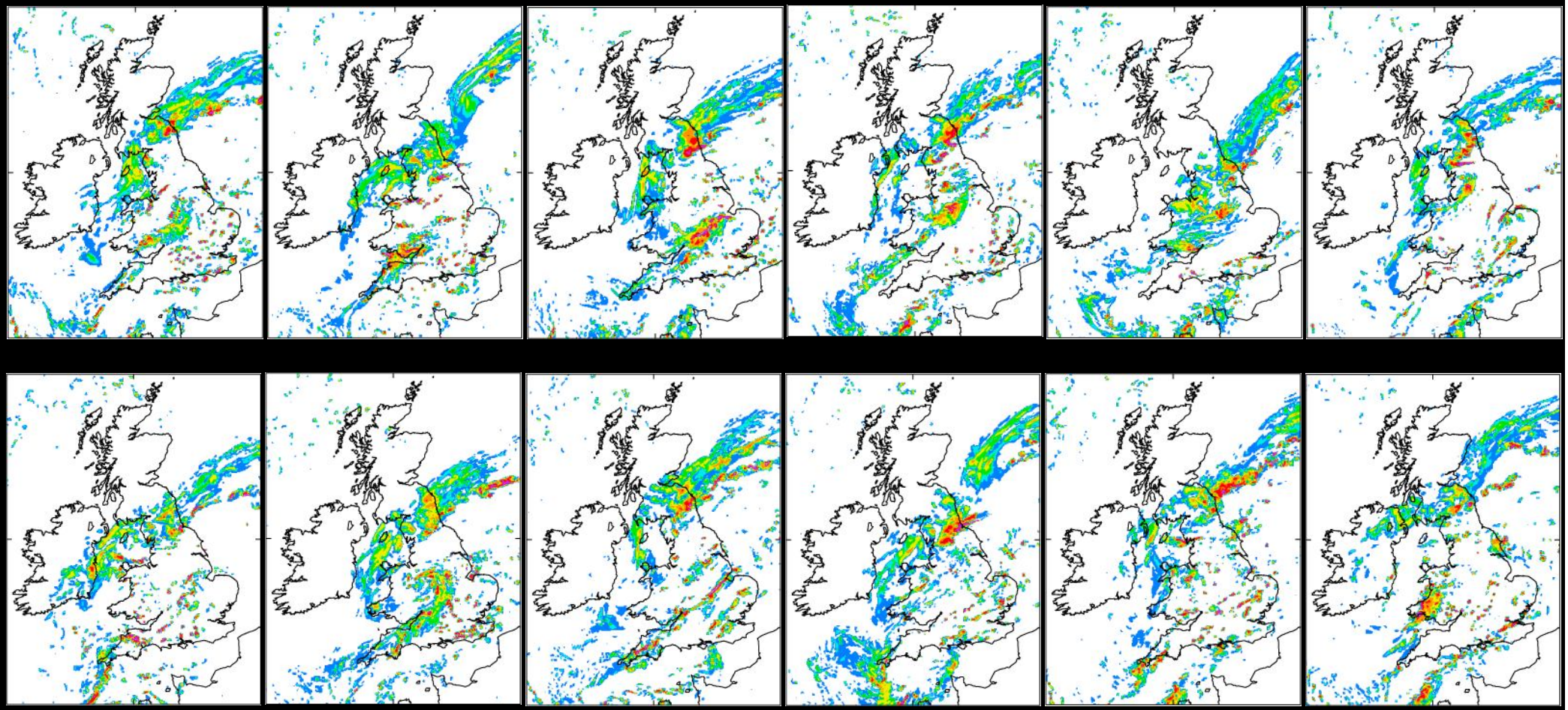
Do it the easy way first !

Spread comes from boundaries for small domain after ~T+4-12, Vié et al 2010, Gebardht et al 2011 (mesoscale uncertainty).

2.2 km near enough to deterministic 1.5 km and still ‘permits’ UK convection. Higher resolution -> too few members.

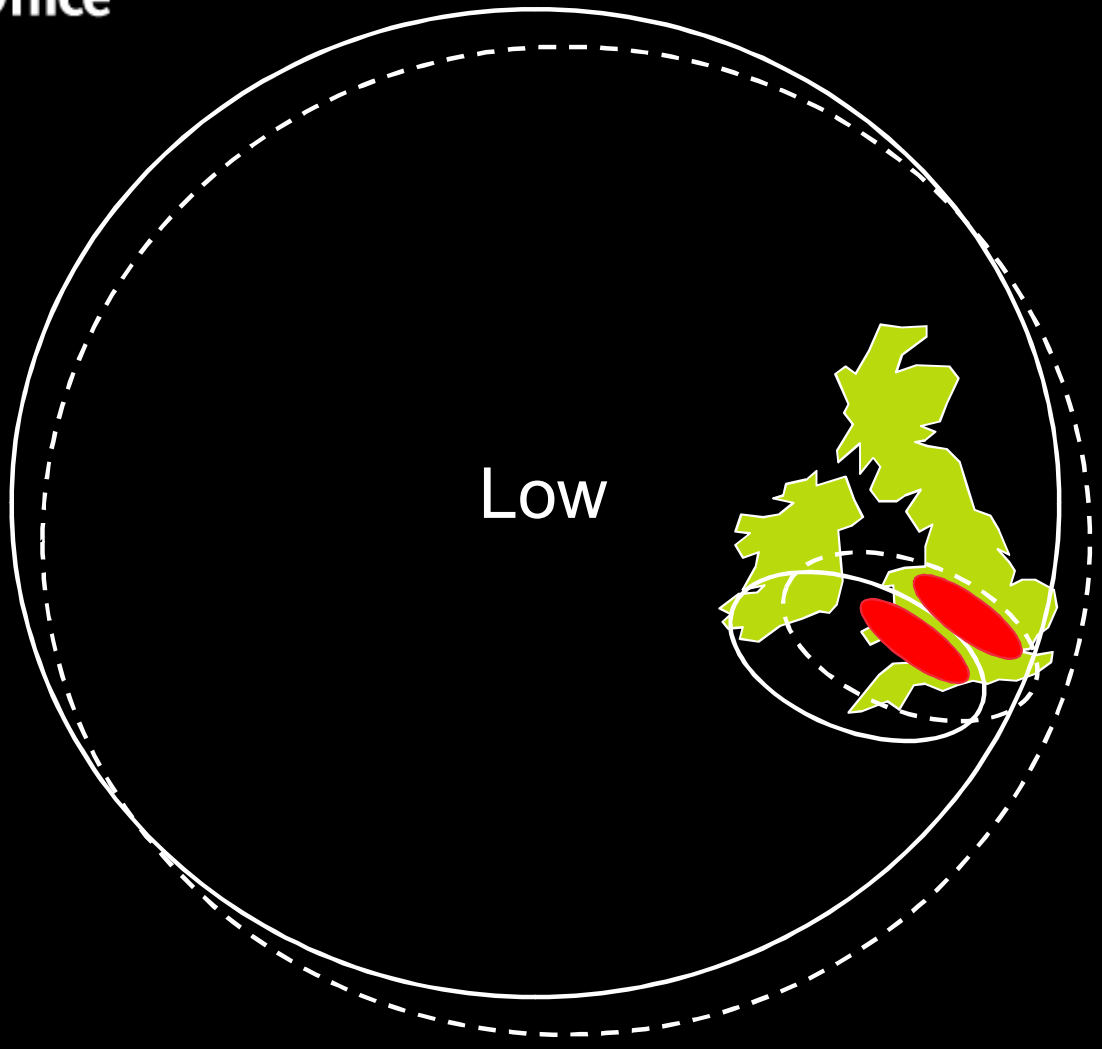
Ensemble size sufficient after post processing

Example



Is it possible to represent uncertainty in local weather with only 12 members (and a marginally convection resolving model) ?

Small uncertainty at large scales = large uncertainty at small scales



Smallest scales (Storm detail) unpredictable ‘noise’.

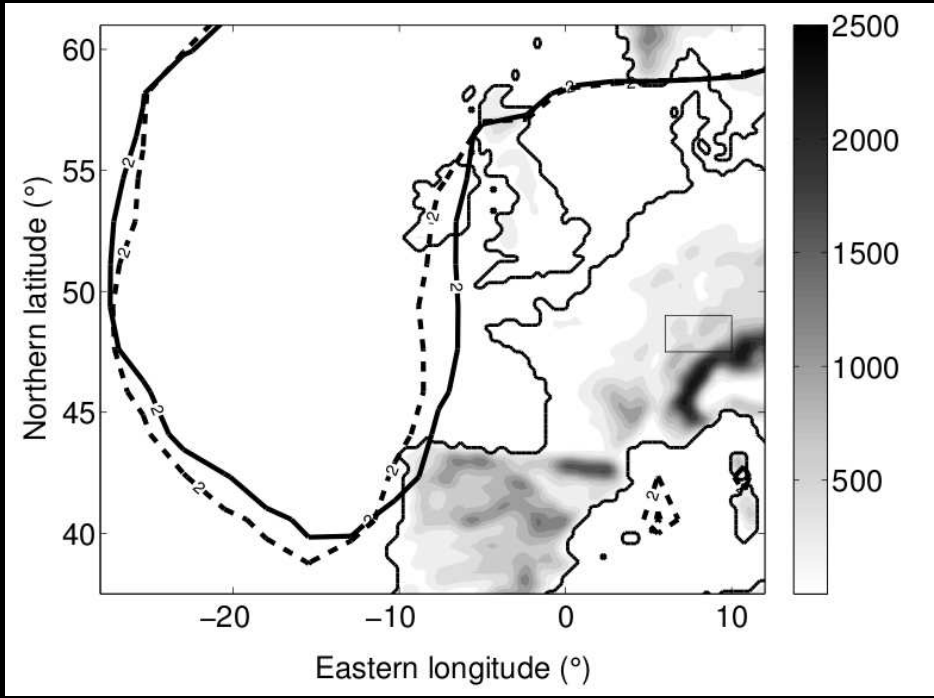
Can’t be represented by 12 members.

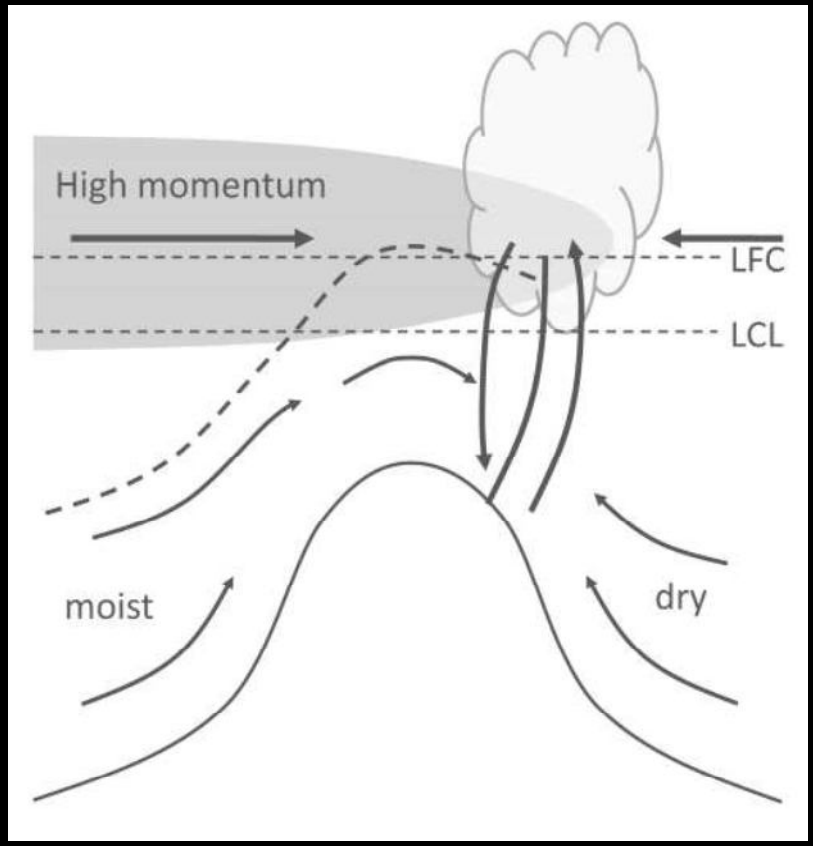
5% error at 1000 km = 100% error at 50 km

LBC driven uncertainties

COPS IOP 8b at 12 UTC on July 27th 2007

Kirsty Hanley et al (2011) QJ

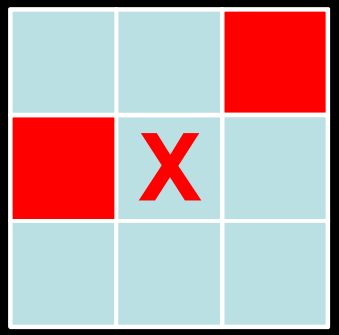




PVU. Solid: six strongest convection members.
Dashed: six weakest convection members (dashed)

Neighbourhood processing – a way of getting more members

Can be shown that at least several hundred members are needed to give smooth probabilities of high-impact rainfall. We have 12 !



3x3 neighbourhood

What happens at a particular model grid square is equally likely to occur at nearby grid squares

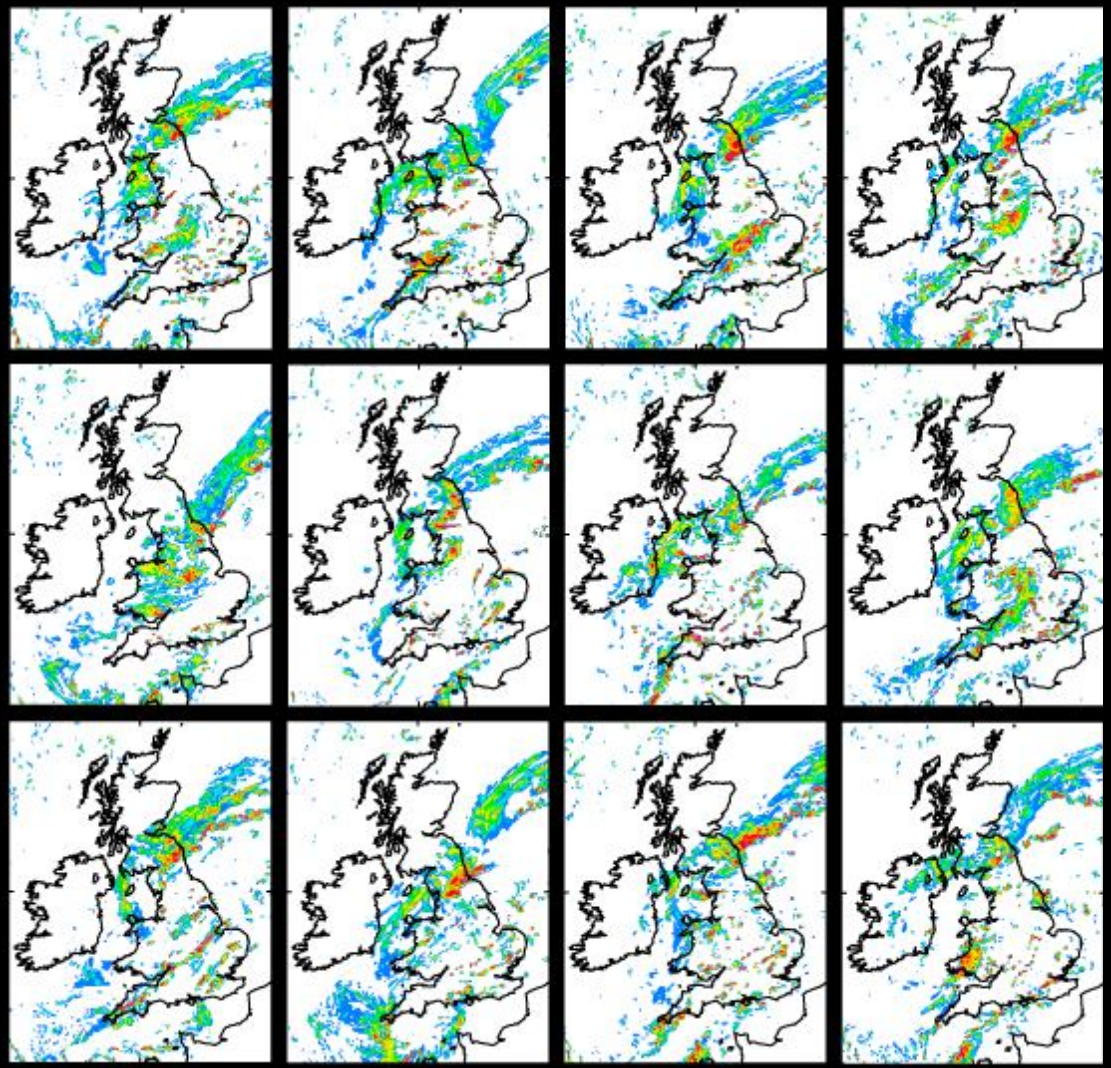
Probability at **X** = 2/9 = 22%

A 9x9 neighbourhood x 12 members = 972 members

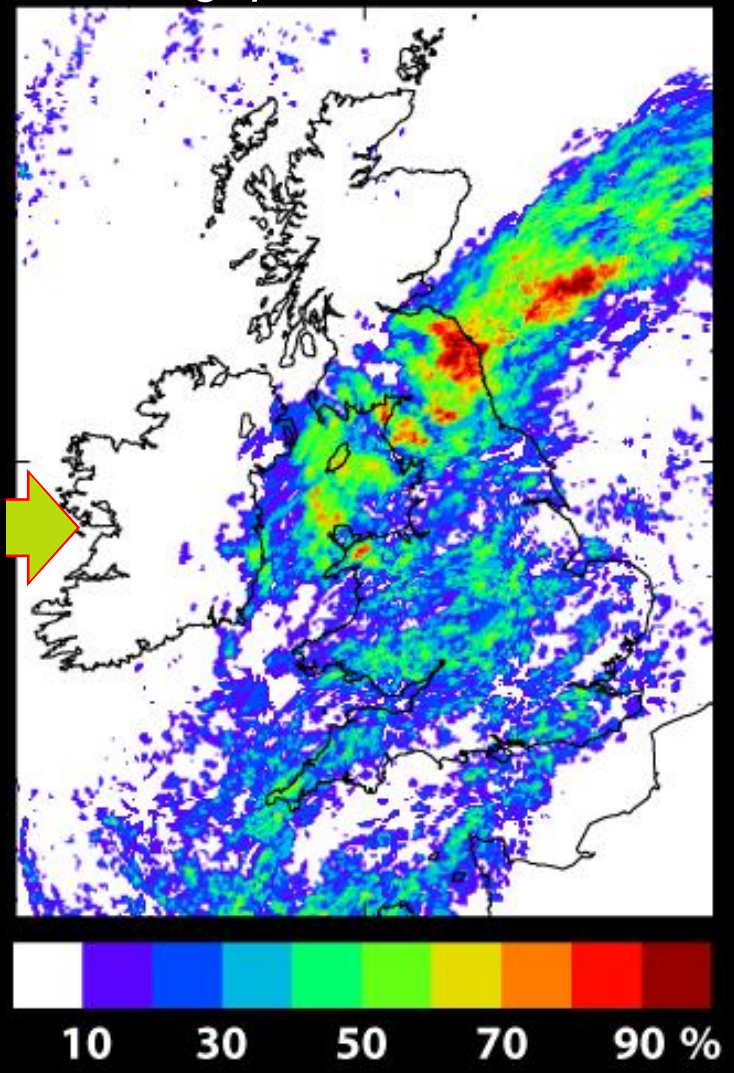
Not independent members – justifiable for unpredictable scales

Theis et al 2005, Roberts 2005, Schwartz et al 2010
Can be more refined e.g. Gaussian Kernal Sobash et al 2011

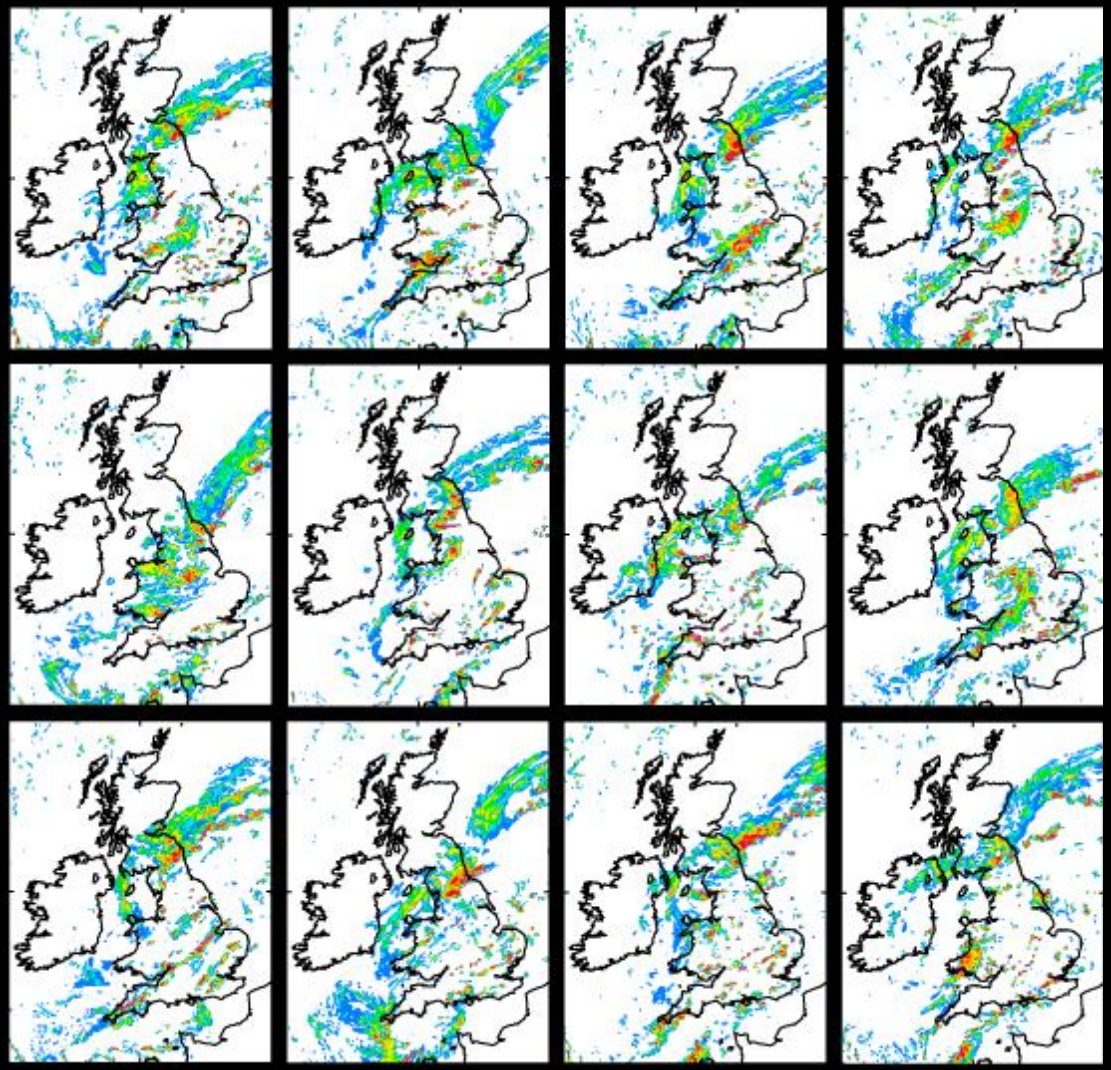
Constructing a probability forecast



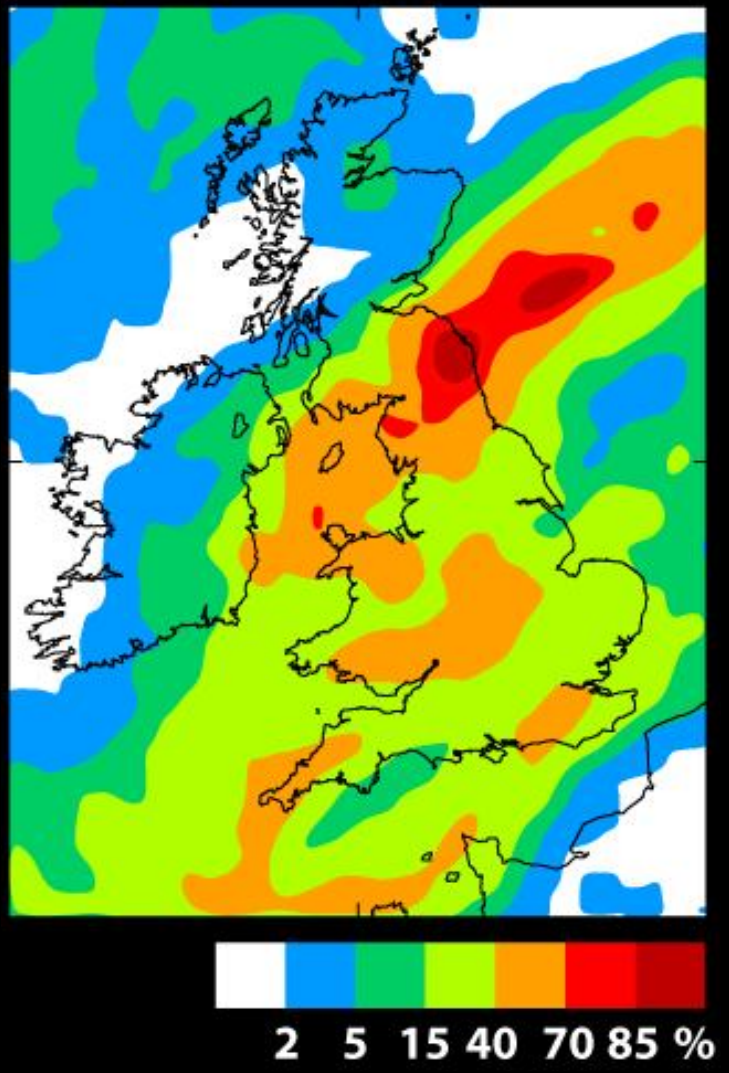
Insufficient ensemble size leaves gaps



Constructing a probability forecast

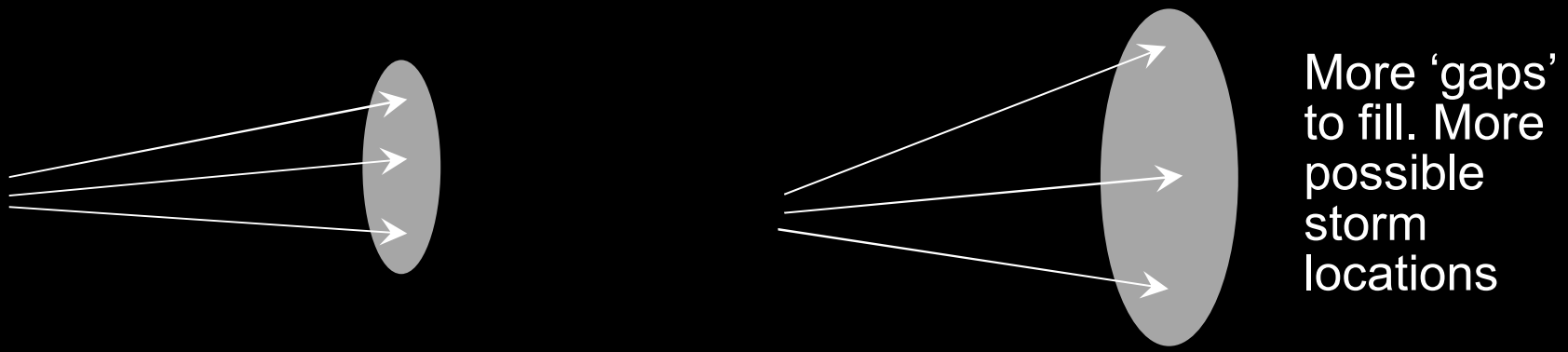


Probability of rain in period around the time of interest



How large should the neighbourhood be?

The neighbourhood size should depend on the spatial ensemble spread

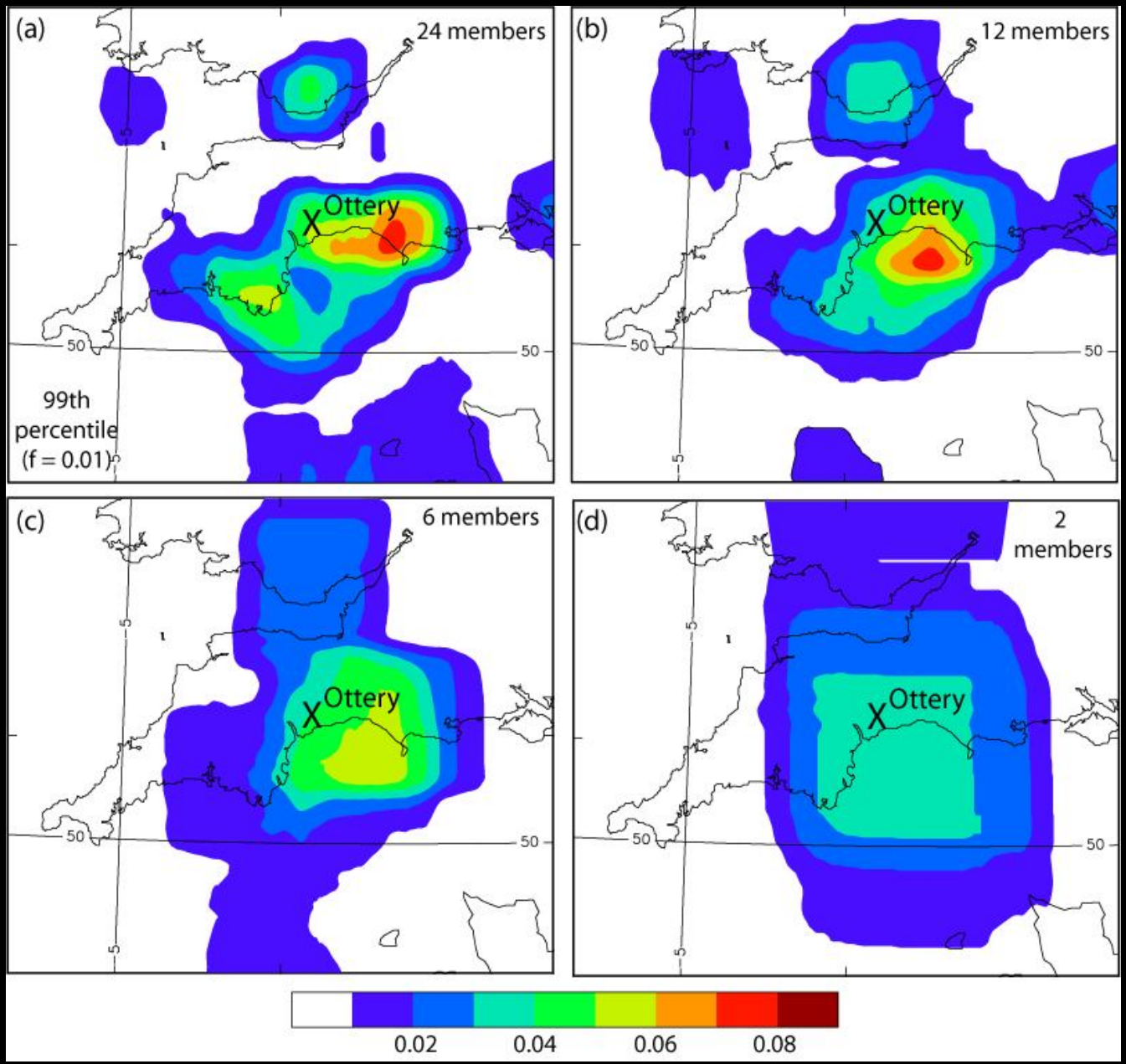


More ‘gaps’ to fill. More possible storm locations

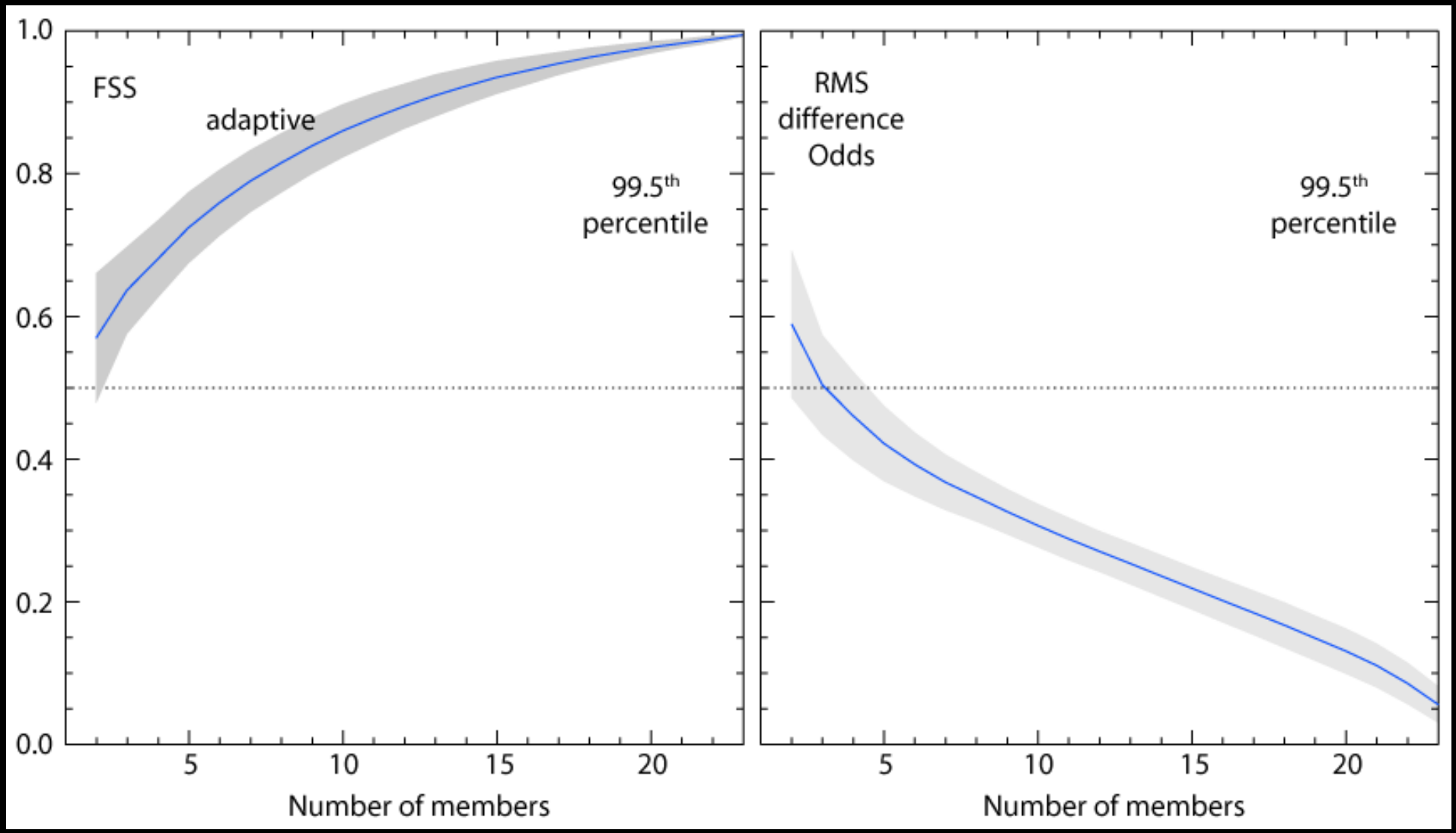
Provided that driving ensemble (MOGREPS-R in our case) has appropriate spread at larger scales (spans the grey area).

Use the Fractions Skill Score (FSS) spatial verification method (Roberts and Lean MWR 2008) to compute the spatial differences between members and find an optimal adaptive neighbourhood size for a particular variable.

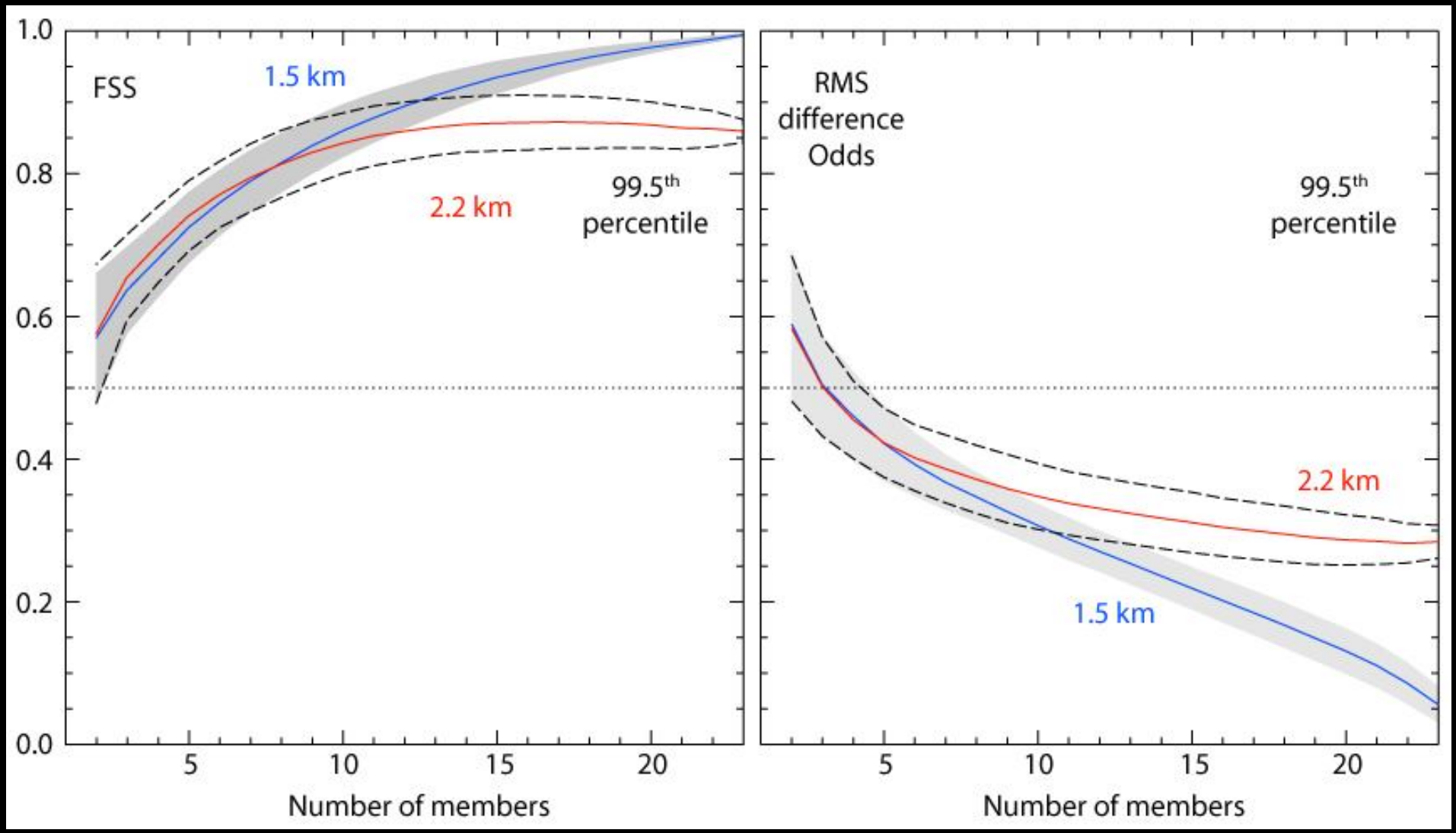
Adaptive neighbourhood processed probabilities



Comparison of ensemble sizes



Comparison of ensemble sizes and resolution



Future directions for MOGREPS-UK

Incorporate time-lagging

Evaluate perturbing around the deterministic 1.5 km analysis (rather than downscaling). Gives high resolution start but brings many issues.

Nest directly inside global ensemble (MOGREPS-G) -> ~33 km

Long-term evaluation. Initial results encouraging. Develop spatial ensemble verification methods.

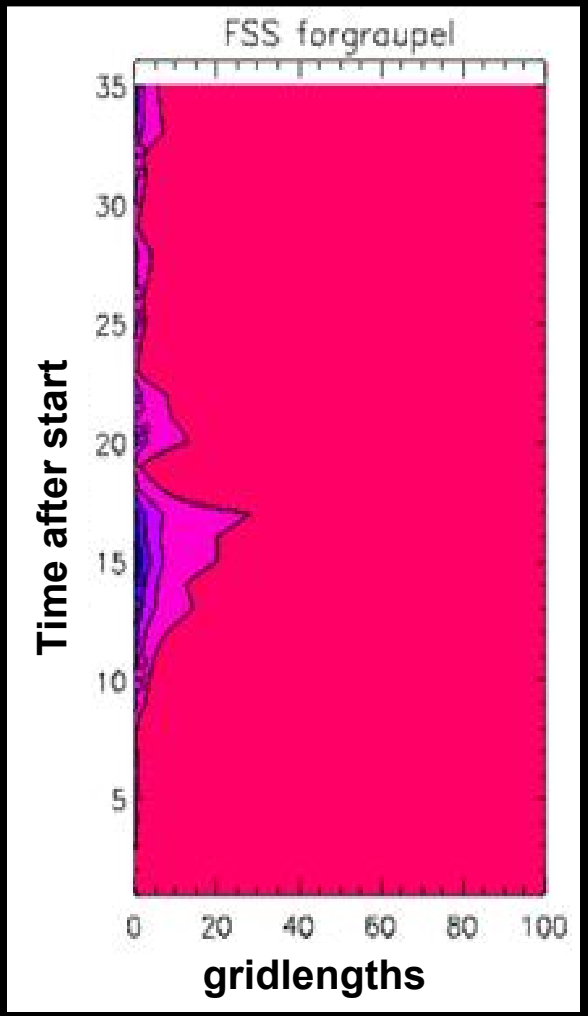
Product development. Testing adaptive neighbourhood.

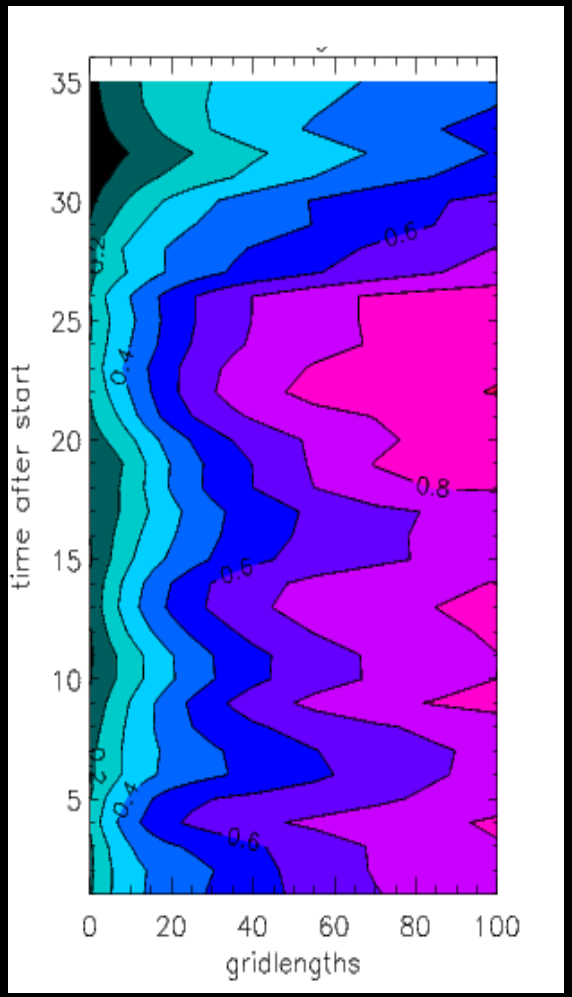
Investigate ‘model error’ perturbations. Model physics. Stochastic backscatter.

Physics vs. boundaries

Seonaid Dey and Giovanni Leoncini

FSS for precipitation hourly accumulations





FSS

- Values 0-1
- 1 = ‘perfect match’

  0 = ‘totally different’
- Contours every 0.1, colours **black at 0.0** to **red at 1.0**
- Graupel / convection scheme / timestep had little effect at reliable scales

Future directions for MOGREPS-UK

Incorporate time-lagging

Evaluate perturbing around the deterministic 1.5 km analysis (rather than downscaling).

Nest directly inside global ensemble (MOGREPS-G) -> ~33 km

Long-term evaluation (at least a year). Initial results encouraging. Develop spatial ensemble verification methods.

Product development vital. Testing adaptive neighbourhood.

Investigate ‘model error’ perturbations. Model physics. Stochastic backscatter.

‘Seamless’ blending with ensemble nowcasting and longer-range ensembles

Investigate different configurations. E.g. domain size, resolution.

Long term – storm-permitting ensemble DA

Thanks for listening

Dale Barker, Andrew Bennett, Jorge Borneman, Neill Bowler, Seoniad Dey, Brian Golding, Nicholas Graham, Simon Jackson, Giovanni Leoncini, Ken Mylne, Clive Pierce, Nigel Roberts, Kelvyn Robertson, Richard Swinbank, Warren Tennant, Clive Wilson ……