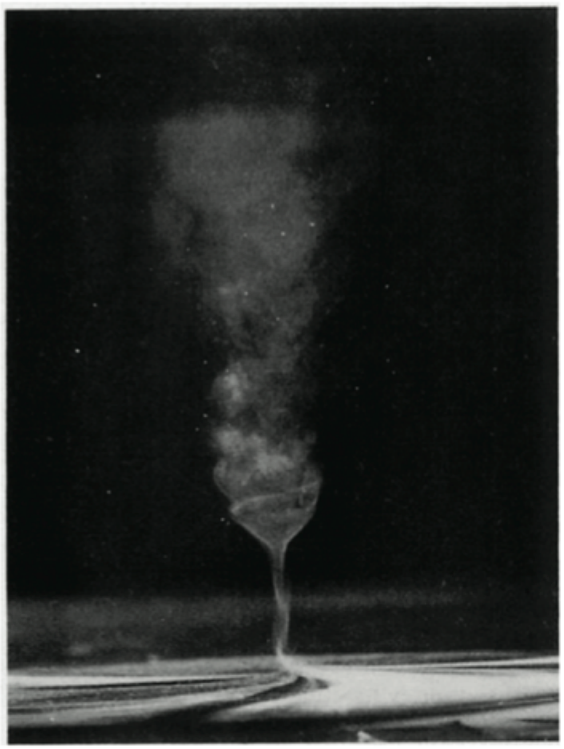
Swirl ratio in tornado chamber experiments

Low swirl

b)



High swirl

Multiple vortices

Low swirl:

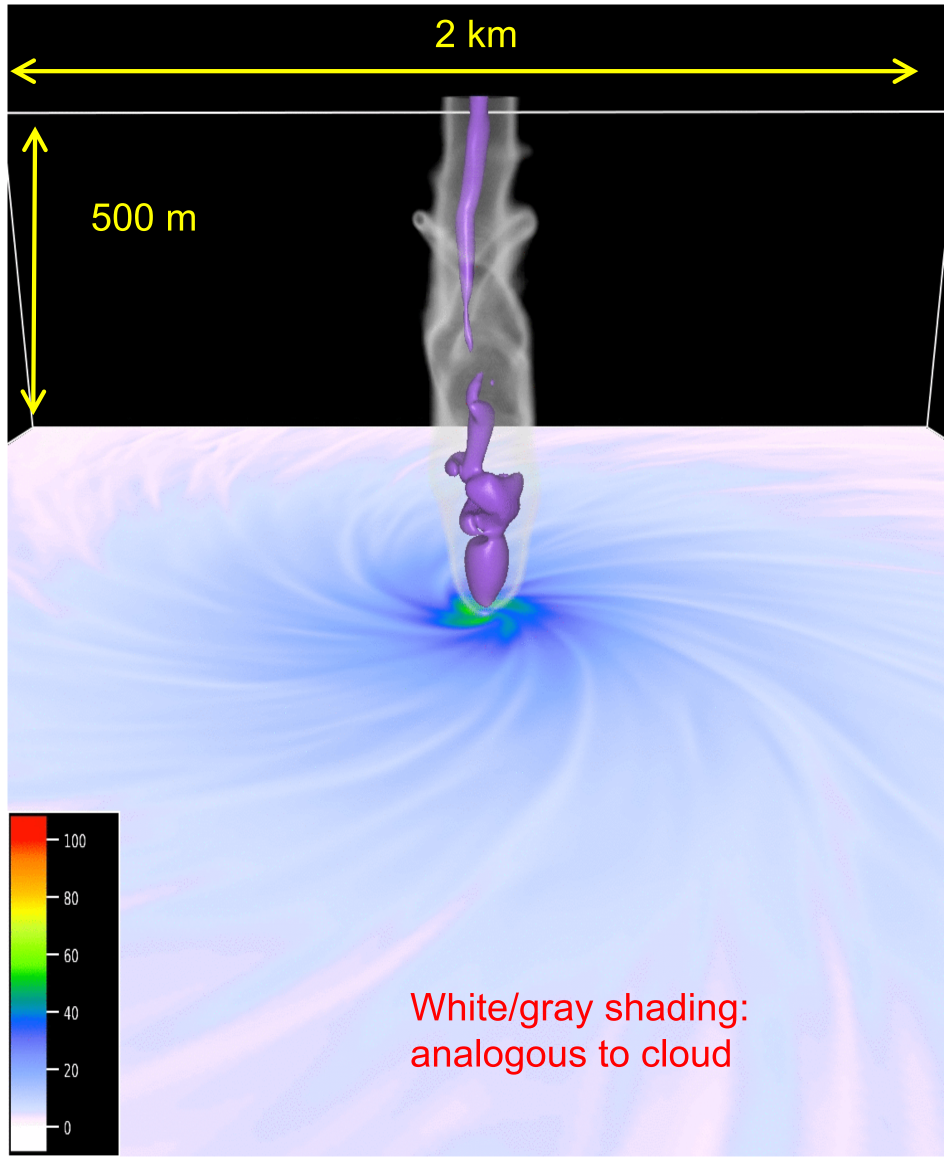
<u>Details</u>:

$\Delta x = \Delta y = 5$ m
$\Delta z = 2.5$ m

10 s animation, image every 0.1 s

Simulations using CM1

Wind speed ($m\ s^{-1}$) at 1 m AGL



High swirl:

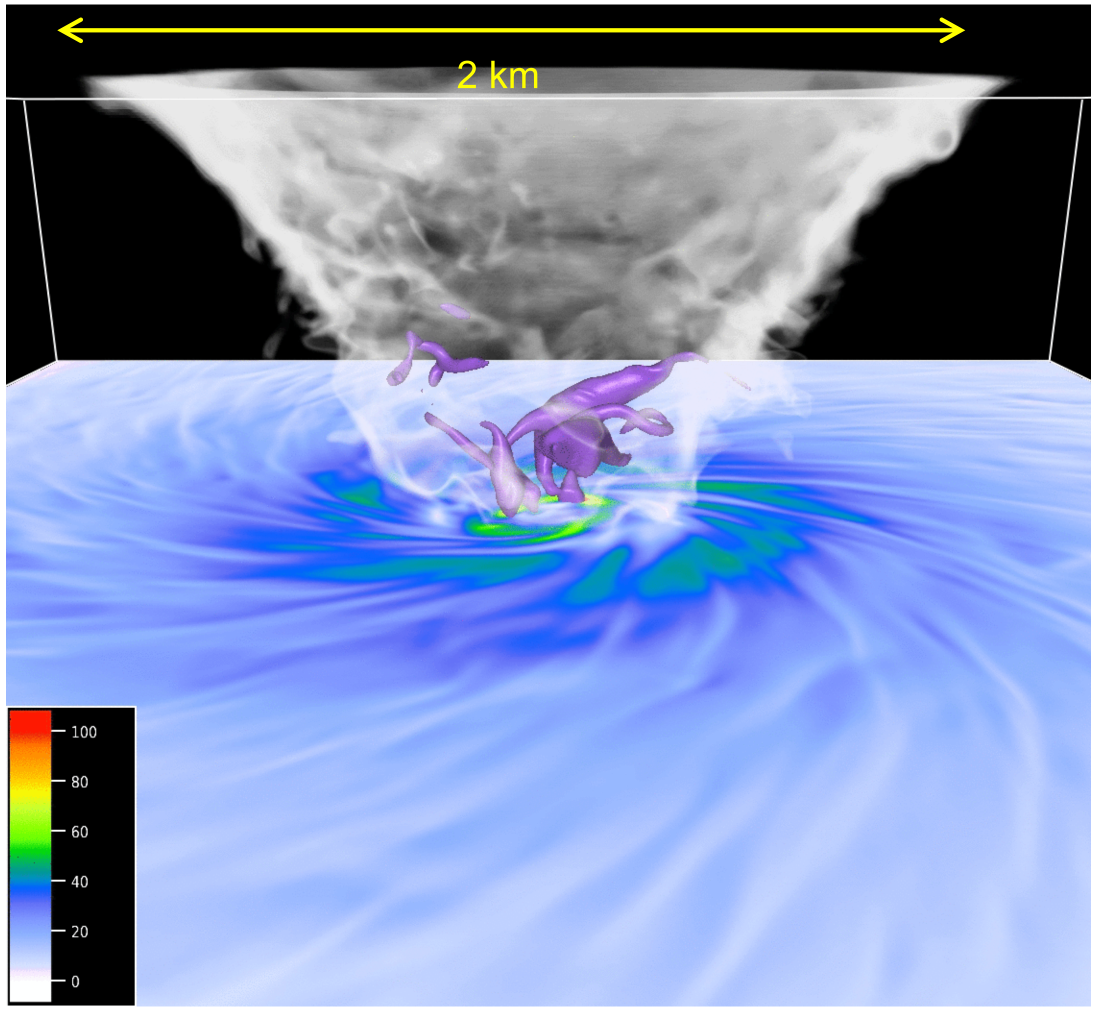
Details:

Δx, Δy = 5 m
Δz = 2.5 m

10 s animation, image every 0.1 s

Simulations using CM1

Wind speed ($m\ s^{-1}$) at 1 m AGL



Low swirl

(Greg Thompson)

High swirl

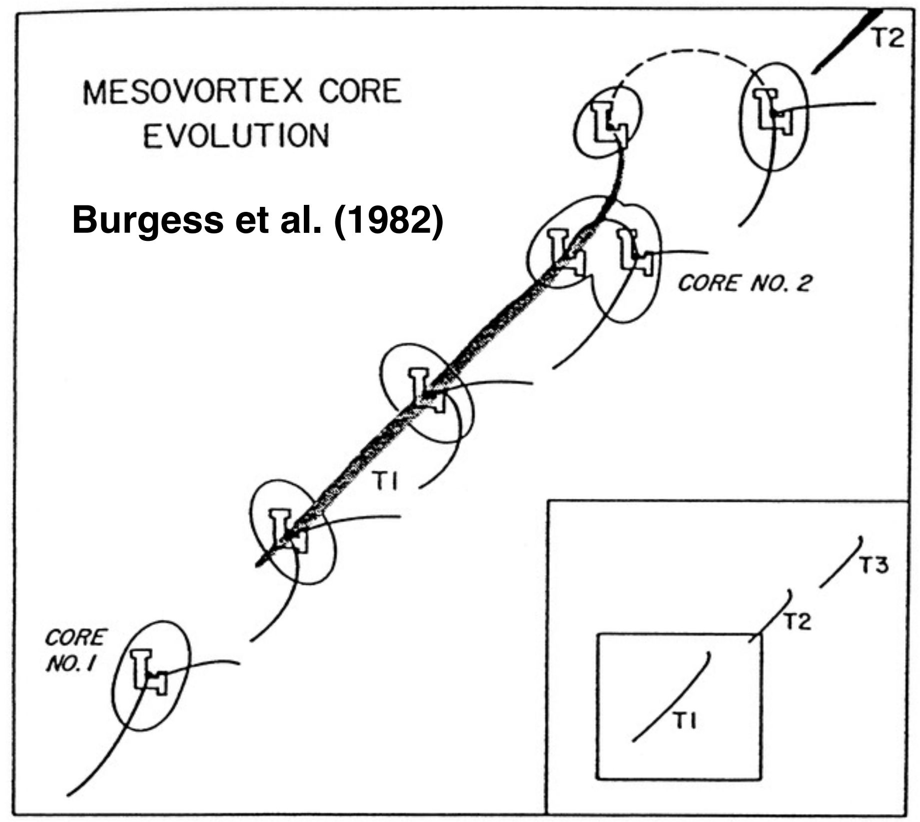
Figure 4: An example of a multiple-vortex tornado (courtesy of H. B. Bluestein)

Cyclic mesocyclogenesis

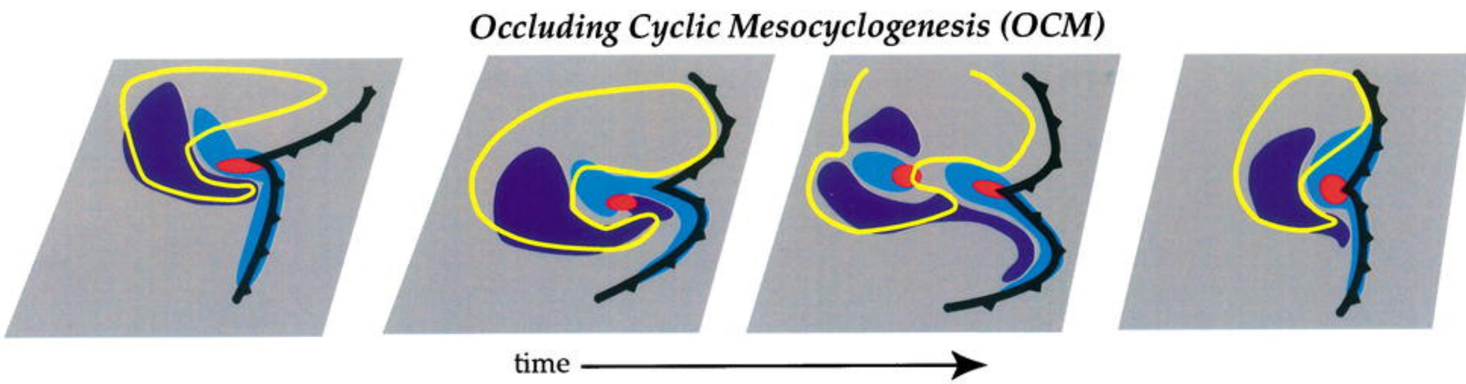
Instead of a long-lived single mesocyclone, some storms possess multiple mesocyclones, forming and dissipating through a **cyclic occlusion process** with a period of ~ 30-60 minutes.

Observed in observational studies (Lemon and Doswell 1979; Burgess et al. 1982).

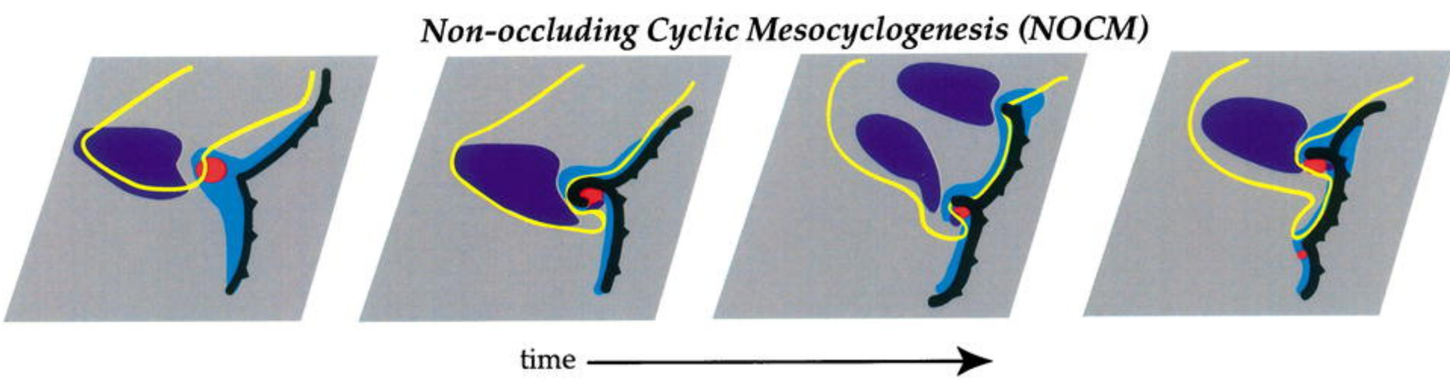
Examined in numerical simulations (Adlerman et al. 1999; Adlerman and Droegemeier 2005).



Cyclic Mesocyclogenesis



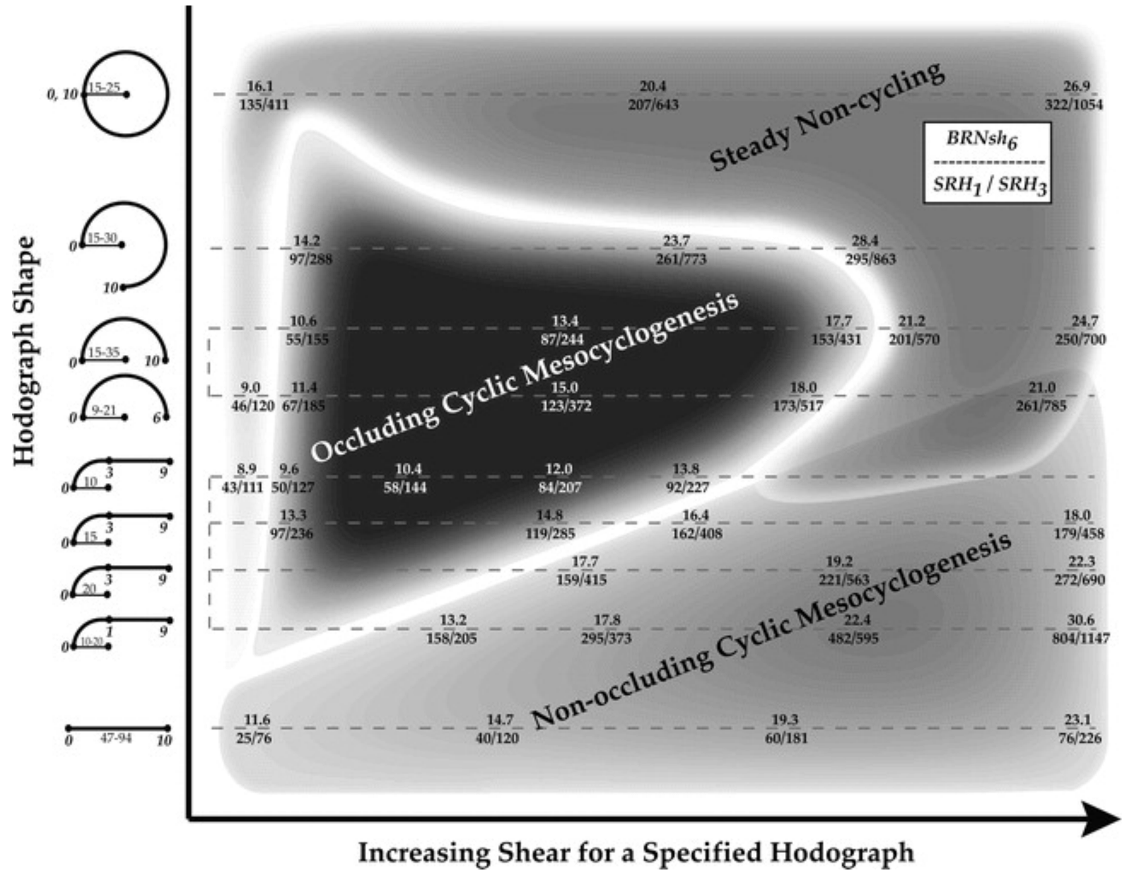
Old mesocyclone occludes (detached from gust front)



Old mesocyclone moves down gust front

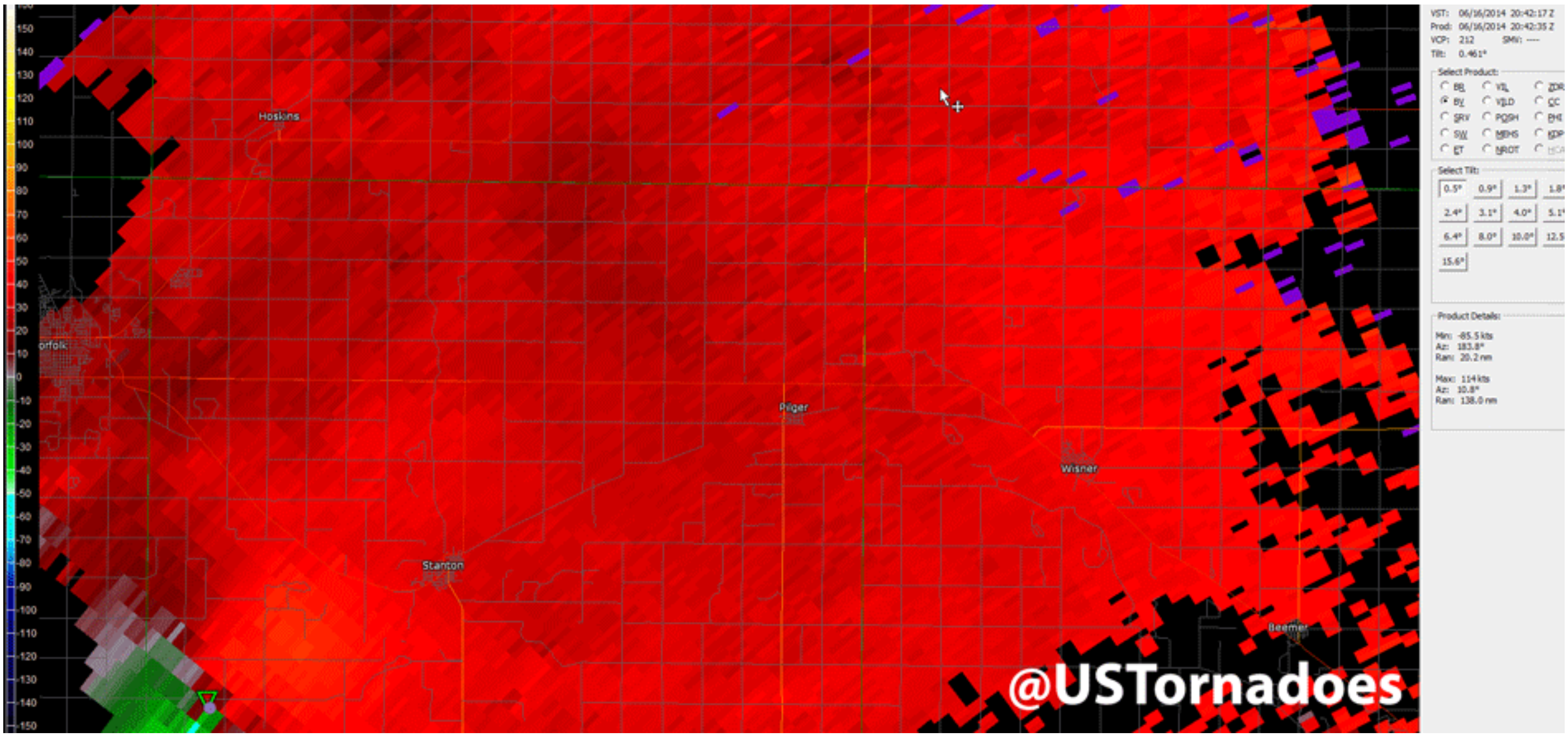
Adlerman and Droegemeier, MWR, 2005

Cyclic Mesocyclogenesis



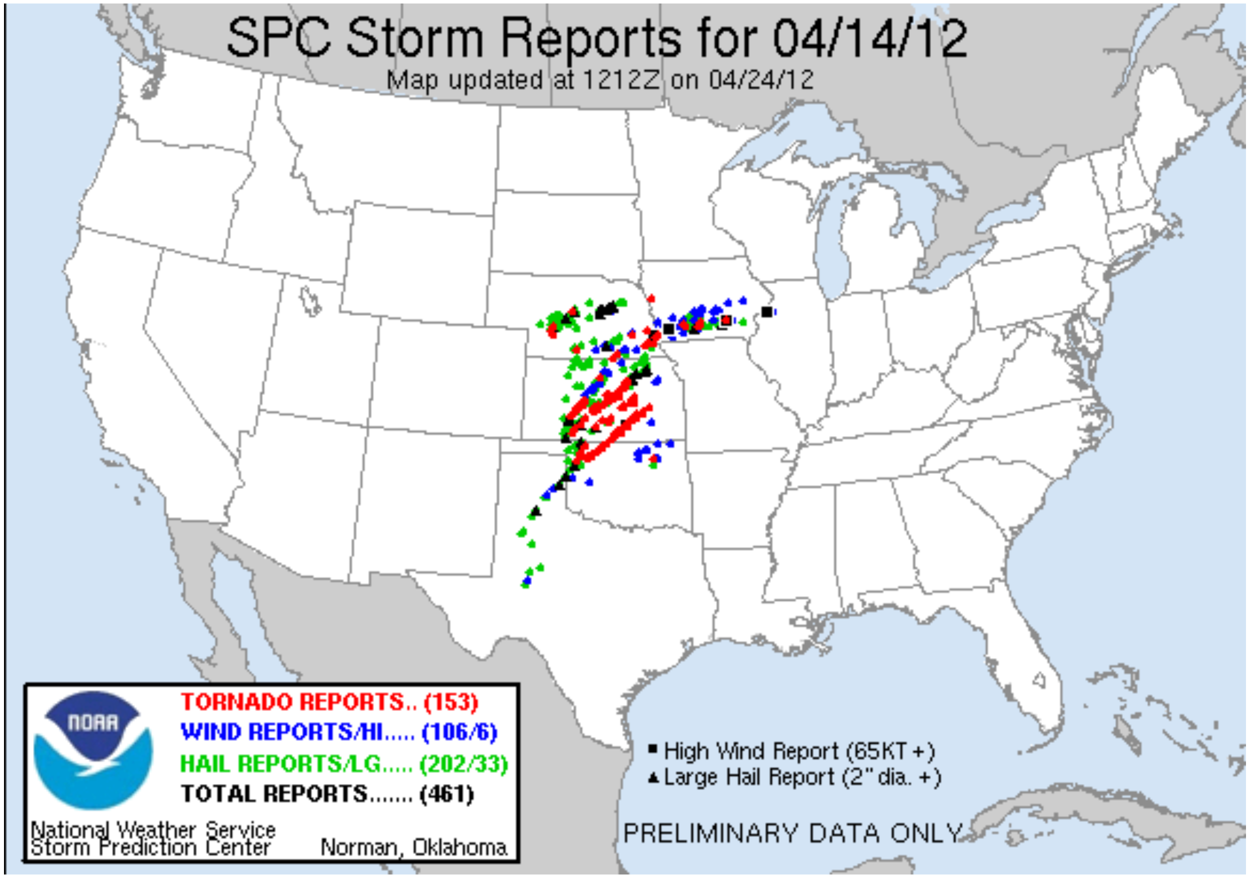
Adlerman and Droegemeier, MWR, 2005

Pilger, NE tornadoes – 16 June 2014

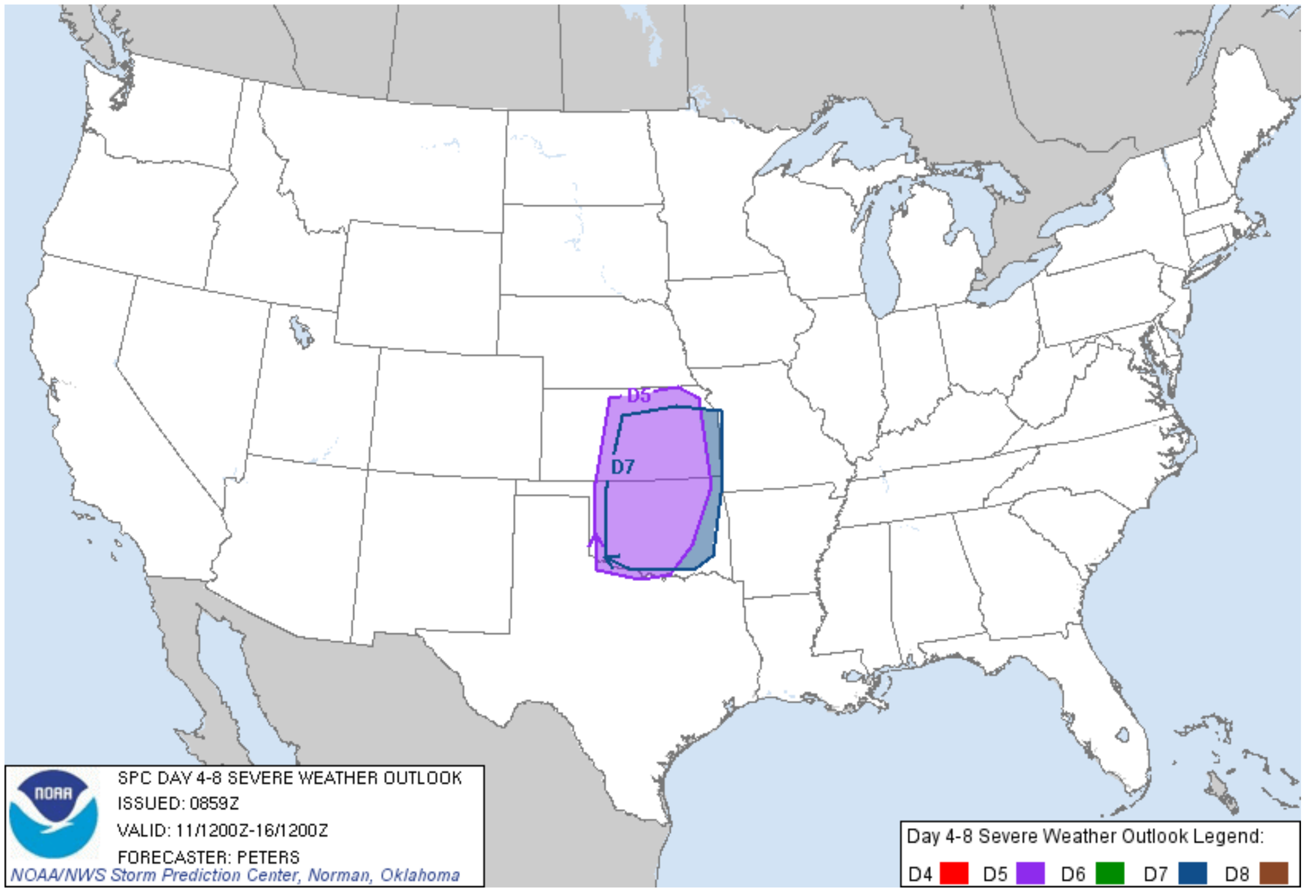


Pilger, NE tornadoes – 16 June 2014

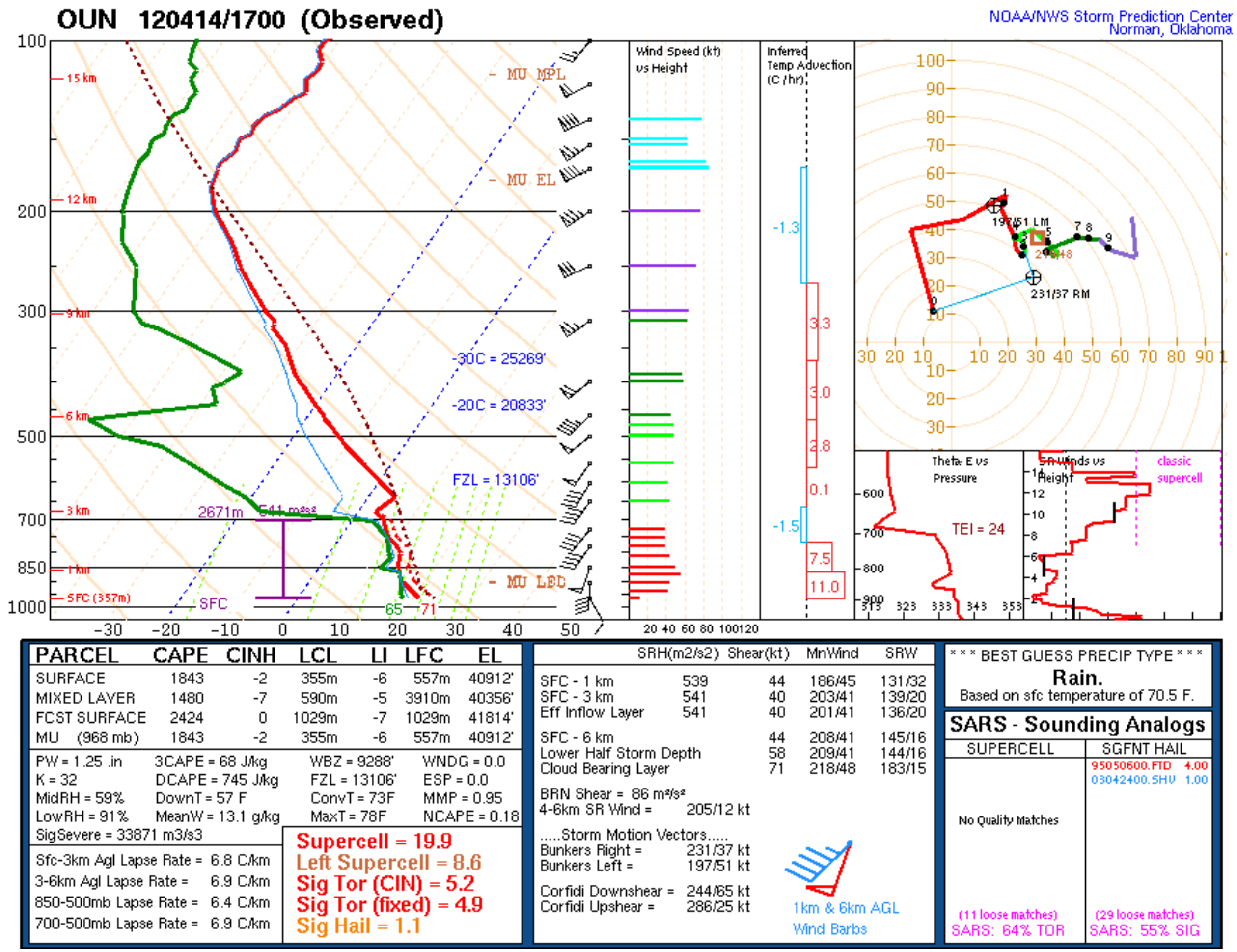
OK/KS Tornado Outbreak 14 April 2012



OK/KS Tornado Outbreak 14 April 2012



OK/KS Tornado Outbreak 14 April 2012



Cherokee, OK tornadoes – 14 April 2012

Upscale growth of convection

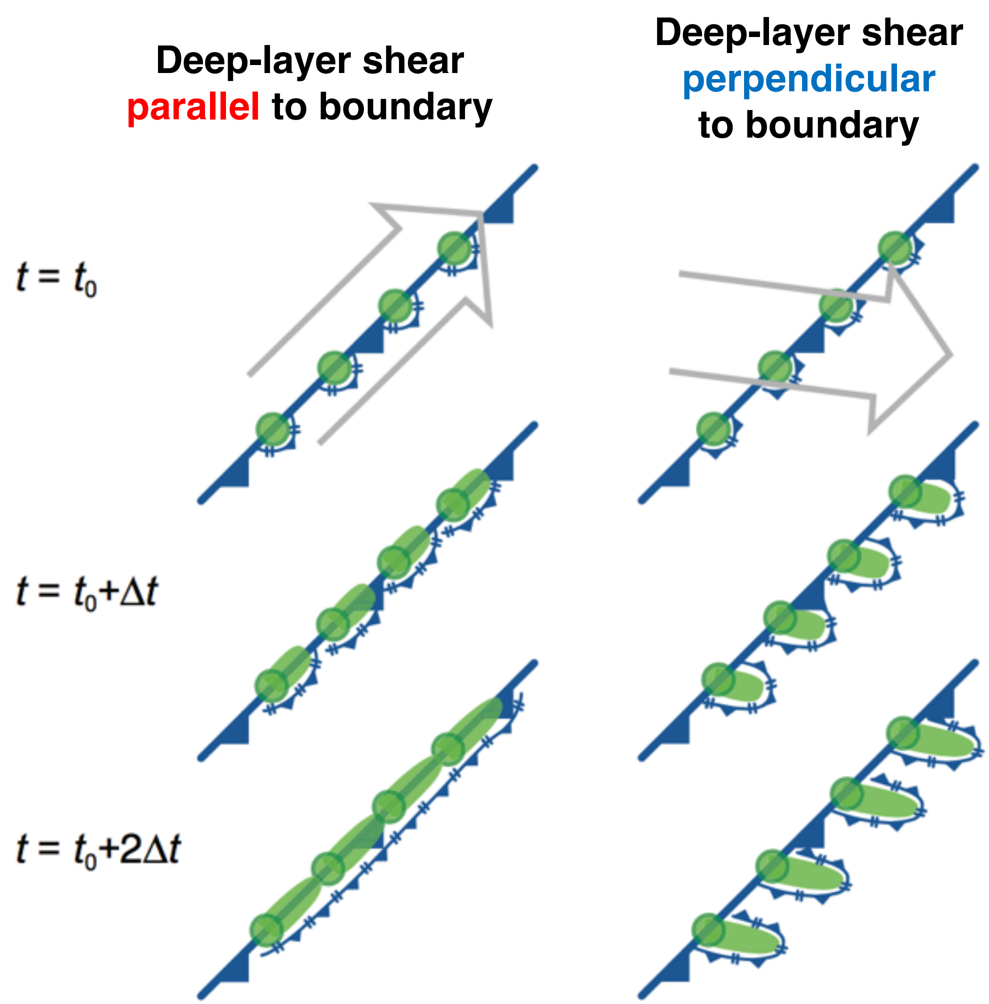
When the deep-layer shear vector (e.g., 0-6km shear vector) is oriented **parallel** to an initiating boundary, precipitation fallout occurs along the boundary.

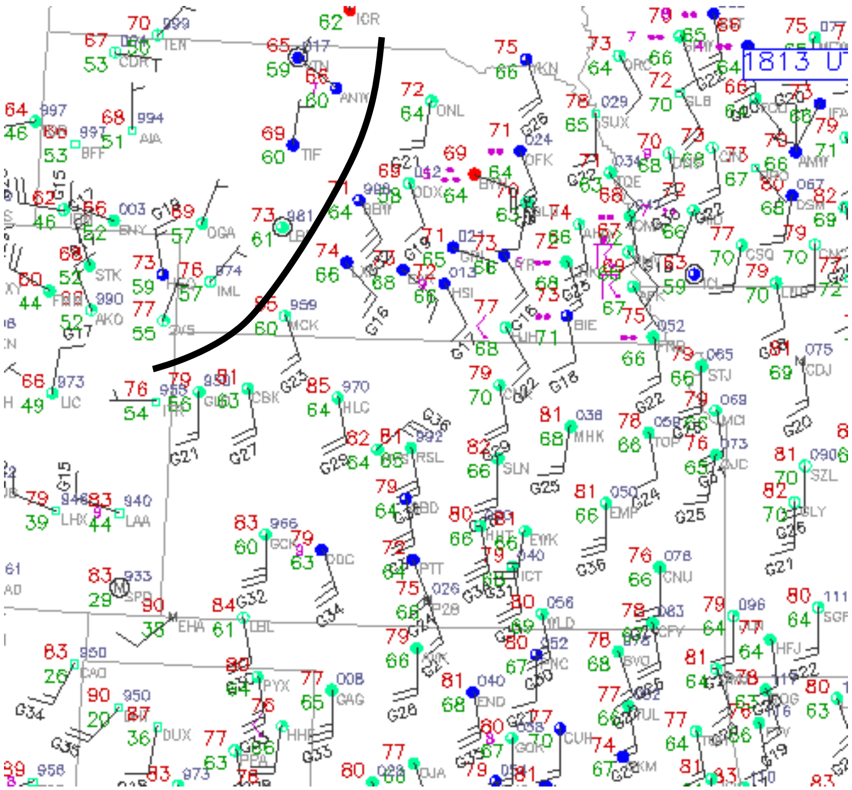
This promotes the development of a contiguous cold pool from initially isolated convection, often hastening the development of a **convective line**.

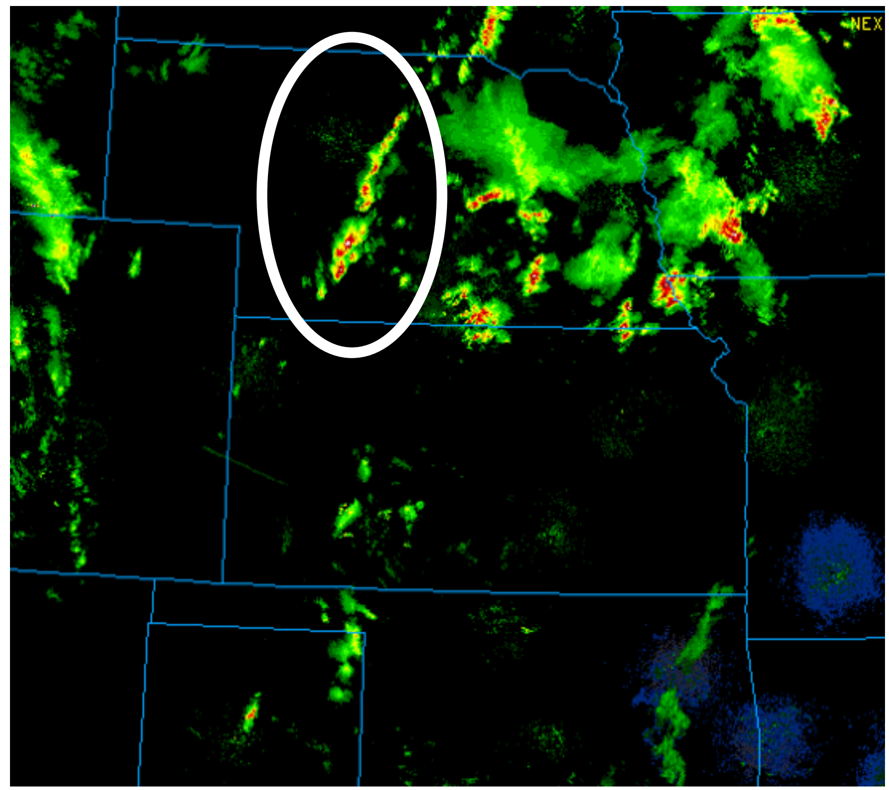
When the deep-layer shear vector is oriented **perpendicular** to an initiating boundary, precipitation fallout occurs away from the boundary.

This allows for convective cells to remain discrete for a longer period of time.

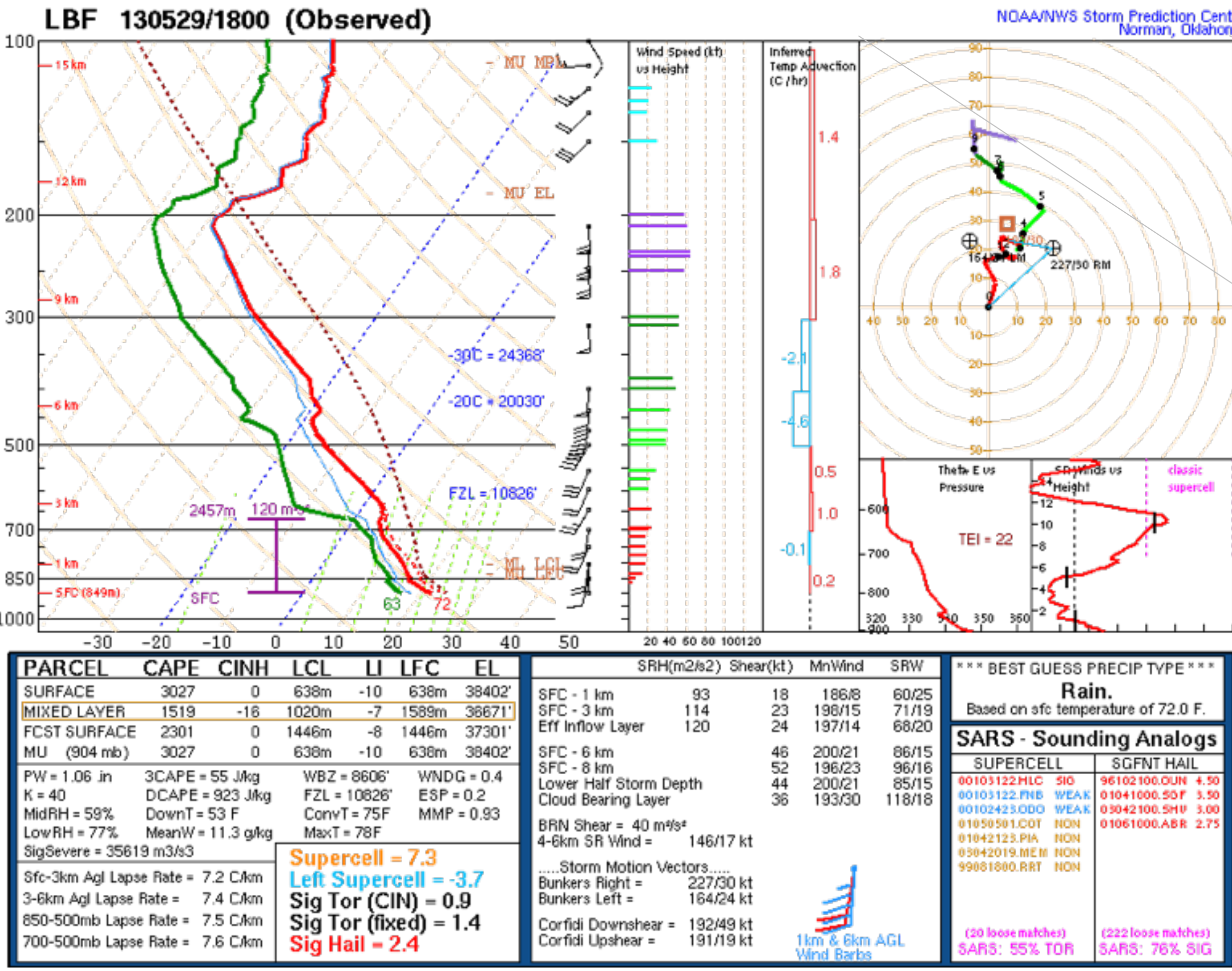
If storm splitting is active, then splits may merge to hasten upscale growth.



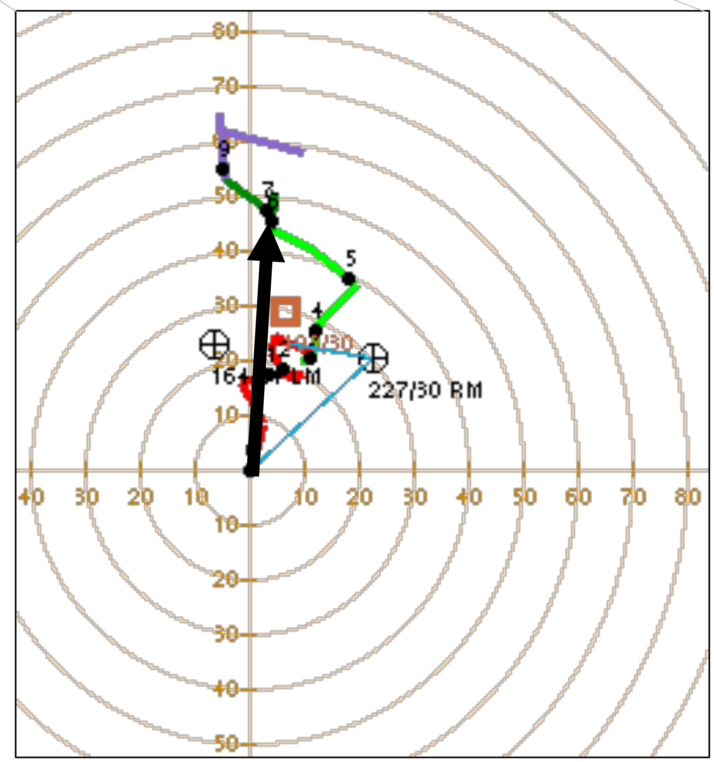


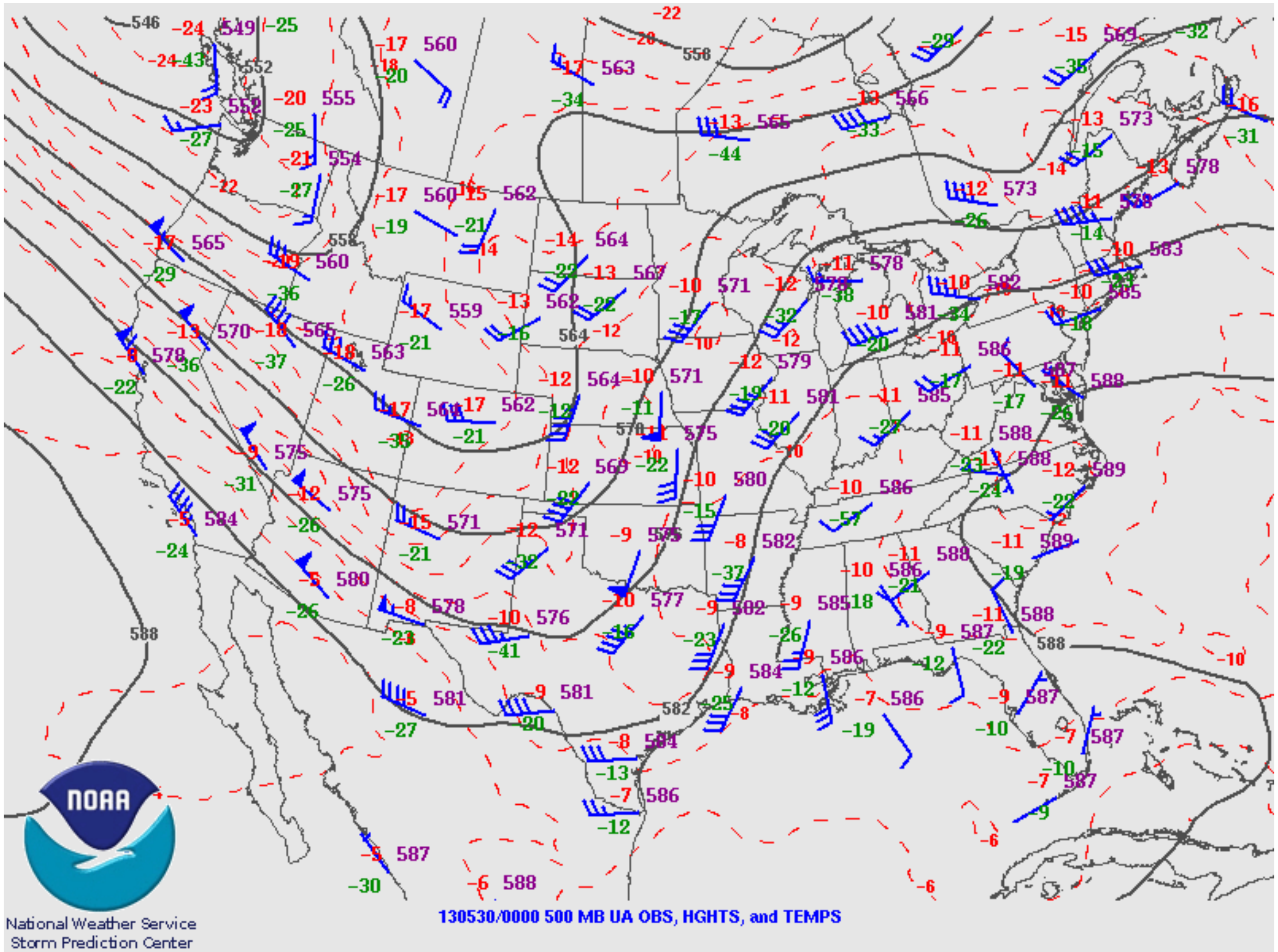


~1800 UTC 29 May 2013

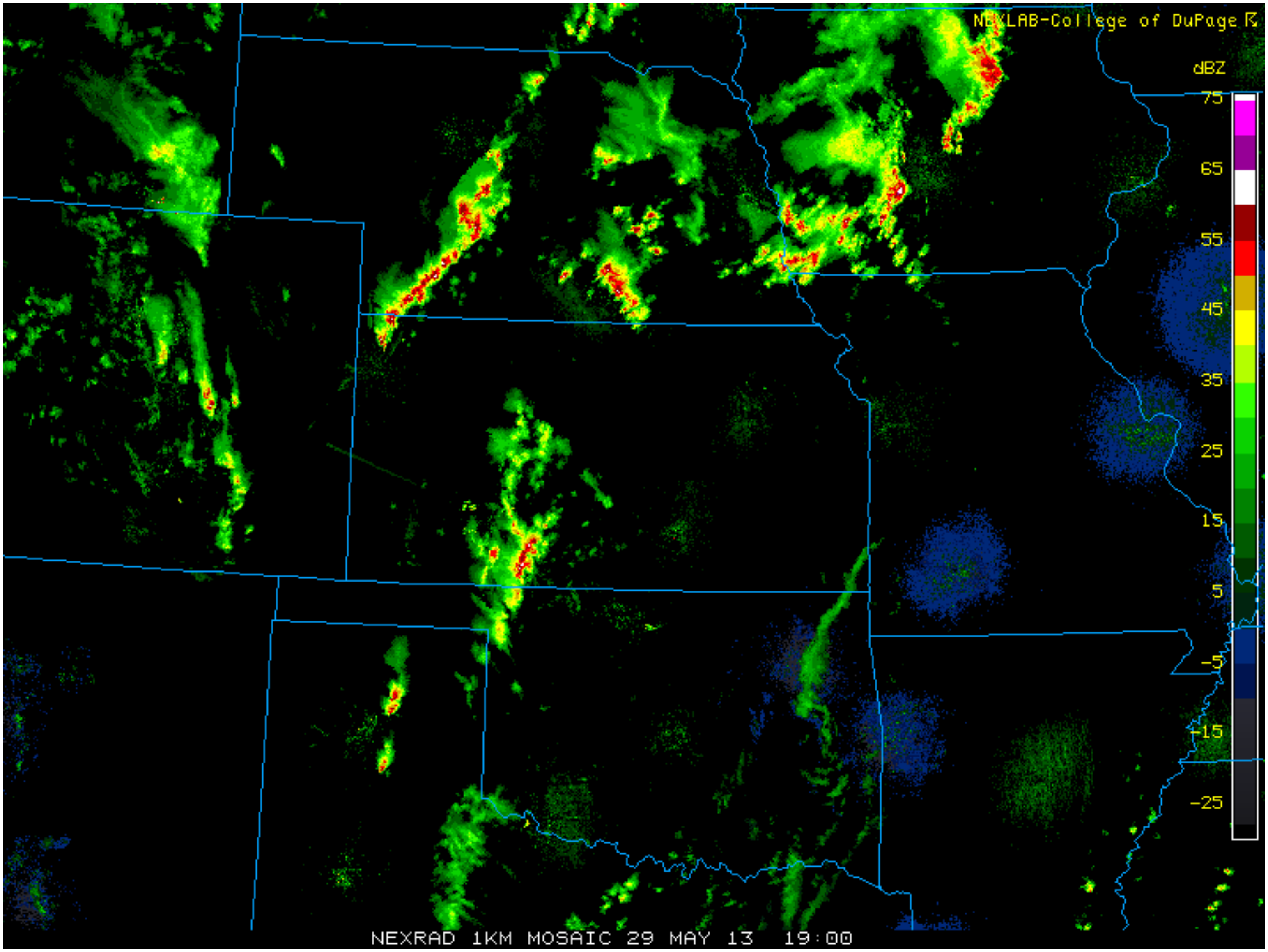


Deep-layer shear vector nearly parallel to initiating boundary





NOAA
National Weather Service
Storm Prediction Center
130530/0000 500 MB UA OBS, HGHTS, and TEMPS



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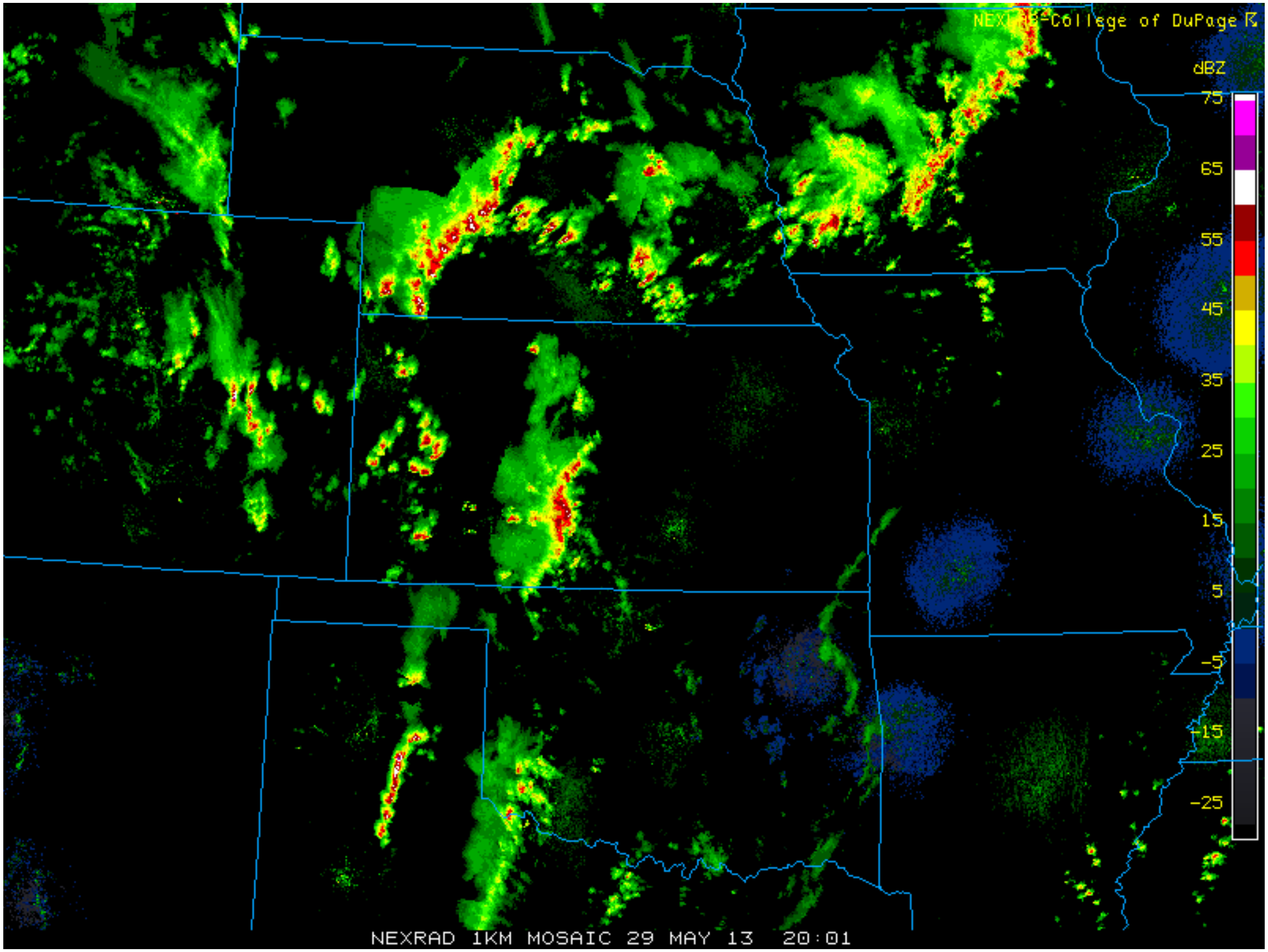
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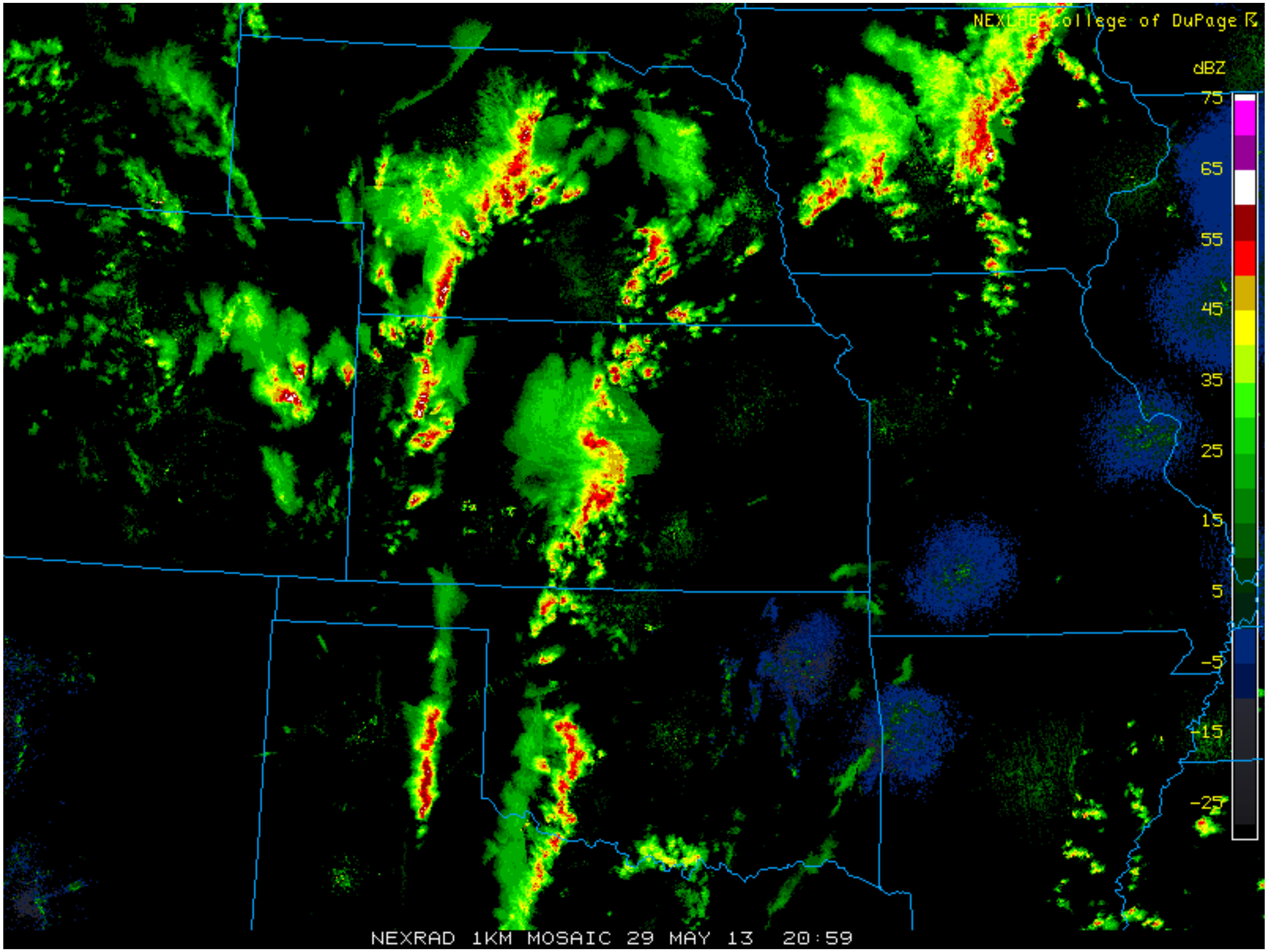
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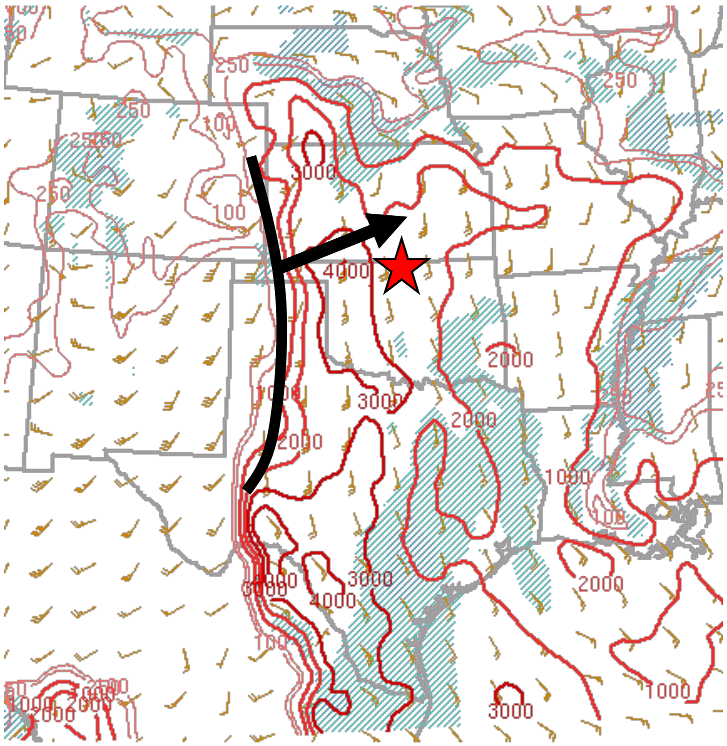
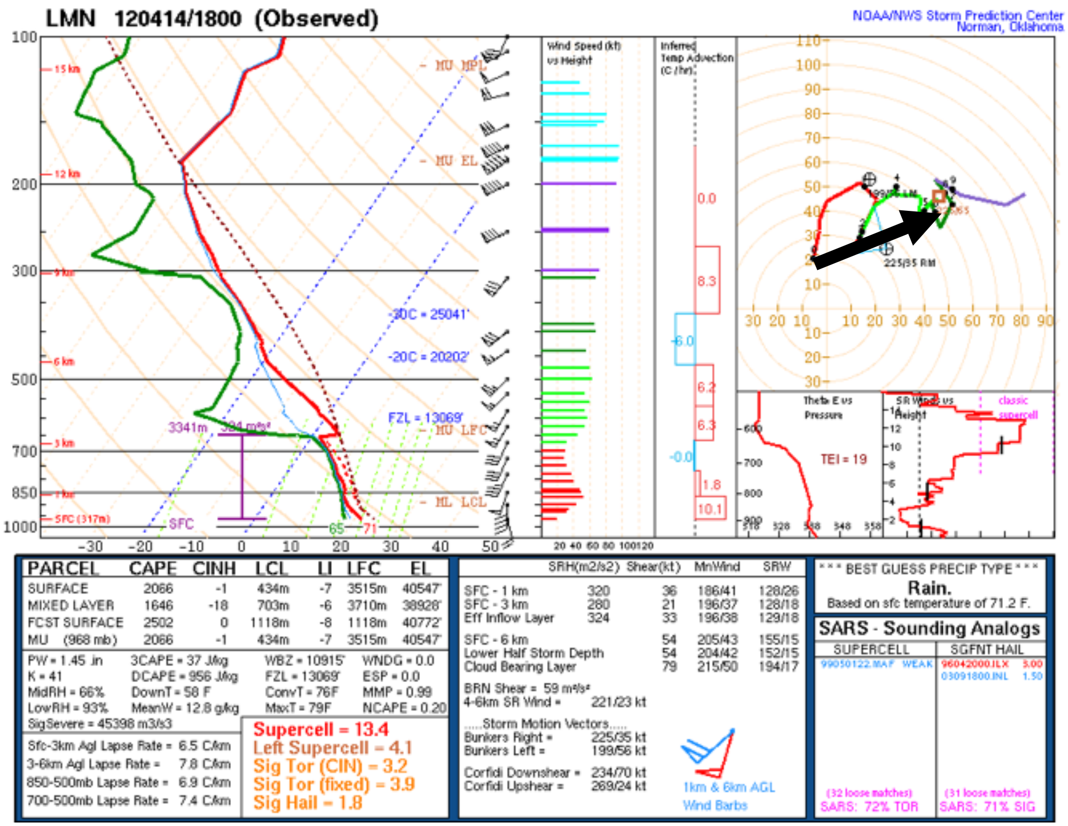
Initiating boundary and deep-layer shear vector orientation

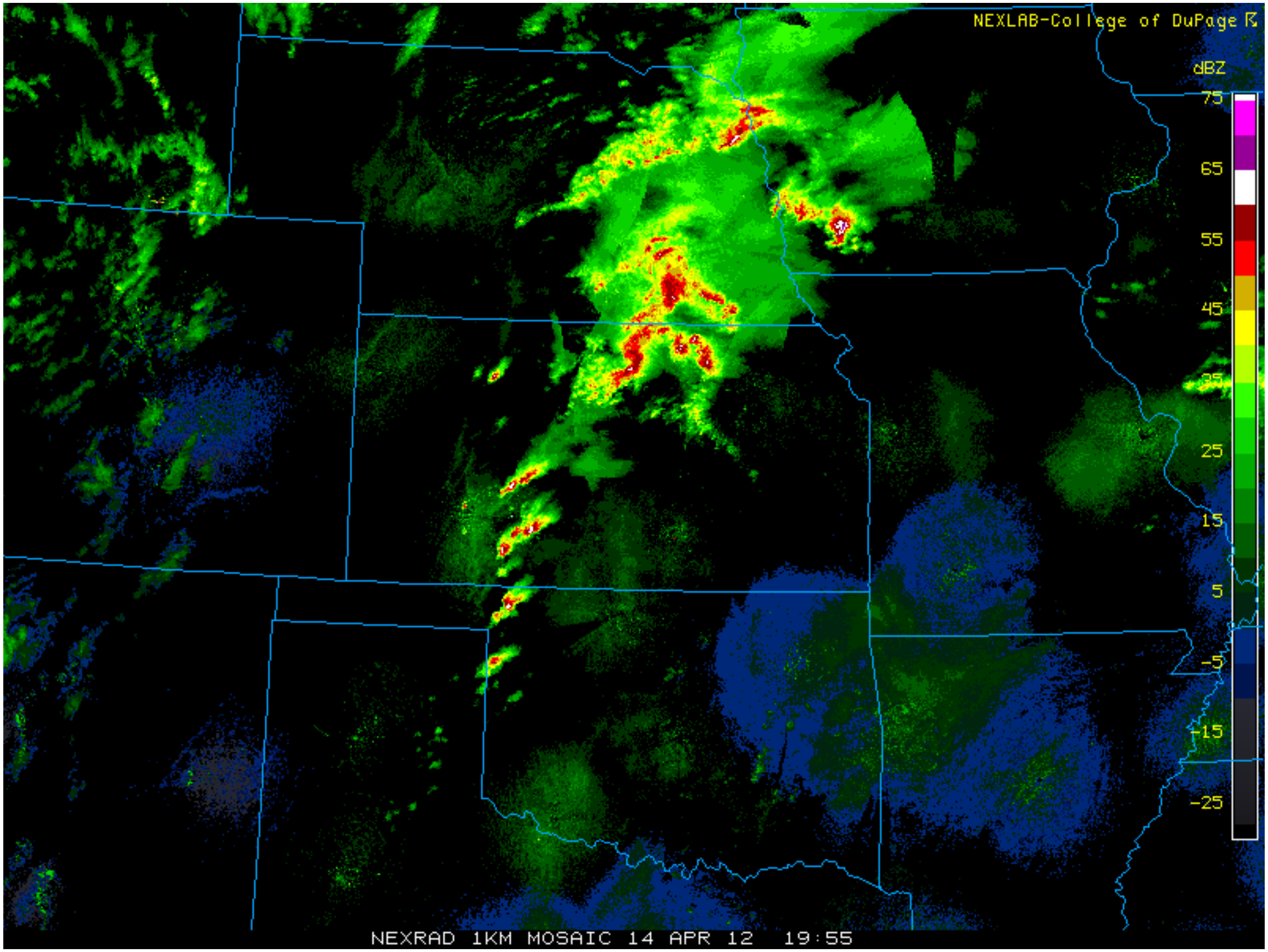


120414/2000 SBCAPE (contour) and SBCIN (J/kg, shaded at 25 anc

14 April 2012



"**FAVORABLY ORIENTED DEEP LAYER SHEAR ALONG THE DRYLINE**...AS WELL AS VEERING AND INCREASING WINDS WITH HEIGHT WILL STRONGLY FAVOR SUPERCELLS."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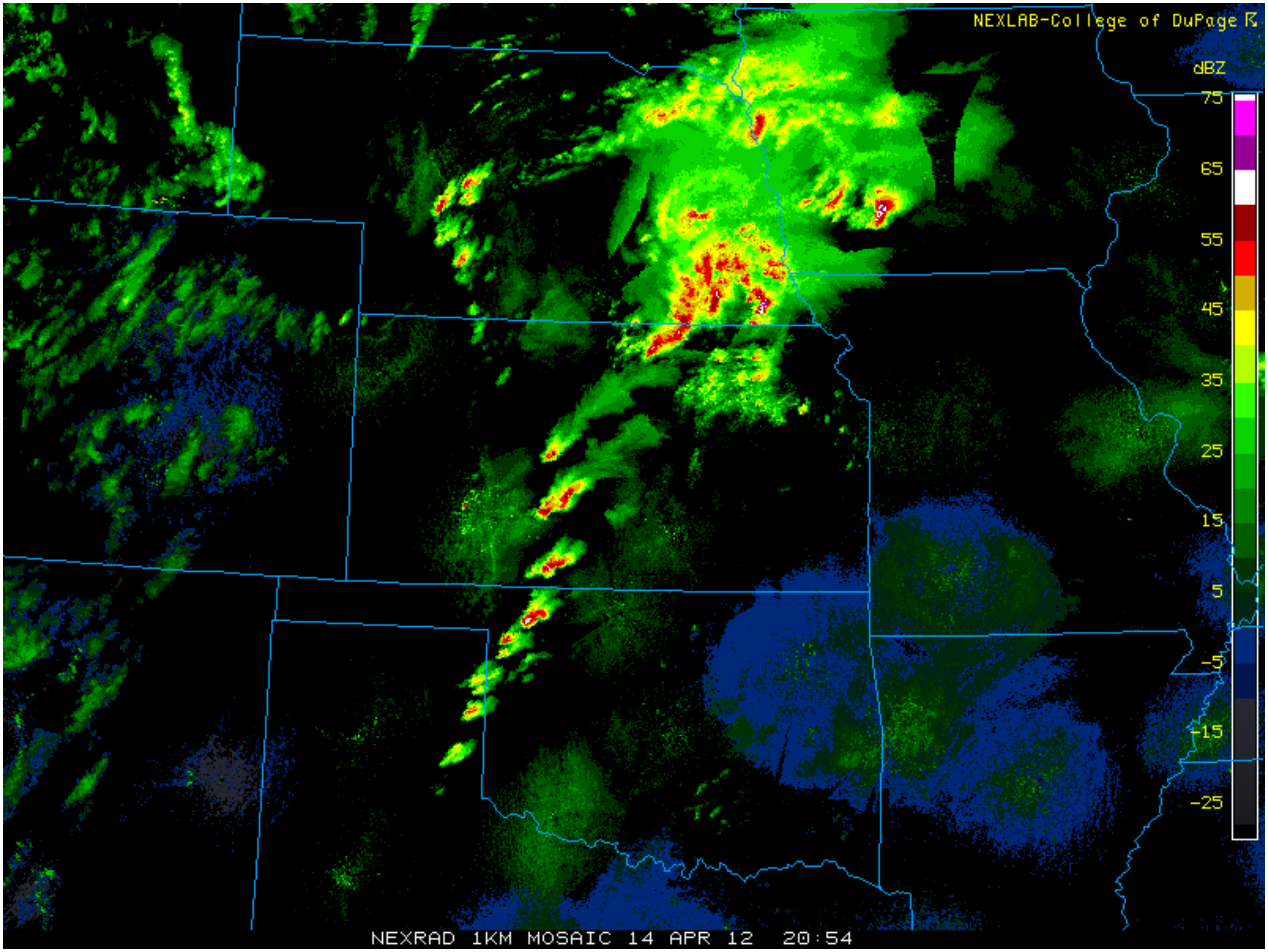
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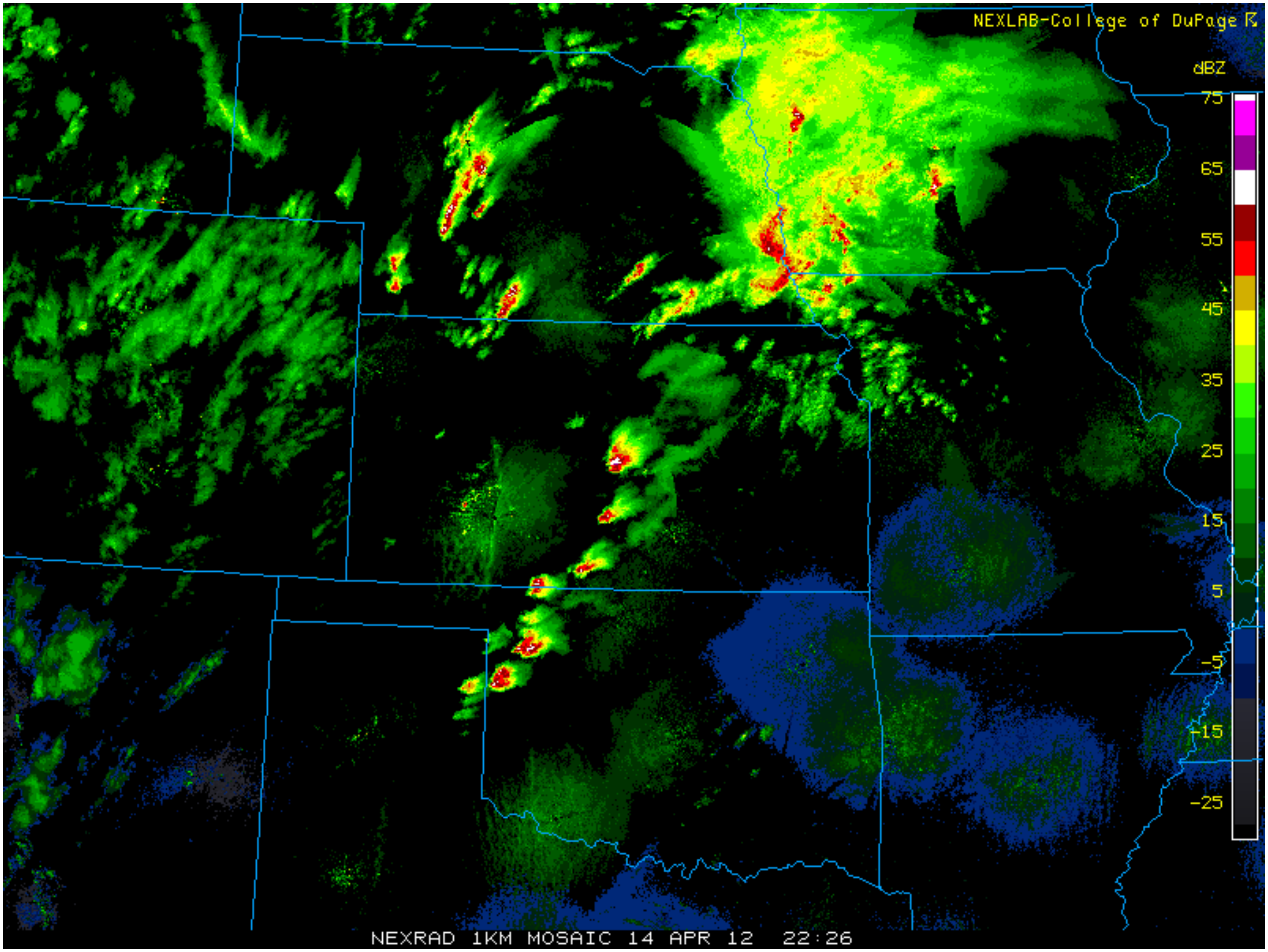
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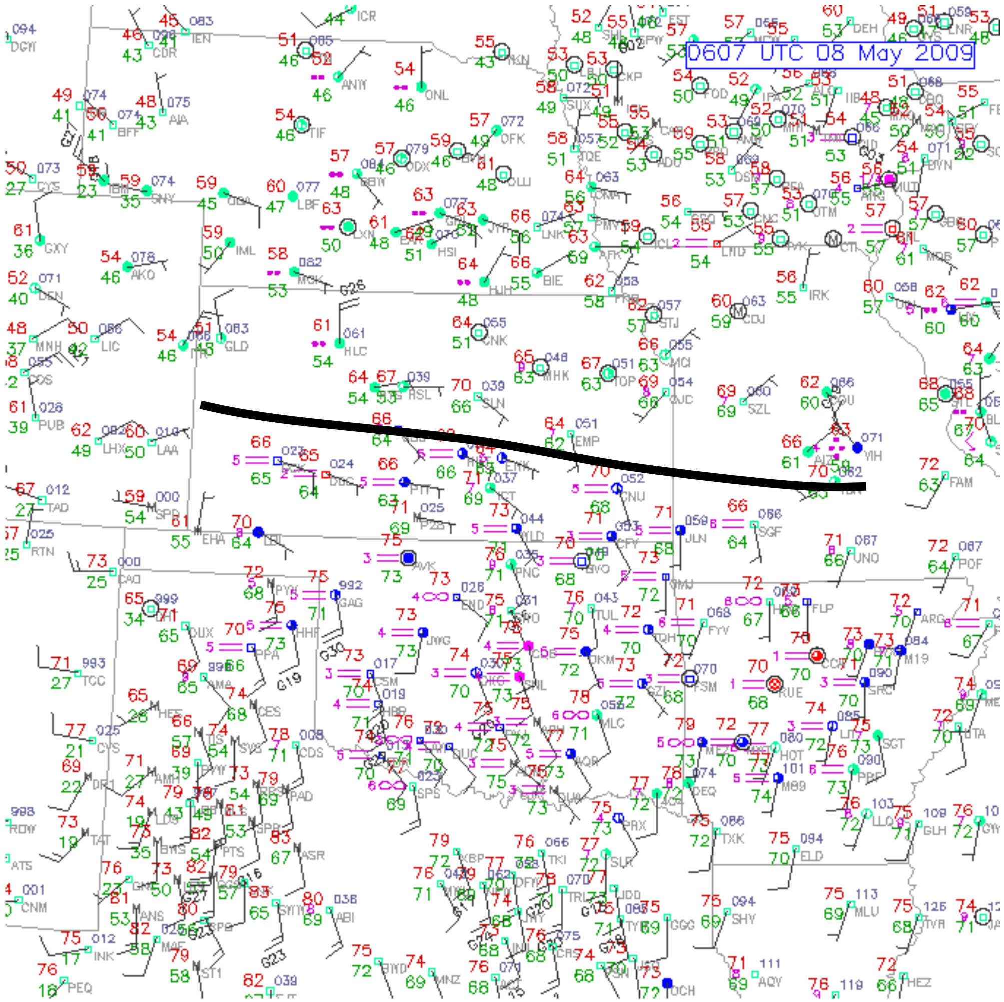
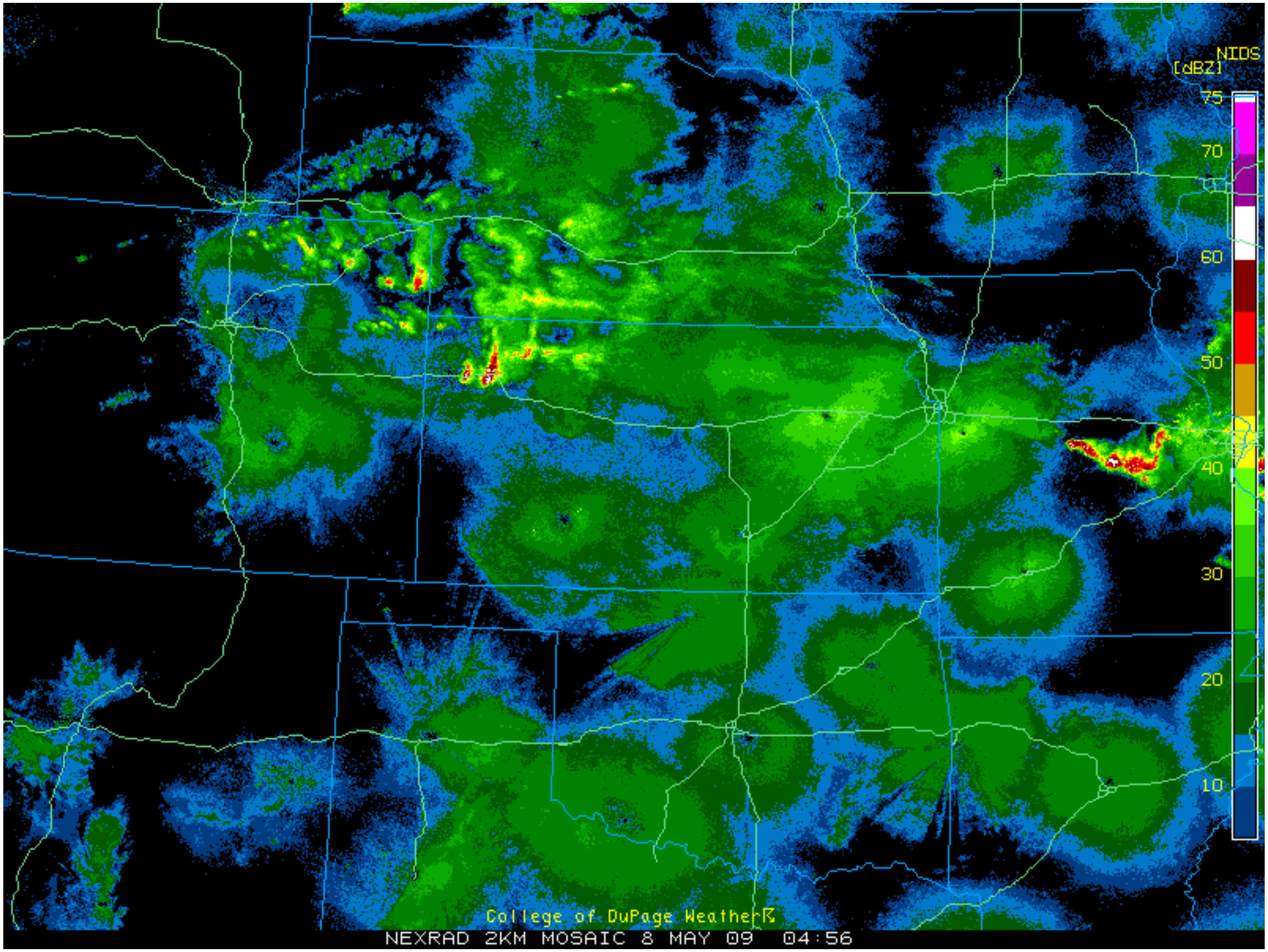
Upscale growth of convection along/north of boundary

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College of DuPage Weather
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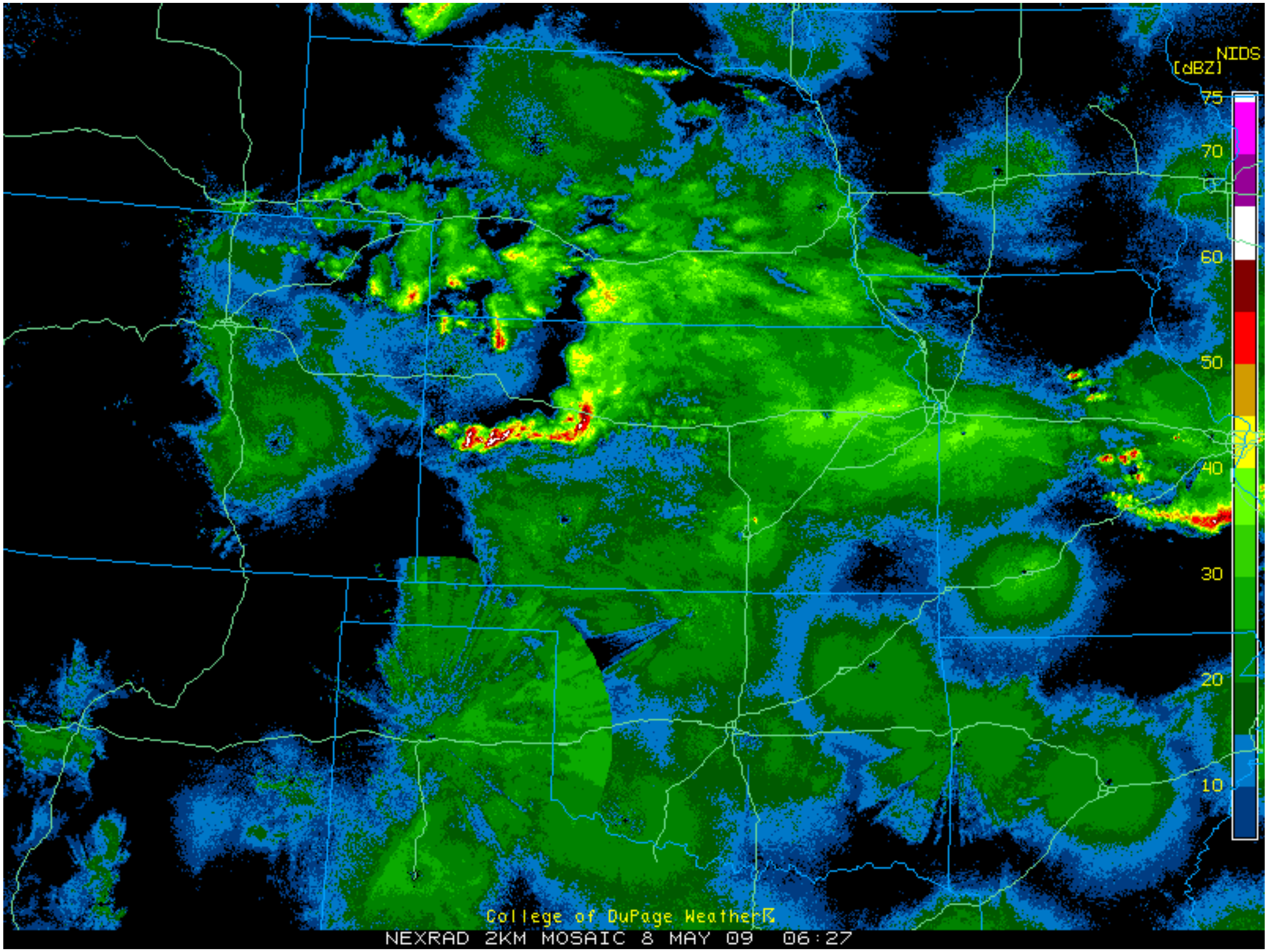
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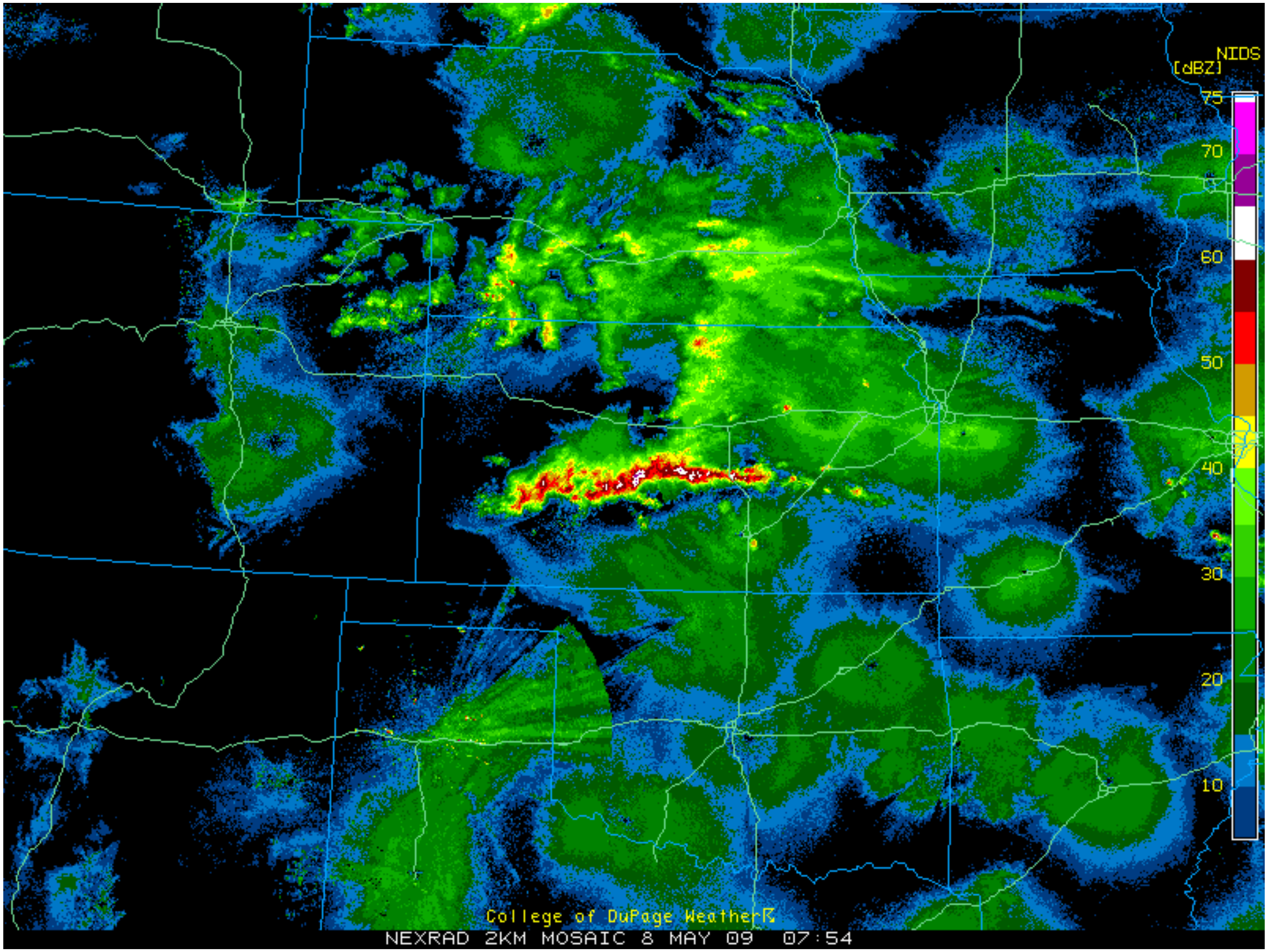
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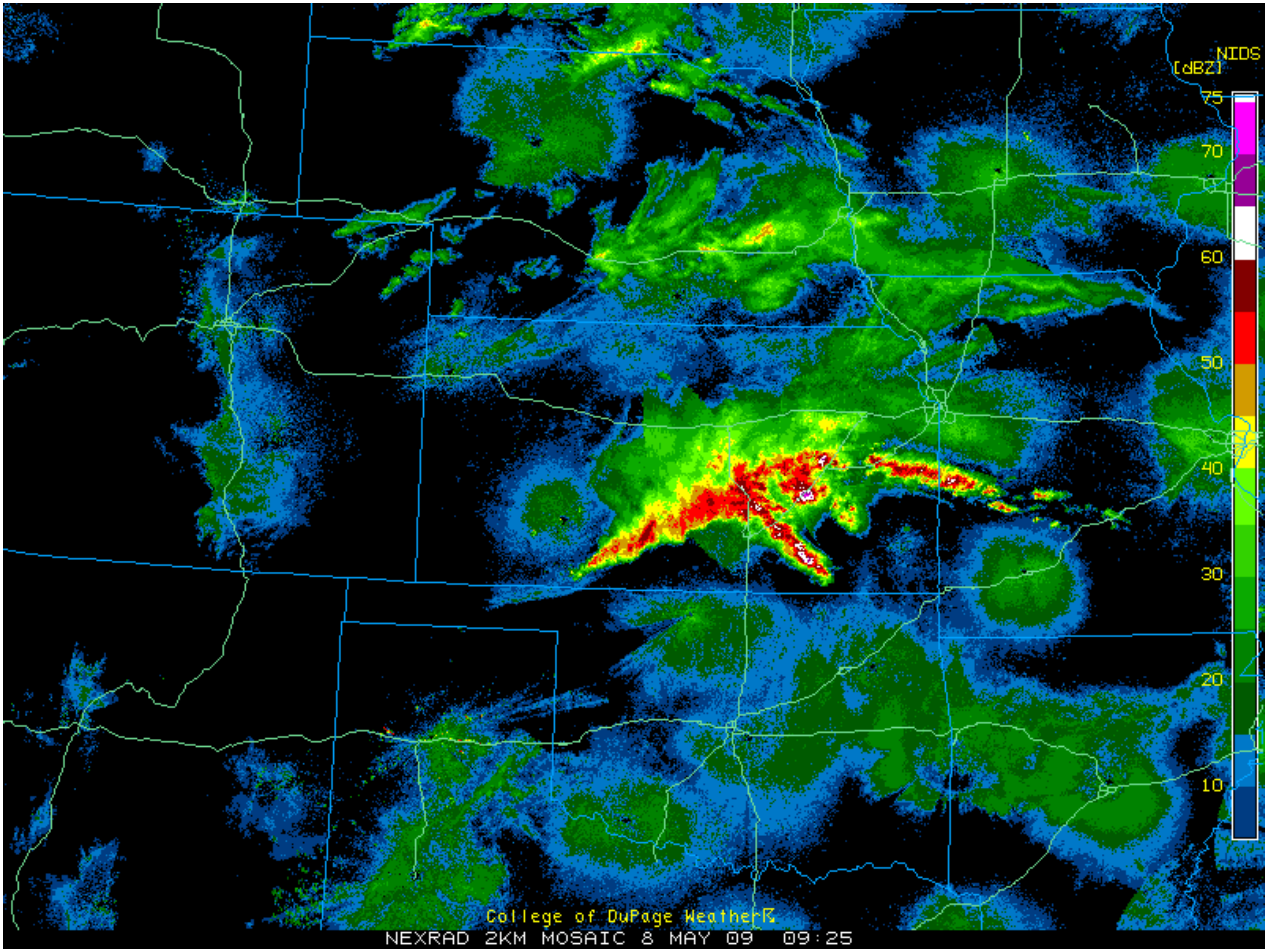
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College of DuPage Weather
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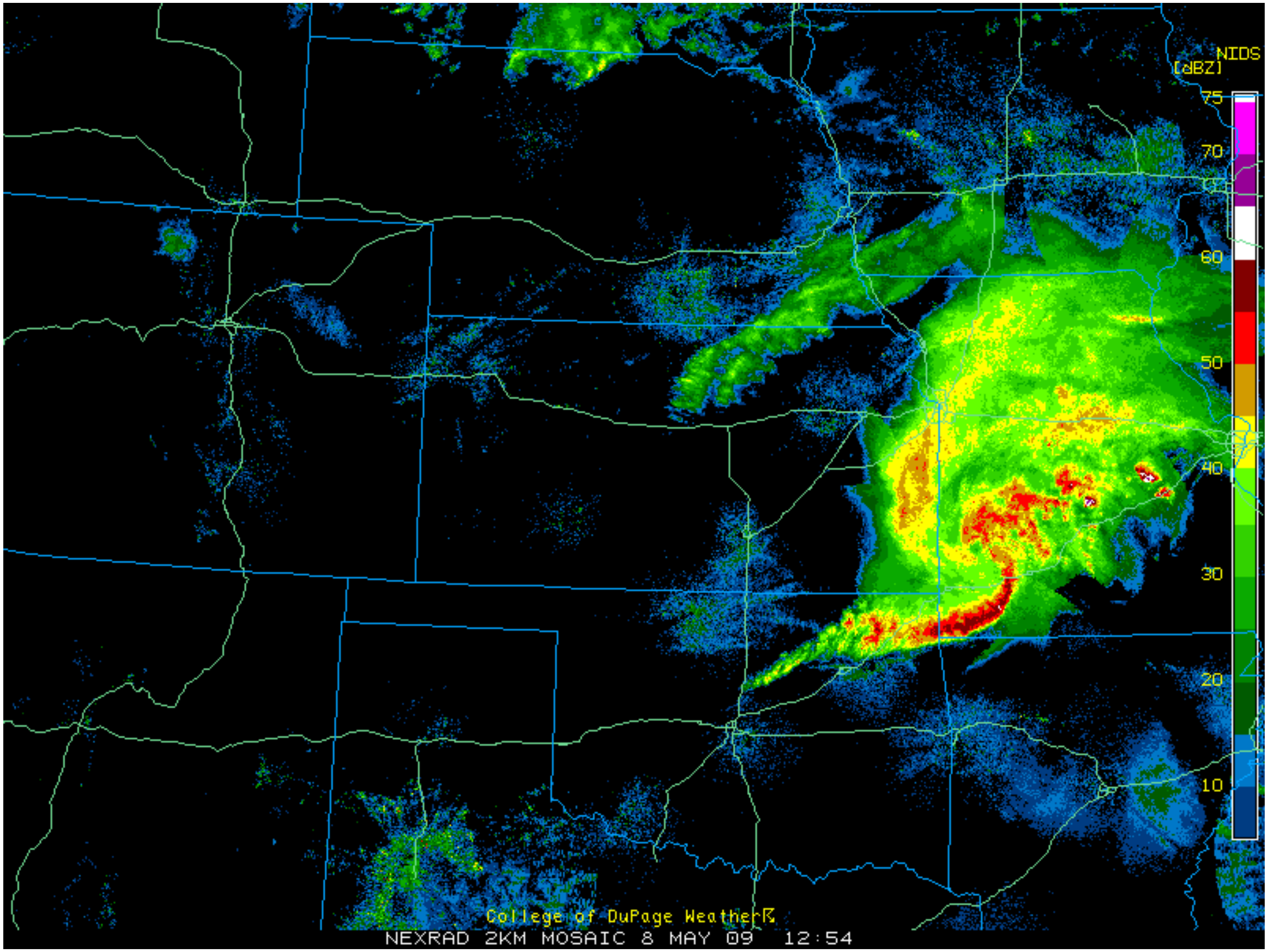
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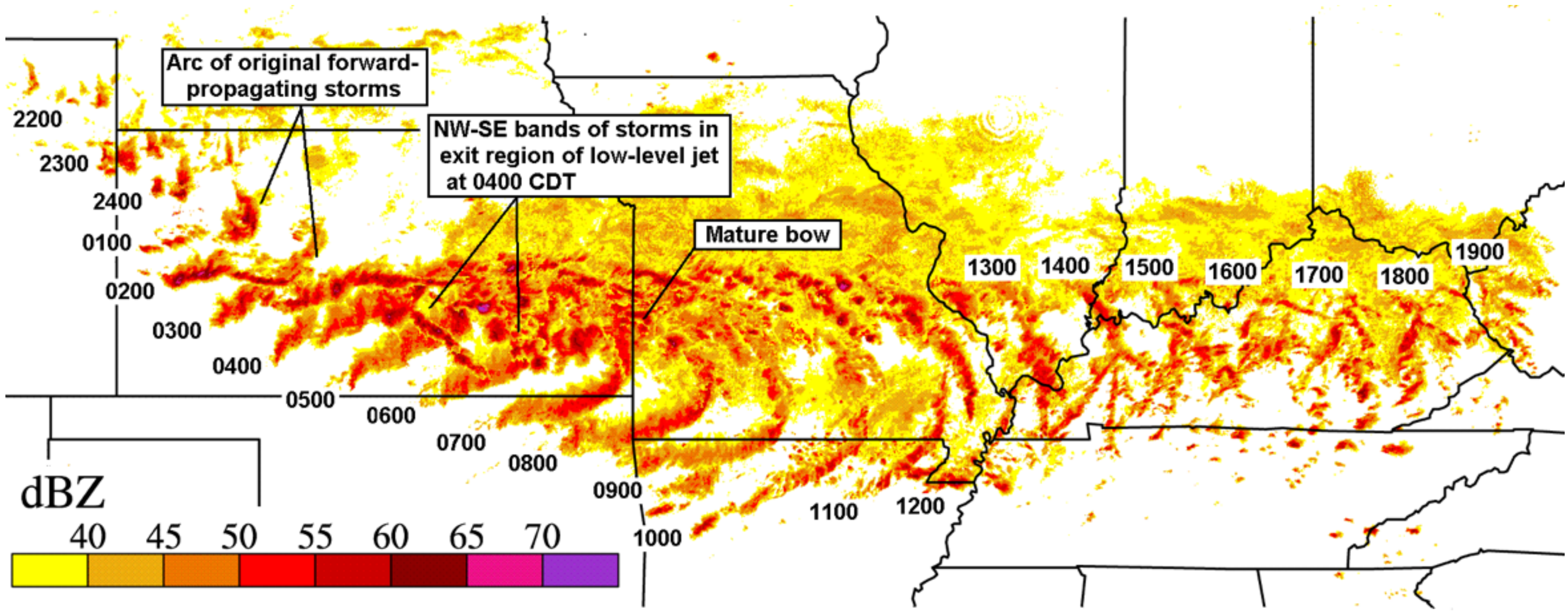

Arc of original forward-propagating storms
NW-SE bands of storms in exit region of low-level jet at 0400 CDT
Mature bow
2200
2300
2400
0100
0200
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0600
0700
0800
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Varieties of mesoscale convective systems

MCC – mesoscale convective complex
MCS – mesoscale convective system
LEWP – line-echo wave pattern
QLCS – quasi-linear convective system