RE-EMPHASIZING THE IMPORTANCE OF PRE-EXISTING SURFACE BOUNDARIES IN NON- SUPERCELLL (NST) TORNADOGENESIS

12th Annual High Plains NWA Conference

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National Weather Service

Omaha/Valley

Supercell Storms – No Problem!

Supercell storms pose multiple warning challenges.

However, supercell storms often present clear-cut signals on when to issue the TOR, or whether to continue an existing warning.

Supercell storms typically have many (several) minutes lead time and some of the decisions are essentially "*no-brainers*".

Non-Supercell Tornadoes (NSTs) – Watch Out!

Much more difficult to predict with any degree of certainty or with any meaningful lead time, even though the threat to life and property is no less.

NSTs are often are the result of pre-existing surface boundary interactions within favorable near storm environments that are conducive for non-supercell tornadoes.

NST Ingredients

- High values of 0-3km CAPE.
- Steep low level lapse rates.
- Rich sources horizontal surface vorticity (i.e. boundaries ***key component**).
- ESP – Enhanced stretching parameter.
- NST – Non Supercell Tornado parameter.

Things to Think About

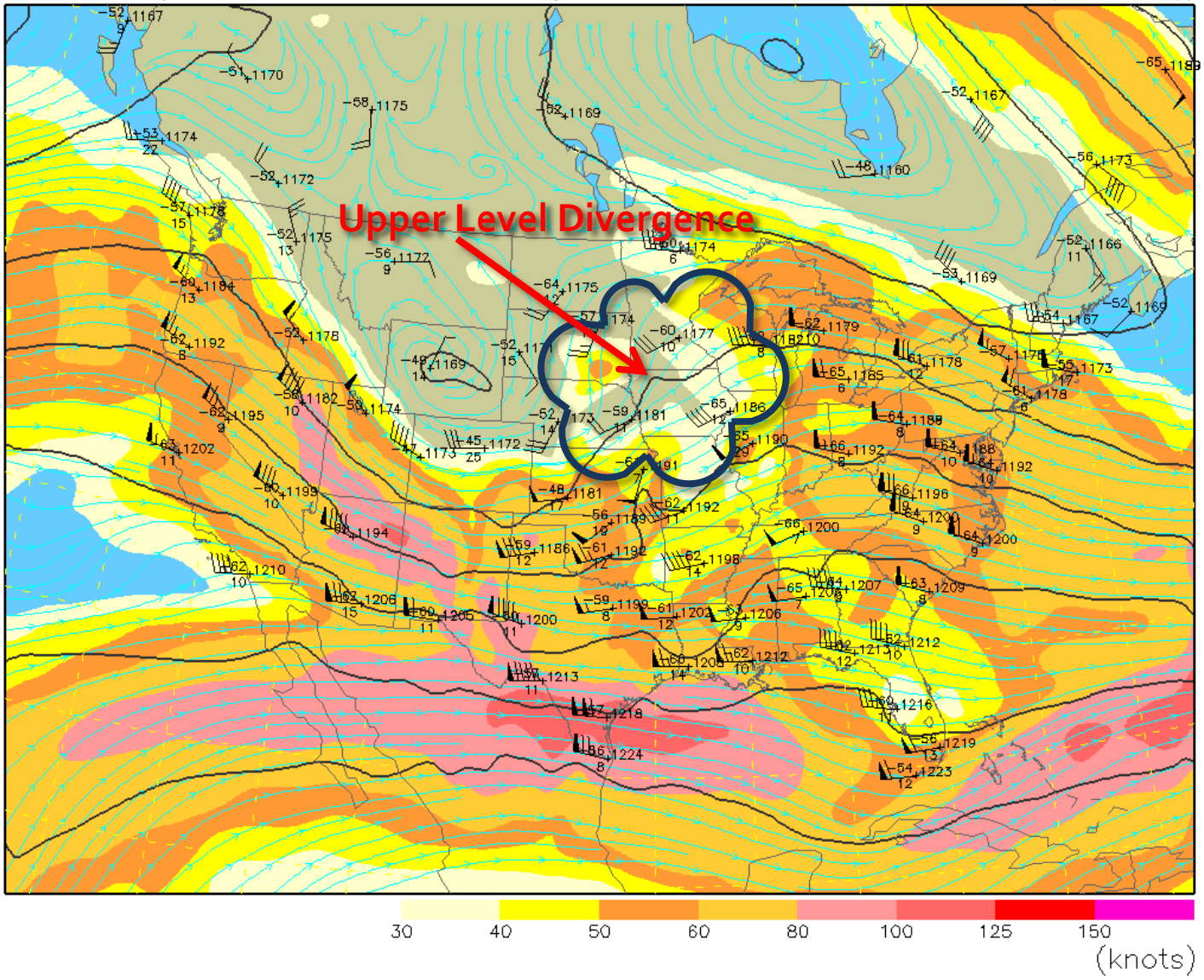
- Typically have to lower your threshold for pain on NST days and remain *meticulously* aware of pre-existing surface boundaries interacting with favorable environments.
- Don't lose focus on small-scale or benign-looking features (remember, the devil is in the details).
- Increased resolution of Build10 radar data can help pinpoint mesoscale boundaries.
- Don't be afraid to issue a TOR, the public will appreciate it even if it's just a wimpy landspout!

Case Studies

- Currently have 5 case studies for review where boundary interactions were key to tornadogenesis.
- DOH! ! No time for 5 cases today, but let's review a high-shear hybrid case from
  May 1, 2008!

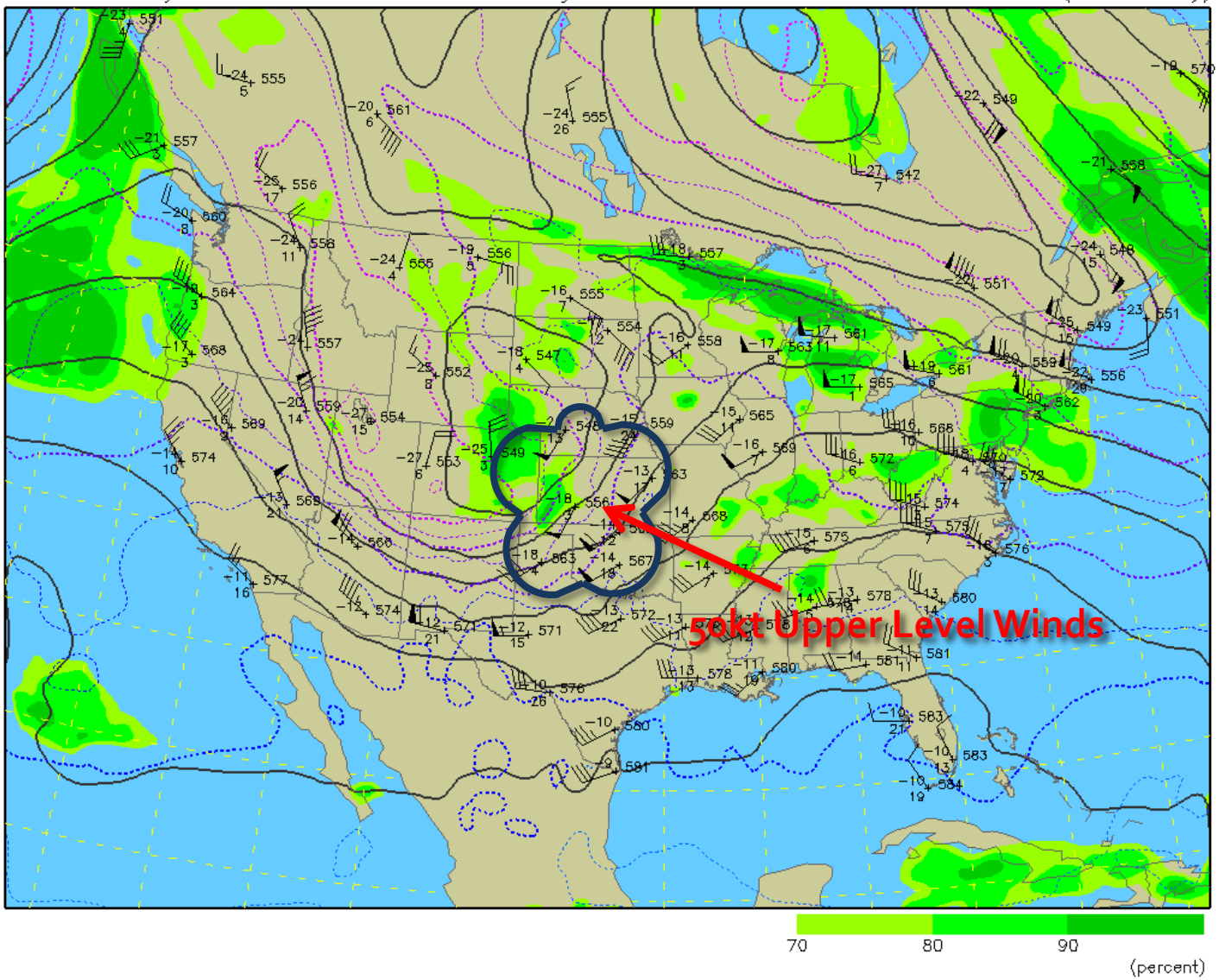
200 mb rawinsonde data 00z Fri 02 May 2008

200 mb Heights (dm) / Isotachs (knots)



500 mb rawinsonde data 00z Fri 02 May 2008

500 mb Heights (dm) / Temperature (°C) / Humidity (%)



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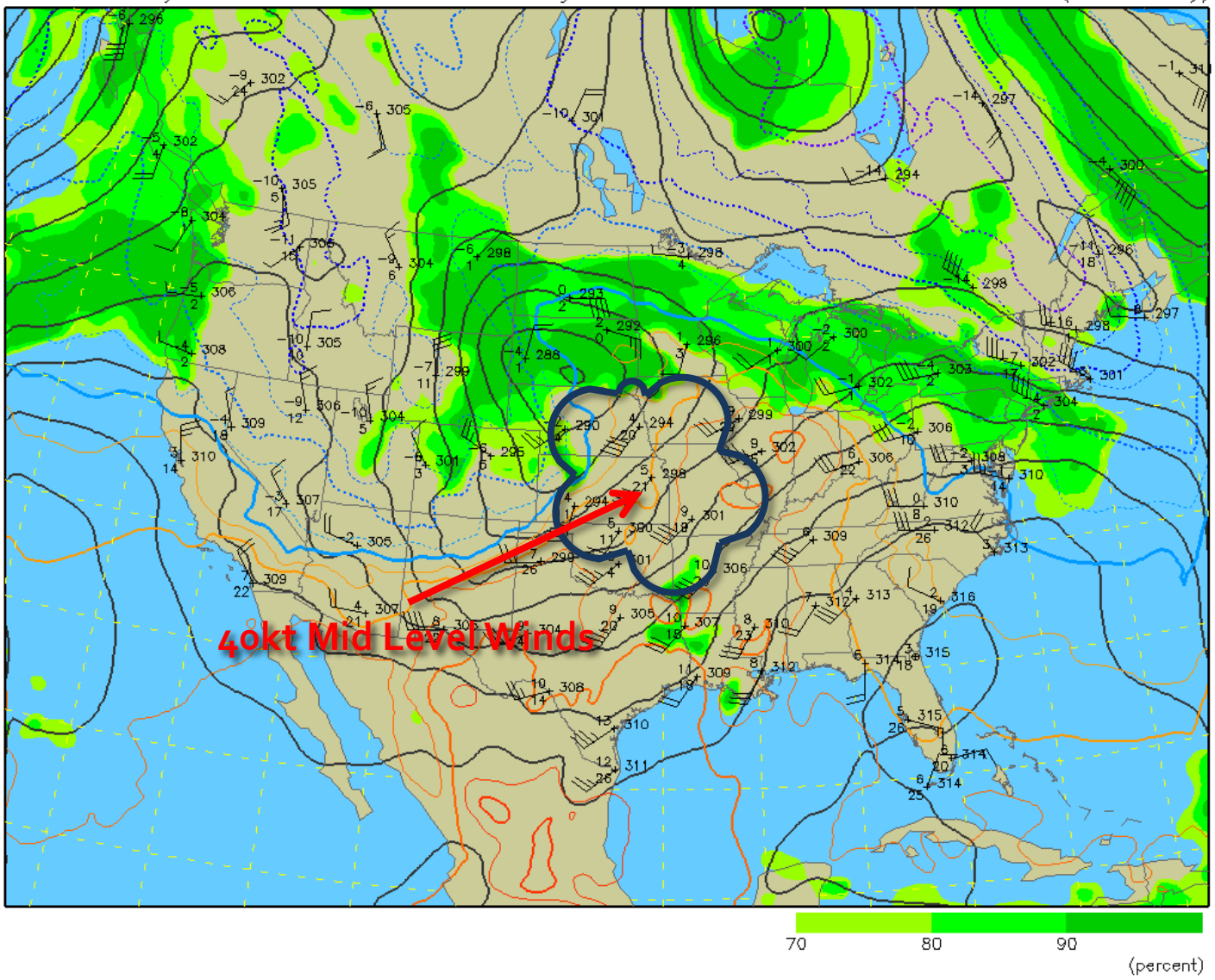
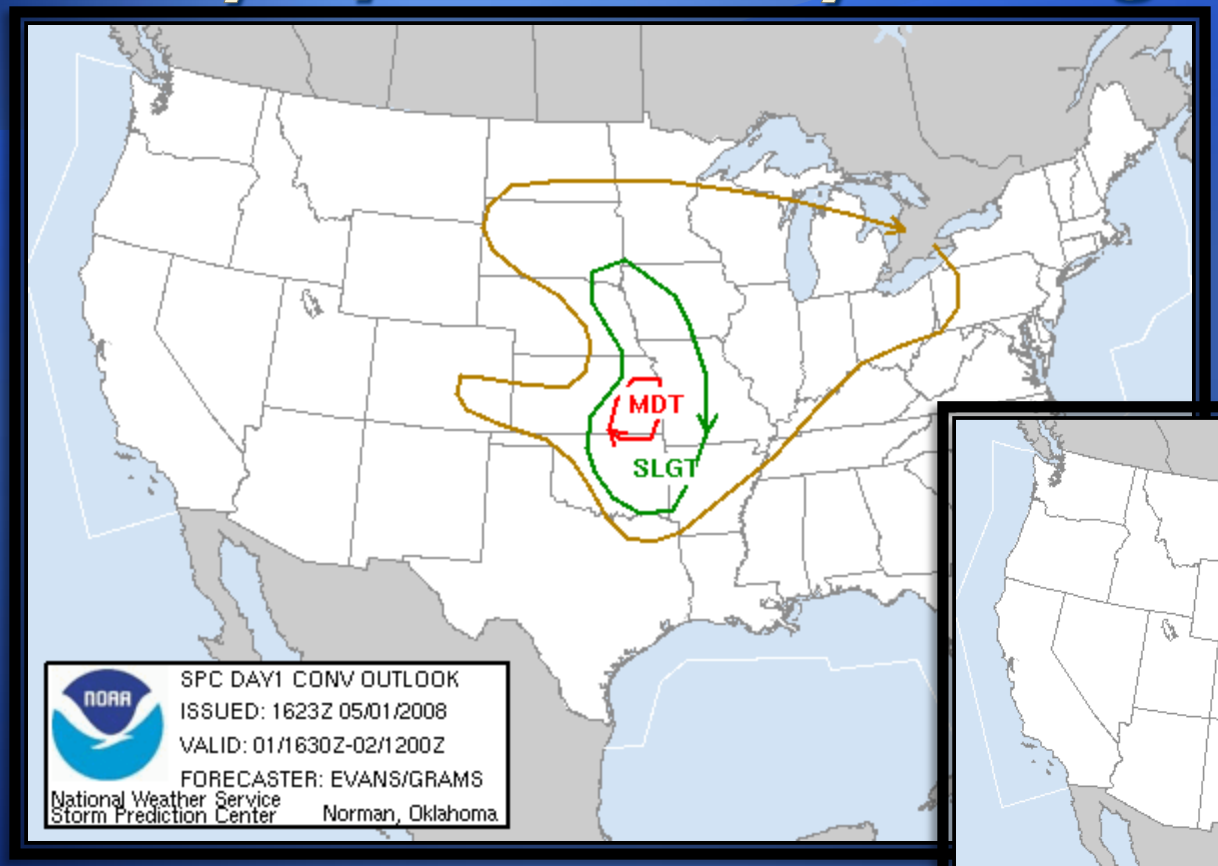
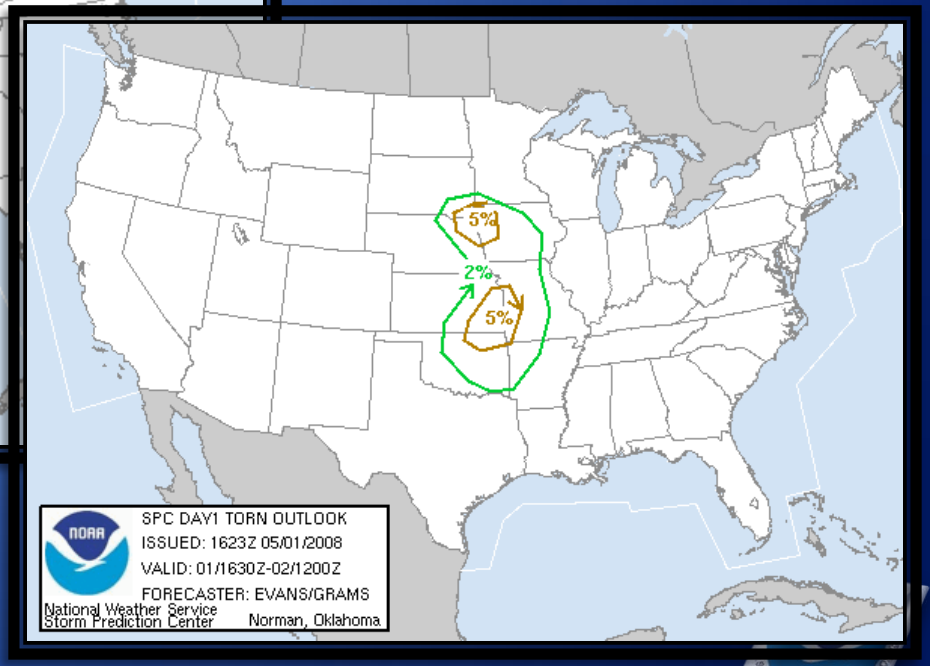
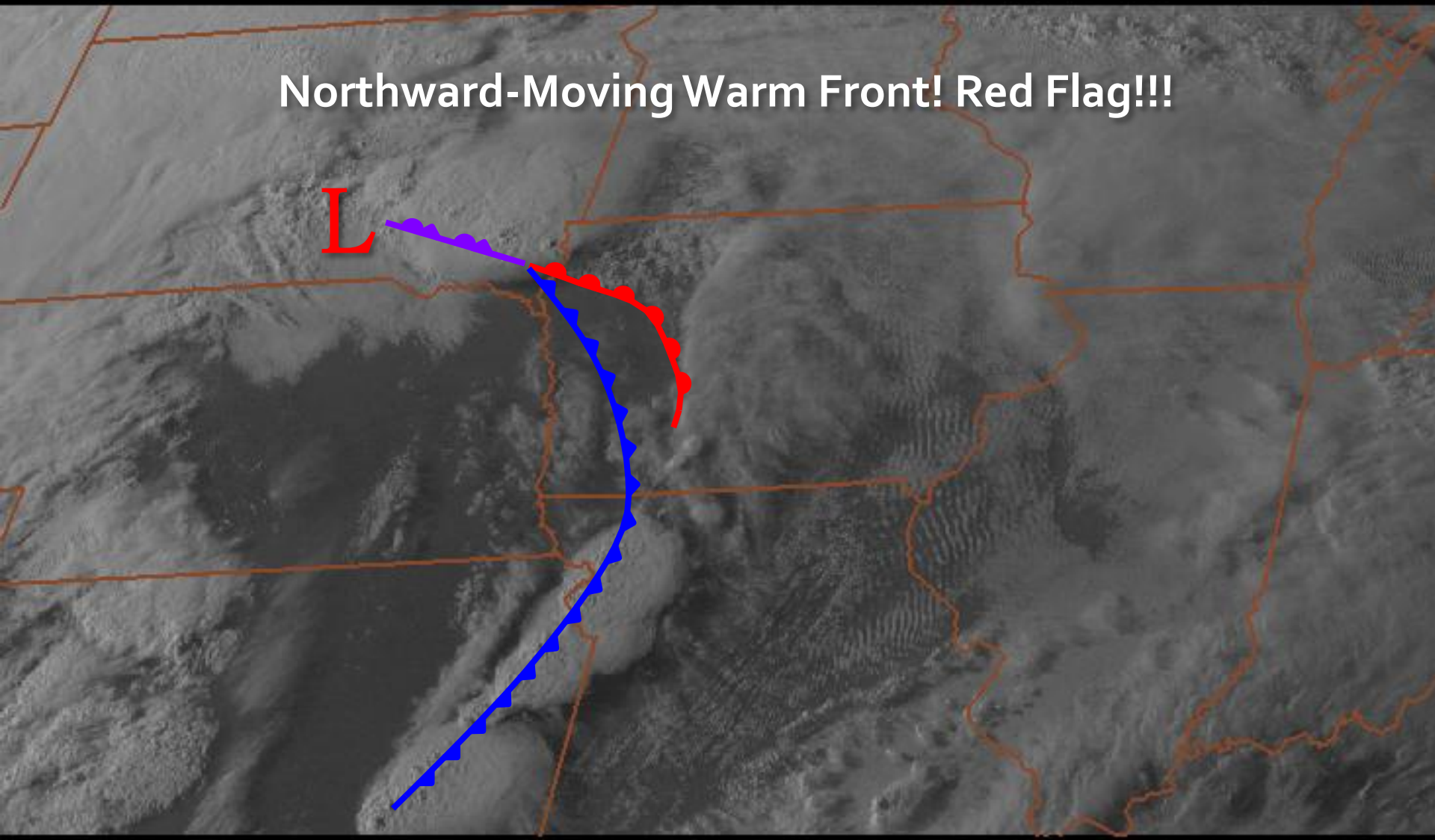
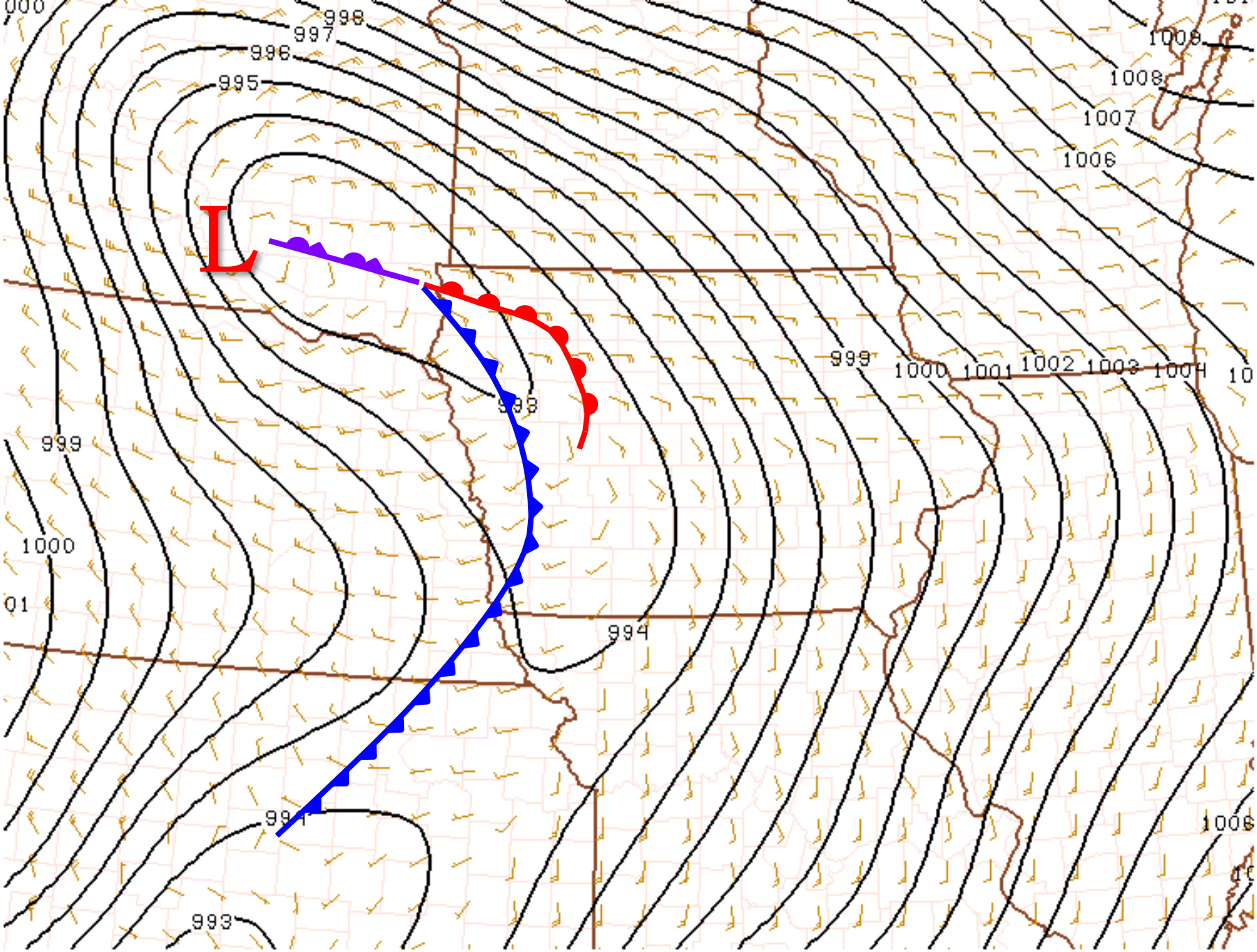


May 1, 2008 Day-1 1630z Outlook






Northward-Moving Warm Front! Red Flag!!!
L
NOAA/NWS/SPC
GOES Visible Satellite
20080501/2325
2325Z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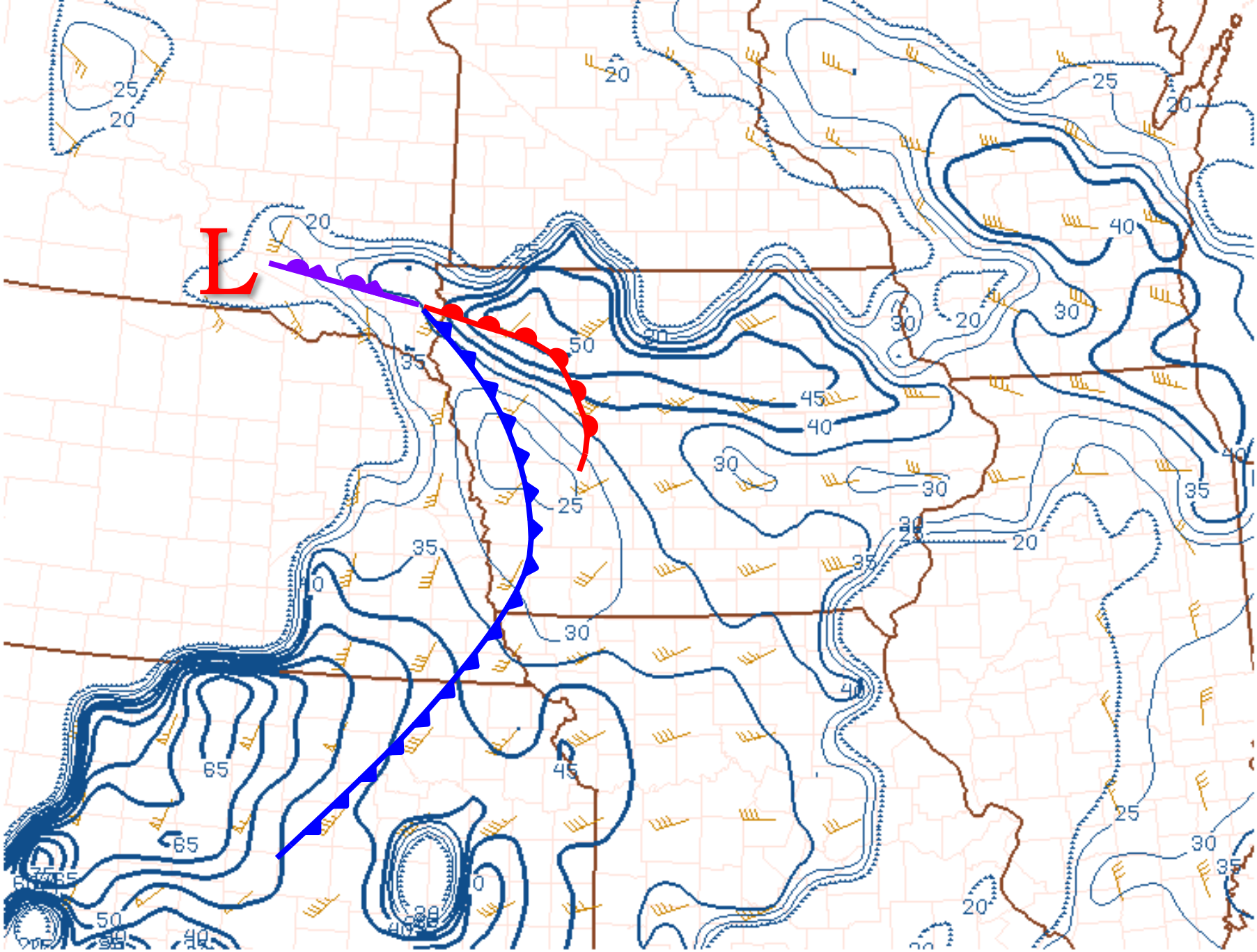
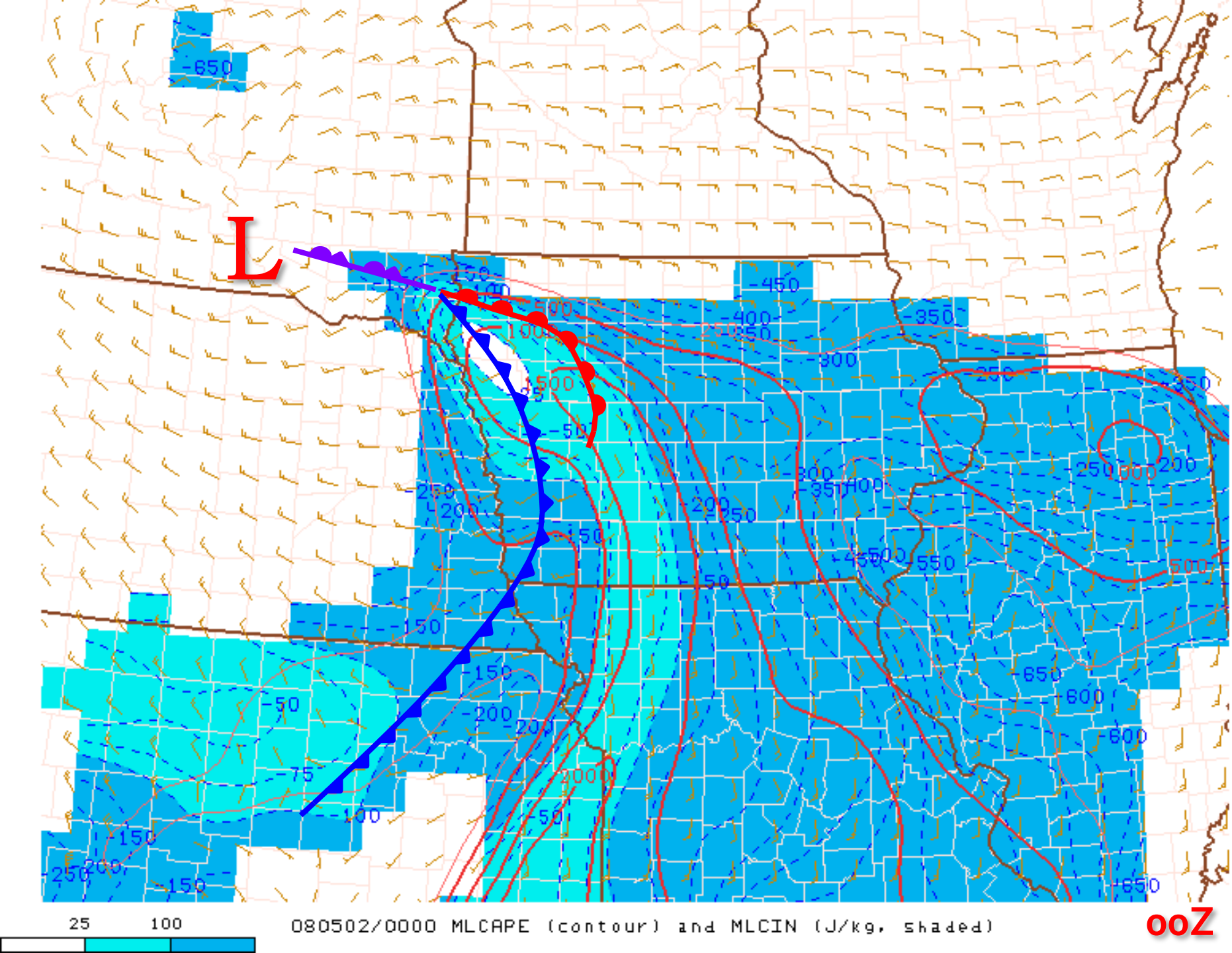
080502/0000 MSL Pressure and surface wind
ooZ


L
080502/0000 Effective bulk shear (kt)
ooZ


L
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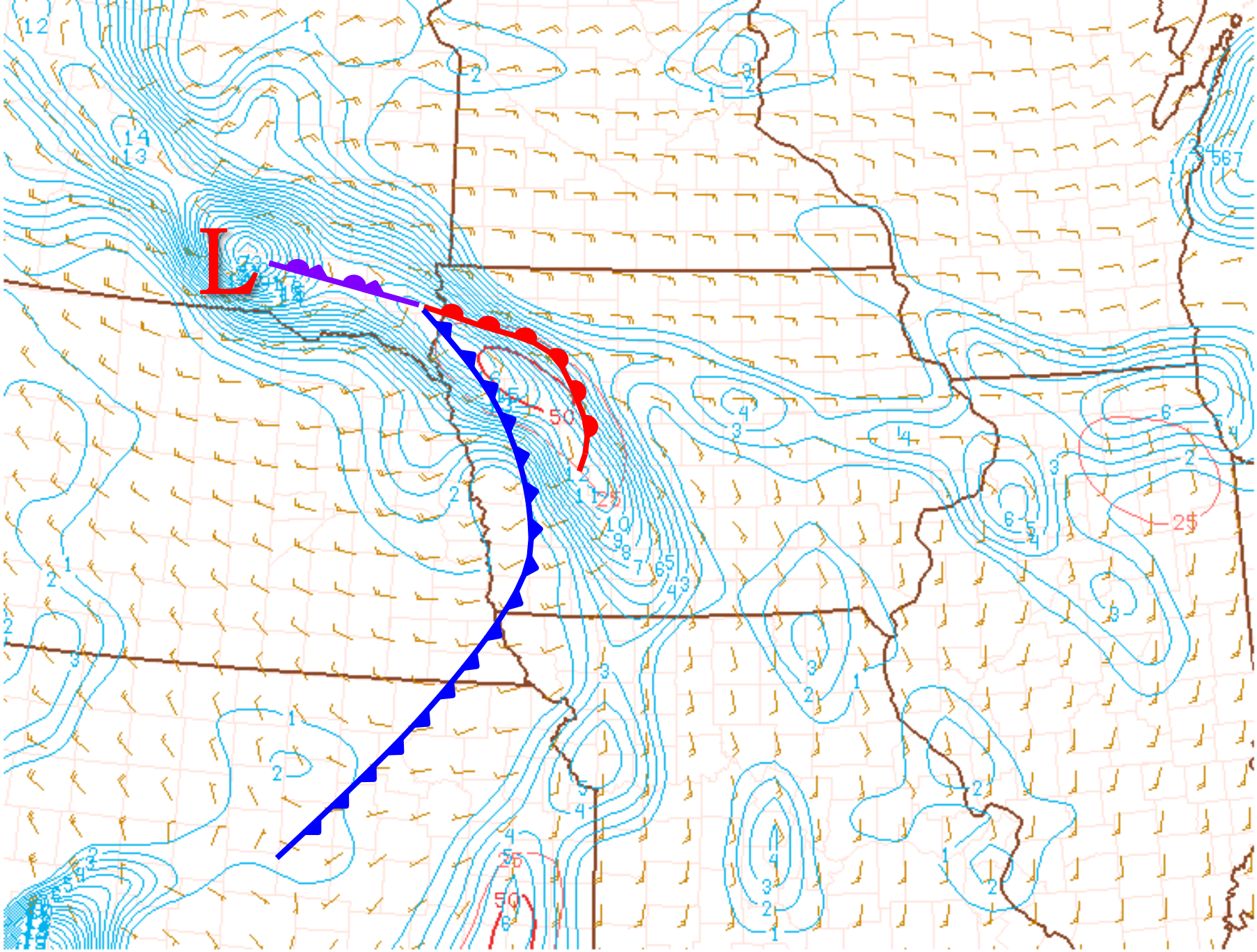
100
080502/0000 MLCAPE (contour) and MLCIN (J/kg, shaded)
ooZ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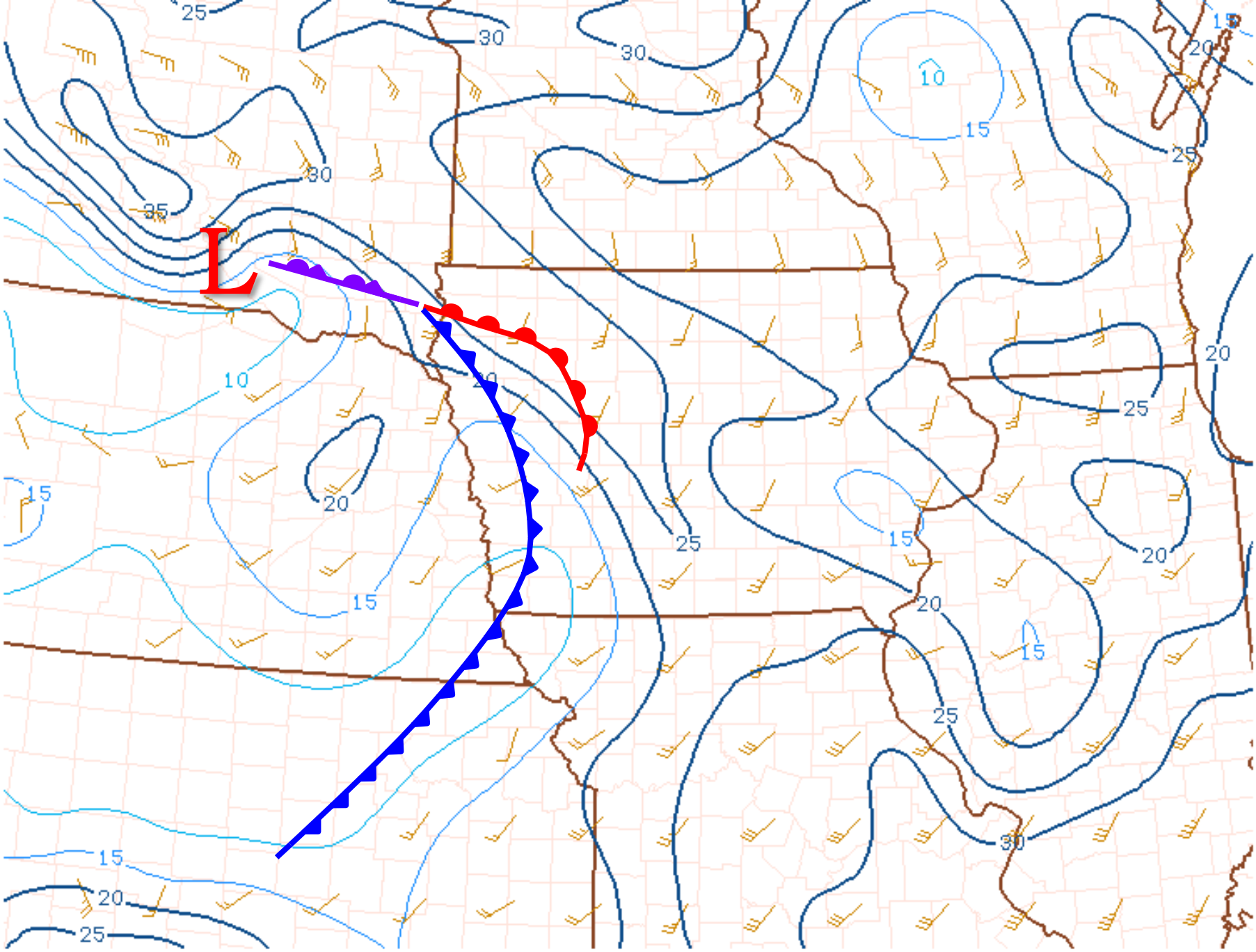
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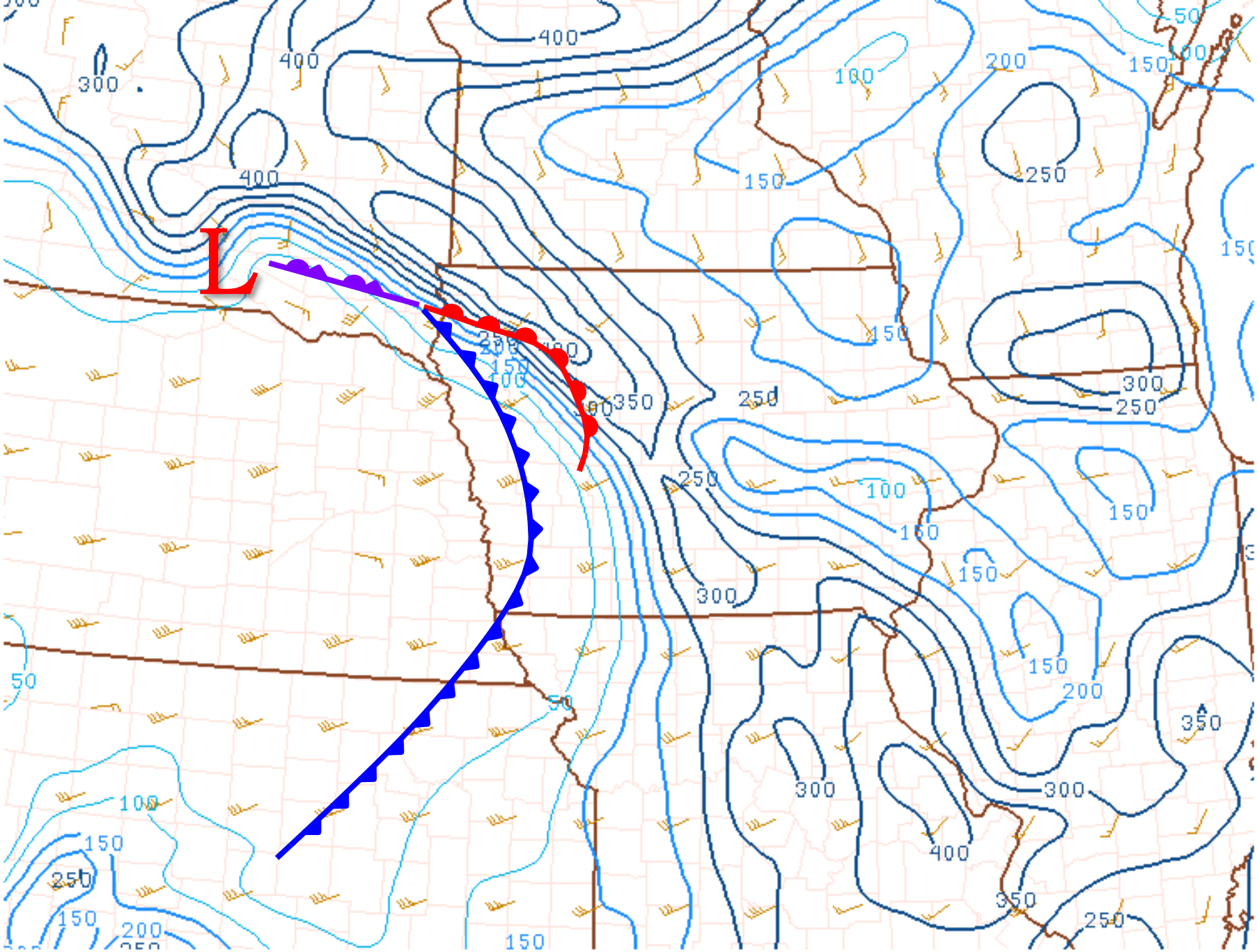
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080502/0000 0-1 km SRH (m2/s2) and storm motion (kt)
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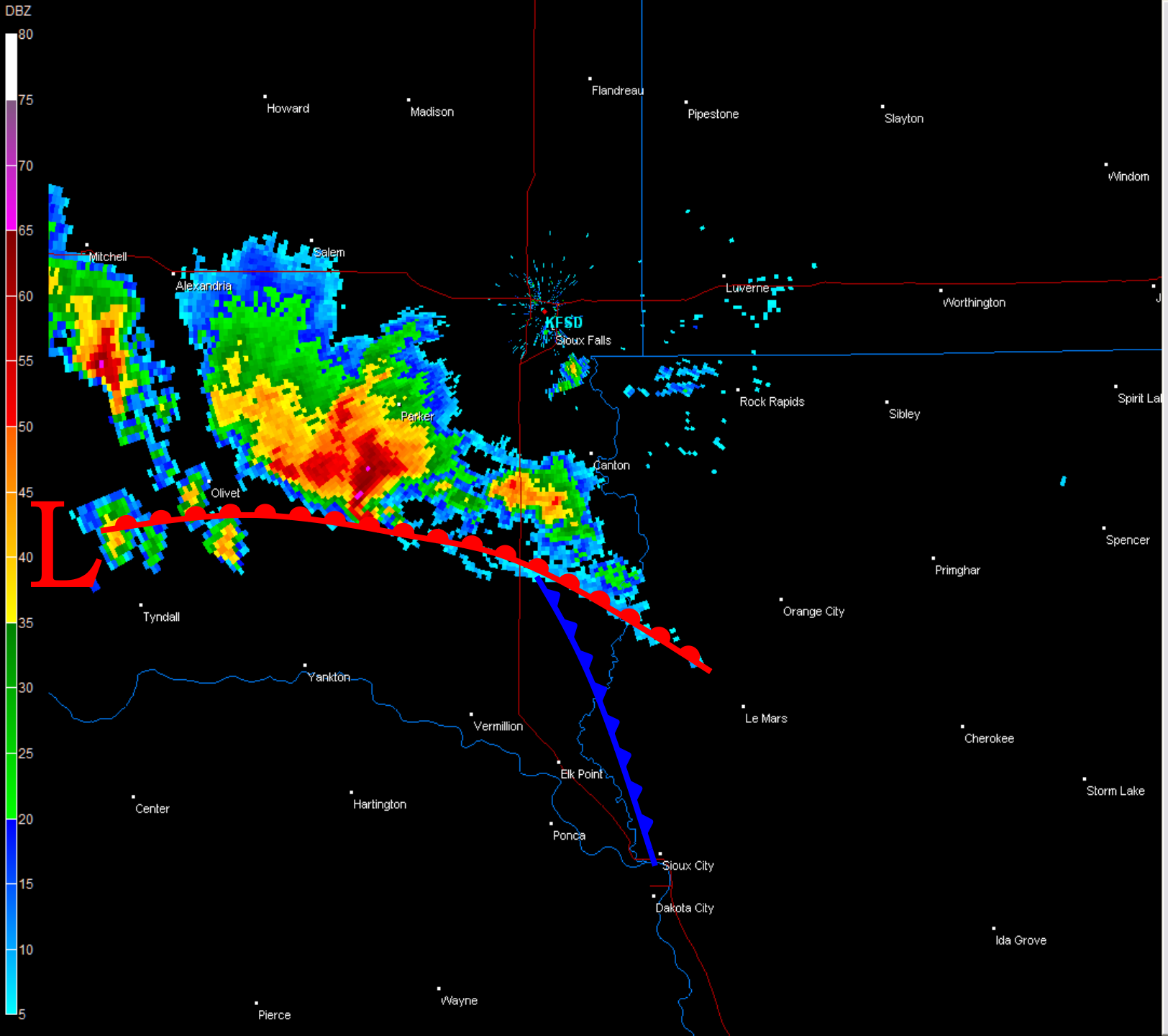

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VST: 05/01/2008 23:30:21 Z
Prod: 05/01/2008 23:30:52 Z
VCP: 12 SMV: 184° 30 kts
Tilt: 0.890°

Select Product:

BR	VIL	ZDR
BV	VILD	RHO
SRV	POSH	PHI
SW	MEHS	KDP
ET	NROT	HCA

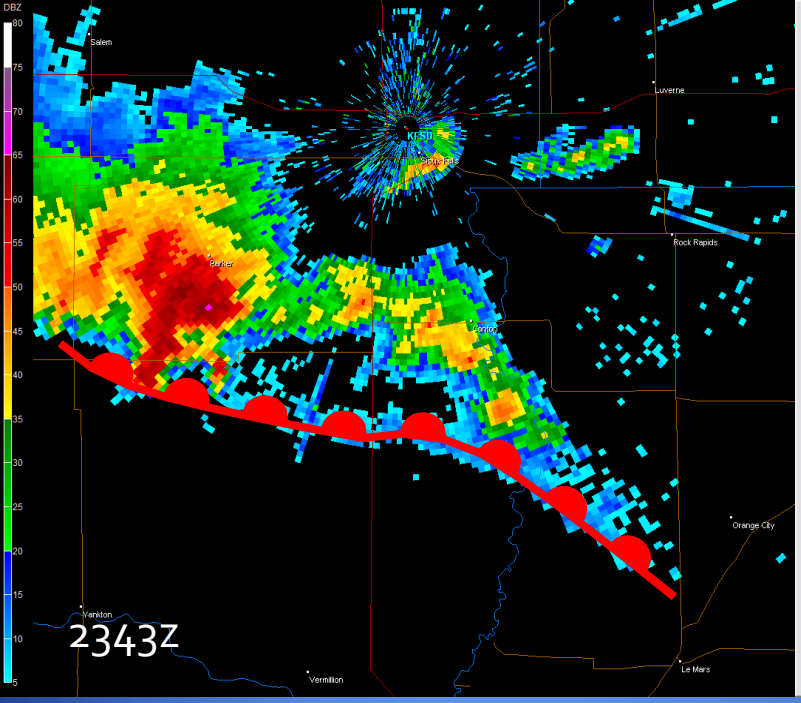
Select Tilt:

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°	19.5°		

Warnings:
- [x] Flash Flood - 4
- [x] Thunderstorm - 10
- [x] Tornado - 1

Product Details:
Max: 66.0 dbz
Az: 226.5°
Ran: 31.6 nm

2330Z


DBZ
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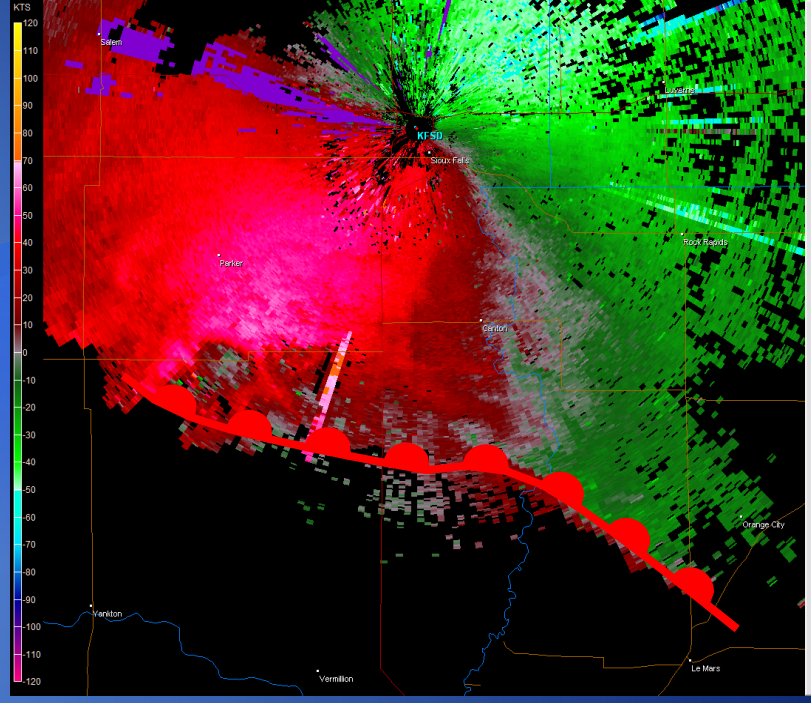
Luverne
KFSD
Sioux Falls
Rock Rapids
Parker
Canton
Orange City
Yankton
Vermillion
Le Mars
2343Z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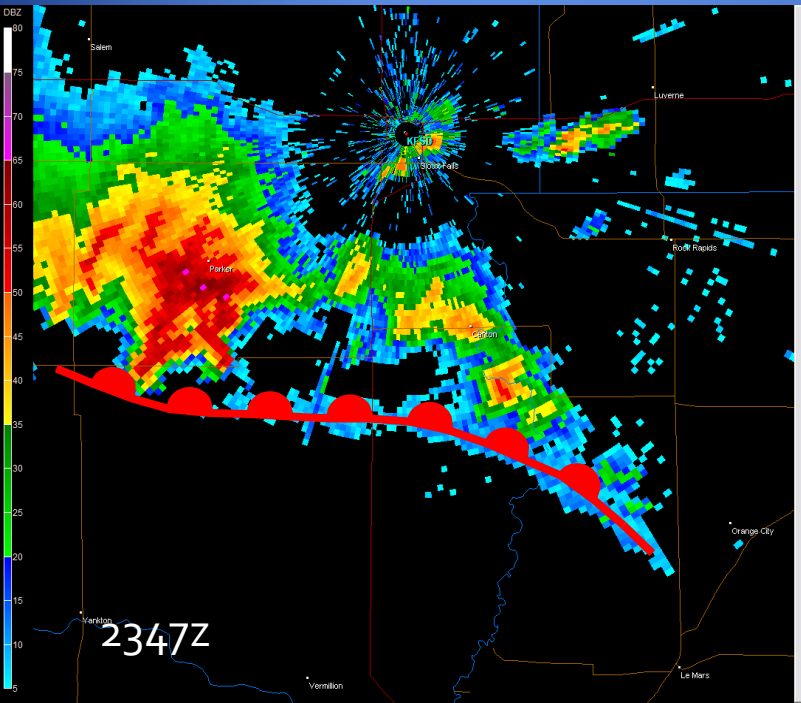
Sioux Falls
Rock Rapids
Parker
Canton
Orange City
Yankton
Vermillion
Le Mars


DBZ
Salem
Luverne
KFSD
Sioux Falls
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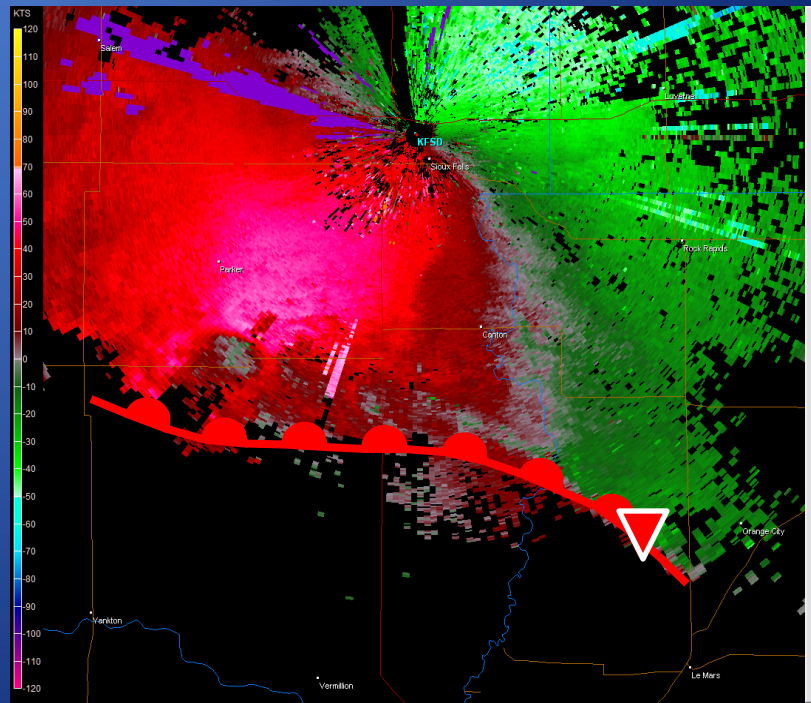
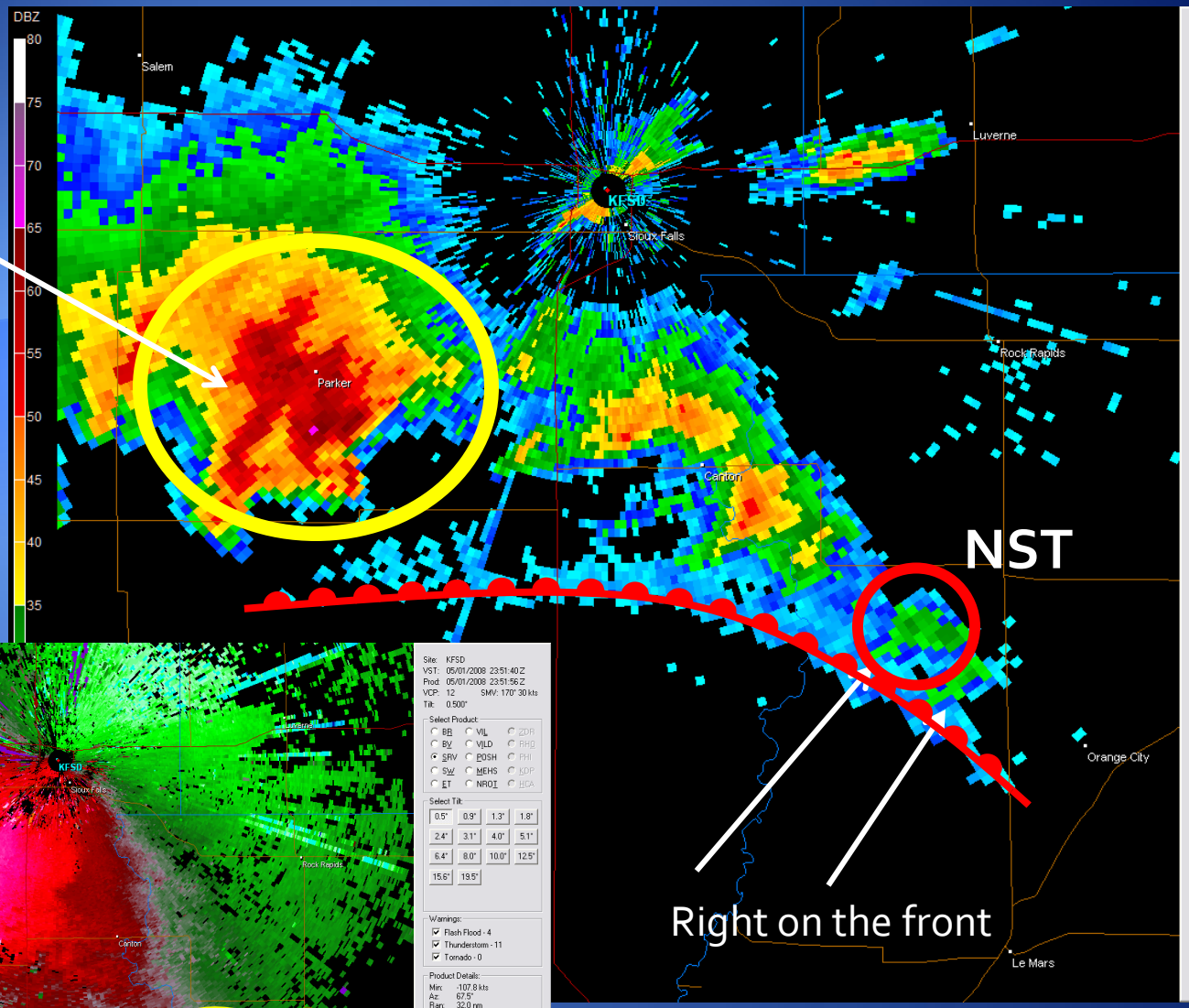
Parker
Canton
Orange City
Yankton
Vermillion
Le Mars
2347Z

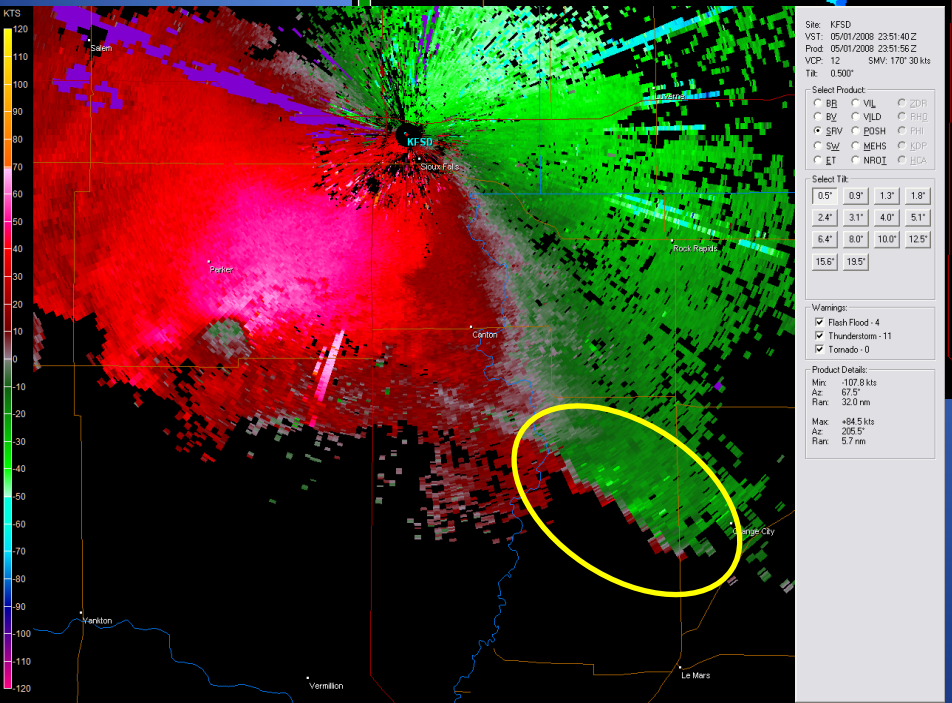

KTS
Salem
Luverne
KFSD
Sioux Falls
Rock Rapids
Parker
Canton
Orange City
Yankton
Vermillion
Le Mars


2346Z


2347Z

Too far north??



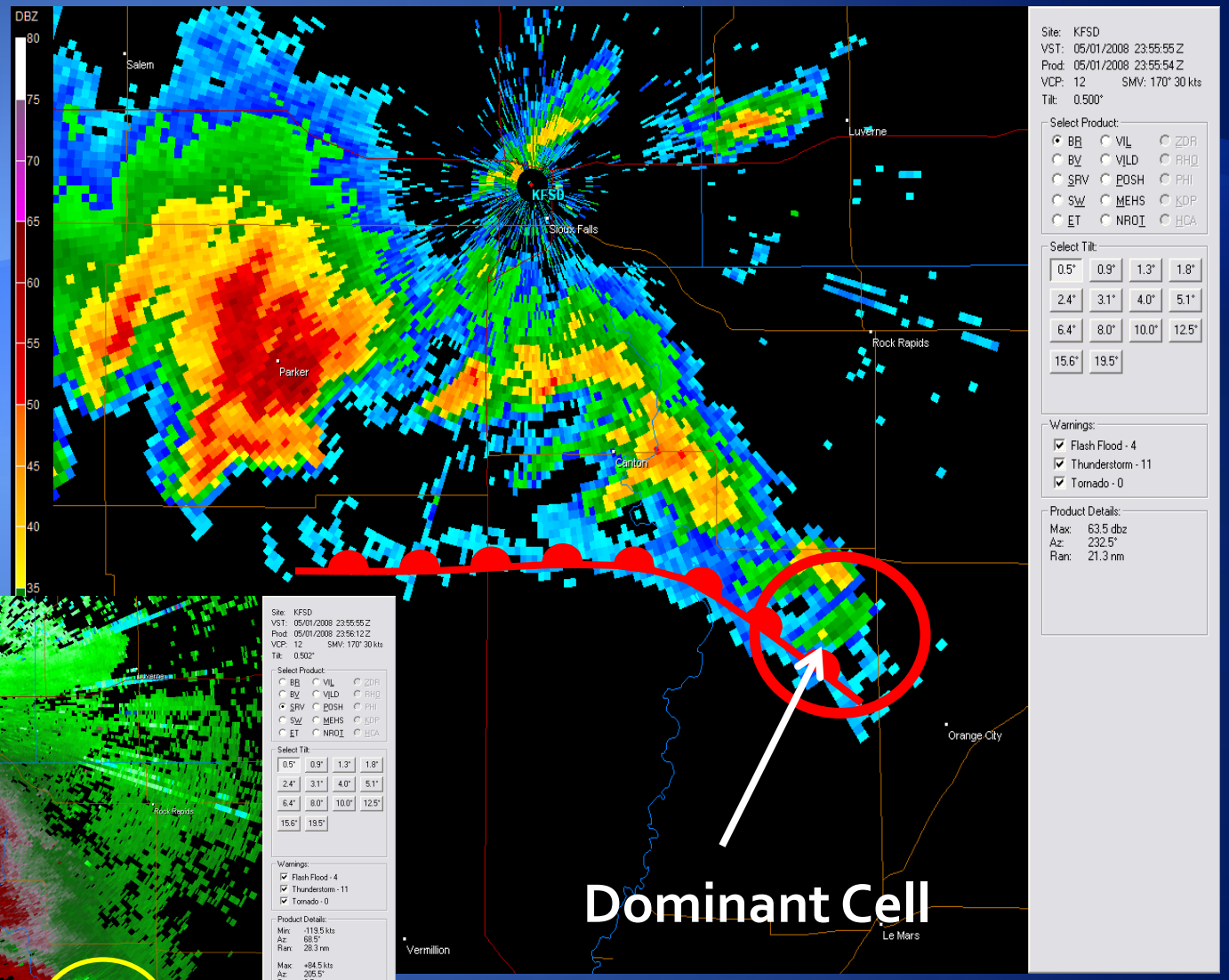


2351Z


2351Z


23556

2355Z


DBZ
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Salem
Luverne
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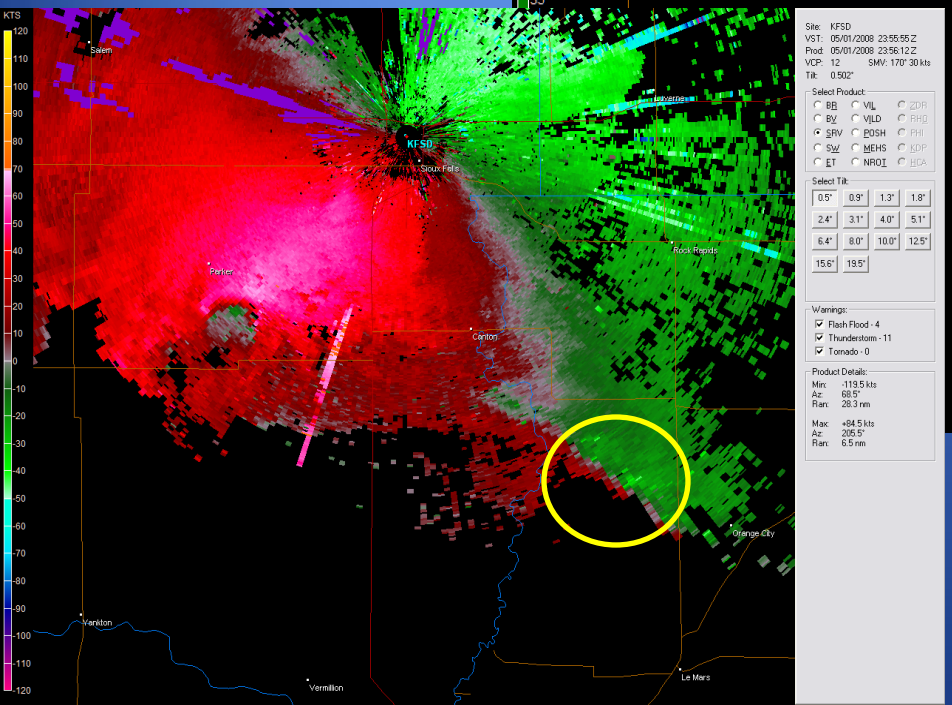
Sioux Falls
Parker
Rock Rapids
Canton
Orange City
Vermillion
Le Mars
Site: KFSD
VST: 05/01/2008 23:55:55 Z
Prod: 05/01/2008 23:55:54 Z
VCP: 12
SMV: 170° 30 kts
Tilt: 0.500°
Select Product:
BR
VIL
ZDR
BV
VILD
RHO
SRV
POSH
PHI
SW
MEHS
KDP
ET
NROT
HCA
Select Tilt:
0.5°
0.9°
1.3°
1.8°
2.4°
3.1°
4.0°
5.1°
6.4°
8.0°
10.0°
12.5°
15.6°
19.5°
Warnings:
Flash Flood - 4
Thunderstorm - 11
Tornado - 0
Product Details:
Max: 63.5 dbz
Az: 232.5°
Ran: 21.3 nm
Dominant Cell


KTS
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-120
Salem
Luverne
KFSD
Sioux Falls
Parker
Rock Rapids
Canton
Orange City
Yankton
Vermillion
Le Mars
Site: KFSD
VST: 05/01/2008 23:55:55 Z
Prod: 05/01/2008 23:56:12 Z
VCP: 12
SMV: 170° 30 kts
Tilt: 0.502°
Select Product:
BR
VIL
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BV
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RHO
SRV
POSH
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MEHS
KDP
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NROT
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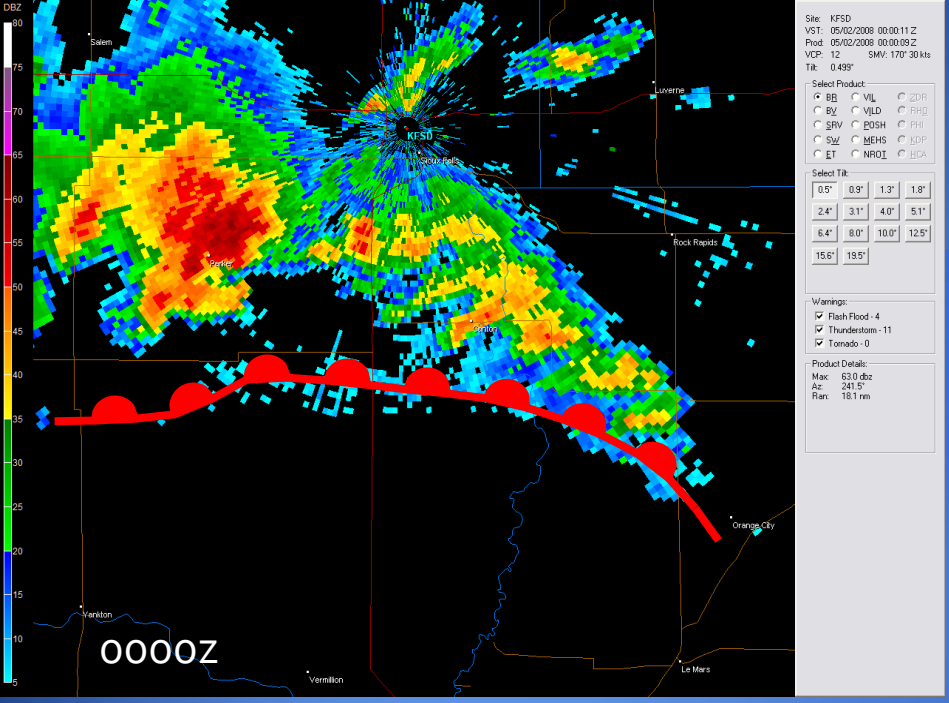
Select Tilt:
0.5°
0.9°
1.3°
1.8°
2.4°
3.1°
4.0°
5.1°
6.4°
8.0°
10.0°
12.5°
15.6°
19.5°
Warnings:
Flash Flood - 4
Thunderstorm - 11
Tornado - 0
Product Details:
Min: -119.5 kts
Az: 68.5°
Ran: 28.3 nm
Max: +84.5 kts
Az: 205.5°
Ran: 6.5 nm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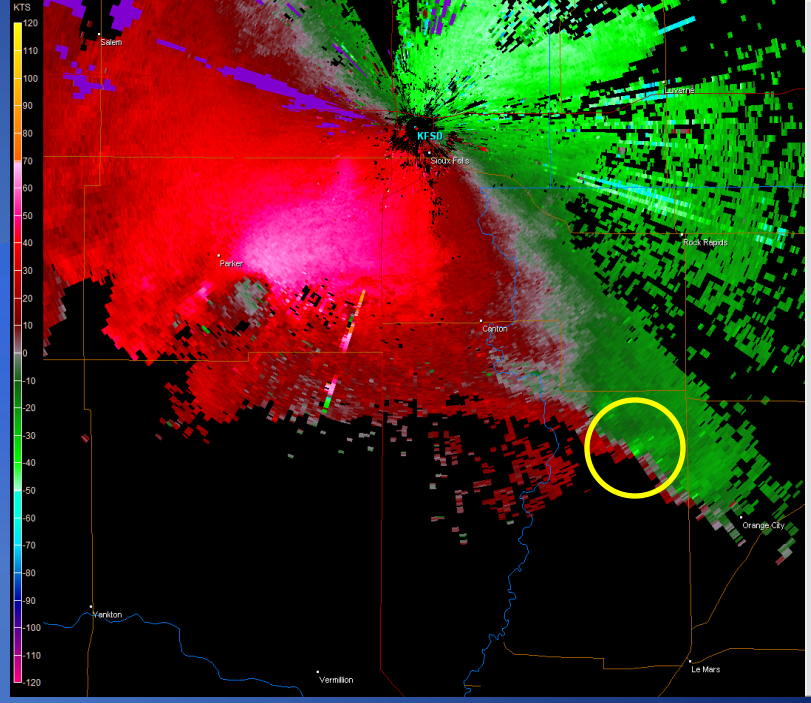
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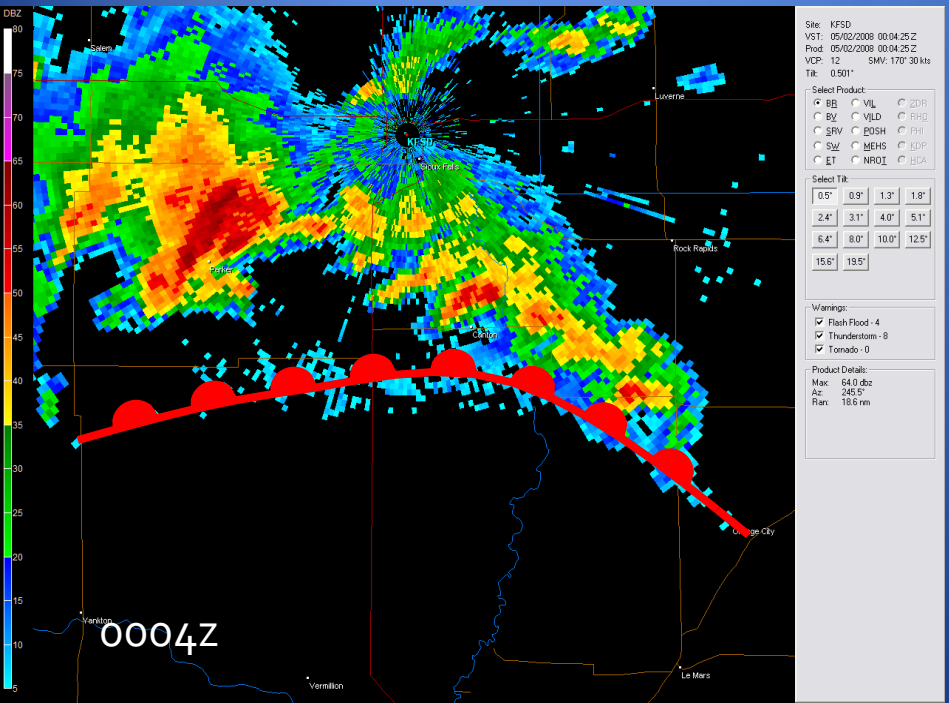
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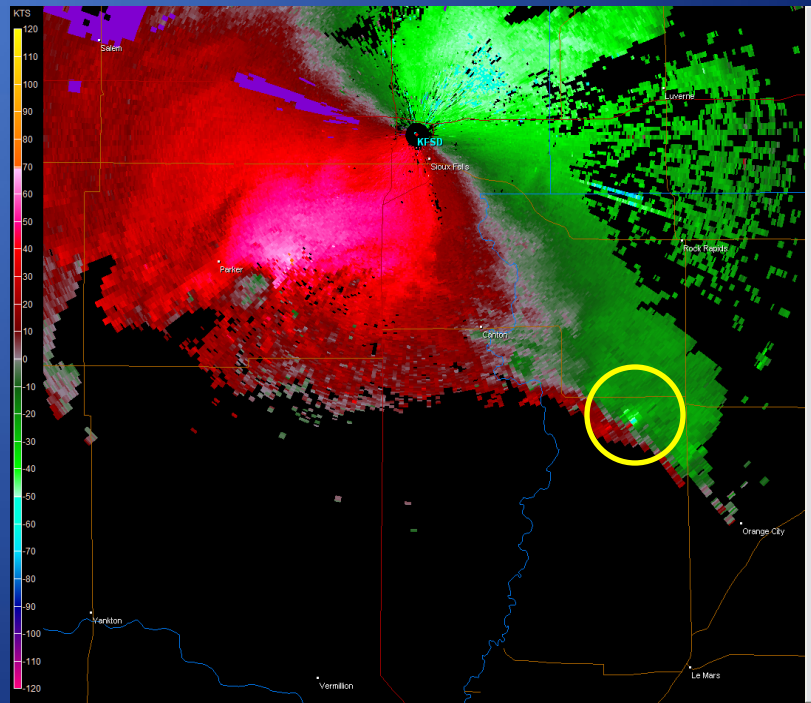
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Vermillion
Le Mars

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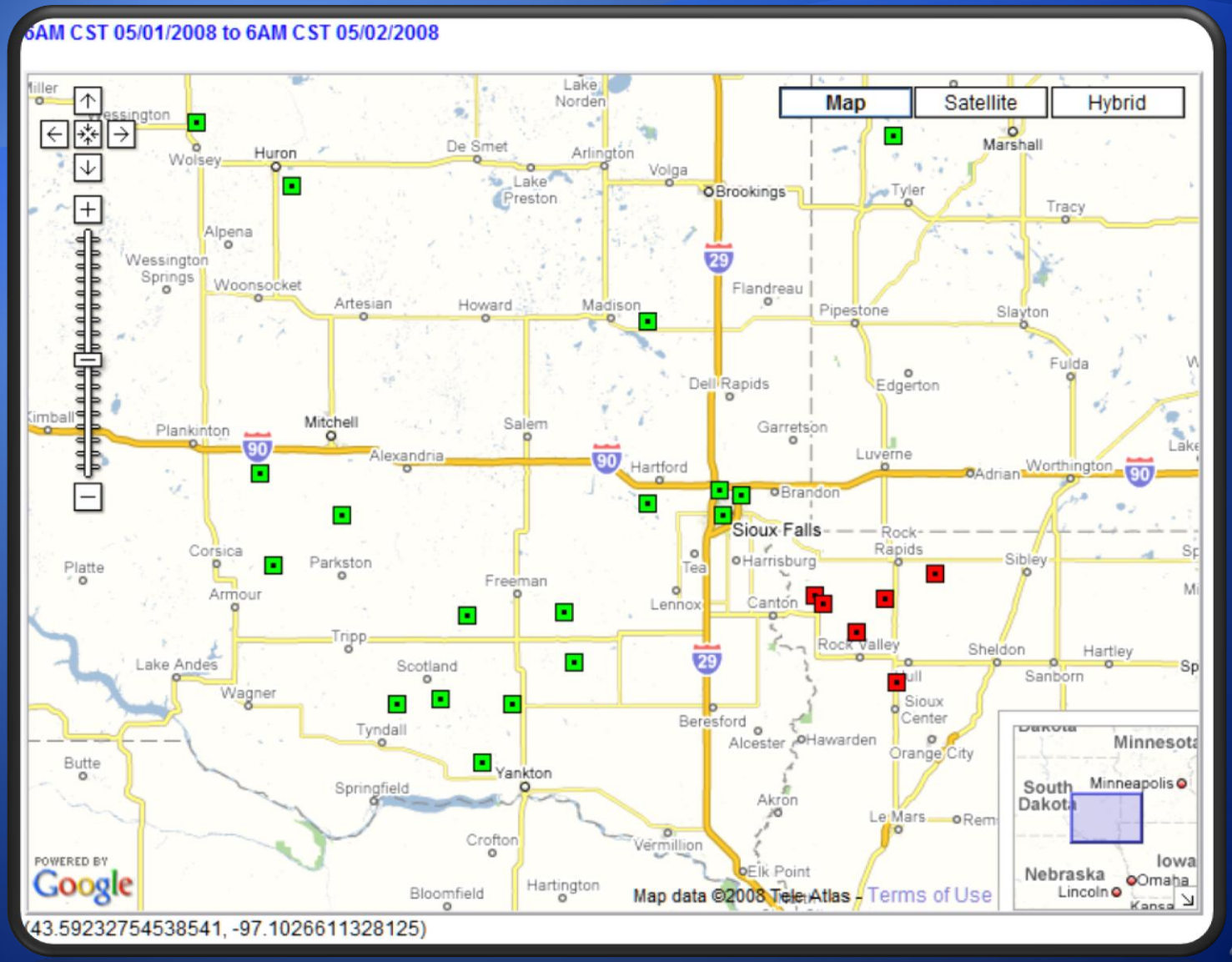
Hybrid Tornado At Its Widest Point

- ¼ mile wide
- 13 mile track length
- 30 minute lifespan
- EF2 intensity
- PRICELESS!!

Storm Reports from 5/1/2008



May 1, 2008 Summary

- NST developed as dust devil on a northward moving warm front, but then dissipated 10 minutes later.
- Hybrid tornado resulted an EF2 with a 13-mile track and was ¼ mile wide at times.
- 4 other NST/Hybrid touchdowns.
- Developed in an area of 50 kts of effective bulk shear, combined with 25 kts of 0-1km shear, along with 400 units of 0-1km SRH, within an area of 50 J/kg of 0-3km CAPE.

In Summary – My Bottom Line

- NSTs pose significant challenges to warning forecasters, even though the threat for life is no less.
- Often, we simply react to reports of existing activity rather than provide meaningful lead time for the point of impact.
- **NSTs often require snap decisions, result in little or no lead time, and are extremely difficult to predict with any degree of certainty.**
- There remains much research that can be done to help forecasters (me) better understand NSTs.