Dynamical and Microphysical Evolution of Convective Storms

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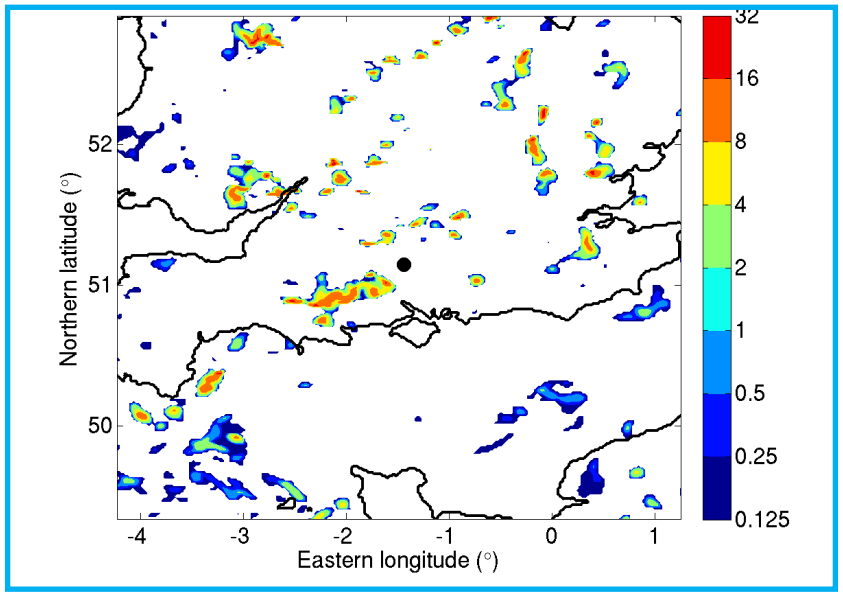
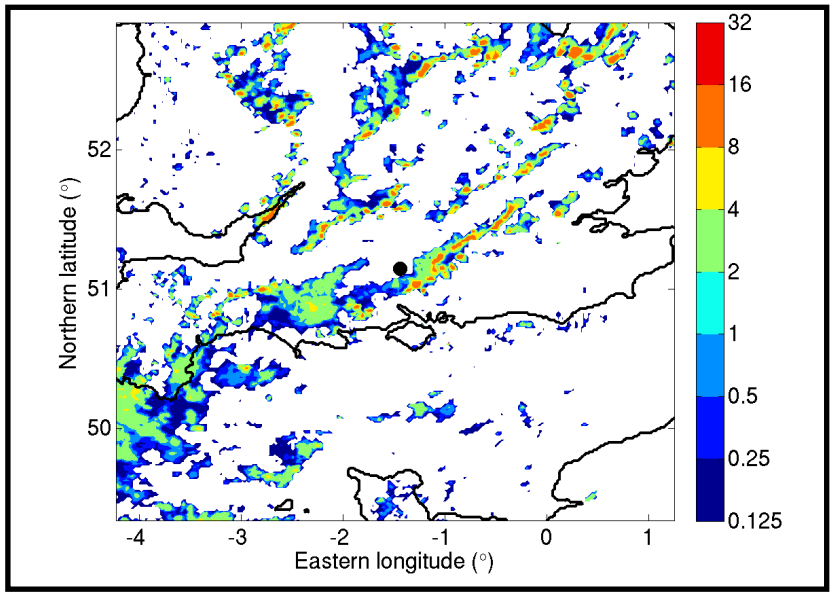
Convection in the UKV

- At 1.5 km grid length, convection in the Met Office UKV is still under-resolved.
- Individual cells are often too large, too far apart, with too much heavy rain and a lack of light rain.

UKV



Nimrod



14 UTC on 25th August 2012

Average cell size in the UKV

Rainrate threshold (mm/hr)	Radar effective radius (km)	UKV effective radius (km)
0.125	4.41	9.05
0.5	3.57	7.45
1.0	3.15	6.61
2.0	2.50	5.60
4.0	1.85	4.49
8.0	1.45	3.36
16.0	1.20	1.90

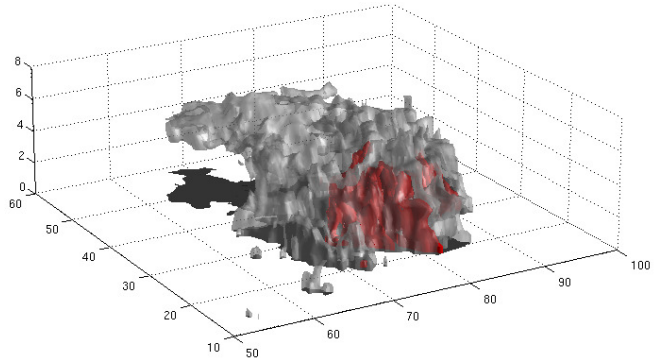
Based on ~30 cases

The DYMECS approach: beyond case studies

Track storms in real time and automatically scan Chilbolton radar.

Derive properties of hundreds of storms on ~**40 days**:

- Vertical velocity
- 3D structure
- Rain & hail
- Ice water content
- TKE & dissipation rate

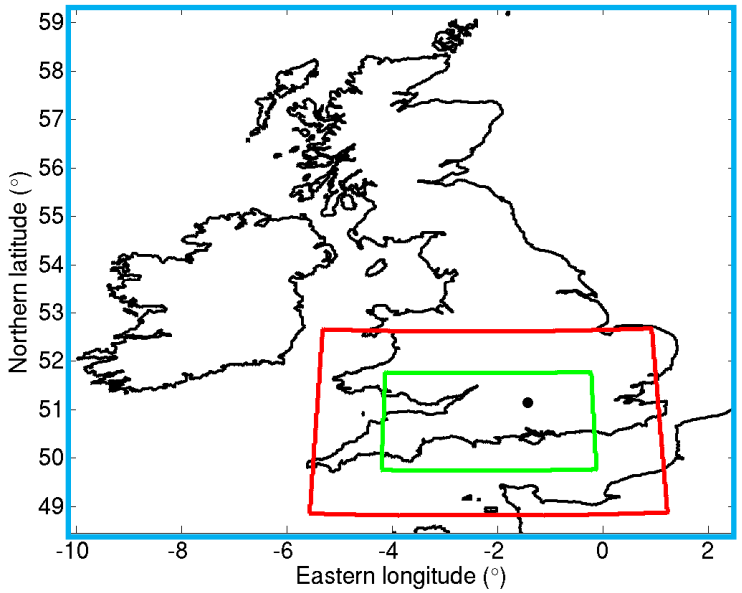


Evaluate these properties in Met Office UM varying:

- Resolution
- Parameters in the microphysics scheme
- Parameters in the sub-grid turbulence scheme

Model setup – UM vn7.8

Set of nested models.

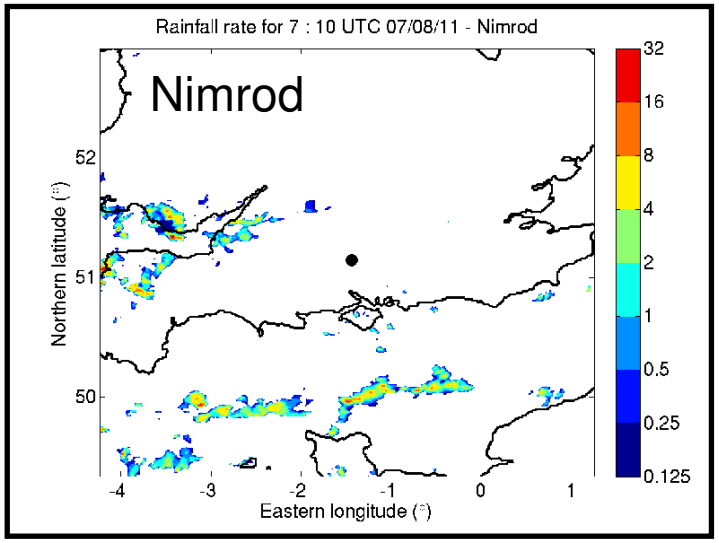


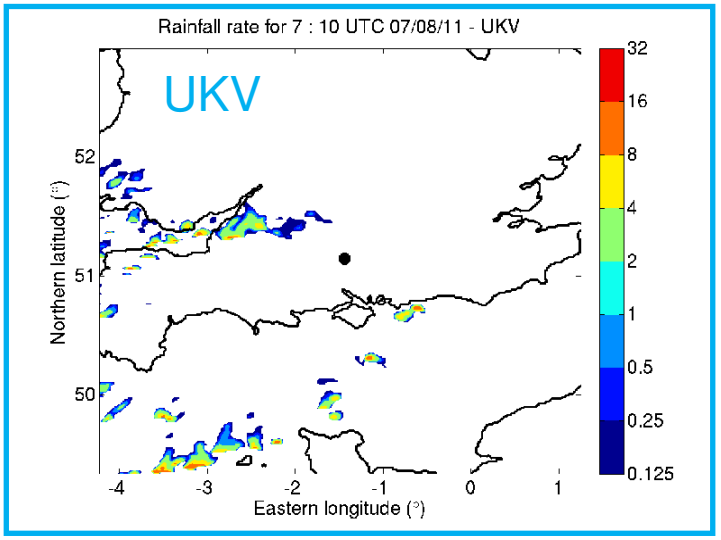
UKV – 1.5km grid length,
70 vertical levels,
2D subgrid turbulence scheme,
BL mixing in vertical.

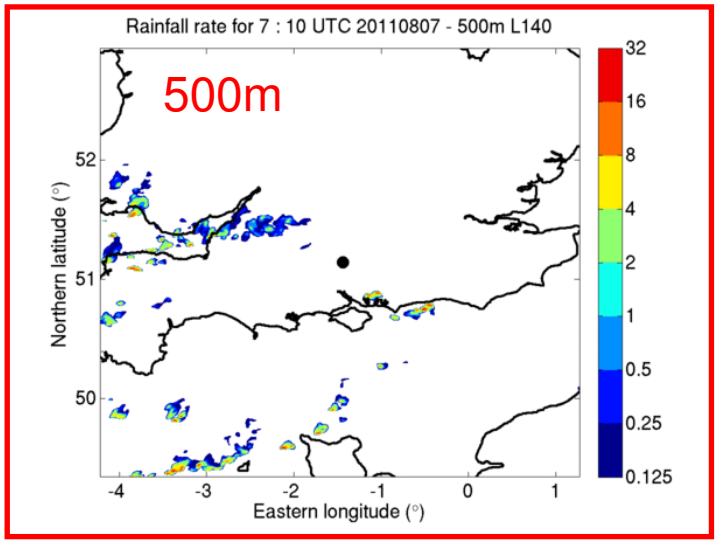
500m model – 500x425 km,
140 vertical levels,
3D subgrid turbulence scheme.

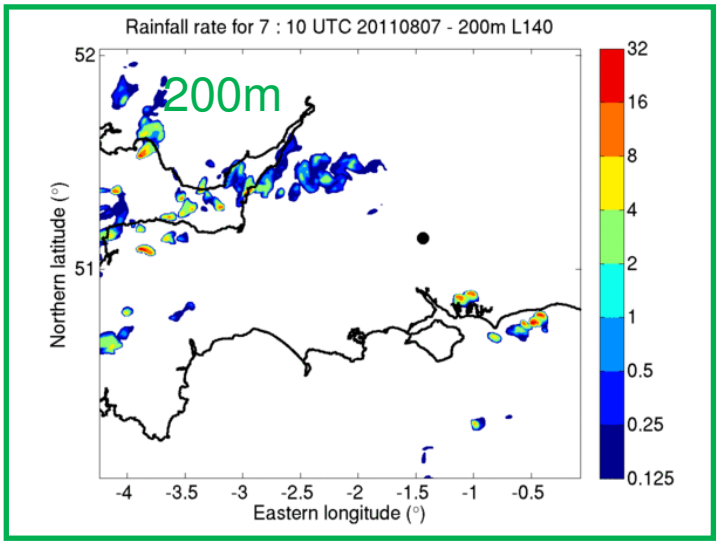
200m model – 300x225 km,
140 vertical levels,
3D subgrid turbulence scheme.

7th August 2011







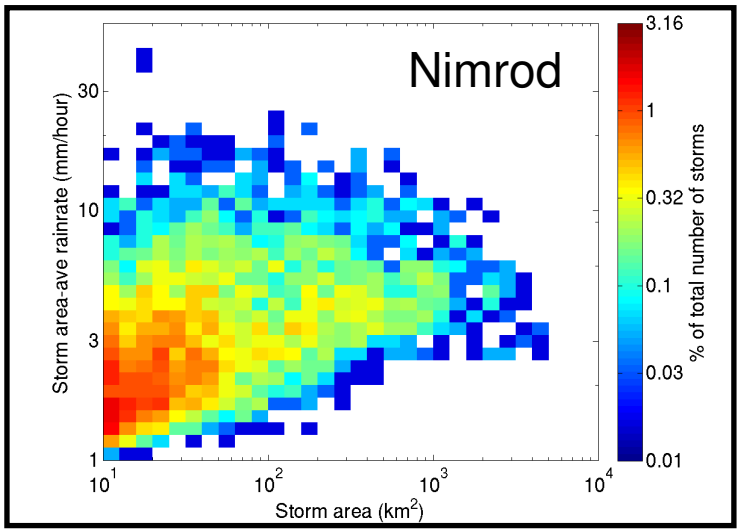


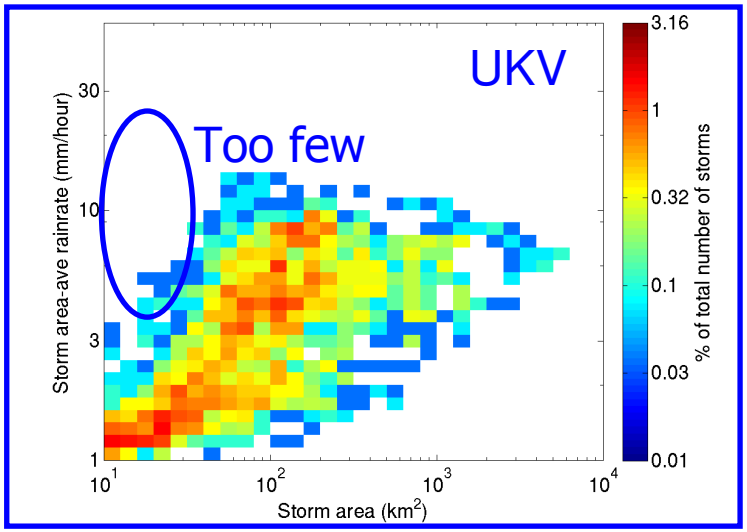
7th August 2011 – cell statistics

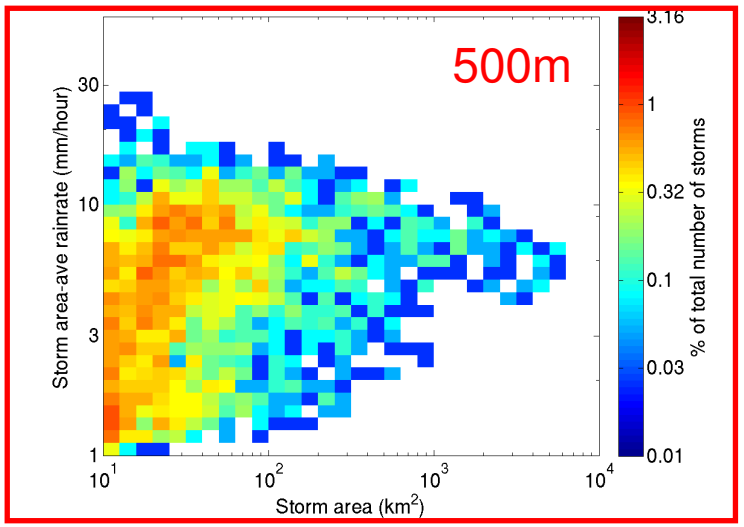
Thresholds:

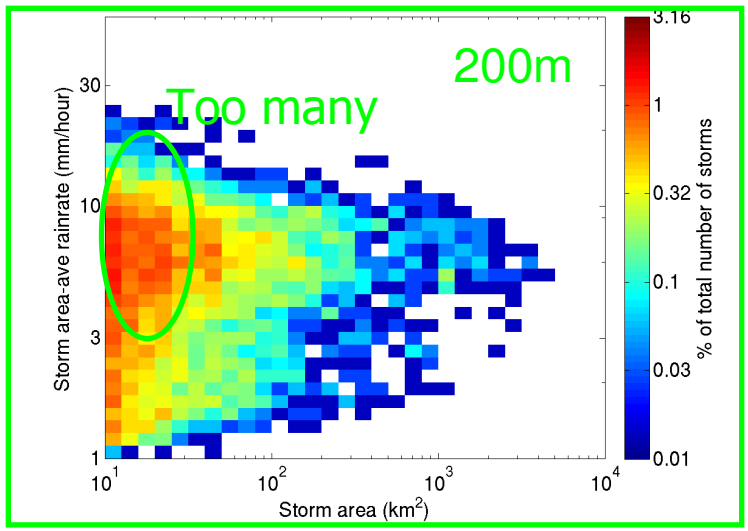
R > 1 mm/hr

A > 10 km²

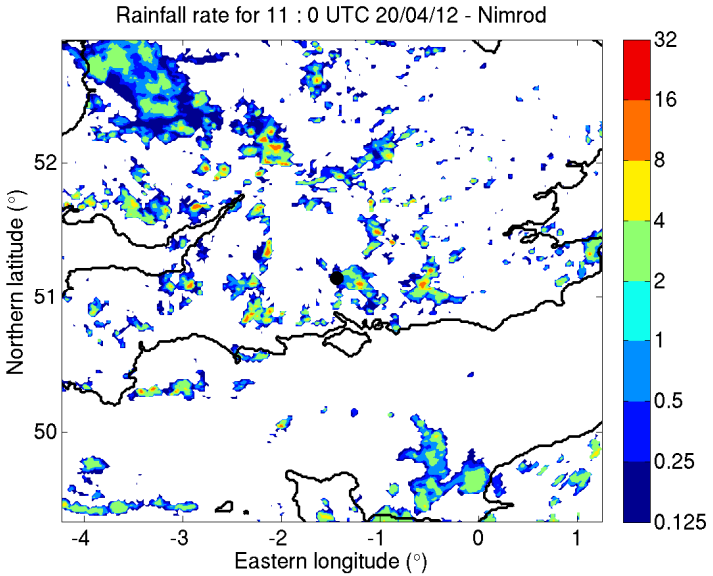


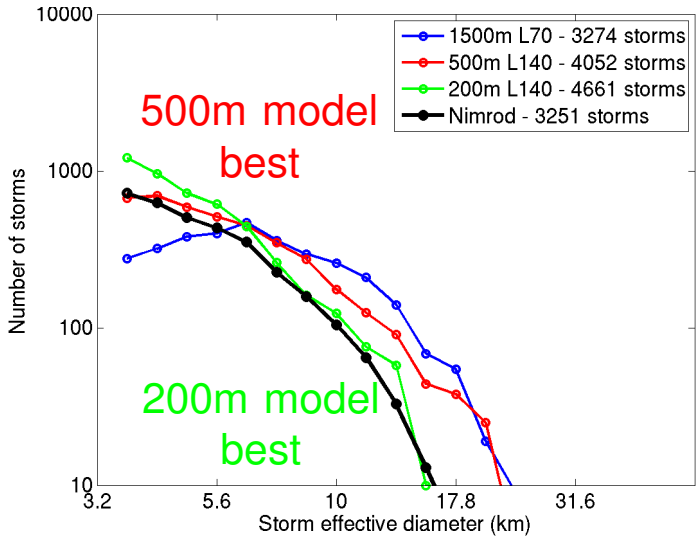




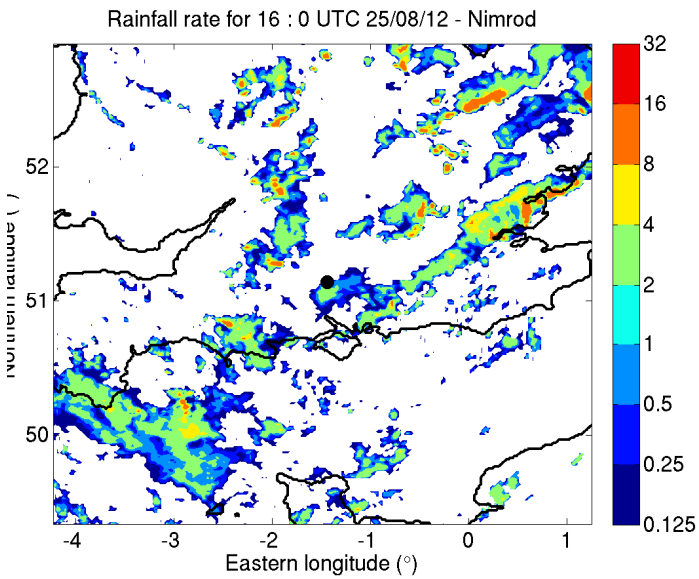


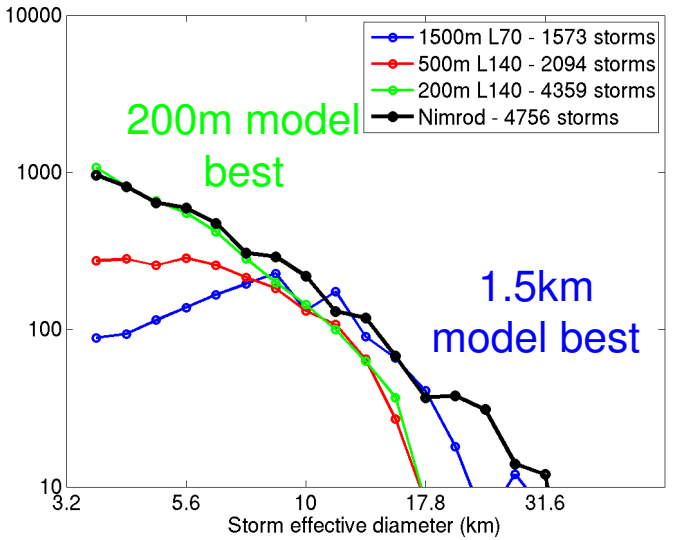
20 April 2012





25 Aug 2012



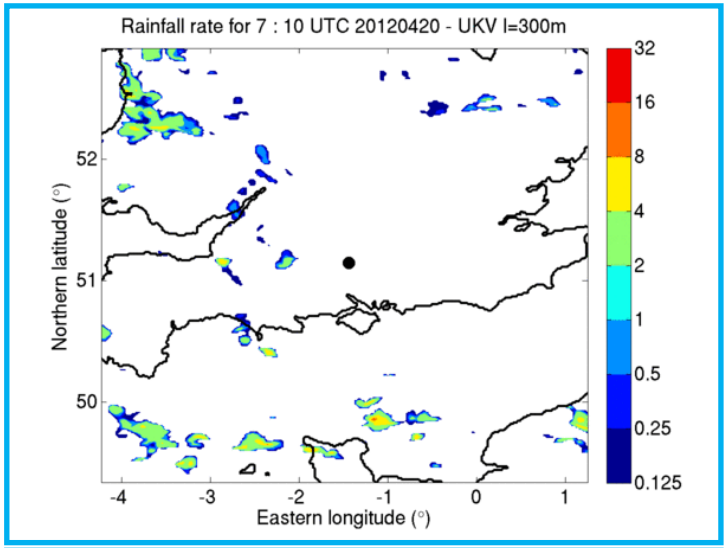


Mixing length sensitivities

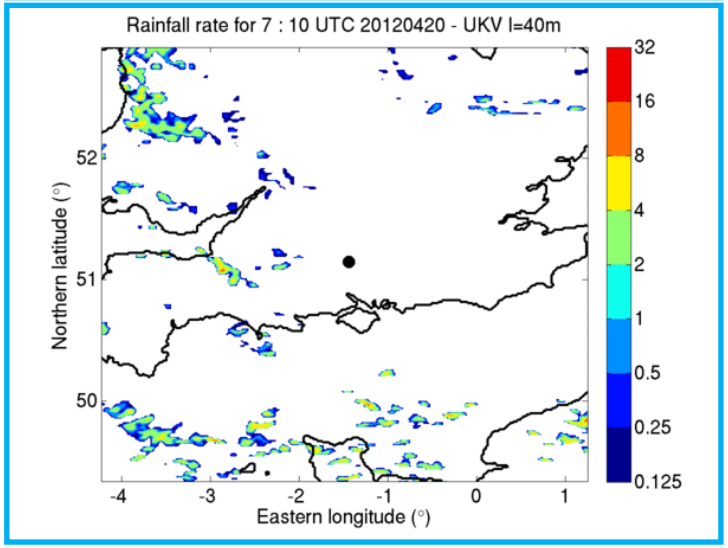
Varying the mixing length

20 April 2012

- The mixing length used in the subgrid turbulence scheme is l = 0.2 x grid length at all resolutions.
- There is uncertainty in the value of l.
- Increasing l, increases the subgrid mixing, smoothes fields and can reduce the number of small cells.
- The UKV and 500m-model have been run with a mixing length of 300m, 100m and 40m.
- The mixing length plays a key role in determining the number of small storms.



UKV – l=300m

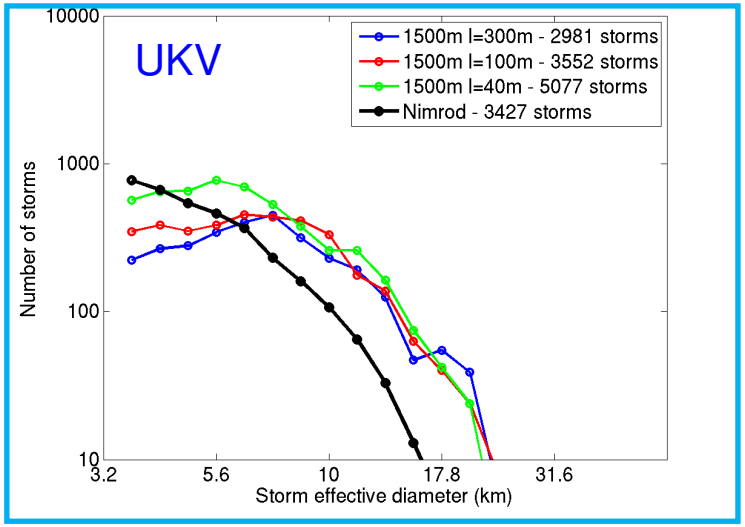


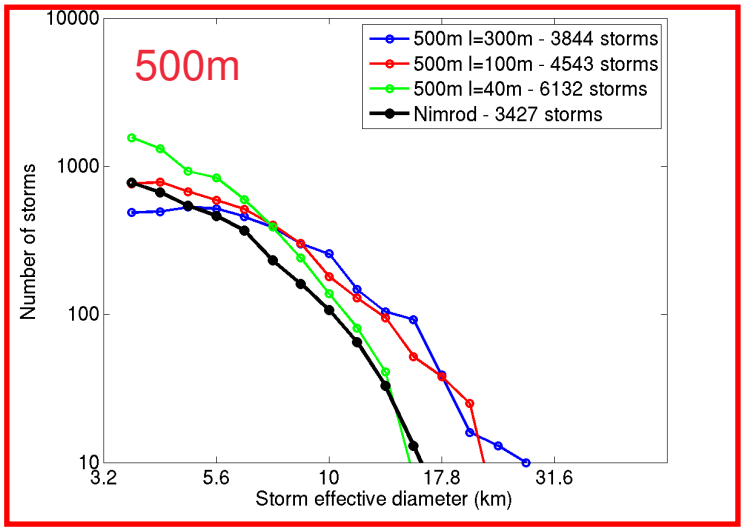
UKV – l=40m

Varying the mixing length

20 April 2012

- The mixing length used in the subgrid turbulence scheme is $l = 0.2 \times$ grid length at all resolutions.
- There is uncertainty in the value of *l*.
- Increasing *l*, increases the subgrid mixing, smoothes fields and can reduce the number of small cells.
- The UKV and 500m-model have been run with a mixing length of 300m, 100m and 40m.
- The mixing length plays a key role in determining the number of small storms.





Summary and Future Work

- The UKV does not correctly reproduce the observed sizes of the convective storms.
- The 200m model tends to predict too many small storms.
- The model that performs “best” is case dependent.
- The model is very sensitive to the subgrid turbulence scheme.
- What is the magnitude and scale of convective updraughts? How do the model updraughts compare with reality?
- What model configurations lead to the best 3D storm structure and evolution, and why? (Poster Z38)
- See Posters Z37, Z38 and Z39 - Friday 13:30–15:00

Questions and answers