Warning Challenges and Successes of the June 16-17 Southern Wisconsin Nocturnal QLCS

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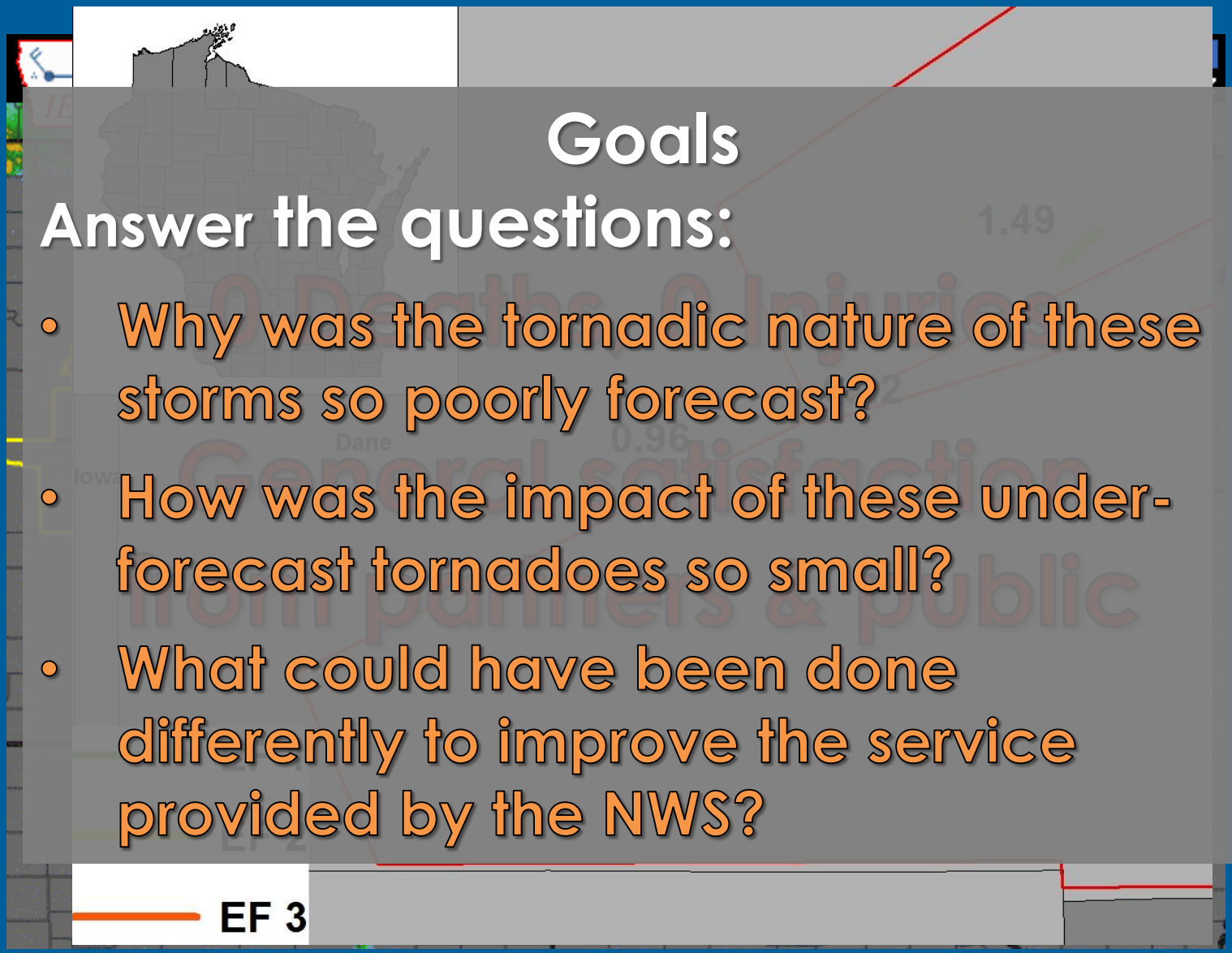
Motivation?



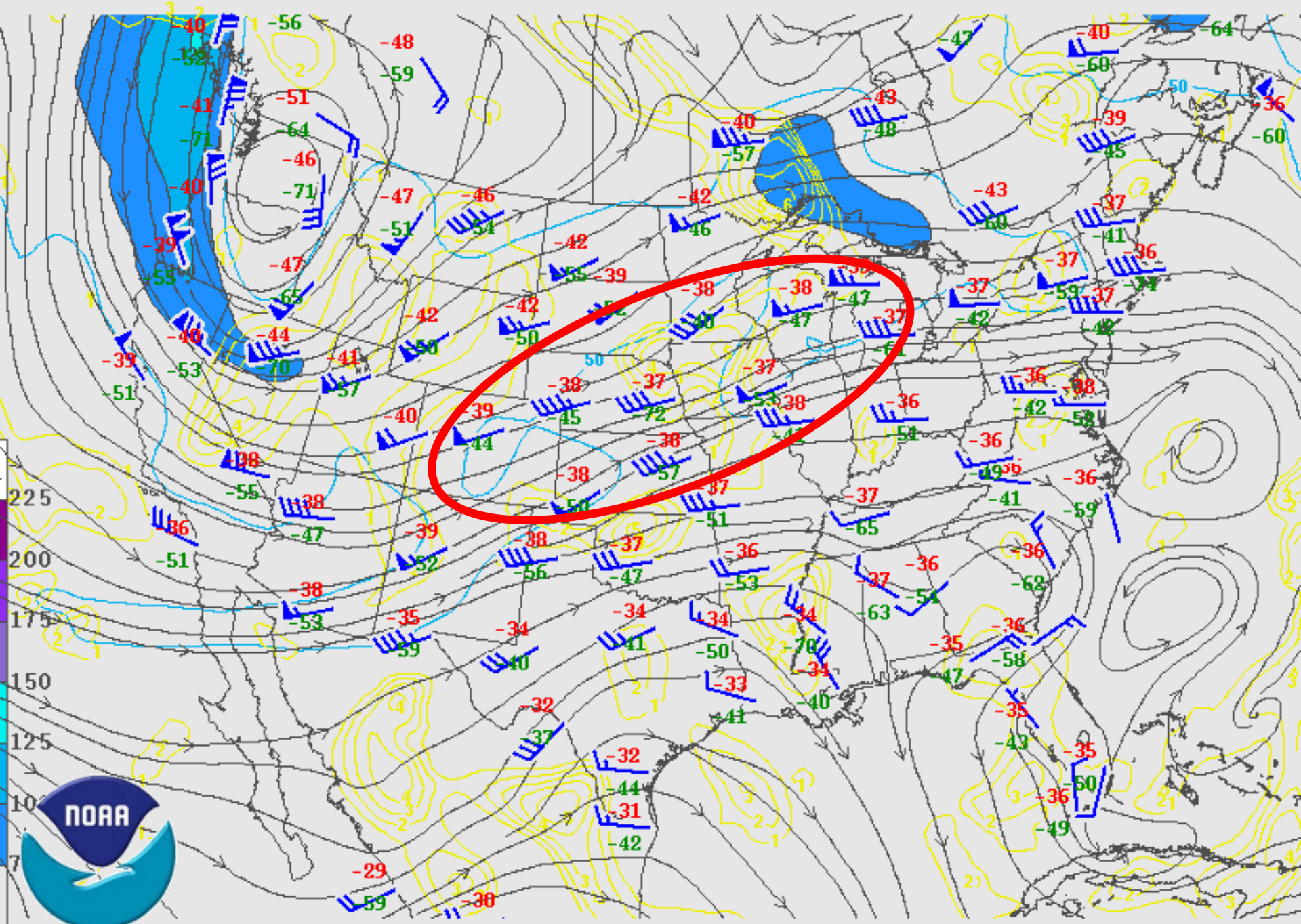
Goals

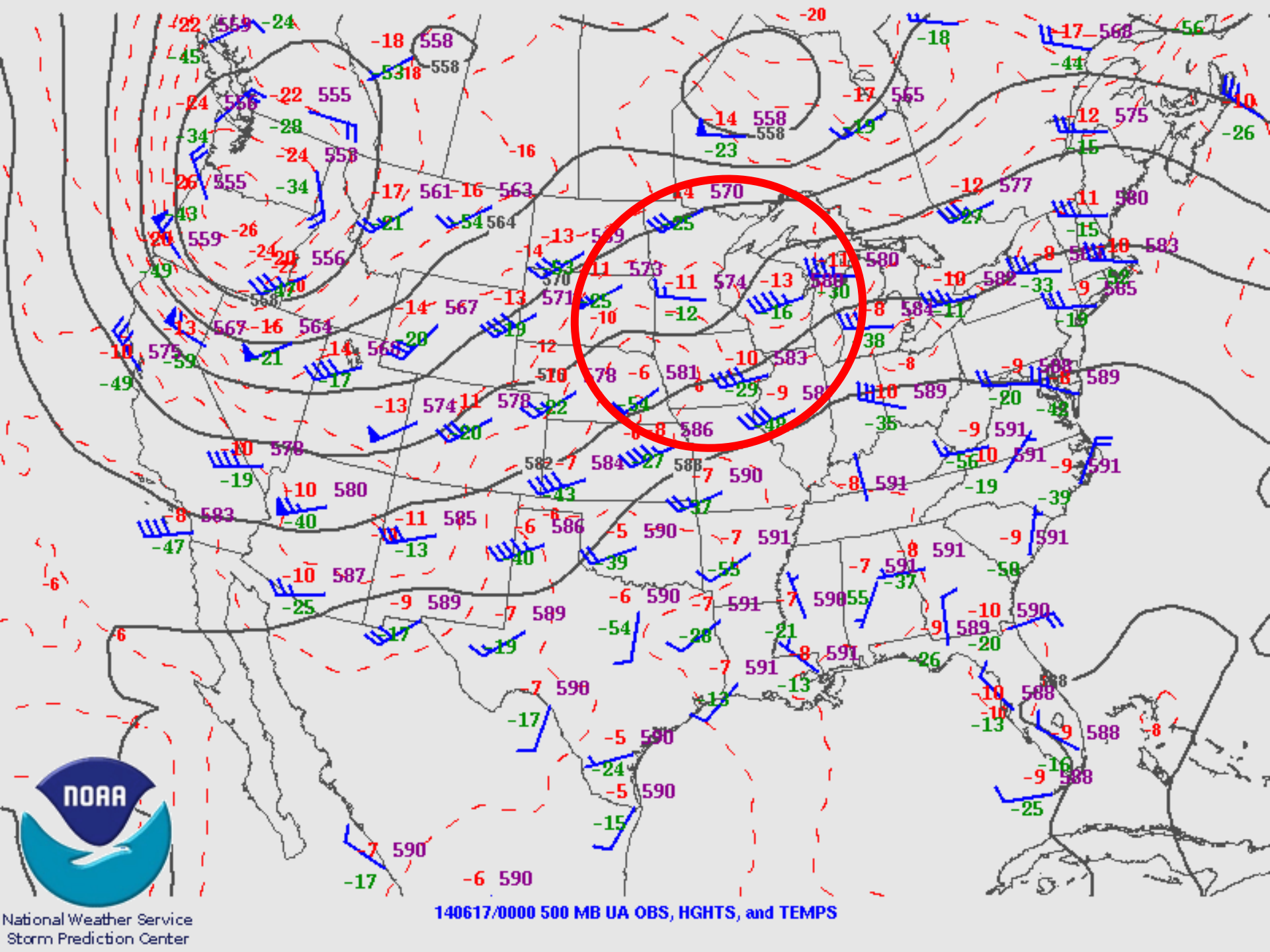
Answer the questions:

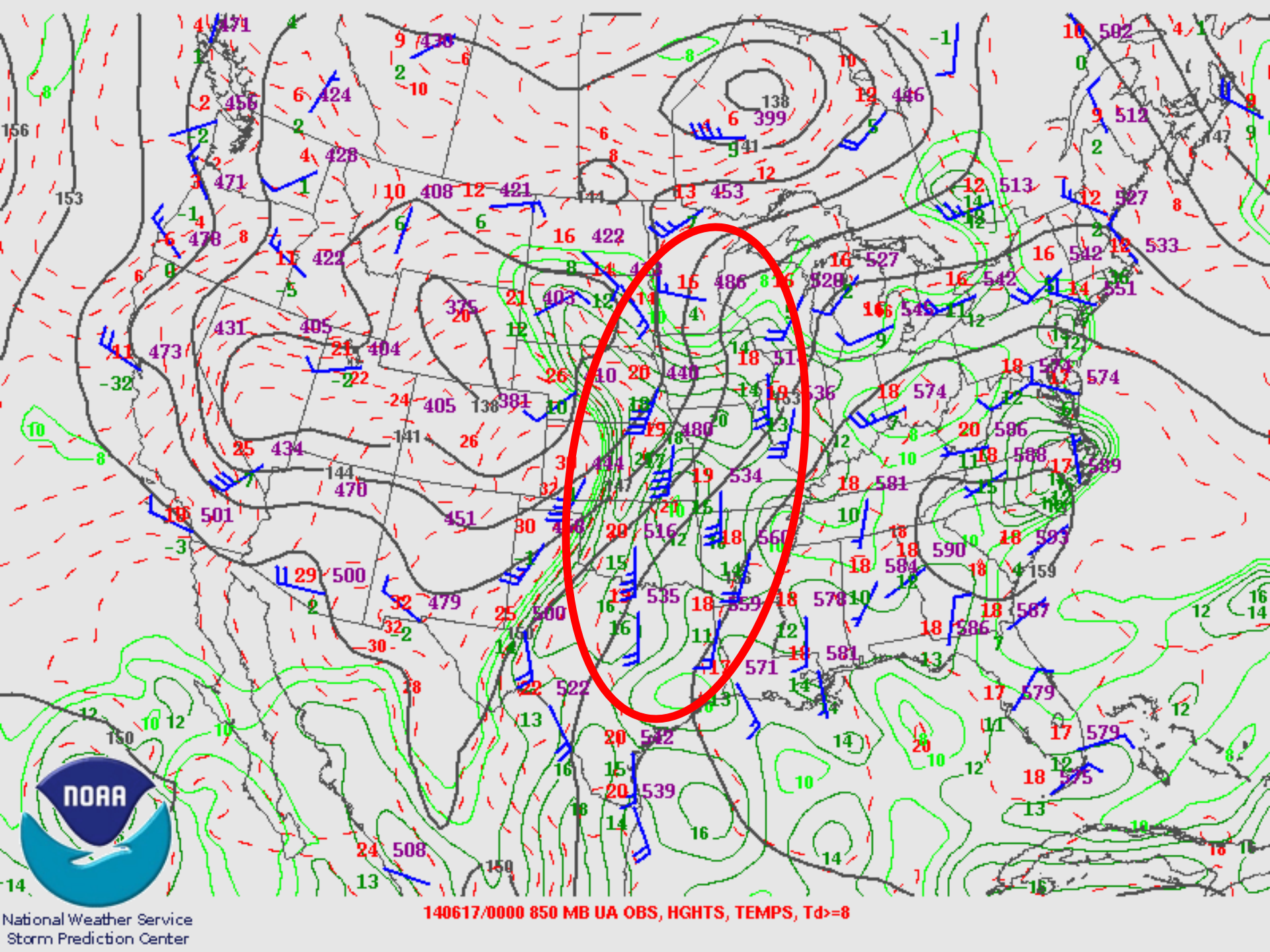
- Why was the tornadic nature of these storms so poorly forecast?
- How was the impact of these under-forecast tornadoes so small?
- What could have been done differently to improve the service provided by the NWS?

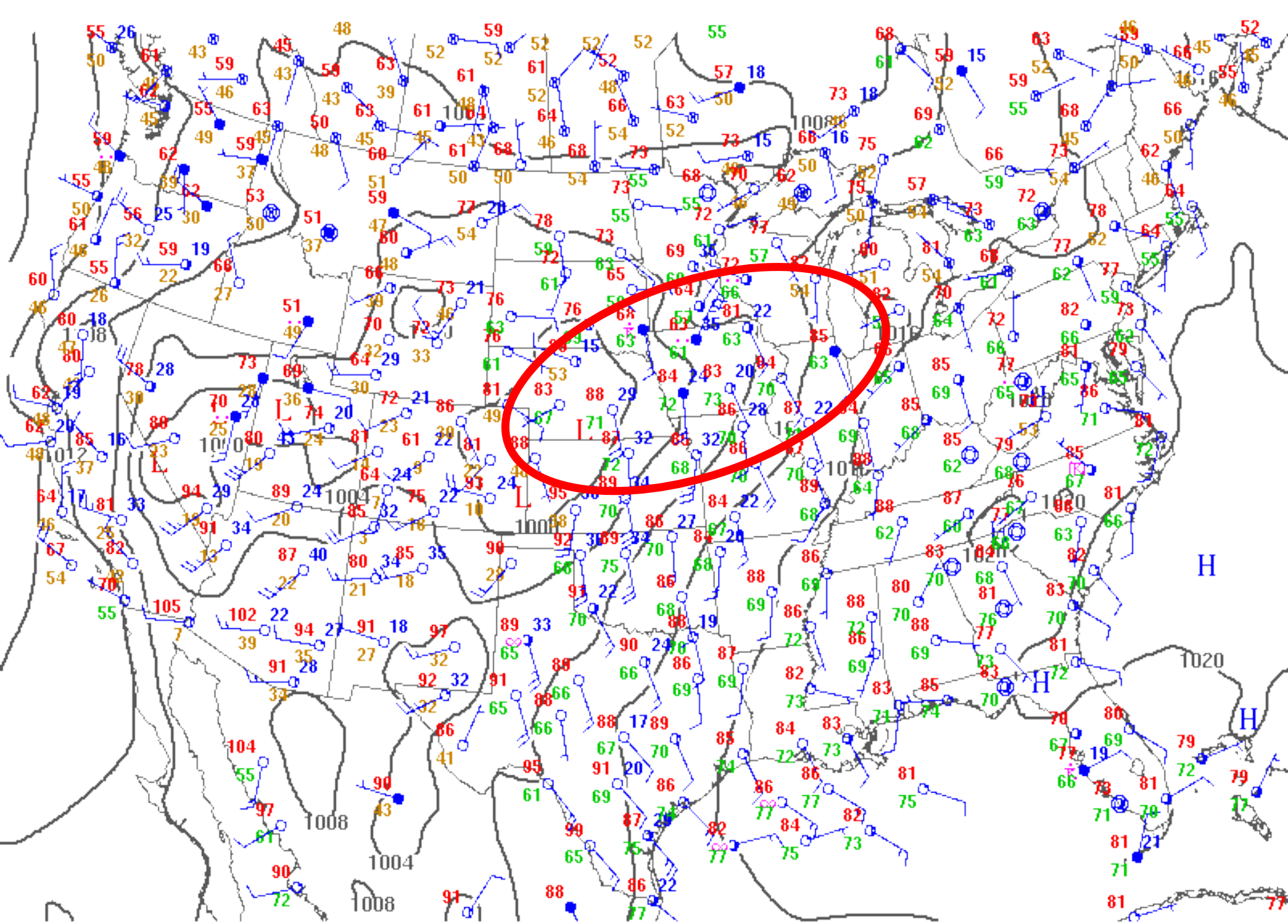
Outline

- Step into the warning desk!
- Walk through radar data & warning decisions.
- Discuss what went **wrong.**
- Discuss what went **right.**
- **What can we do to get better?**


225
200
175
150
125
NOAA
National Weather Service
Storm Prediction Center
140617/0000 300 MB UA OBS, ISOTACHS, STREAMLINES, DIVERGENCE

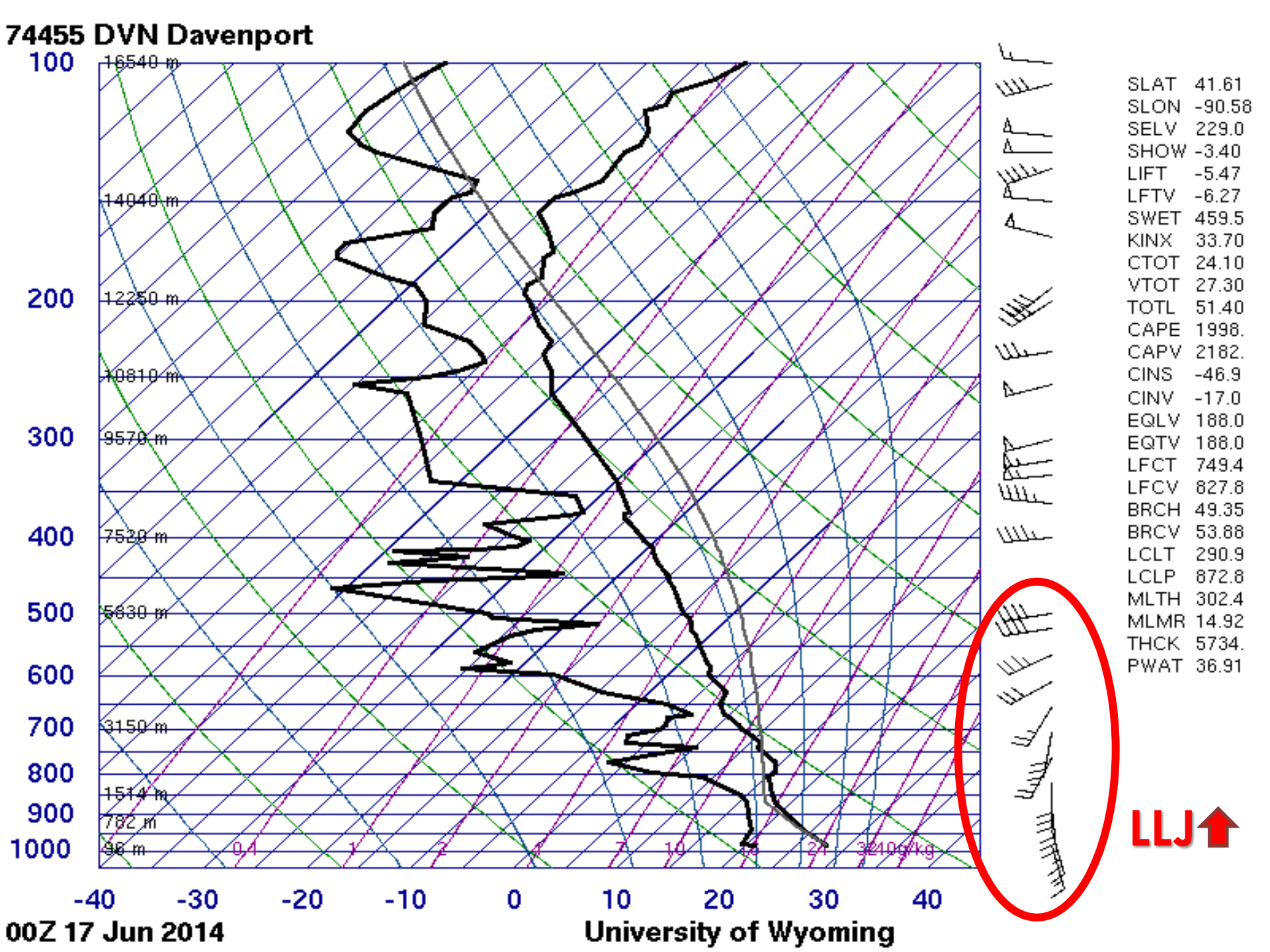

NOAA
National Weather Service
Storm Prediction Center
140617/0000 500 MB UA OBS, HGHTS, and TEMPS


NOAA
National Weather Service
Storm Prediction Center
140617/0000 850 MB UA OBS, HGHTS, TEMPS, Td>=8

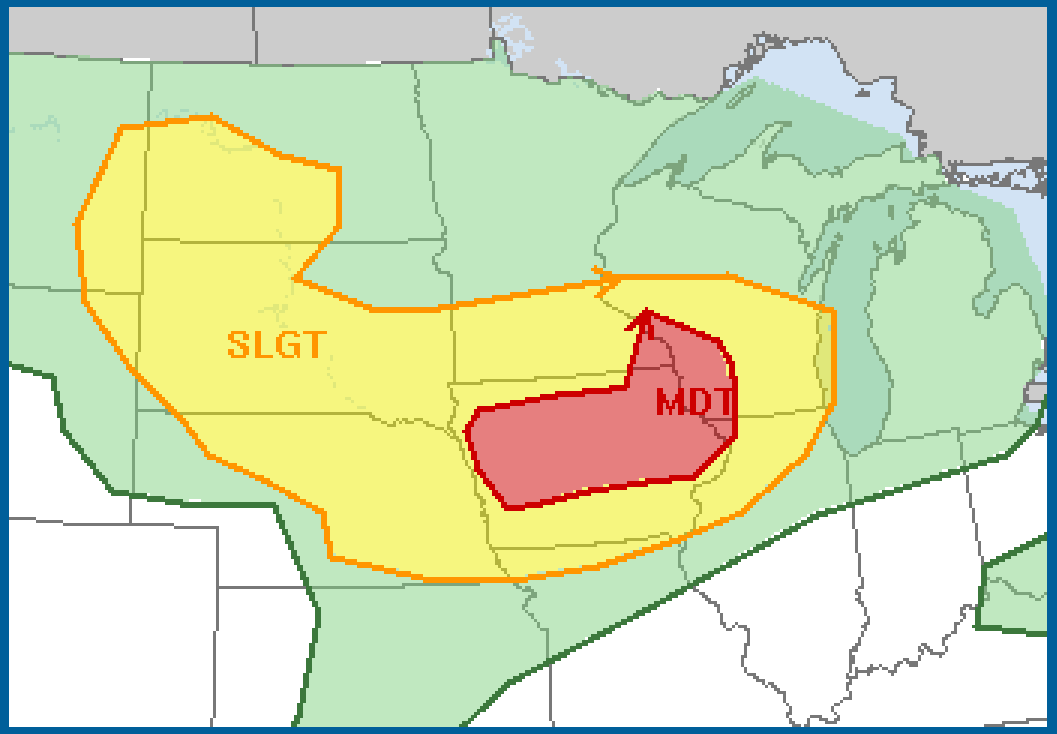


140617/0000 Surface OA Pressure and Obs

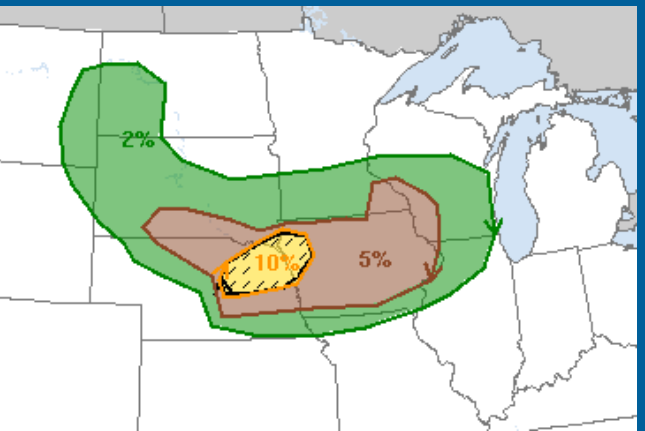
Weather, Temp, Dwpt, Gusts


74455 DVN Davenport
100
200
300
400
500
600
700
800
900
1000
16540 m
14040 m
12250 m
10810 m
9570 m
7520 m
5830 m
3150 m
1514 m
782 m
96 m
0.4
1
2
4
7
10
16
24
32
40g/kg
-40
-30
-20
-10
0
10
20
30
40
00Z 17 Jun 2014
University of Wyoming
SLAT 41.61
SLON -90.58
SELV 229.0
SHOW -3.40
LIFT -5.47
LFTV -6.27
SWET 459.5
KINX 33.70
CTOT 24.10
VTOT 27.30
TOTL 51.40
CAPE 1998.
CAPV 2182.
CINS -46.9
CINV -17.0
EQLV 188.0
EQTV 188.0
LFCT 749.4
LFCV 827.8
BRCH 49.35
BRCV 53.88
LCLT 290.9
LCLP 872.8
MLTH 302.4
MLMR 14.92
THCK 5734.
PWAT 36.91
LLJ

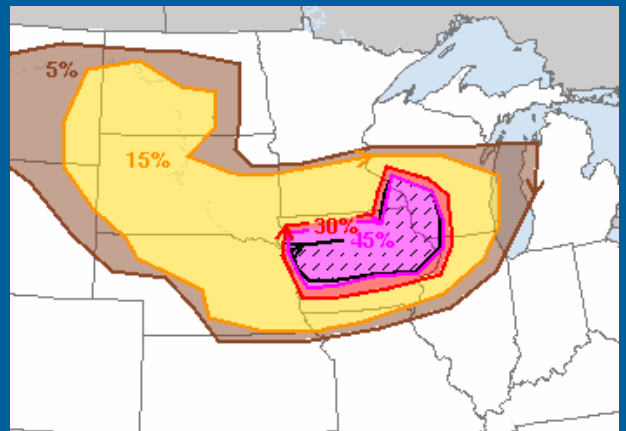
June 17 0100Z Day 1 Convective Outlook



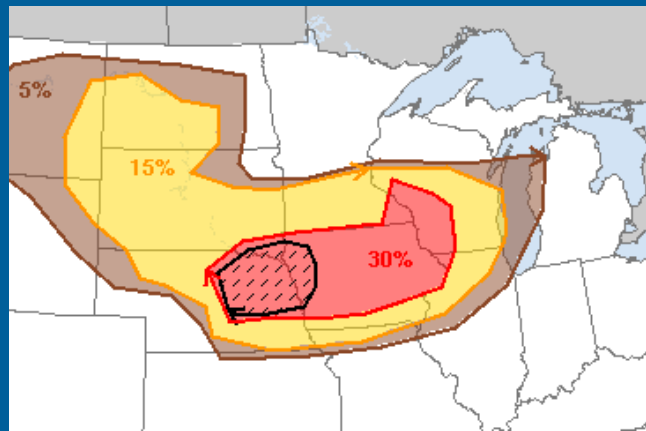
Tornado



Hail



Wind



Watches Issued by Storm Prediction Center

Tornado Watch 306
Valid from 2250Z to 0600Z

Severe Thunderstorm Watch 308
Valid from 0225Z to 0800Z

PRIMARY THREATS INCLUDE...
SCATTERED DAMAGING WIND GUSTS TO 70 MPH POSSIBLE ISOLATED LARGE HAIL EVENTS TO 1.5 INCHES IN DIAMETER POSSIBLE

WELL-DEVELOPED MCS WILL CONTINUE ESEWD ALONG INSTABILITY GRADIENT WITH A CONTINUING RISK FOR DAMAGING WINDS AND ISOLATED LARGE HAIL WITH THE STRONGER EMBEDDED STORMS.

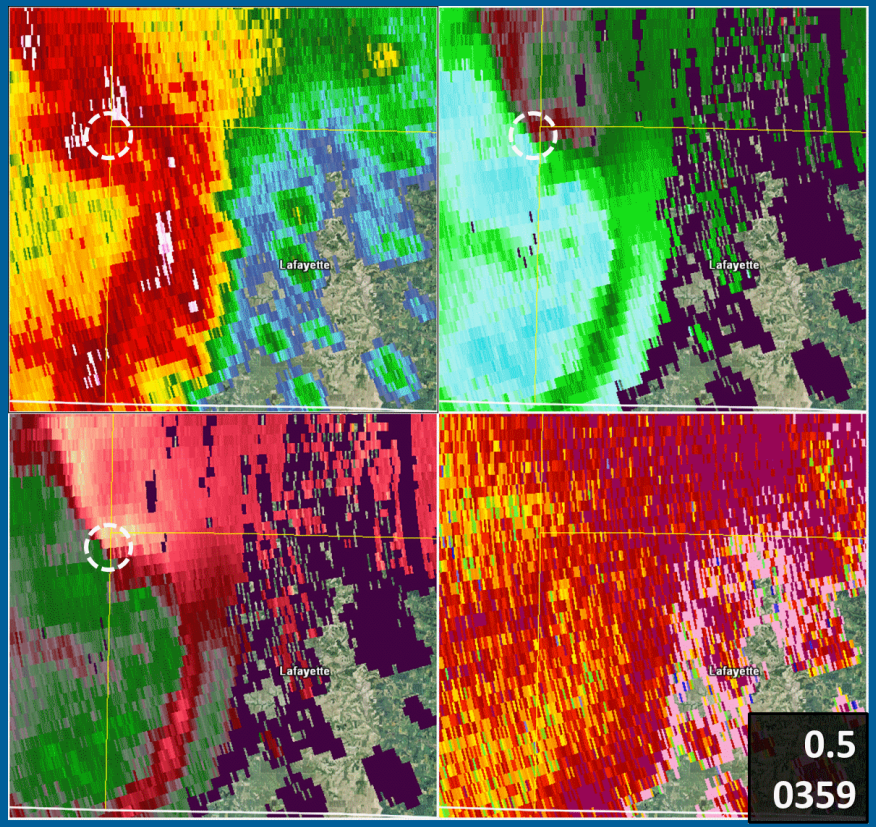
SPC Mesoanalysis Summary

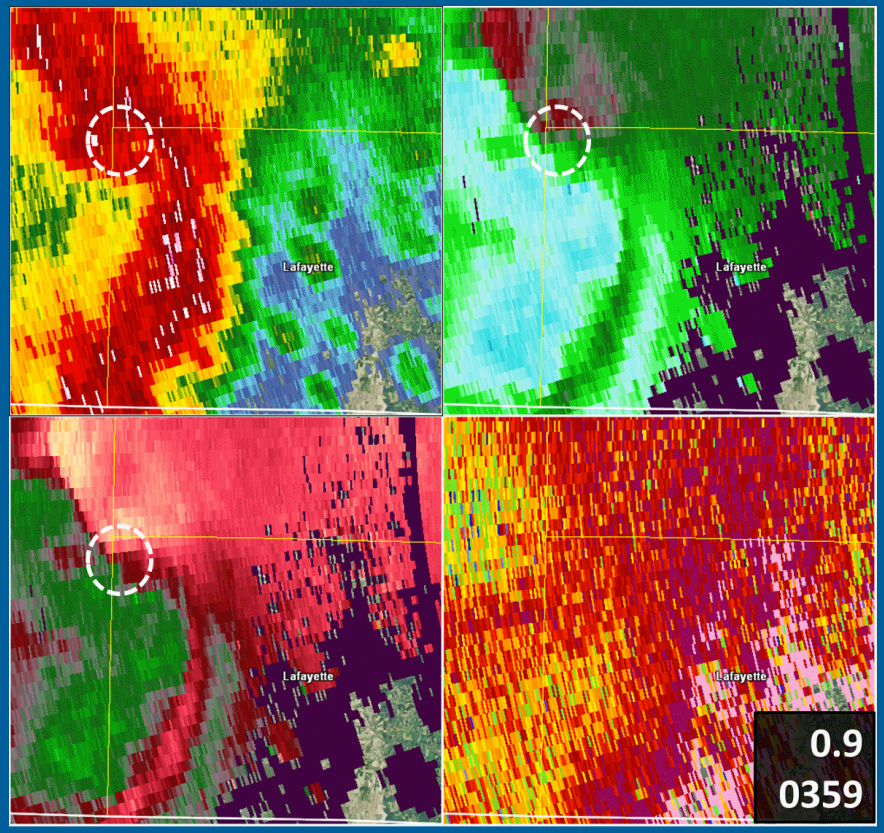
EF-1
EF-2
EF-3

	0200Z	0300Z	0400Z	0500Z
ML CAPE	2000 J kg^{-1}	2500 J kg^{-1}	1500 J kg^{-1}	1000 J kg^{-1}
ML CIN	~25 J kg^{-1}	~25 J kg^{-1}	~50 J kg^{-1}	~75 J kg^{-1}
0-1 km SRH	200 $m^2 s^{-2}$	250 $m^2 s^{-2}$	300 $m^2 s^{-2}$	400 $m^2 s^{-2}$
0-3 km SRH	300 $m^2 s^{-2}$	300 $m^2 s^{-2}$	350 $m^2 s^{-2}$	400 $m^2 s^{-2}$
0-1 km Shear	30 kts S	30 kts S	35 kts S	40 kts S
0-6 km Shear	55 kts W	55 kts W	50 kts SW	50 kts S

0-3 km Shear ~ 35 kts WSW

Tornadoes 1 - 3

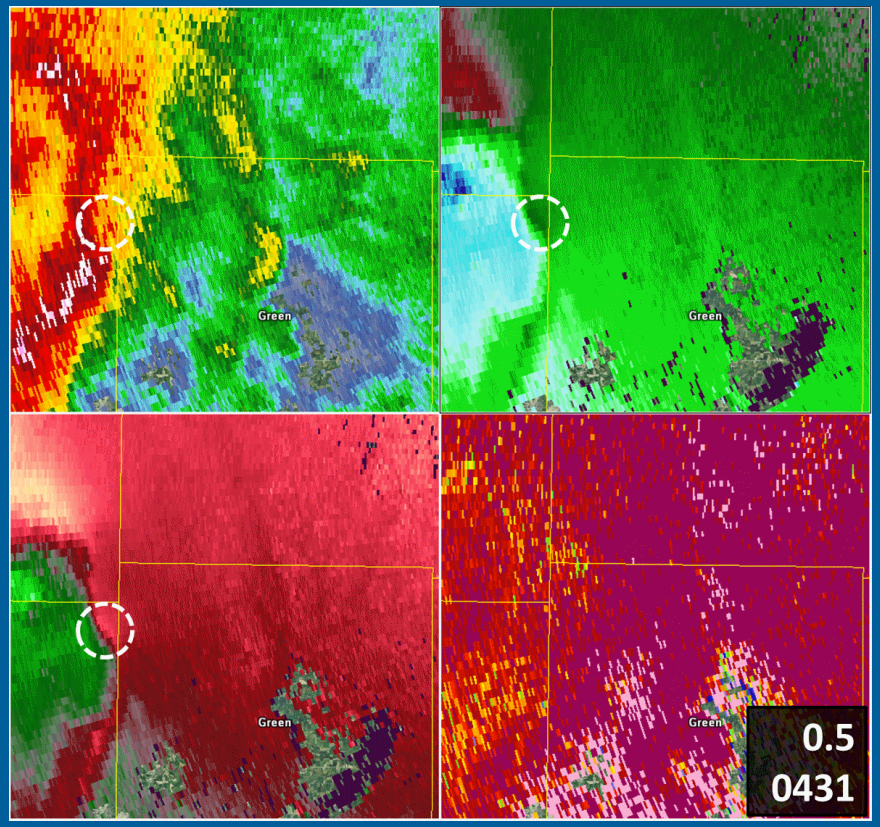


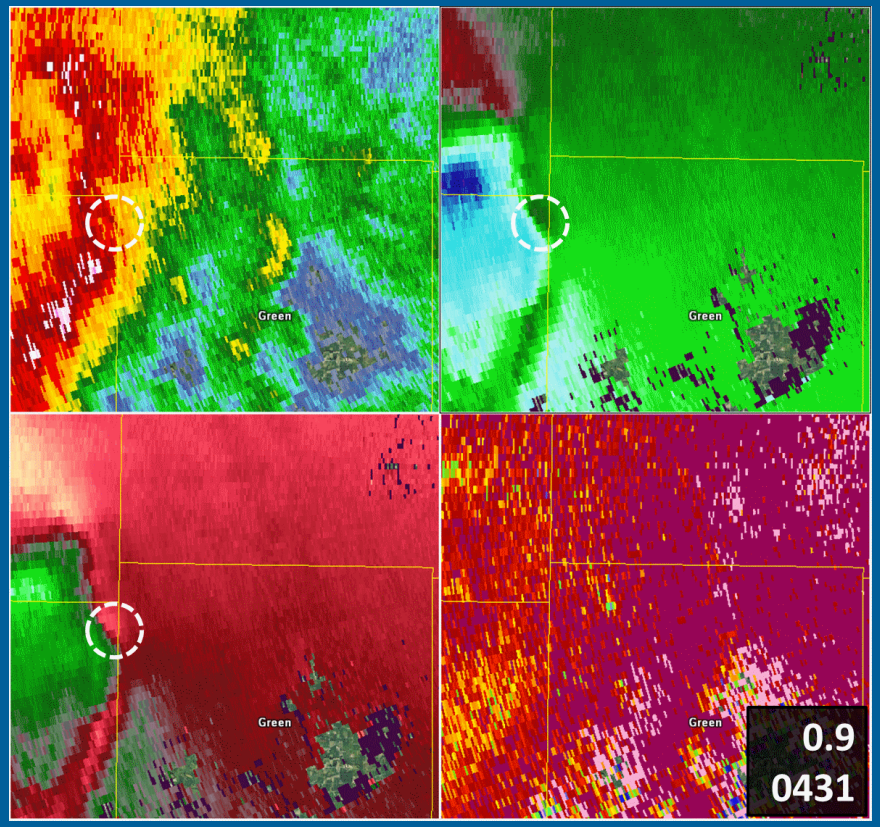


- All associated with bookend vortex.
- EF-1 from 0400Z-0411Z (4.35 mi).

- EF-1 at 0400Z, 1 minute long.
- EF-1 at 0410Z, 1 minute long.
- 0 spotter reports of tornadoes.

Tornadoes 4 & 5

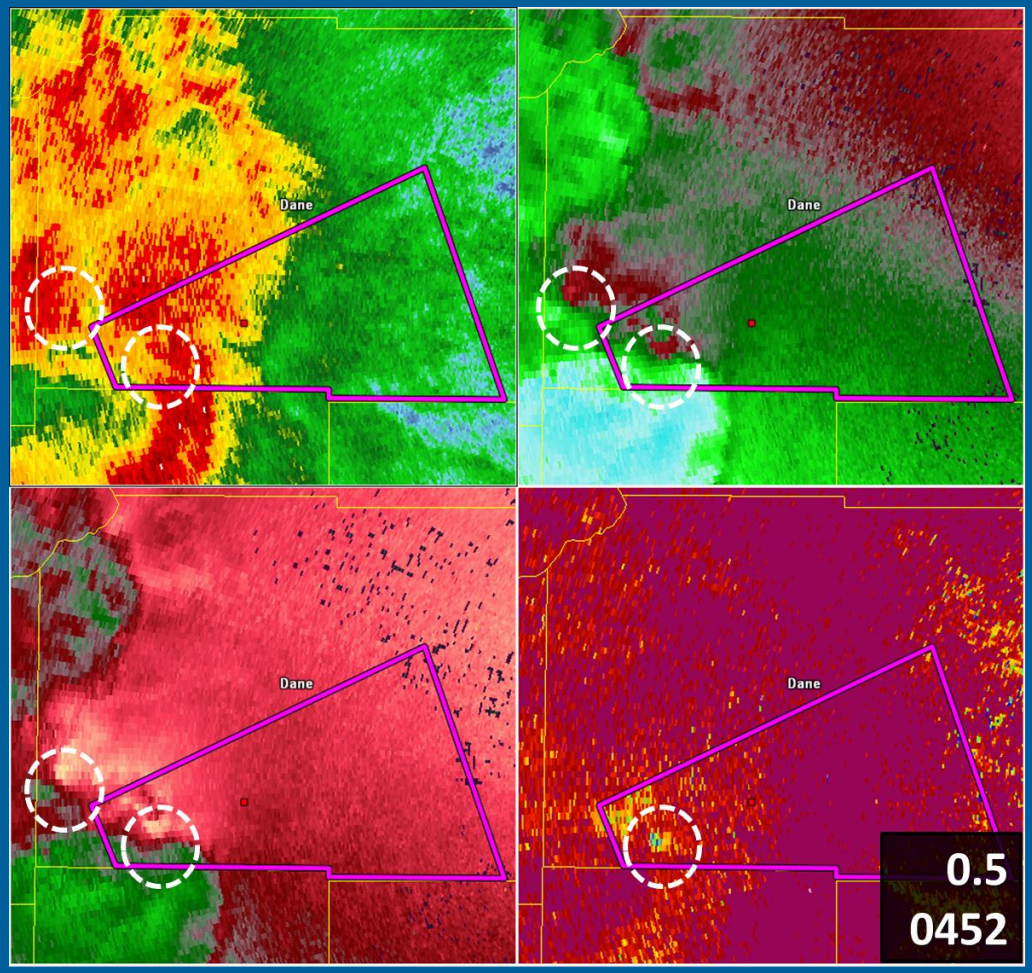




- Classic QLCS tornadoes on bow echo, north of apex.
- Both 1 minute long; 1st at 0436Z, 2nd at 0445Z.

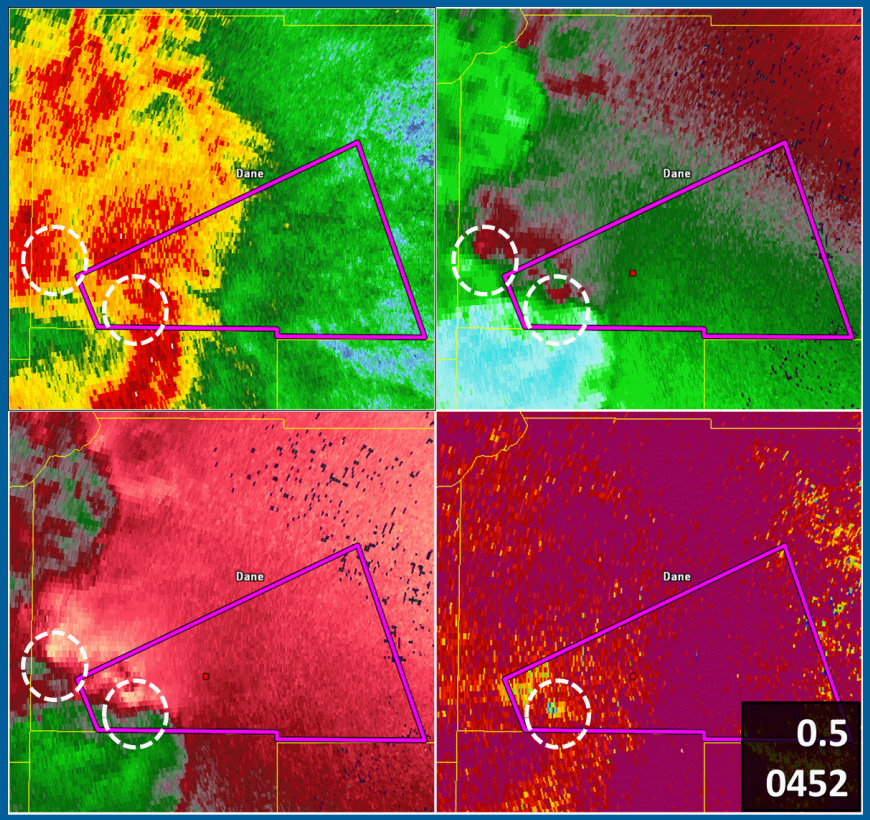
- Both rated EF-1.
- TDS on both tornadoes.
- Still no spotter reports.

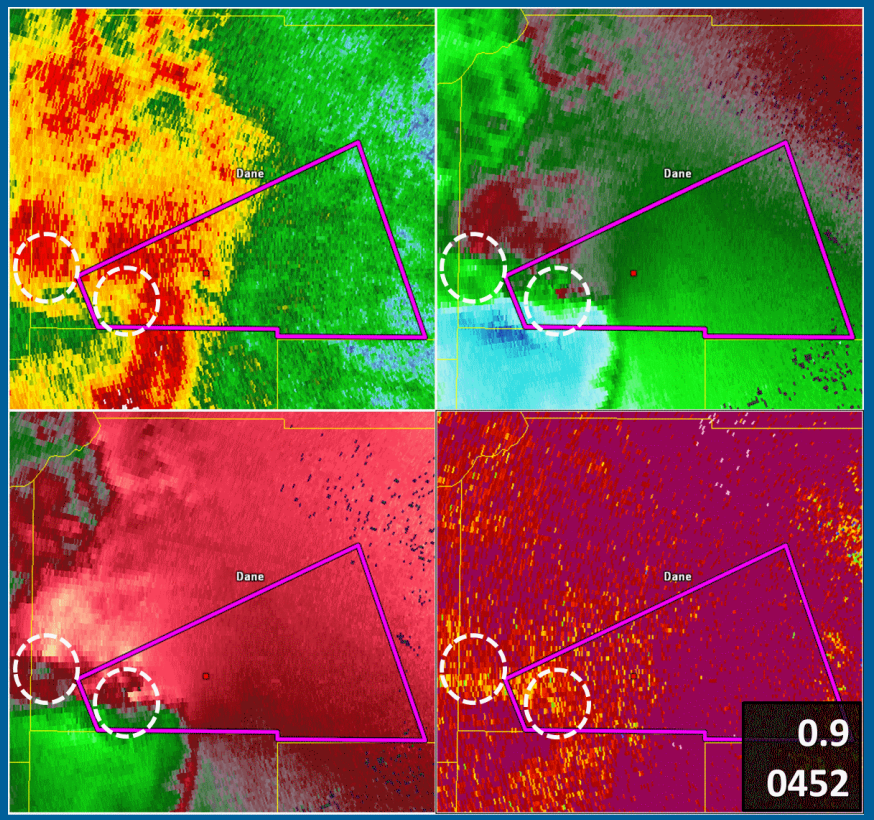
Tornado Warning Issued



- Warning issued at **0451Z.**
- **South** of bookend circulation.
  - Attempt to **capture TDS detection.**
  - **Don't often expect to see tornadoes with bookend vortex.**
  - 0 spotter reports of tornadoes so far on bookend vortex.
- Main circulation on bookend vortex **begins to strengthen** right at time of issuance.

Tornadoes 6 - 8



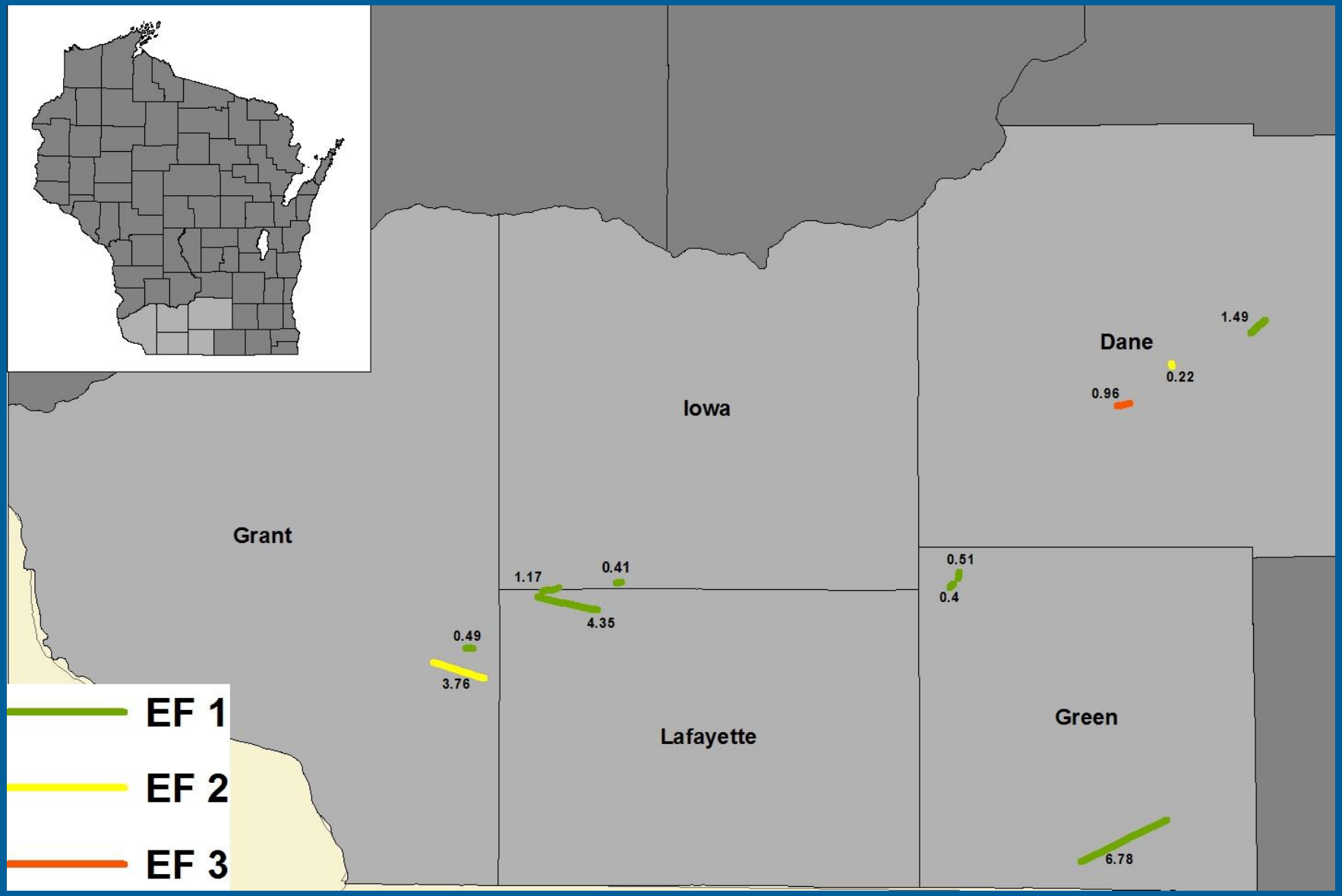


- All associated with bookend vortex.
- EF-3 hit Verona at 0508Z, just north of warning. TDS detection but 0 reports.
- Warning expired at 0514Z, EF-2 hit at 0515Z with marginal TDS.
- New warning at 0520Z.
- EF-1 hits at 0521Z, within warning.

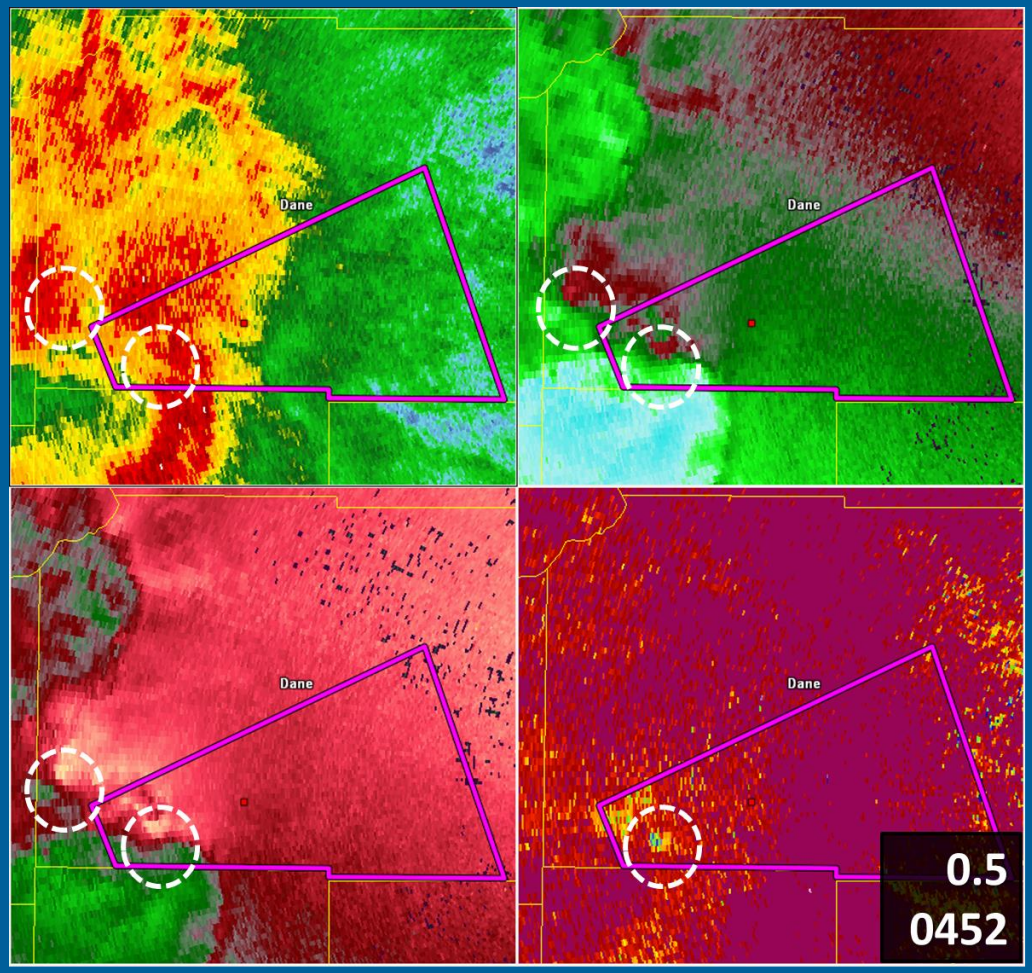
Verona EF-3

Madison EF-2

Tornado Paths



What Went Wrong?



- Did not anticipate favorable QLCS tornado risk in advance of event, despite strong low level shear values and warm front in area.
- Nocturnal tornadoes in WI are rare.
- Tornadoes were very short-lived.
  - By the time warning could be issued, tornado would have dissipated.
- Many tornadoes far from radar.
- 0 spotter reports of tornadoes as the event was unfolding.
- The first tornado warning missed circulation in bookend vortex, and did not remain in effect long enough.

What Went Right?

- All Severe Thunderstorm Warnings mentioned threat of brief tornadoes (TORNADO POSSIBLE tag).
- Tornado Warnings were communicated effectively through Wireless Emergency Alerts.
  - Most people we spoke to near Tornado Warnings got the warning through these messages and had plenty of time to shelter.
- Madison sounded sirens city-wide.
- Most tornadoes in rural areas.
- Recently upgraded radar technology:
  - Dual-Pol showed Tornadic Debris Signature, our only confirmation.
  - SAILS scanning strategy allowed for more rapid radar updates.

How Do We Improve Our Service?

- *Anticipate the favorable QLCS tornado risk!*
  - When you have very strong low level shear values, persistent low to mid level rotation and a surface boundary, pull the trigger on a Tornado Warning!
- If a Tornado Warning is issued, be sure to include all possible tornado sources (environment, TDS, spotter reports, etc…).
- Make sure to keep warnings large enough, and long enough in duration, to cover re-generating tornadic circulations within QLCS.

- *QLCS Tornadoes – Warning Decisions w/Polygons*:
  - Severe Thunderstorm Warning with TORNADO POSSIBLE tag?
  - Tornado Warning describing several brief tornadoes within line of severe storms?
  - Several smaller Tornado Warnings within larger Severe Thunderstorm Warning?

The End

Questions?