“Convective system structure, evolution and severe weather potential in 1 versus 3 km WRF forecasts”

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QLCS characteristics:
...convective initiation
...cold pool strength/propagation
...surface winds
...mesovortices
...rear-inflow jet
...updraft helicity

Radar

04/27/11
12 Severe Squall Line Cases:

Radar
SPC Storm Reports

29 June 2012

Radar 23:00 UTC
29 June 2012

Dayton, OH

DTheta ~17 k  72 kts

1 km model

DTheta ~16 k  54 kts
Delta-Theta Obs
29 June 2012

Surface Theta (2m)

1 km

21:00 UTC
30 June 2012
00:00 UTC

Radar

1 km

3 km

3 km system propagation more accurate for this case
27 April 2011

SPC Storm Reports for 04/27/11
Map updated at 1212Z on 05/07/11

Radar 11:00 UTC
27 April 2011

Max Surface Wind (10m)

1 km

3 km

12:00 UTC
27 April 2011  

850 hPa Winds 

1 km 

3 km 

10:00 UTC
27 April 2011

Max Updraft Helicity (0-1km)

Hourly max 0-1 km AGL updraft helicity


1 km

12:00 UTC

3 km
Summary Cold Pool Statistics:

**Delta-Theta**

- (1 km grid colder)

**Theta-E**

- (Theta-E lower than obs)
Summary Max Surface Wind Statistics:

(1 km grid stronger surface winds)
QLCS characteristics: 1 vs. 3 km

...convective initiation (similar)

...cold pool strength/propagation (1km cooler, a bit faster)

...surface winds (1 km stronger)

...mesovortices (more leading line vortices at 1 km)

...rear-inflow jet (similar)

Caution: present results could be sensitive to microphysics (Thompson)
27 April 2011

Max Updraft Helicity

Hourly-max 0-1km AGL updraft helicity

Init: Wed 2011-04-27 00 UTC
Valid: Wed 2011-04-27 18 UTC - Thu 2011-04-28 00 UTC

1 km 0-1 UH

00:00 UTC

1 km 2-5 UH
Theoretical speed of propagation:

\[ c^2 = 2 \int_{o}^{H} (-B) \, dz \quad B \equiv -g \frac{\rho'}{\bar{\rho}} \equiv g \frac{\theta'}{\bar{\theta}} \]

\[ c = \sqrt{2 g \frac{\theta'}{\bar{\theta}} H} = \sqrt{2 \frac{\Delta P}{\bar{\rho}}} \]

Strength of a cold pool can be estimated from change in surface T, Theta, P....
27 April 2011

13:00 UTC
27 April 2011

KTCL : 2011-04-27/00 UTC through 2011-04-28/12 UTC

1 km

DTheta ~6 k  63 kts

DTheta ~7 k  56 kts

1 km
29 June 2012

850 hPa Winds

21:00 UTC