



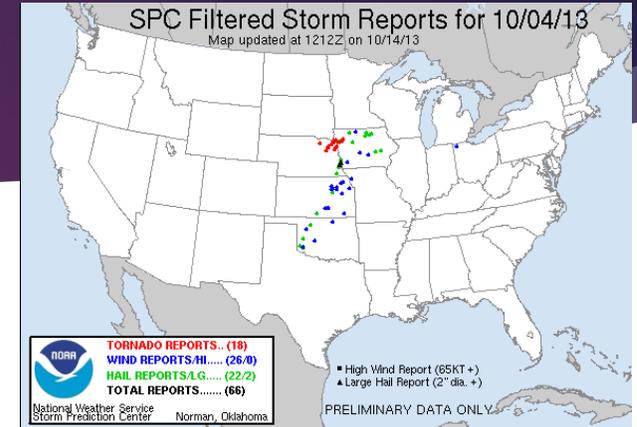
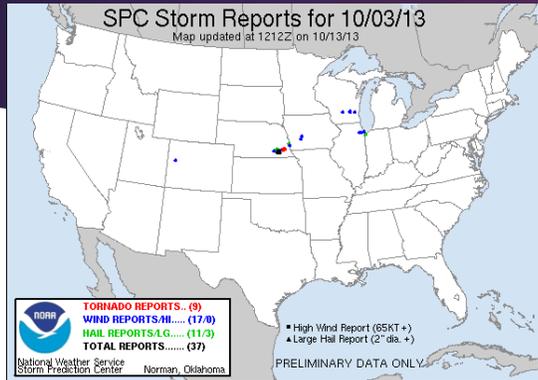
October Severe Storms in Eastern Nebraska and Northwestern Iowa

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UNIVERSITY CORPORATION FOR ATMOSPHERIC RESEARCH

LOCATED AT OFFUTT AIR FORCE BASE, NEBRASKA

Event Summary



- ▶ 11 tornadoes over two days in eastern Nebraska and northwestern Iowa, including five tornadoes rated EF-2 or greater and two tornadoes rated EF-4
 - ▶ Statistics courtesy: <http://www.spc.noaa.gov/wcm/>
- ▶ Members of the Wayne State College softball team urgently evacuated practice field shortly before complex was destroyed
- ▶ Wayne, NE tornado captured on video at more than a mile in width
- ▶ NO fatalities, ~15 injuries
- ▶ Most injuries in a Nebraska tornado in 9 years
- ▶ First EF-4 tornado in Nebraska in 9 years
- ▶ If you didn't look at the calendar... this event probably wouldn't surprise anybody
- ▶ But... It's October... Do you believe your environment when storms form at the edge of your forecast area?

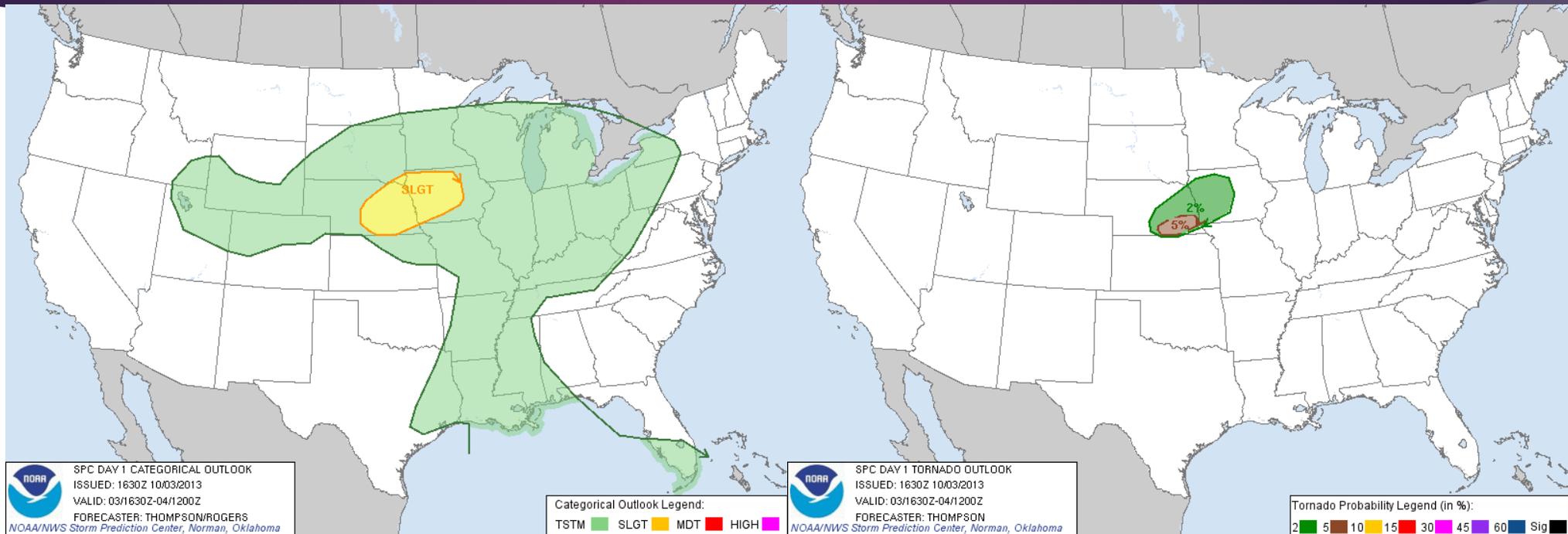
October Tornado Climatology Tidbits

- ▶ 10th and 11th EF2+ October tornado days in Nebraska since 1950
- ▶ 13 EF2+ tornadoes in October in Nebraska prior to 3 October 2013
- ▶ First October tornadoes and first October EF-2+ tornado in Nebraska since 9 October 2001 (Polk, NE)
- ▶ 15 Octobers since 1950 have seen one or more tornadoes in Nebraska during October (~24% of the time)
- ▶ First October tornadoes in Iowa since 2007
- ▶ Wayne, NE and Pierson, IA tornadoes the 5th and 6th EF4+ October tornadoes in recorded US history

October Tornado Vulnerability

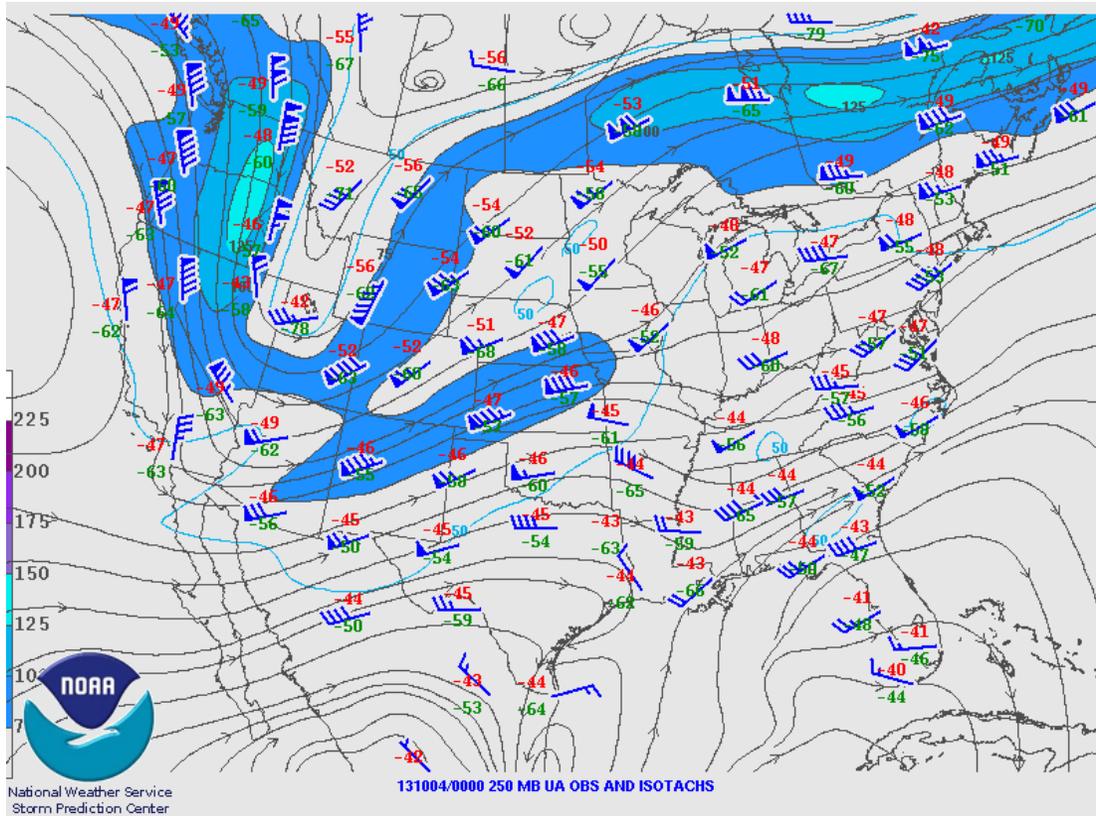
- ▶ Outside of primary severe weather season, particularly distant from prime tornado season
- ▶ Thursday and Friday nights: Cross country, girl's golf, and football
- ▶ Road traveling for high school sporting events
- ▶ Travel to Lincoln for the Saturday Nebraska football game

03 October 2013: 1630Z SPC Outlook

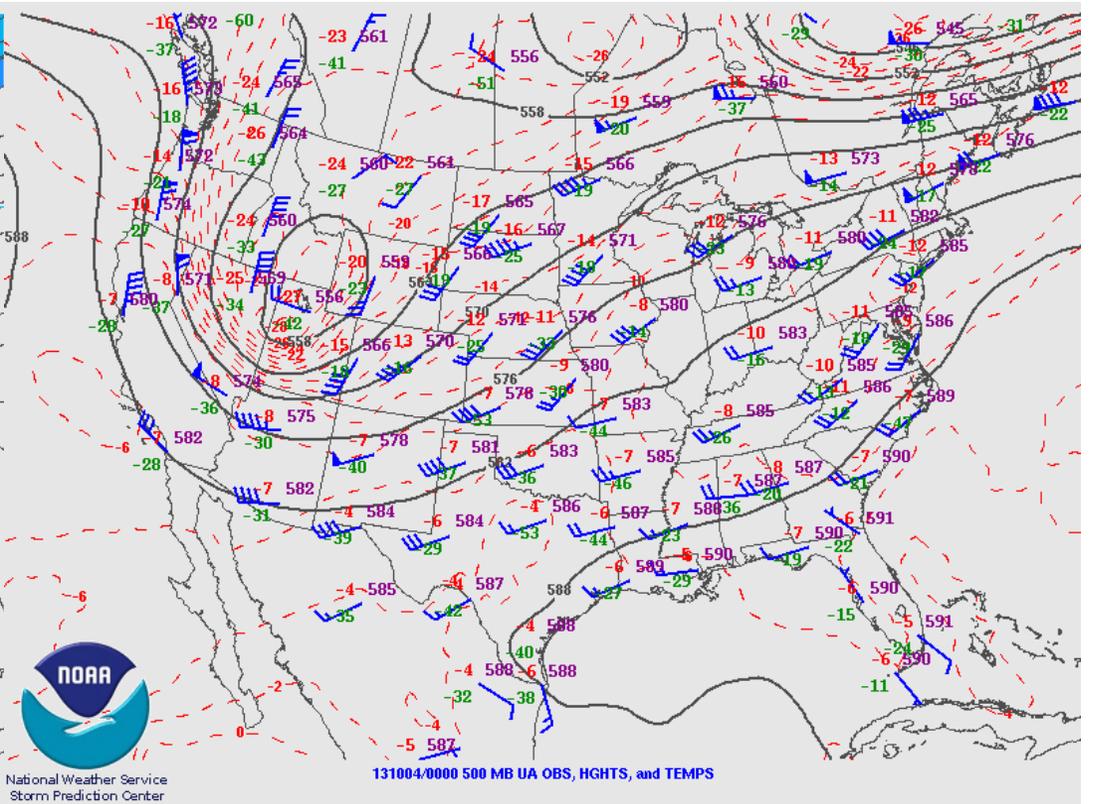


THE PROSPECTS FOR SURFACE-BASED STORM DEVELOPMENT THIS AFTERNOON IN MUCH OF NEB/IA WILL BE LIMITED BY THE STABILIZING EFFECTS OF THE MORNING OUTFLOW. ONE POTENTIAL EXCEPTION TO THIS WILL BE THE INTERSECTION OF THE REMNANT OUTFLOW/Front/DRYLINE ALONG THE NRN KS/SRN NEB BORDER BY THIS EVENING. IF ISOLATED SURFACE-BASED STORMS MANAGE TO FORM... THE COMBINATION OF MLCAPE IN EXCESS OF 2000 J/KG AND EFFECTIVE BULK SHEAR NEAR 40 KT WILL SUPPORT A RISK FOR SUPERCELLS WITH LARGE HAIL AND DAMAGING WINDS...AND PERHAPS A TORNADO OR TWO AS LOW-LEVEL SHEAR INCREASES THIS EVENING PRIOR TO STABILIZATION OF THE BOUNDARY LAYER.

3 October 2013: Upper Air Charts

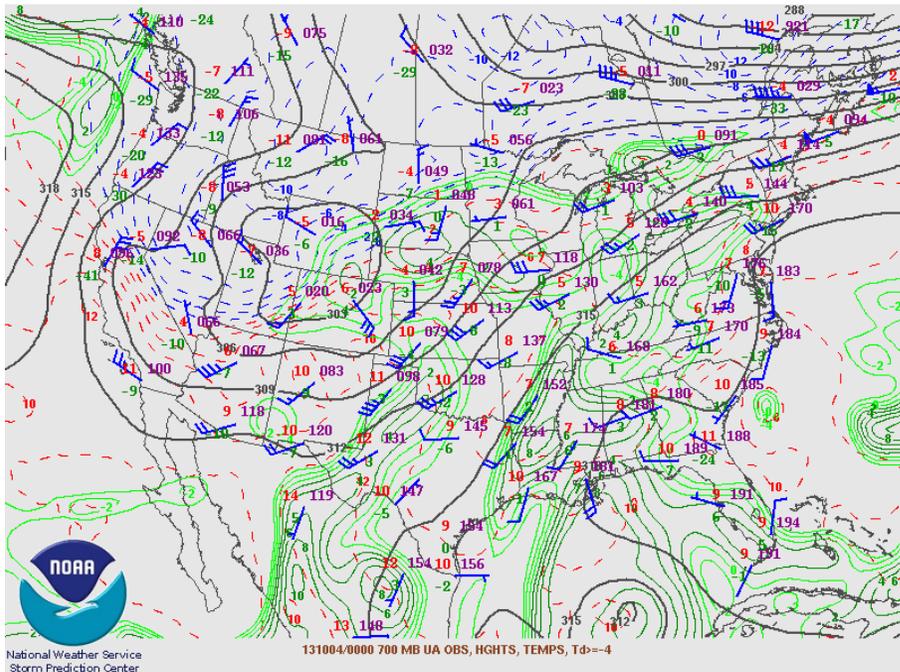


00Z 250 MB chart

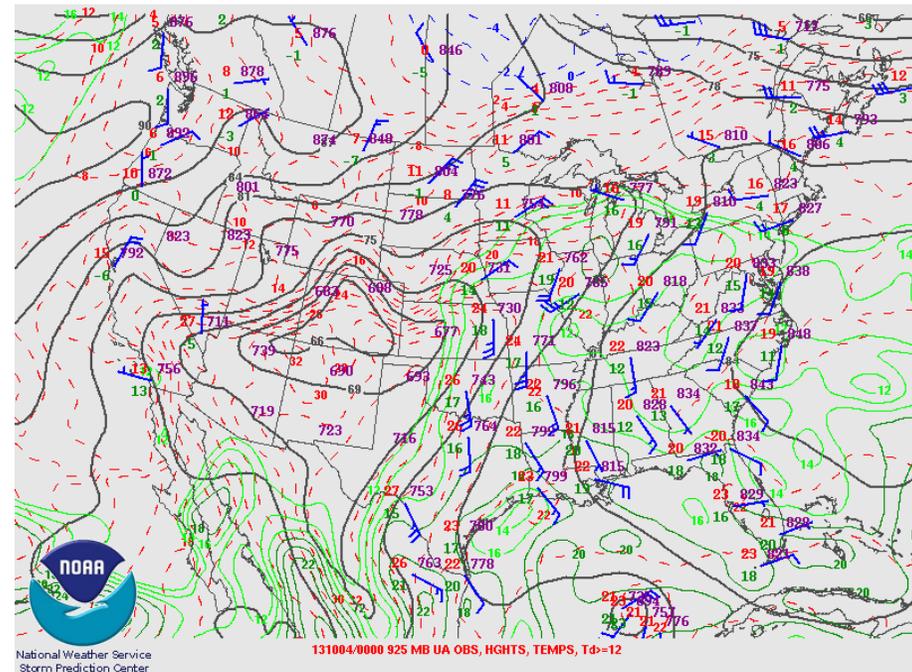


00Z 500 MB chart

3 October 2013: Mid Level Charts

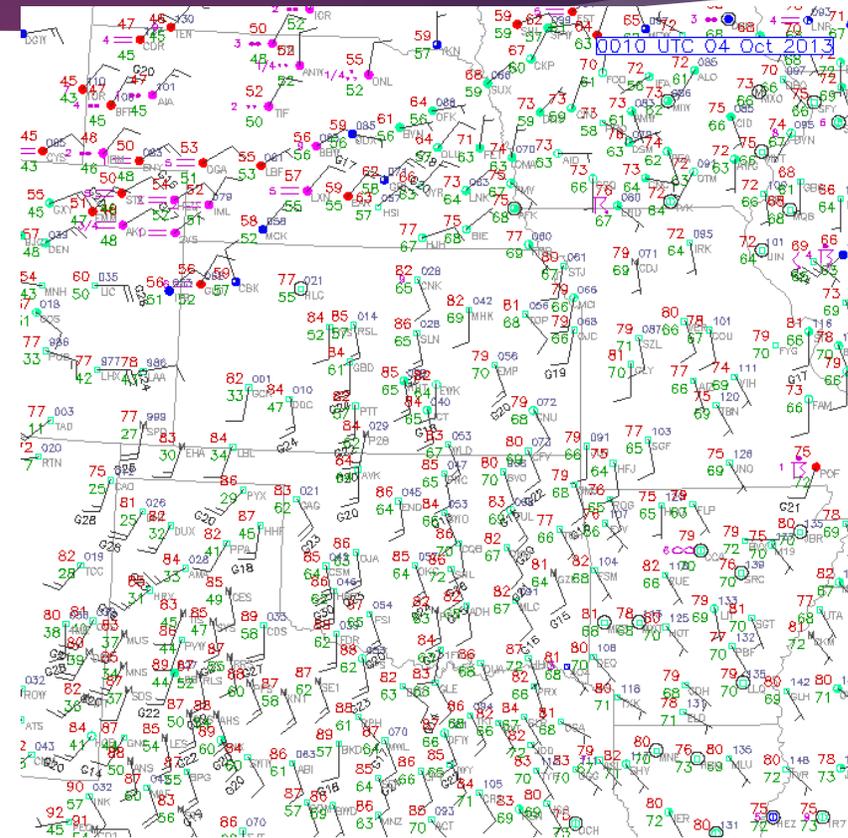
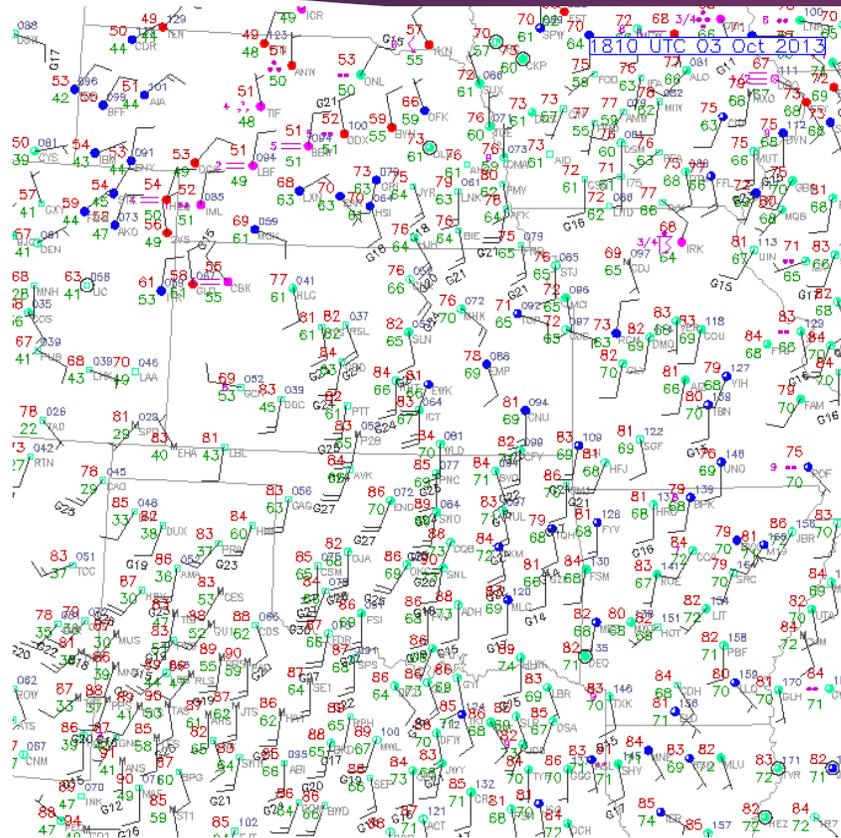


00Z 700 MB Chart



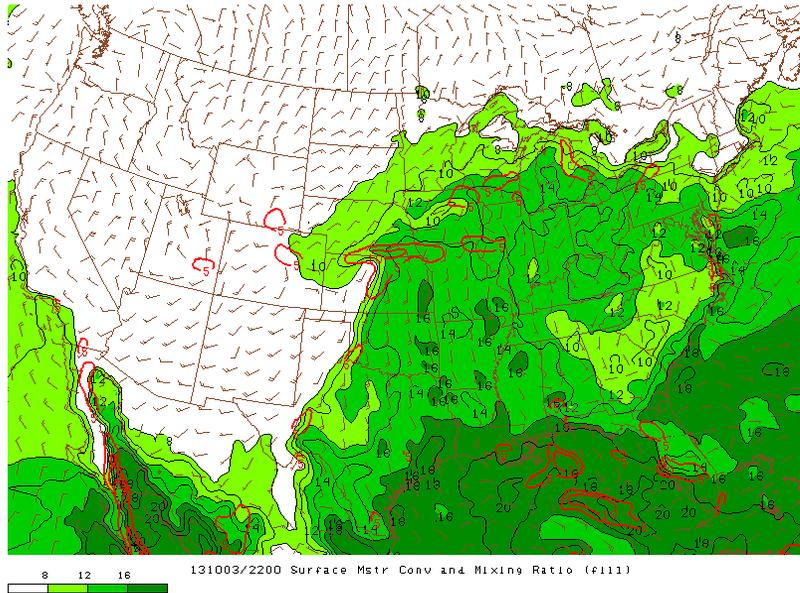
00Z 850 MB Chart

3 October 2013: Surface Charts

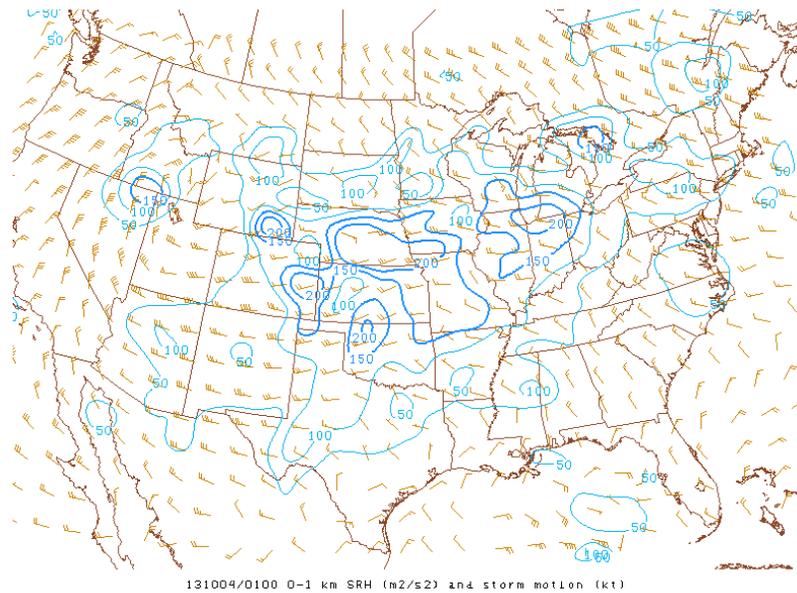


18Z, 00Z Surface Charts (UCAR Image Archives)

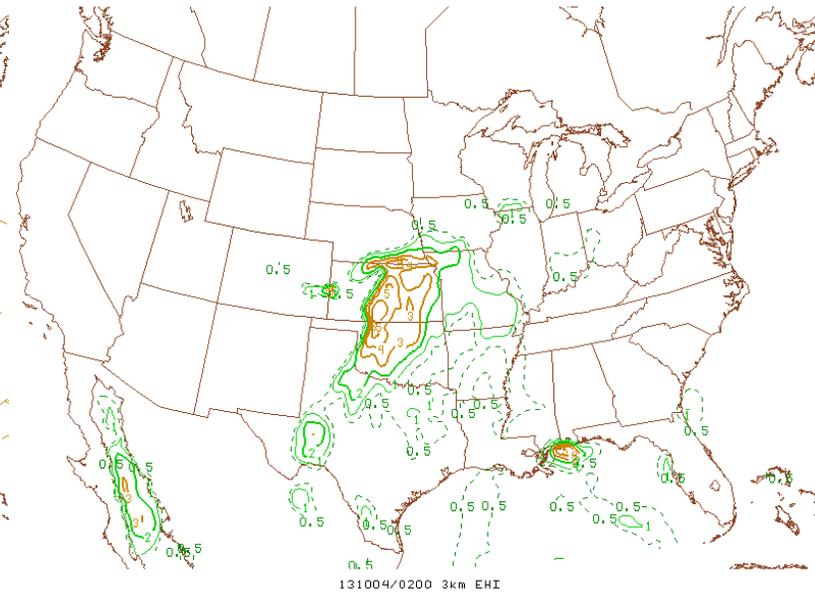
3 October 2013: Mesoanalysis



22Z Moisture Convergence

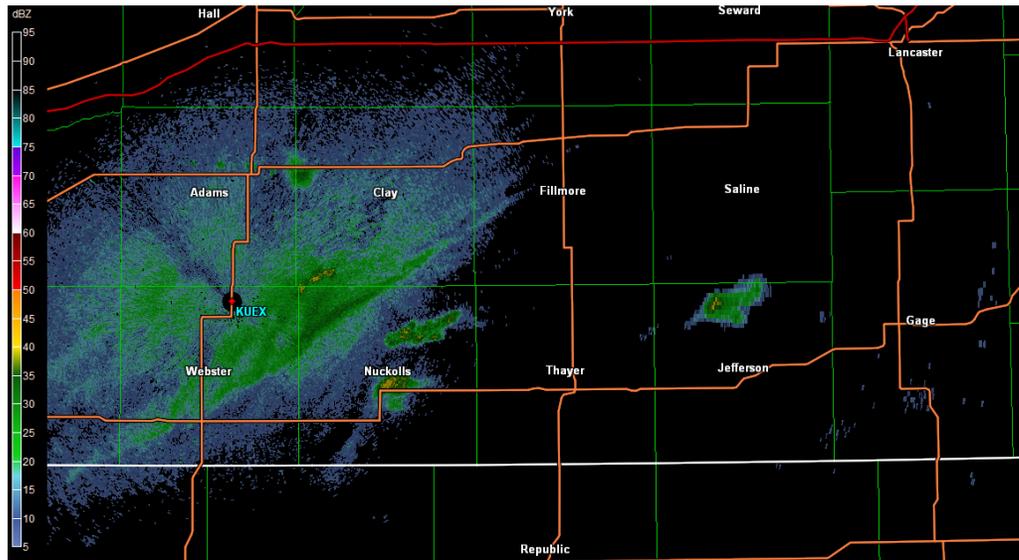


01Z 1 KM SRH

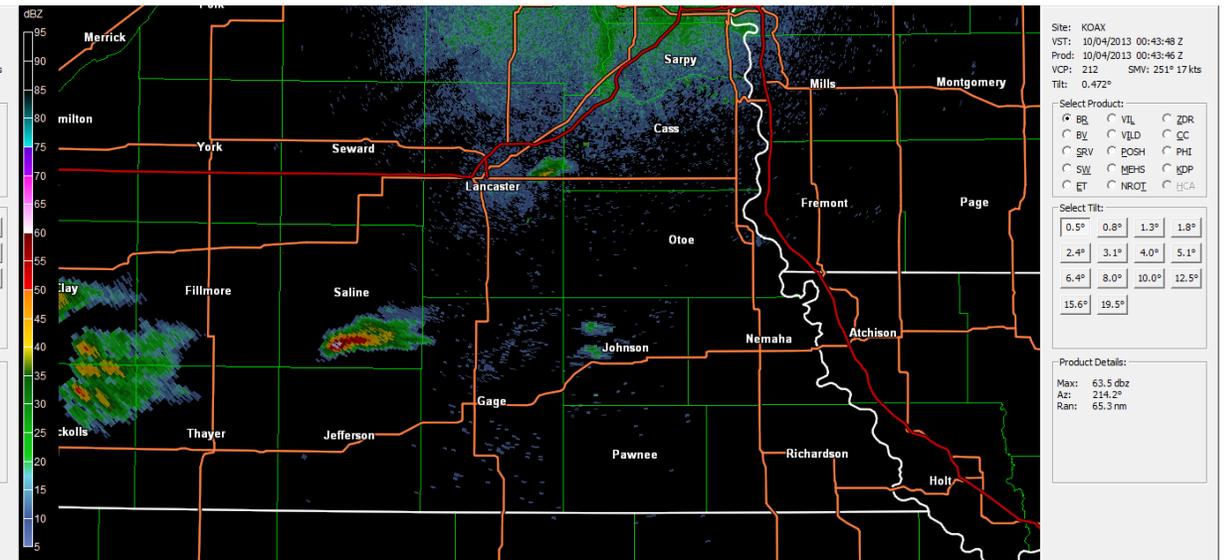


02Z 3 KM EHI

3 October 2013: Convective Initiation

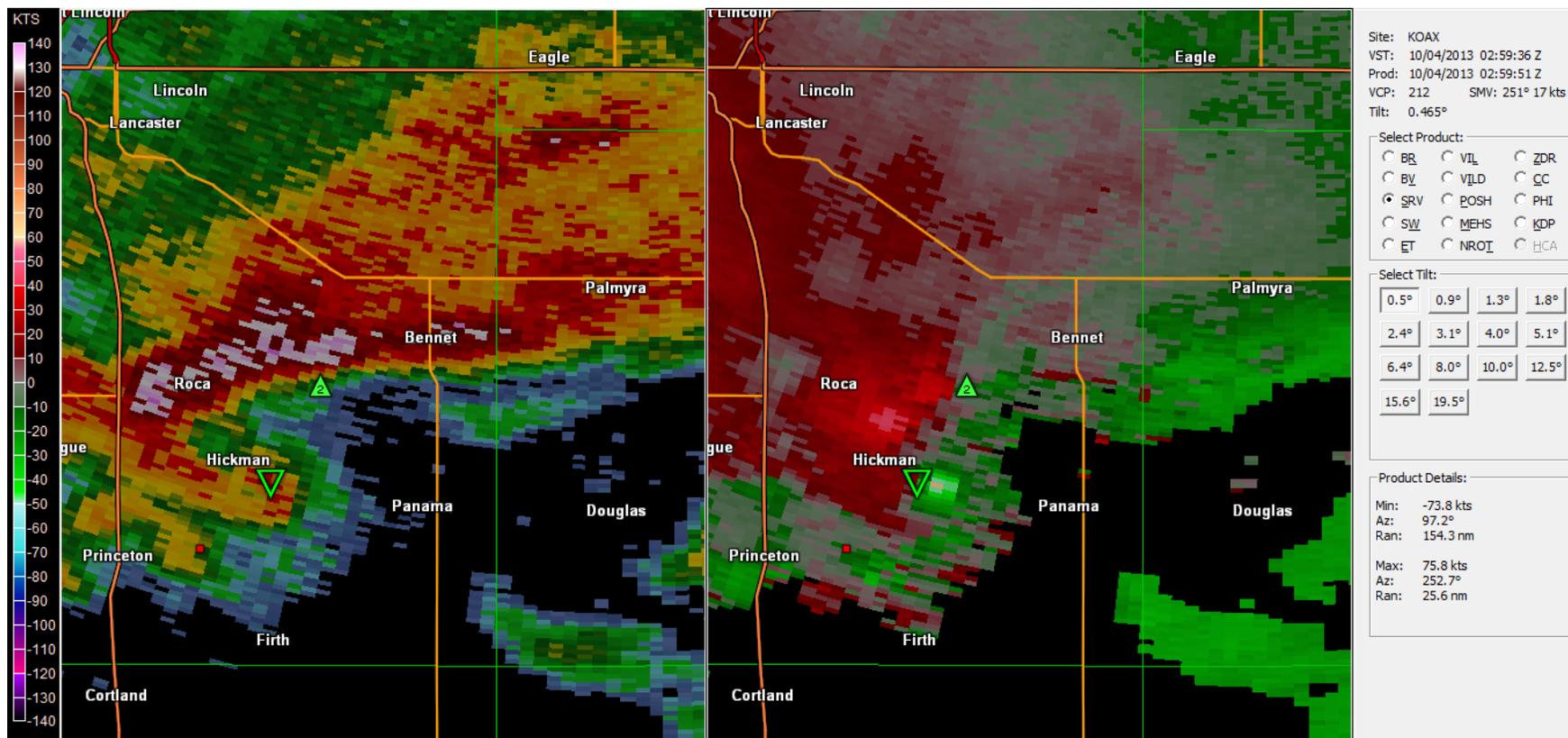


KUEX Base Reflectivity: 0017Z



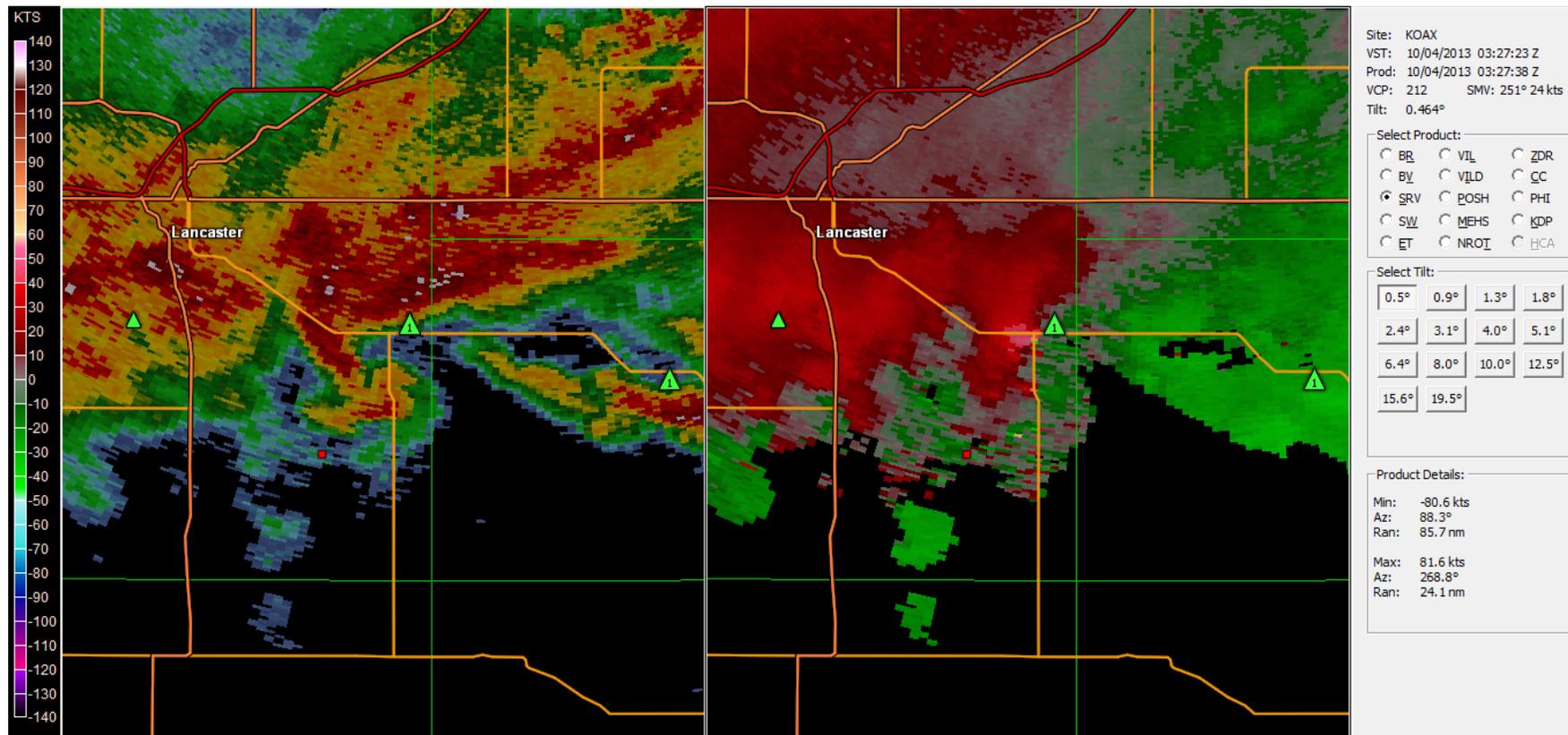
KOAX Base Reflectivity: 0044Z

3 October 2013: Hickman NE Tornado



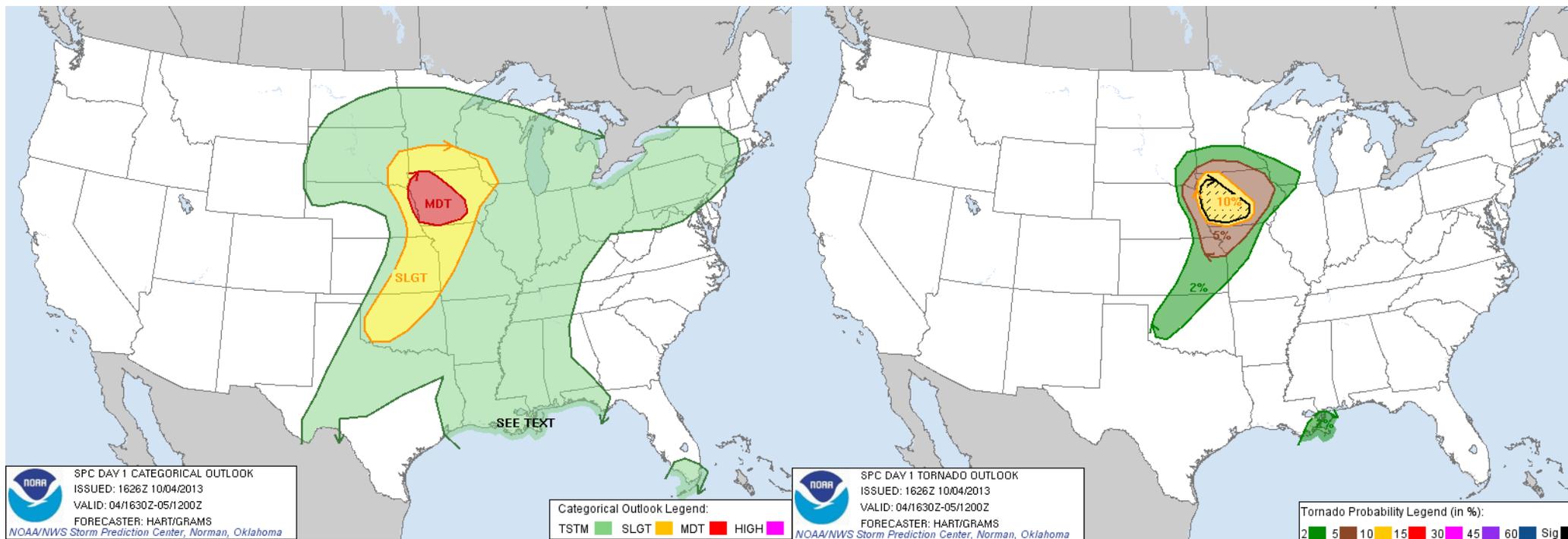
0259Z OAX Base Reflectivity, Base Storm Relative Helicity

3 October 2013: Bennett NE Tornado



0327Z OAX Base Reflectivity, Base Storm Relative Helicity

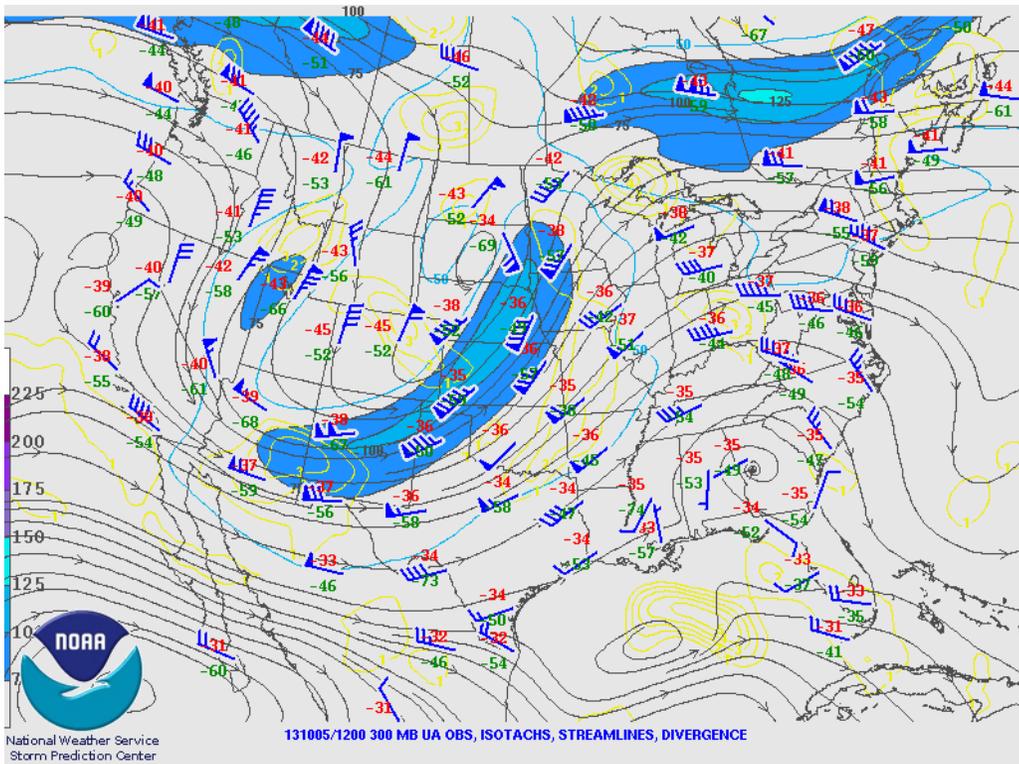
4 October 13: 1630 Z Convective Outlooks



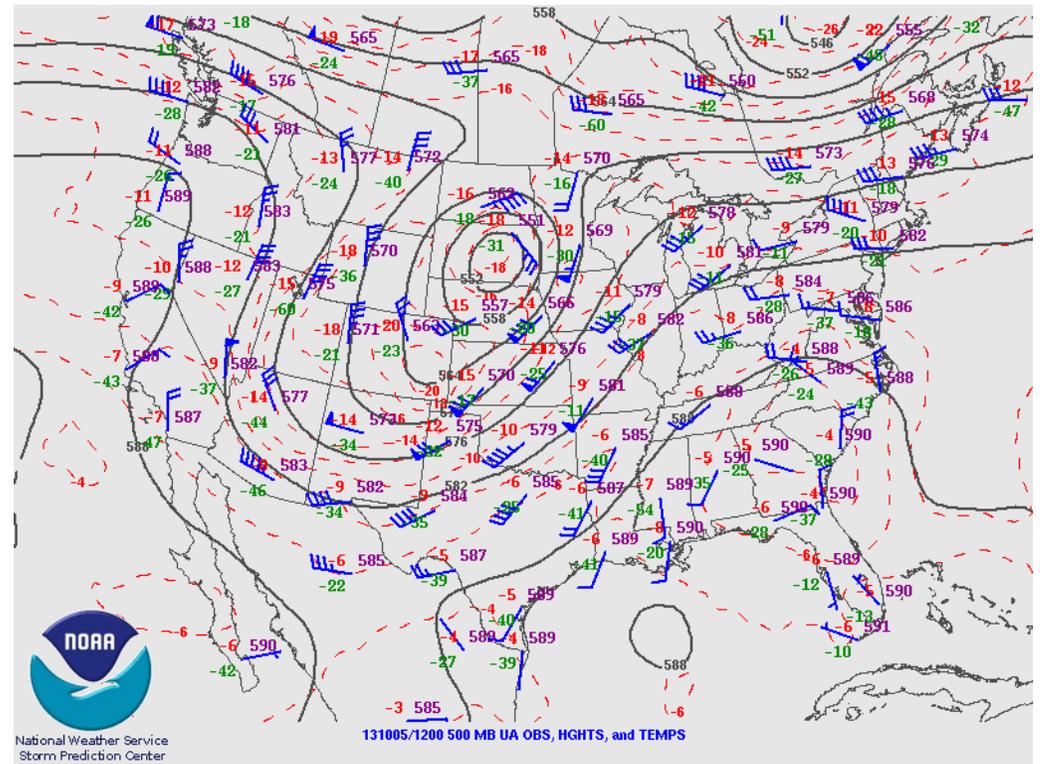
Categorical Outlook

Tornado Probabilities

4 October 2013: Upper Air Charts

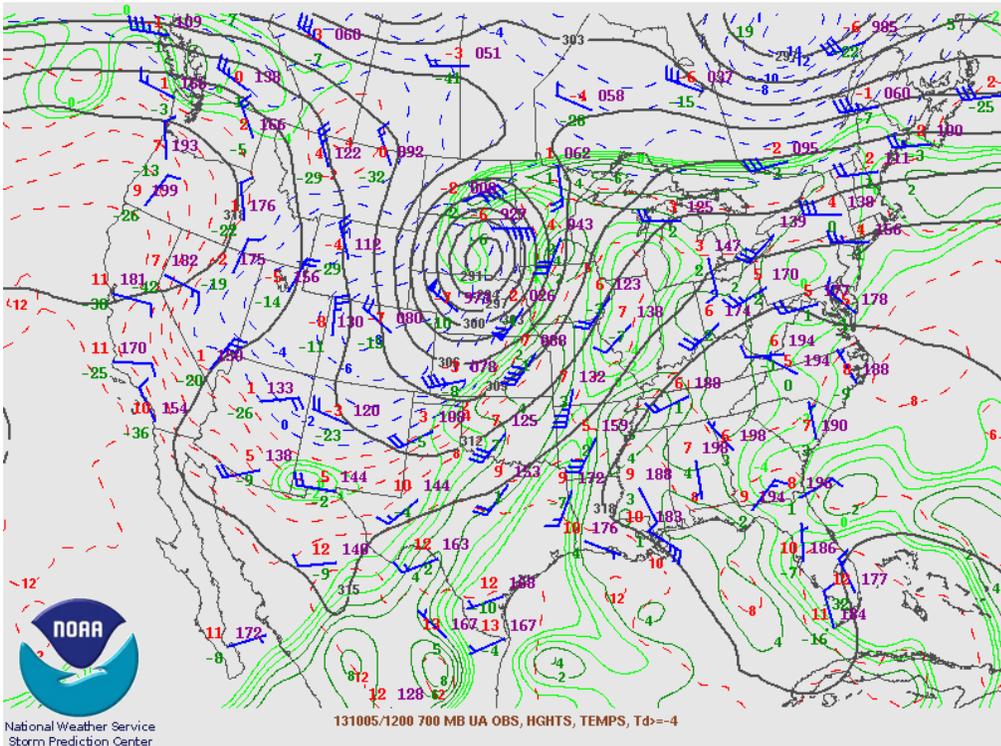


00Z 300 MB Chart

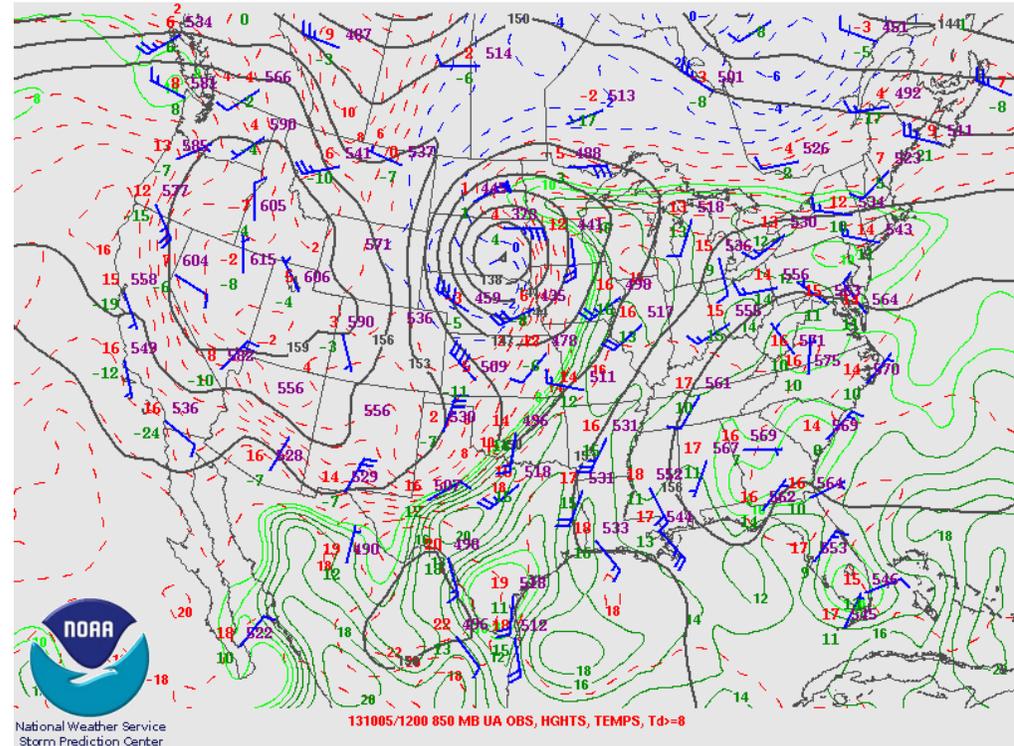


00Z 500 MB Chart

4 October 2013: Mid Level Charts

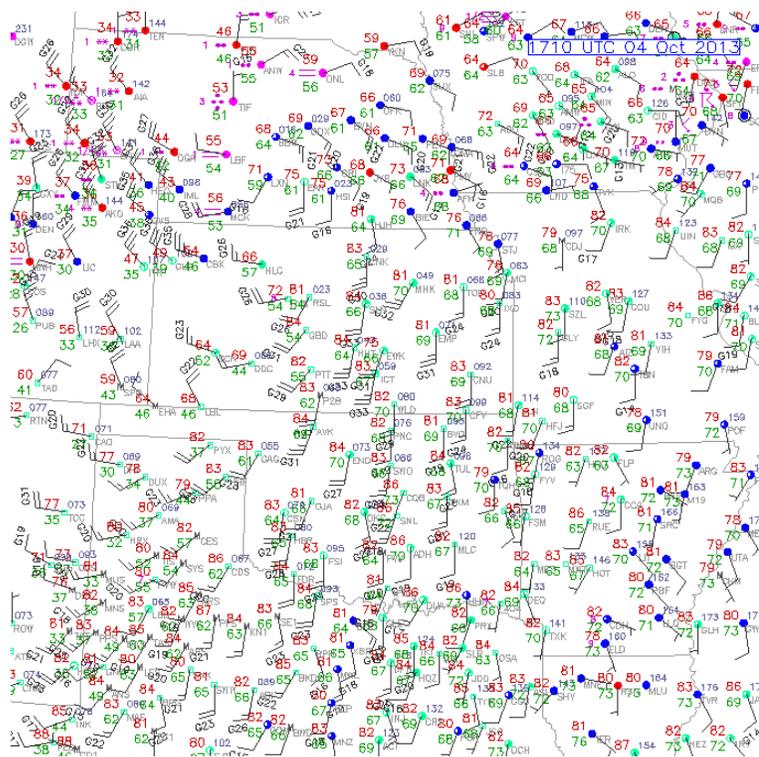


00Z 700 MB Chart

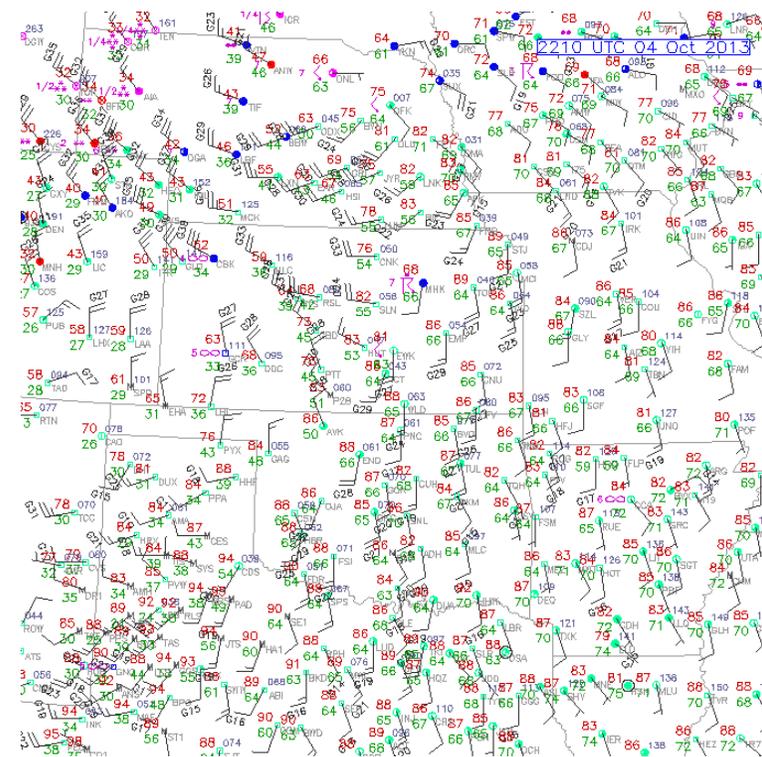


00Z 850 MB Chart

4 October 2013: Surface Charts

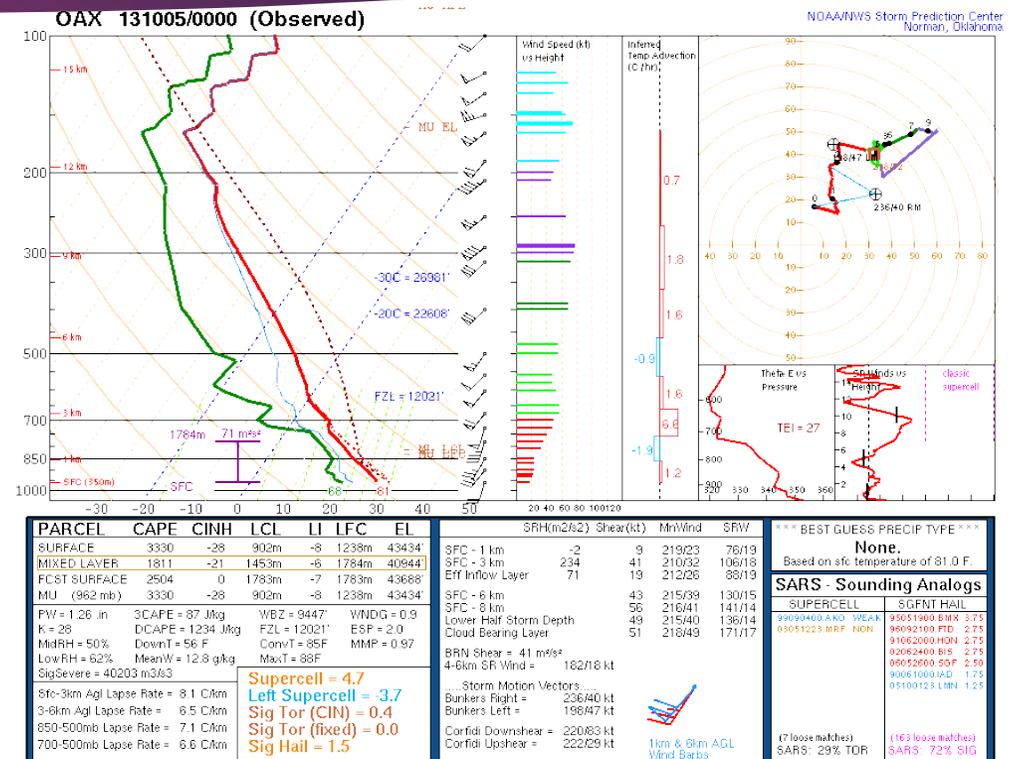
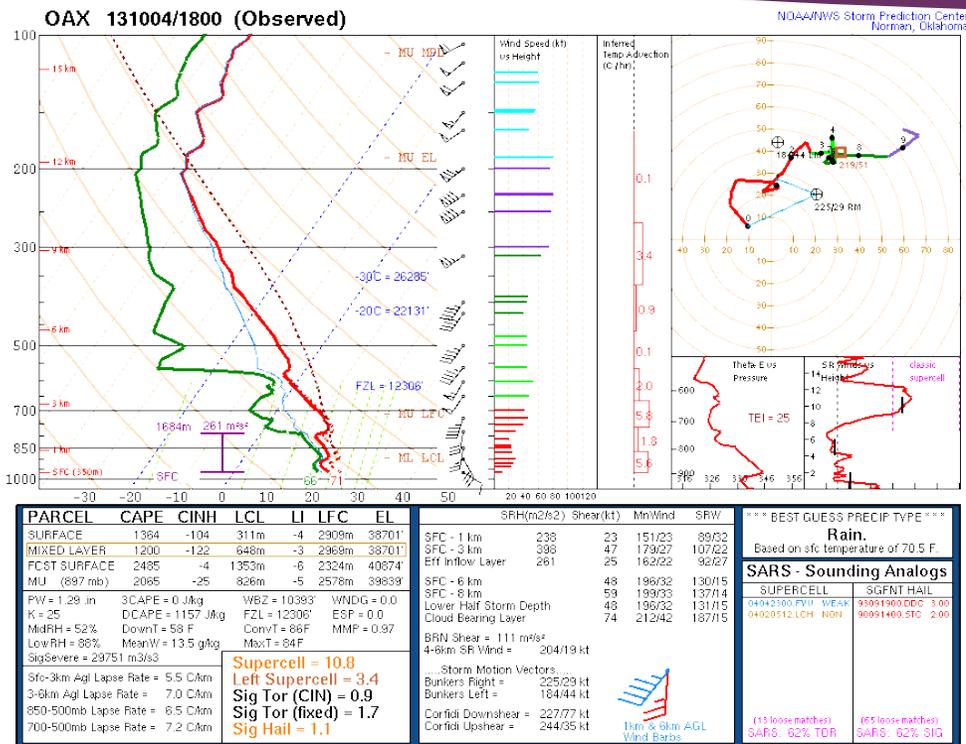


17Z Surface Chart



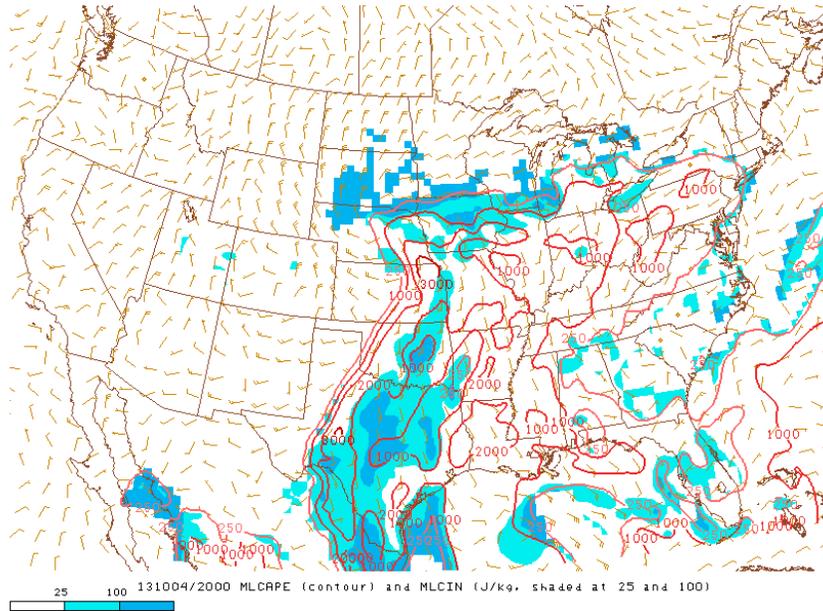
22Z Surface Chart

4 October 2013: OAX 18Z and 00Z Soundings

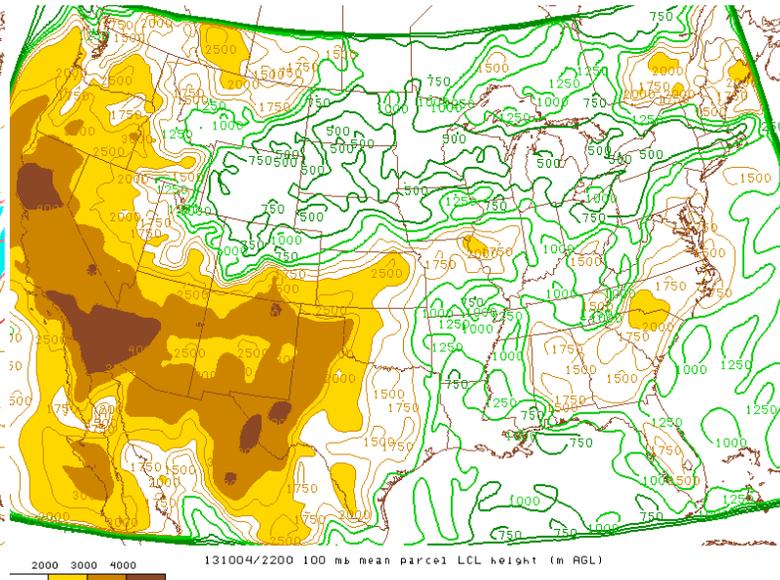


- 1.26 inches of PW ranks in upper 7% for October OAX soundings
- Source: <http://www.crh.noaa.gov/unr/include/pw.php?sid=oax>

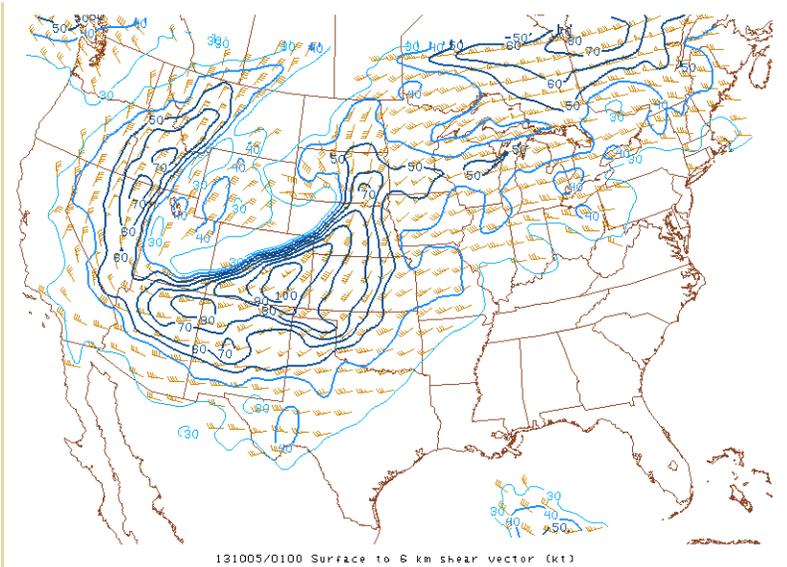
4 October 2013: Mesoanalysis



20 Z ML CAPE

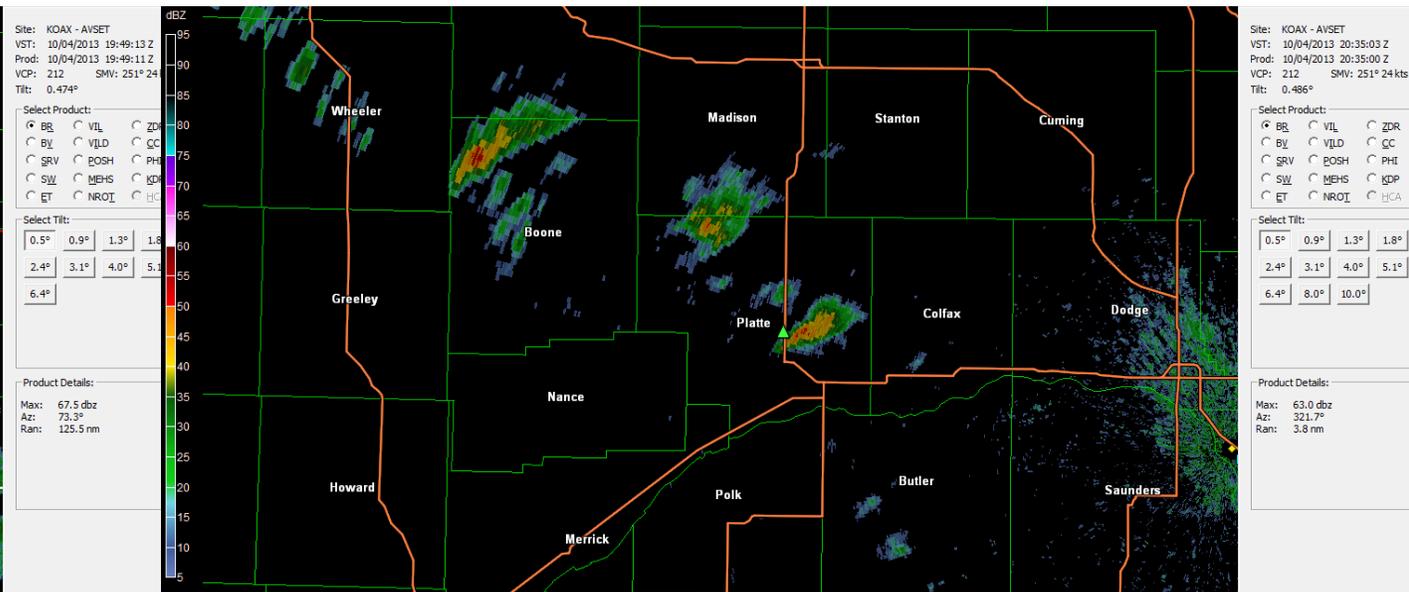
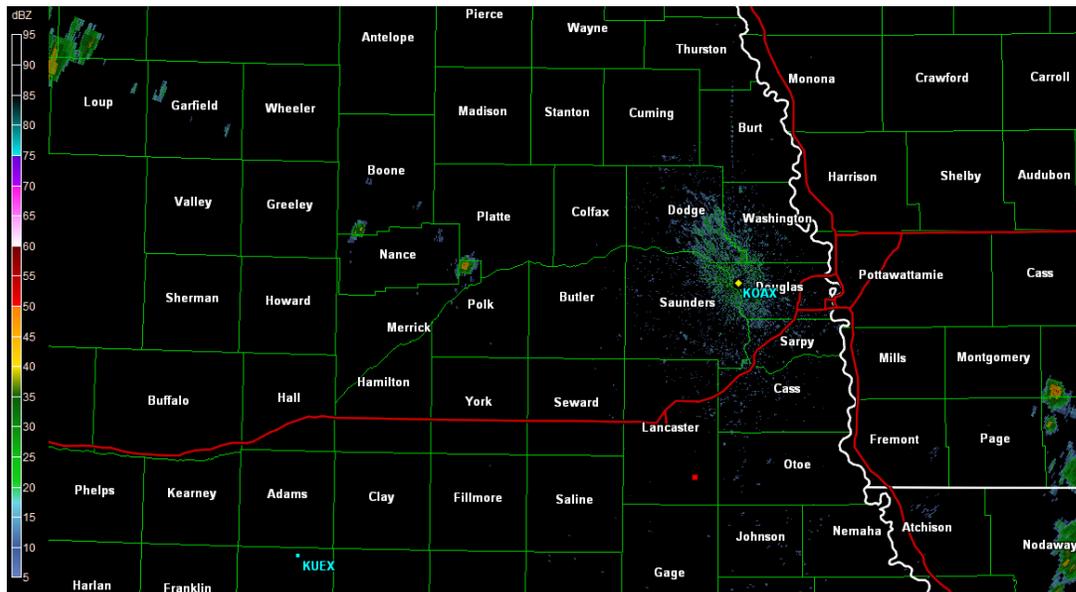


22Z LCL Height



01Z 6 KM Shear Vector

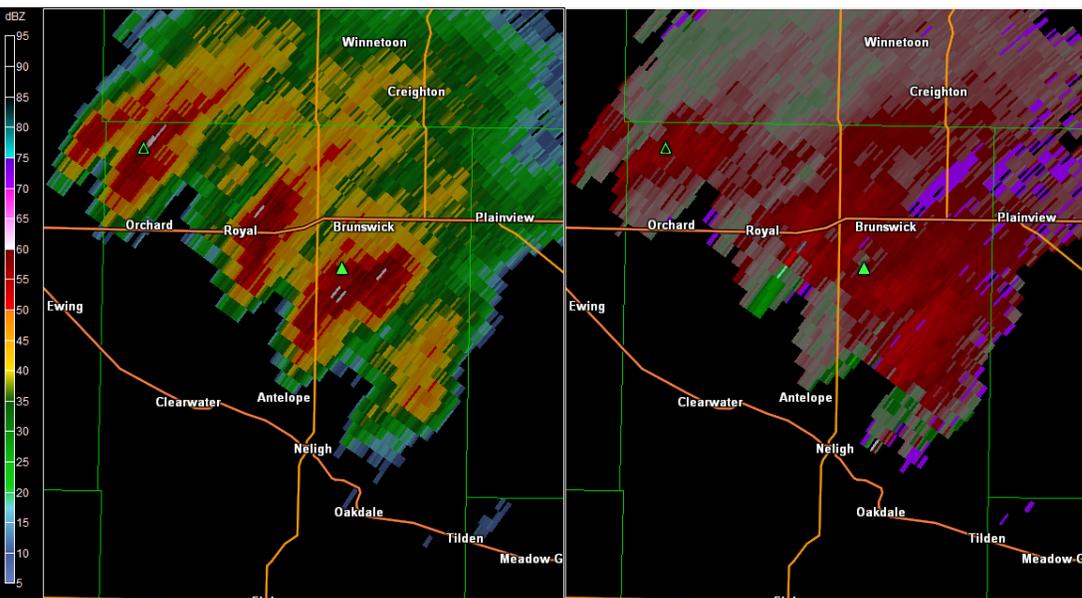
4 October 2013: Convective Initiation



4 October 2013: Royal NE Tornado

2153, 2157 Z OAX Radar

Base Reflectivity, Storm Relative Velocity



Site: KOAX - AVSET
 VST: 10/04/2013 21:53:26 Z
 Prod: 10/04/2013 21:53:23 Z
 VCP: 212 SMV: 184° 28 kts
 Tilt: 0.483°

Select Product:

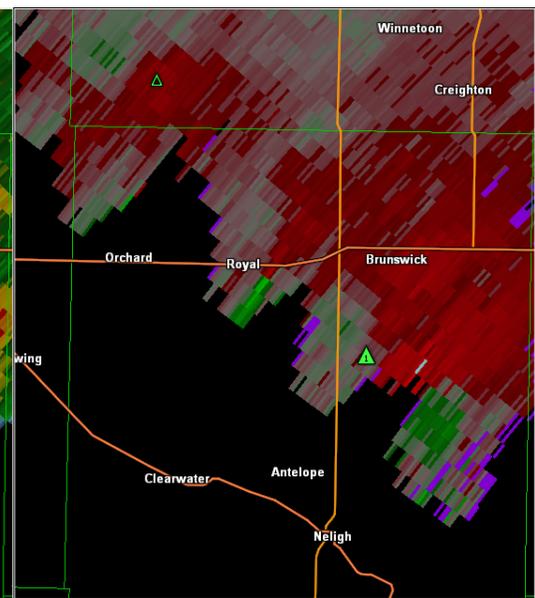
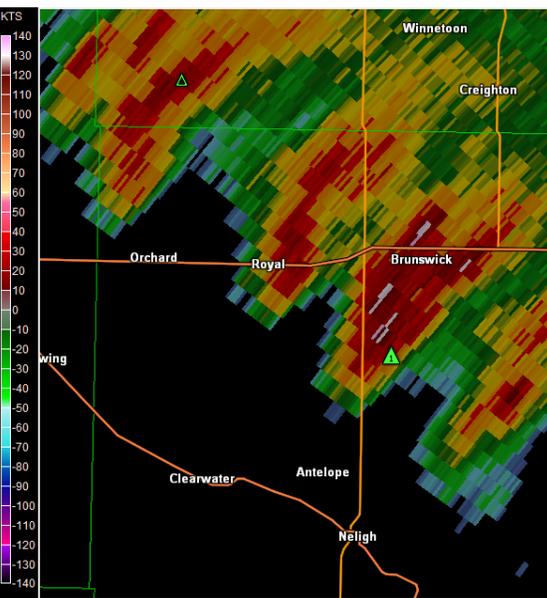
BR VIL ZDR
 BV VLD CC
 SRV POSH PHI
 SW MEHS GDP
 ET NROI HCA

Select Tilt:

0.5° 0.9° 1.3° 1.8°
 2.4° 3.1° 4.0° 5.1°
 6.4° 8.0° 10.0° 12.5°
 15.6°

Product Details:

Max: 64.5 dbz
 Az: 182.7°
 Ran: 121.2 nm



Site: KOAX - AVSET
 VST: 10/04/2013 21:57:49 Z
 Prod: 10/04/2013 21:58:04 Z
 VCP: 212 SMV: 184° 28 kts
 Tilt: 0.464°

Select Product:

BR VIL ZDR
 BV VLD CC
 SRV POSH PHI
 SW MEHS GDP
 ET NROI HCA

Select Tilt:

0.5° 0.9° 1.3° 1.8°
 2.4° 3.1° 4.0° 5.1°
 6.4° 8.0° 10.0° 12.5°
 15.6°

Product Details:

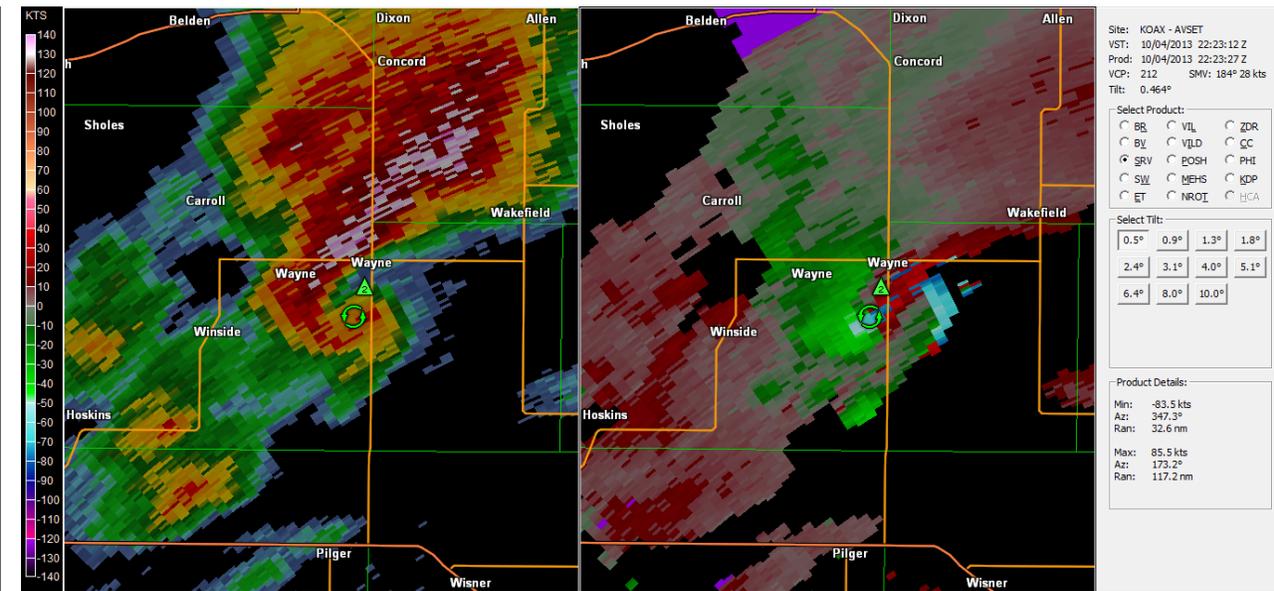
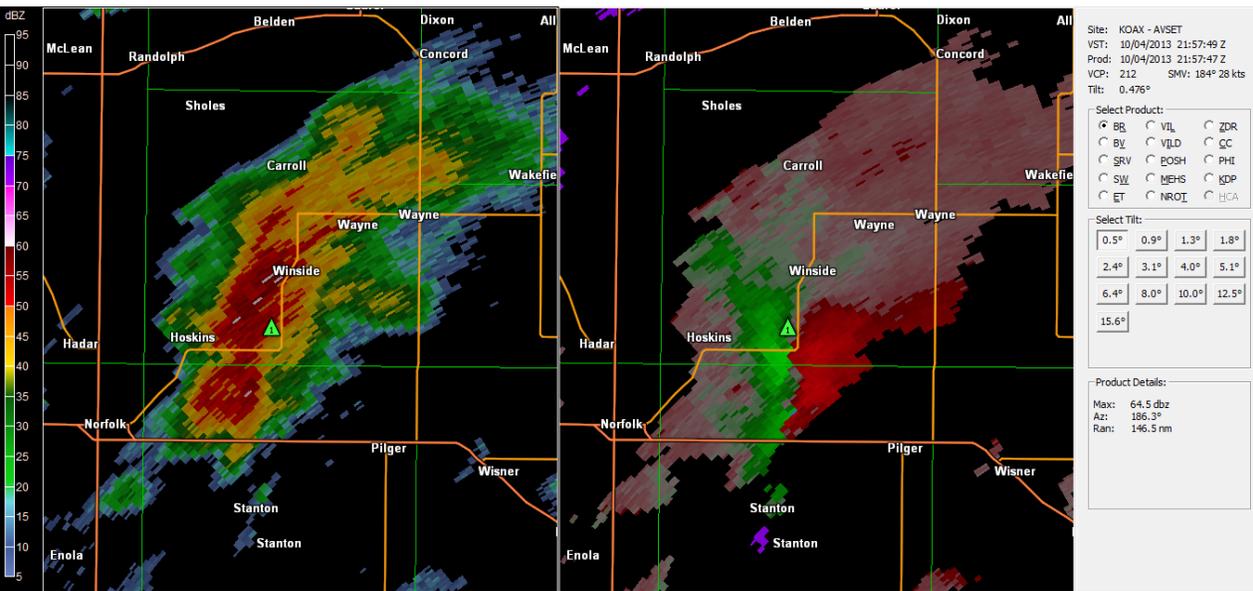
Min: -82.6 kts
 Az: 336.7°
 Ran: 8.3 nm

Max: 85.5 kts
 Az: 178.7°
 Ran: 121.8 nm

4 October 2013: Wayne NE Tornado

2157, 2223Z OAX Radar

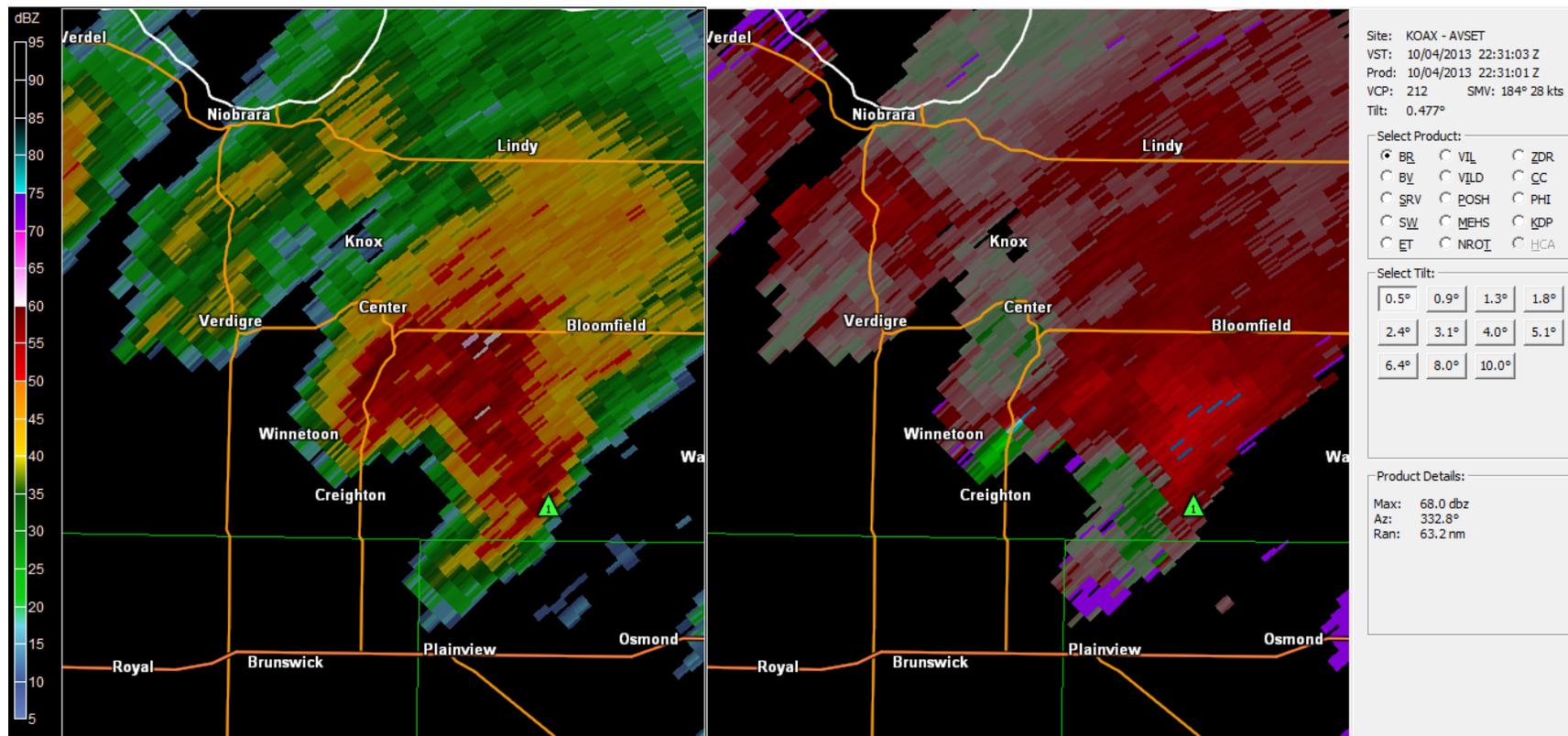
Base Reflectivity, Storm Relative Velocity



4 October 2013: Creighton NE Tornado

2231Z OAX Radar

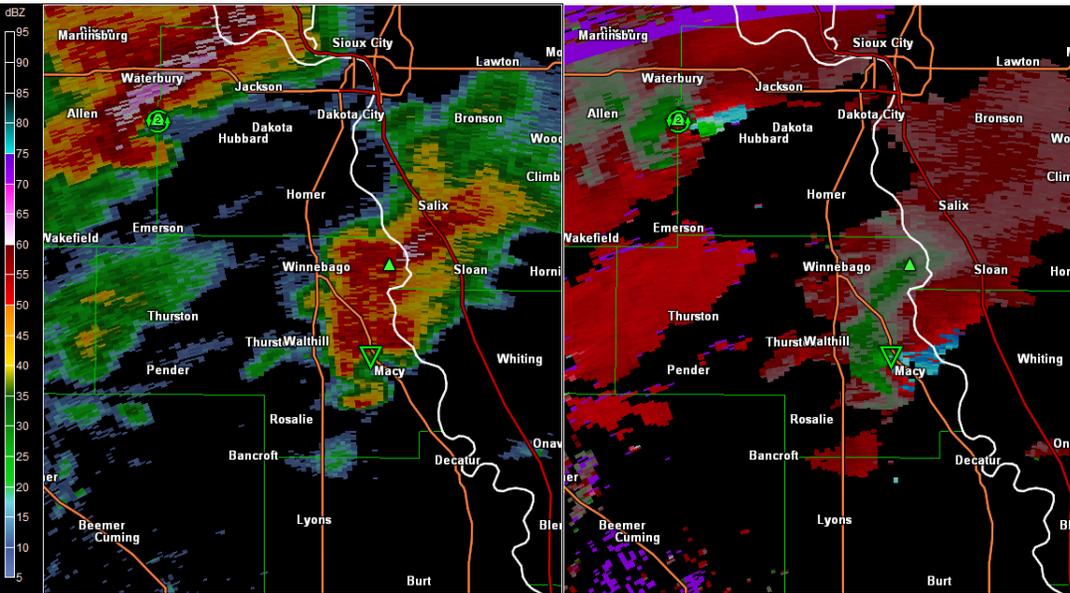
Base Reflectivity, Storm Relative Velocity



4 October 2013: Macy NE Tornado

2300, 2313Z OAX Radar

Base Reflectivity, Storm Relative Velocity

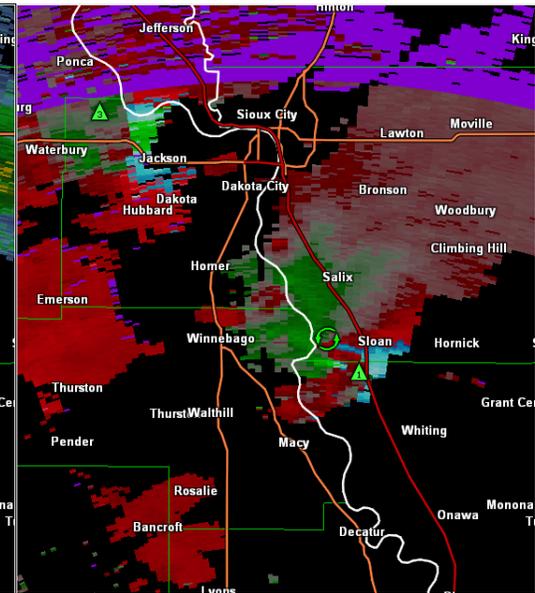
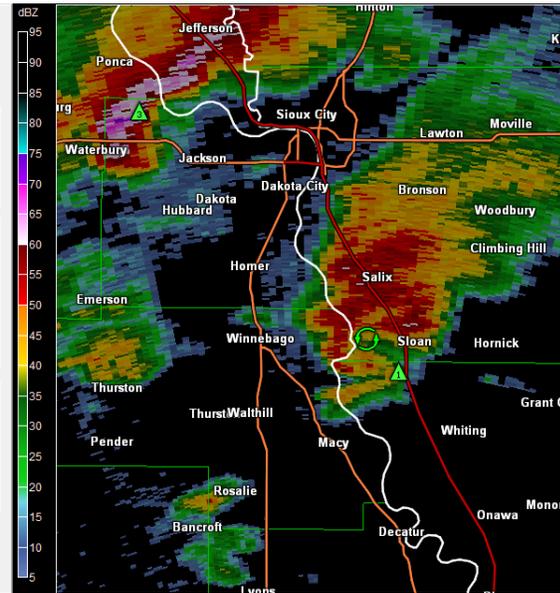


Site: KOAX - AVSET
 VST: 10/04/2013 23:00:20 Z
 Prod: 10/04/2013 23:00:18 Z
 VCP: 212 SMV: 232* 33 kts
 Tilt: 0.481°

Select Product:
 BB VIL ZDR
 BY VLD QC
 SRV POSH PHT
 SW MEHS KDP
 ET NROT HCA

Select Tilt:
 0.5° 0.9° 1.3° 1.8°
 2.4° 3.1° 4.0° 5.1°
 6.4° 8.0° 10.0° 12.5°
 15.6°

Product Details:
 Max: 71.5 dbz
 Az: 150.7°
 Ran: 39.3 nm



Site: KOAX
 VST: 10/04/2013 23:13:45 Z
 Prod: 10/04/2013 23:13:42 Z
 VCP: 212 SMV: 232* 33 kts
 Tilt: 0.463°

Select Product:
 BB VIL ZDR
 BY VLD QC
 SRV POSH PHT
 SW MEHS KDP
 ET NROT HCA

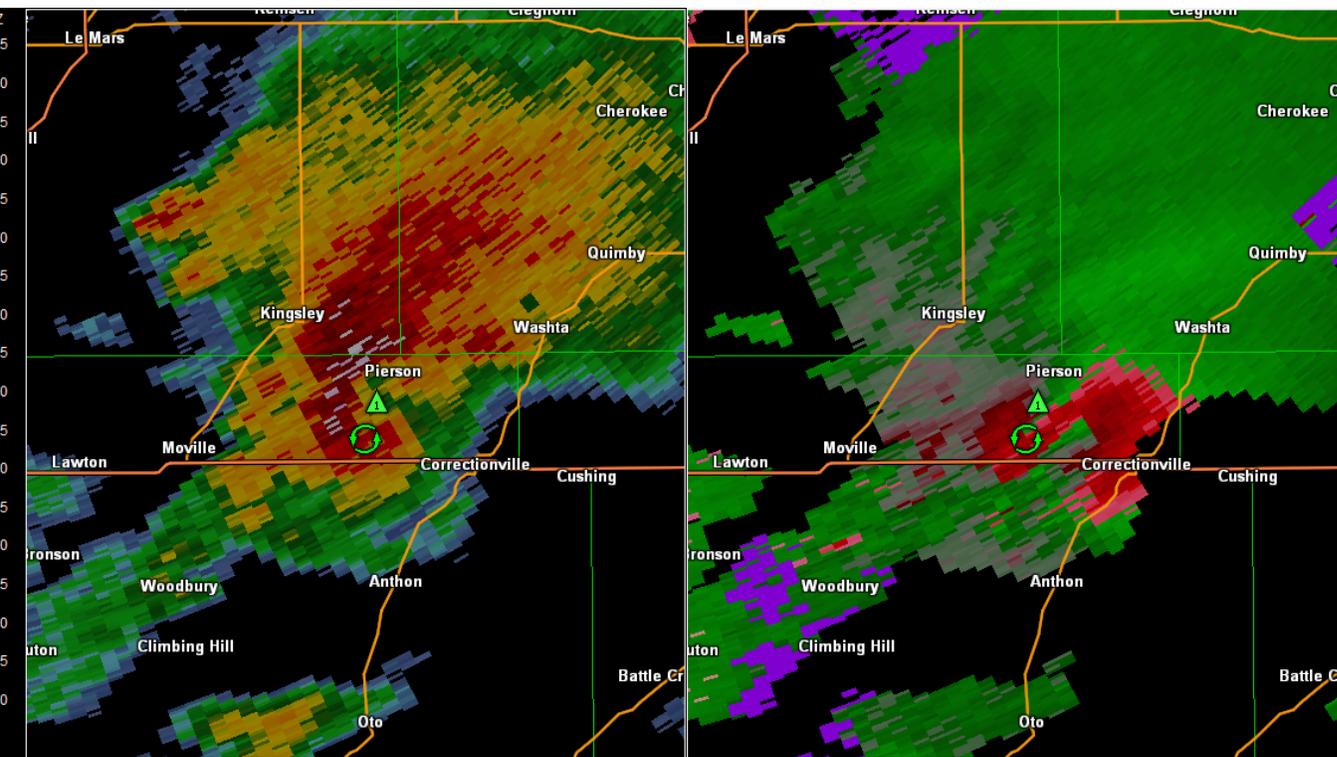
Select Tilt:
 0.5° 0.9° 1.3° 1.8°
 2.4° 3.1° 4.0° 5.1°
 6.4° 8.0° 10.0° 12.4°
 15.6° 19.5°

Product Details:
 Max: 73.0 dbz
 Az: 348.3°
 Ran: 71.1 nm

4 October 2013: Pierson IA Tornado

0003Z FSD Radar

Base Reflectivity, Storm Relative Velocity



Site: KFSD
 VST: 10/05/2013 00:03:05 Z
 Prod: 10/05/2013 00:03:02 Z
 VCP: 12 SMV: 225° 32 kts
 Tilt: 0.505°

Select Product:

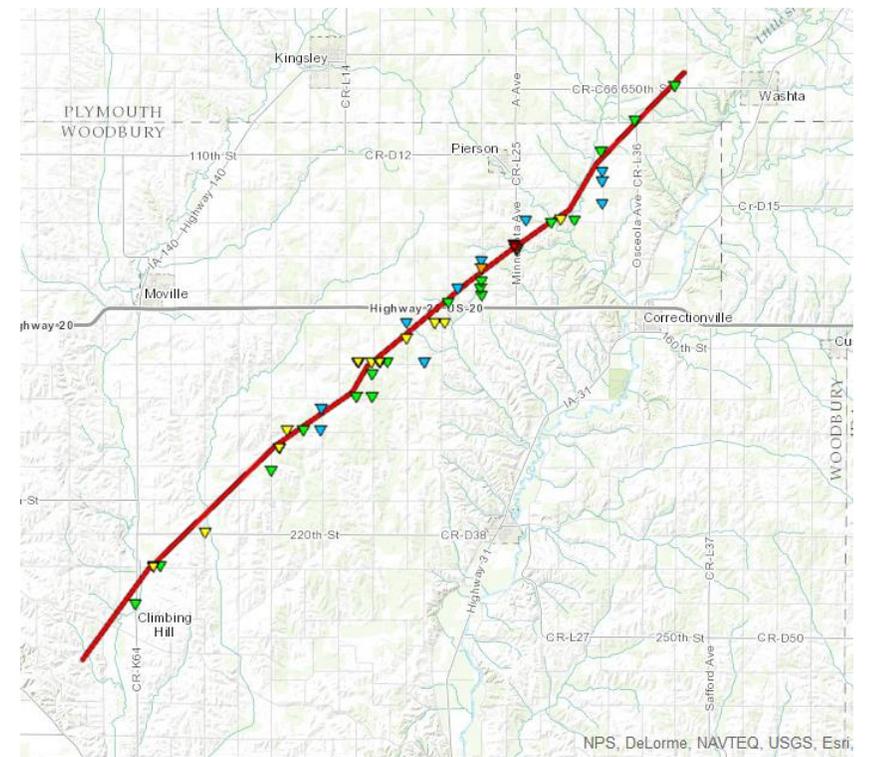
<input checked="" type="radio"/> BB	<input type="radio"/> VIL	<input type="radio"/> ZDR
<input type="radio"/> BV	<input type="radio"/> VLD	<input type="radio"/> CC
<input type="radio"/> SRV	<input type="radio"/> POSH	<input type="radio"/> PHI
<input type="radio"/> SW	<input type="radio"/> MEHS	<input type="radio"/> KDP
<input type="radio"/> ET	<input type="radio"/> NROI	<input type="radio"/> HCA

Select Tilt:

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<input type="radio"/> 15.6°	<input type="radio"/> 19.5°		

Product Details:

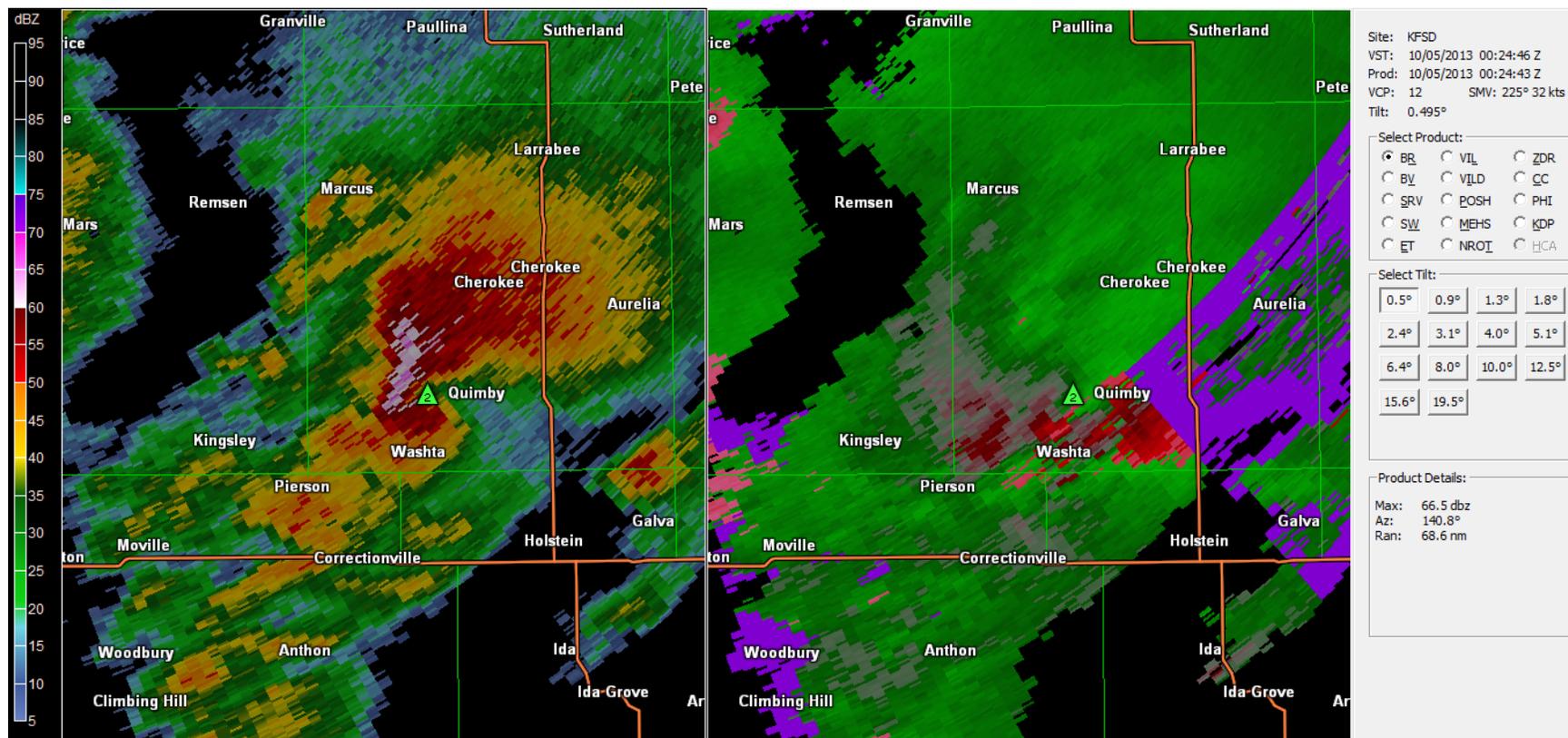
Max: 64.5 dbz
 Az: 161.8°
 Ran: 46.3 nm



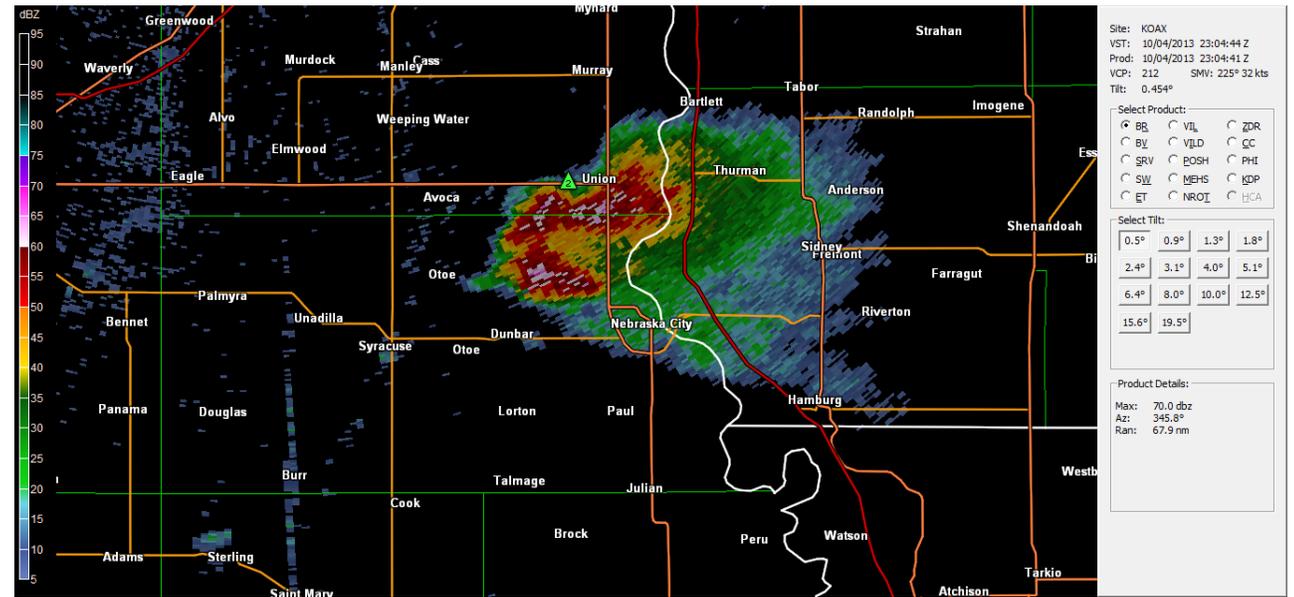
4 October 2013: Quimby IA Tornado

0025Z FSD Radar

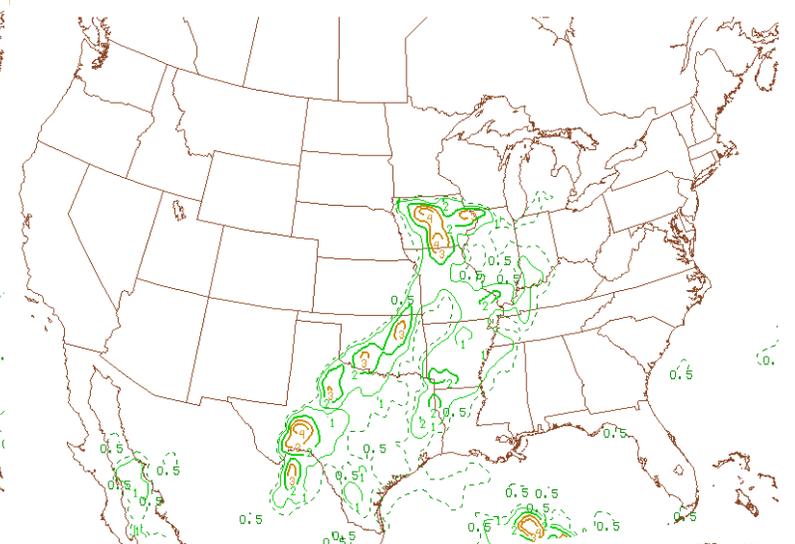
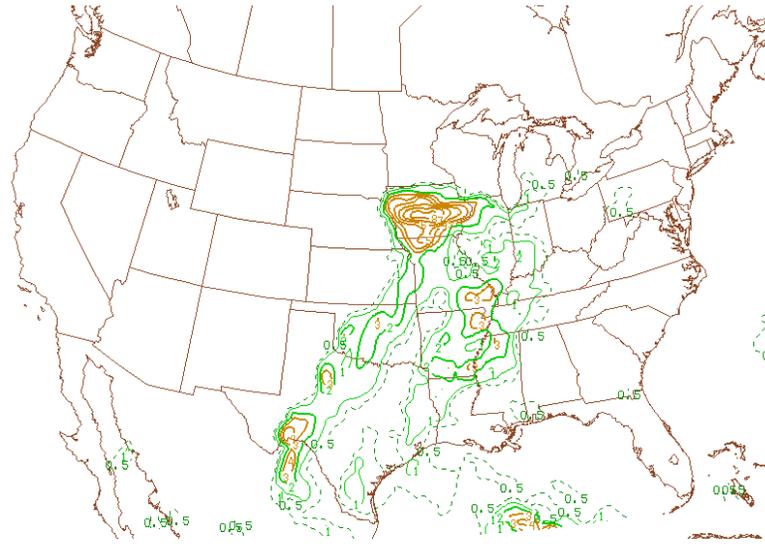
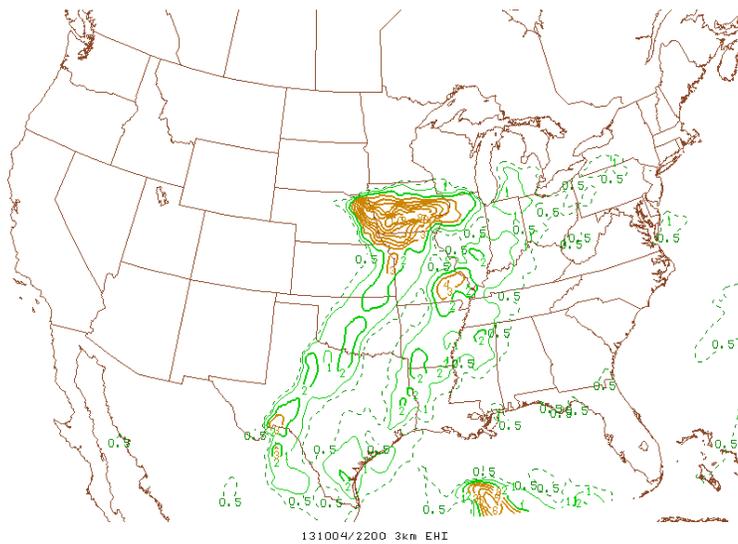
Base Reflectivity, Storm Relative Velocity



4 October 2013: Plattsmouth NE Hail 2304Z OAX Radar Base Reflectivity

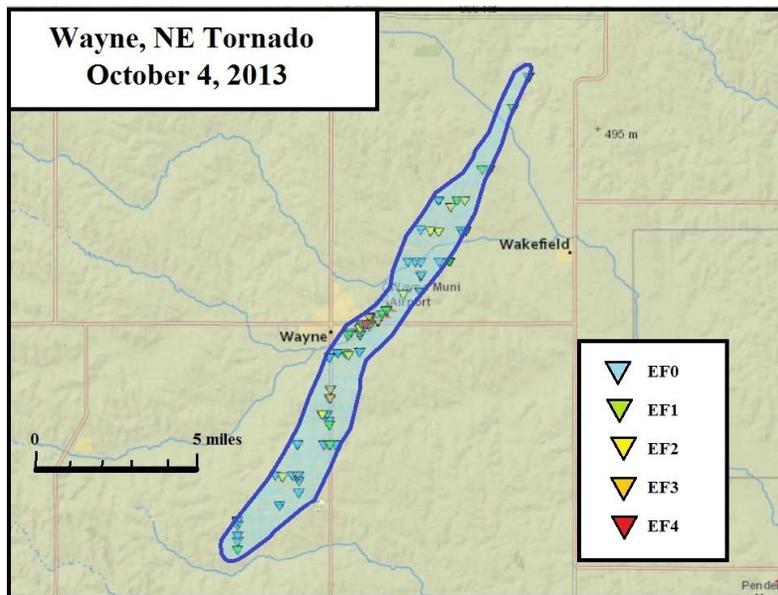


4 October 2013: EHI Progression



Energy Helicity Index: 22Z, 00Z, 02Z

4 October 2013: Wayne NE Area Damage



Courtesy: National Weather Service Valley,
http://www.crh.noaa.gov/news/display_cmsstory.php?wfo=oax&storyid=97453&source=2

Summary and Conclusions

3 October 2013

- ▶ Unseasonable moisture poured north and westward into the central plains in early October ahead of an intense transition season storm system. A crippling blizzard on the back side of the storm dumped several feet of snow in western Nebraska and South Dakota, resulting in a catastrophic loss of local livestock
- ▶ Numerous thunderstorms developed in south central Nebraska near a slowly moving frontal boundary shortly after 00Z; a more isolated thunderstorm developed farther east away from the boundary at the same time along an area of enhanced moisture convergence
- ▶ Hickman NE storm remained isolated on the evening of 3 October 2013 compared to storms that developed farther west along the warm front
- ▶ Enhanced evening helicity allowed storm to thrive for more than an hour after sunset

Summary and Conclusions

4 October 2013

- ▶ Unseasonably humid air remained in place the next day ahead of the ejecting storm system; dry air did not mix across the dry line, leaving an explosive environment for damaging severe storms
- ▶ Dry air surged into eastern Nebraska, sparing the major metropolitan areas of severe convection for the most part, but the instability profile maintained itself in northeastern Nebraska and northwestern Iowa
- ▶ Storms that developed on the nose of the 500 hpa jet streak quickly became tornadic on 4 October 2013; the lone storm south of the jet streak remained only a severe hail threat
- ▶ Storms in northeastern Nebraska remained isolated for extended periods of time, several of which produced strong tornadoes
- ▶ Provided a stiff radar challenge in that strong mesocyclones were constantly present with these storms, though tornadoes were not. Early tornadoes likely alleviated any concern about the “reality” of the October tornado outbreak.
- ▶ Notable absence of hail reports in the storm reports

Acknowledgments/Further Information

- ▶ Gibson Ridge Software
- ▶ National Weather Service Rapid City Forecast Office
- ▶ National Weather Service Sioux Falls Forecast Office
- ▶ National Weather Service Valley Forecast Office
- ▶ Storm Prediction Center
- ▶ UCAR Image Archive, <http://locust.mmm.ucar.edu/>