An Isentropic Perspective on Two Cases of Elevated Convection

Patrick S. Market
Dept. of Soil, Env. & Atmospheric Sciences
University of Missouri

Elevated Convection

INTRODUCTION

Colman (1990a,b)

- Initiated the modern era of elevated convection studies

- Showed the preferred region of elevated convection in US
  - northeast of a surface cyclone
  - north of its attendant warm front

Colman (1990a,b)

- More importantly, suggested that these elevated layers
  - were often devoid of convective available potential energy (CAPE)

- This latter finding suggests an environment ill-suited to deep, moist thunderstorm towers.

Later work

- Yet, ensuing studies have shown elevated convection can result in
  - Heavy rainfall (Rochette and Moore 1996)
  - Heavy snowfall (Moore et al. 1998)

  - Severe weather
    - Grant (1995)
    - Horgan et al. (2006, 2007)
    - Colby and Walker (2007)

Even ***later*** work…

- Further study by Rochette et al. (1999)
  - heightened the contrast with the findings of Colman (1990a,b)
  - showing that there were environments of elevated convection that had *significant* CAPE

Even *later* work…

- Wetzel and Martin (2001)
  - showed decisively that the presence of instability could enhance snowfall totals
- Moore et al. (2003)
  - described the processes leading to a less stable environment as ones leading to greater precipitation totals

Even *later* work…

- Knox and Schultz (2006)
  - factors *not* related to buoyancy might be related to elevated convection
  - Specifically, atmosphere might also be susceptible to inertial (horizontal) instability, especially on the equatorward side of jet streak structures

Even ***later*** work…

- Corfidi et al. (2006)
  - examined the nature of *altocumulus castellanus*
  - determined that the "…division between elevated and surface-based [convective] activity is rarely distinct."

Elevated Convection

METHODOLOGY

Trajectory Analyses

- For this talk, NAM-WRF solutions used
  - Good subjective verification for both cases
  - GFS and RUC trajectories are being created for comparison
    - *Ongoing*

Trajectory Analyses

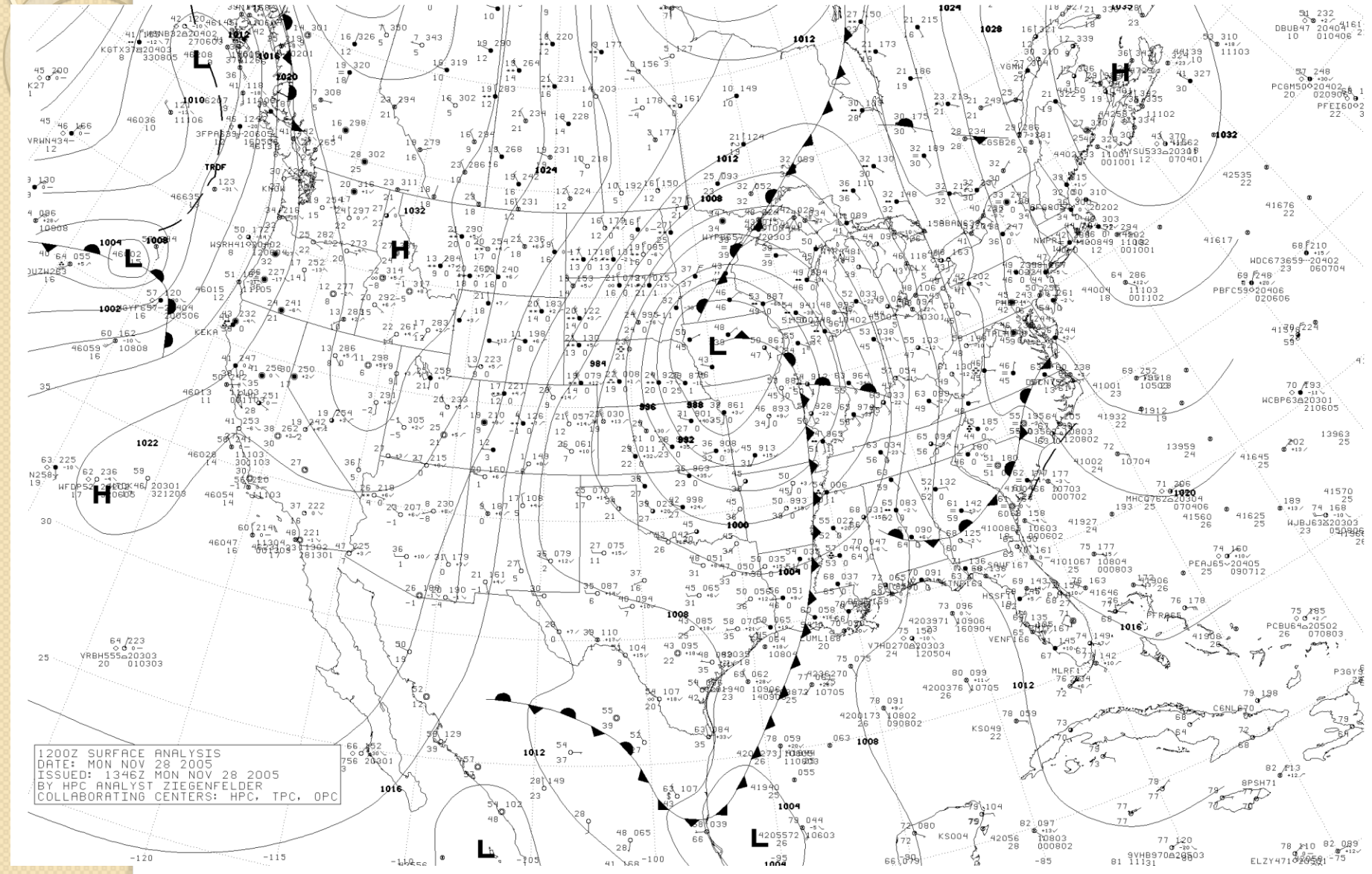
- Trajectory specs
  - 180 minute (3-hr time step)
  - Isentropic
  - Backwards from location of interest

Elevated Convection

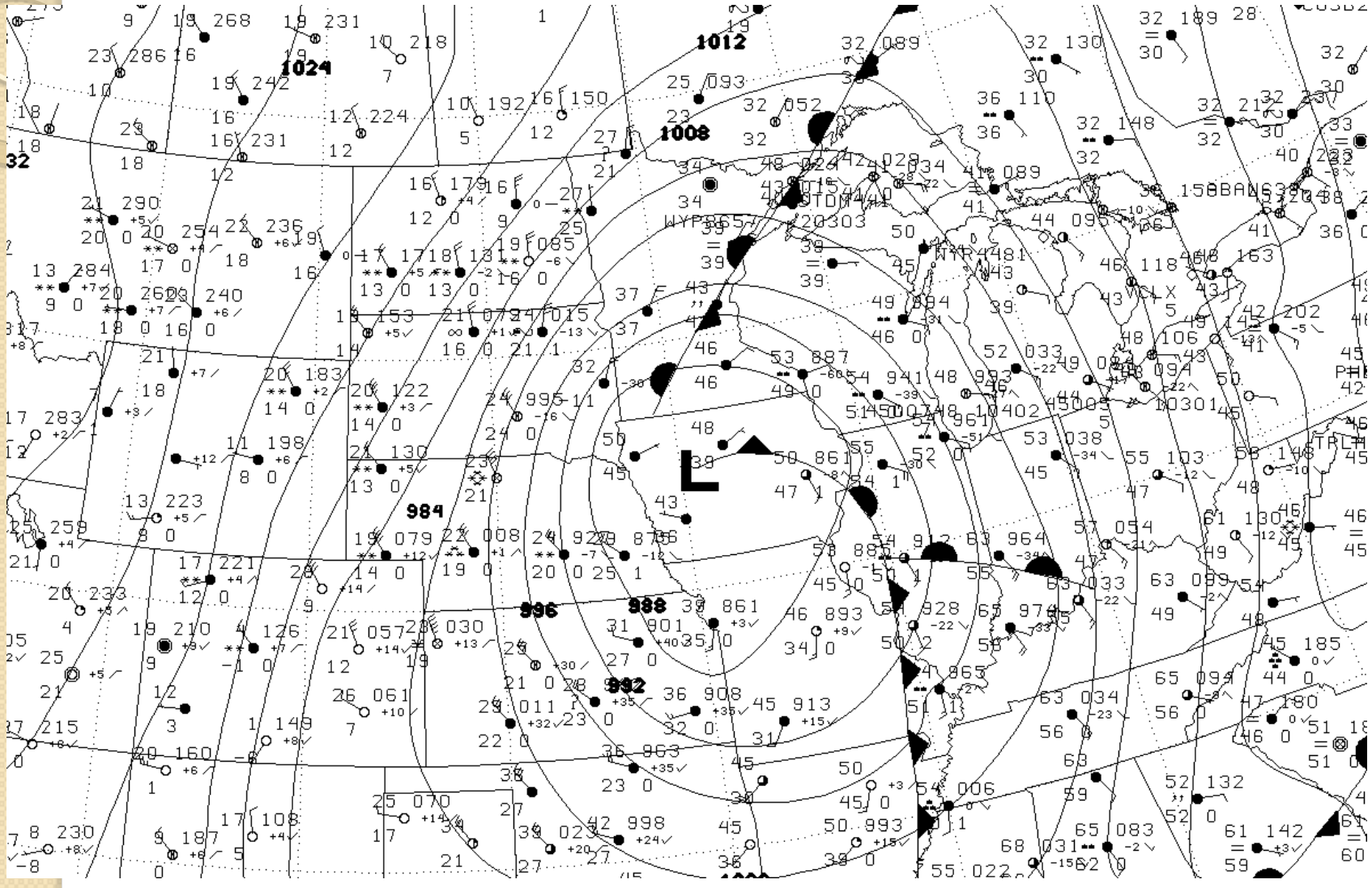
CASE STUDY

28 NOVEMBER 2005 – W MINNESOTA

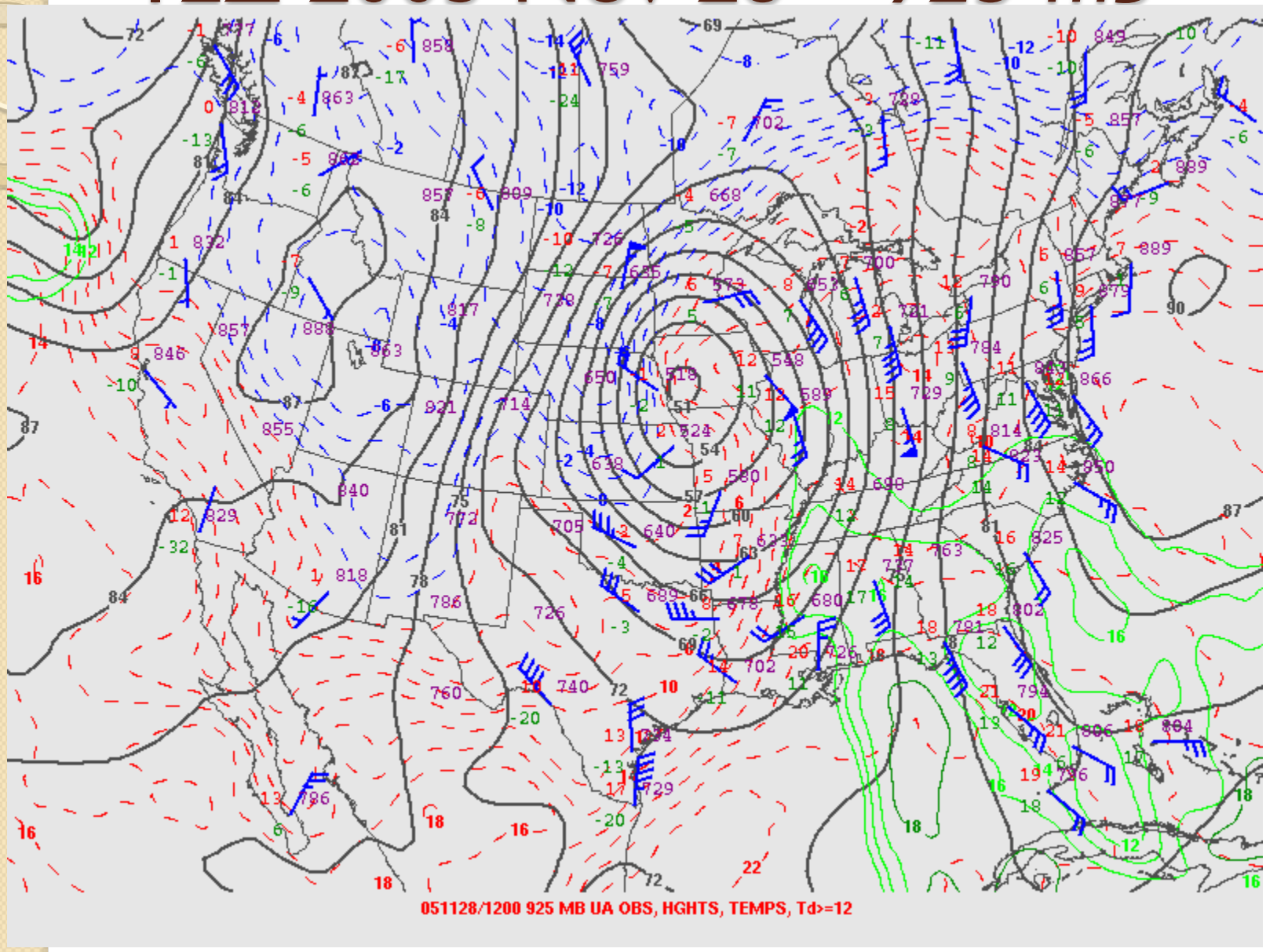
12Z 2005 Nov 28



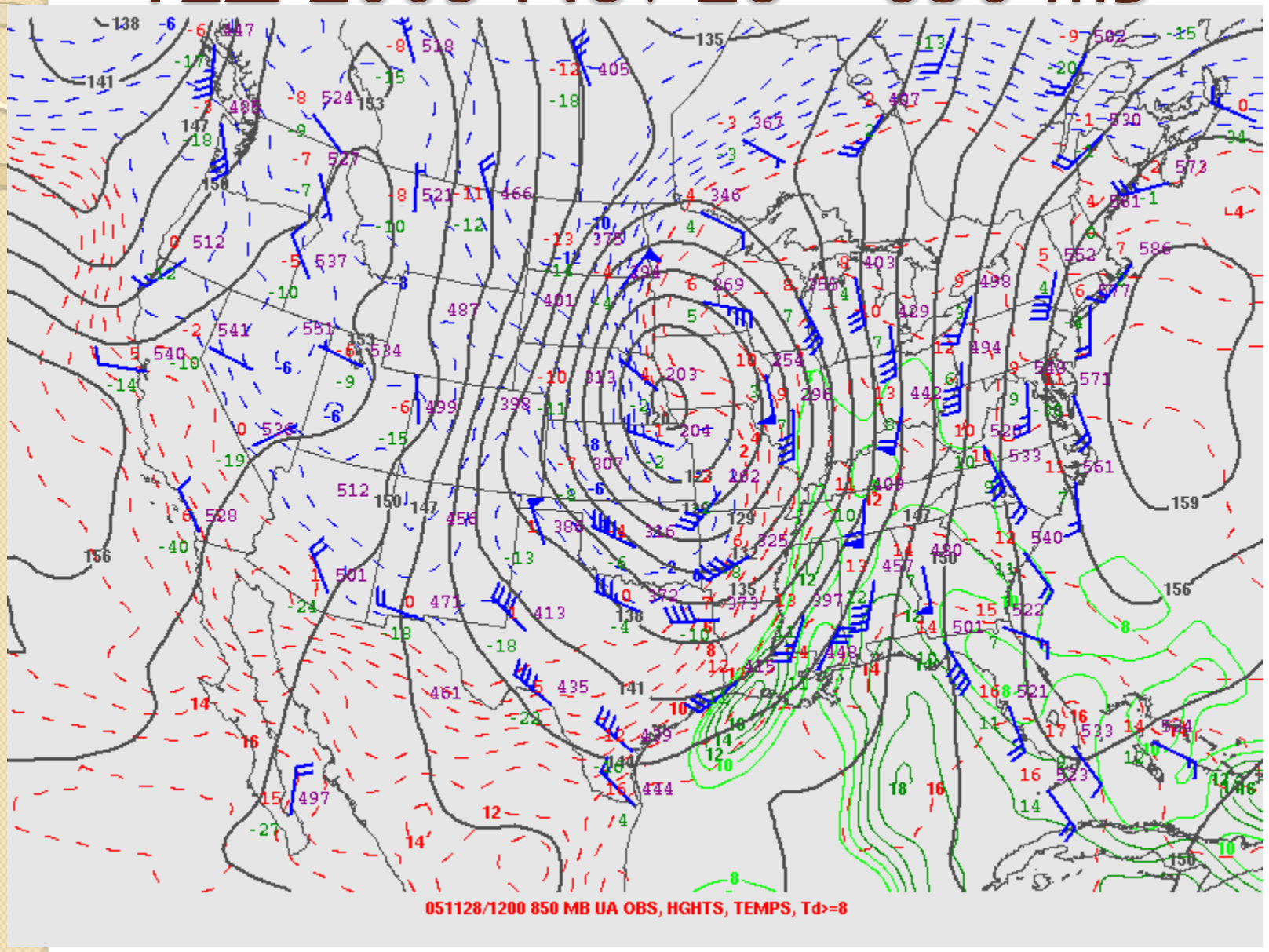
12Z 2005 Nov 28



12Z 2005 Nov 28 – 925 *mb*



12Z 2005 Nov 28 – *850 mb*



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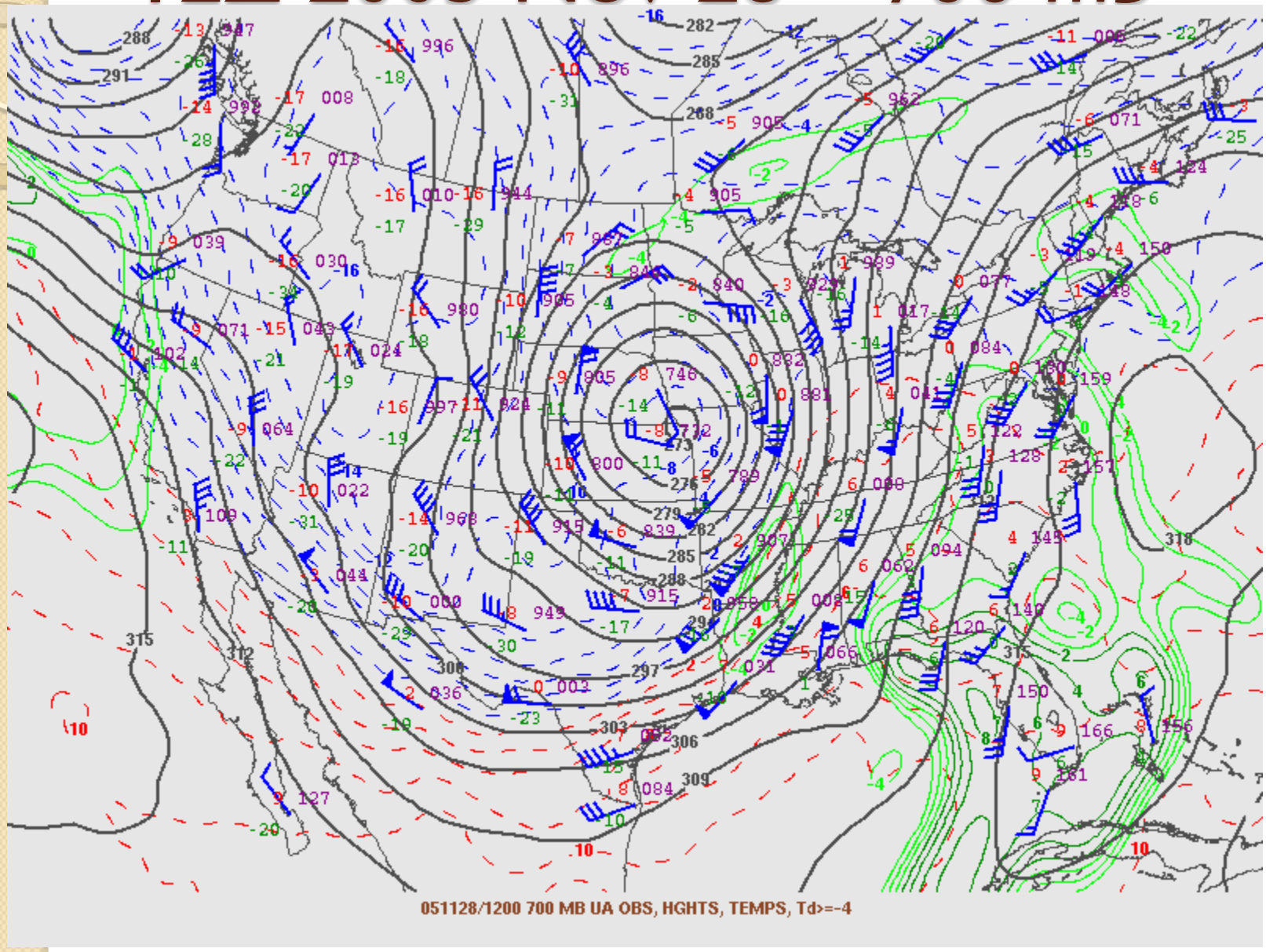
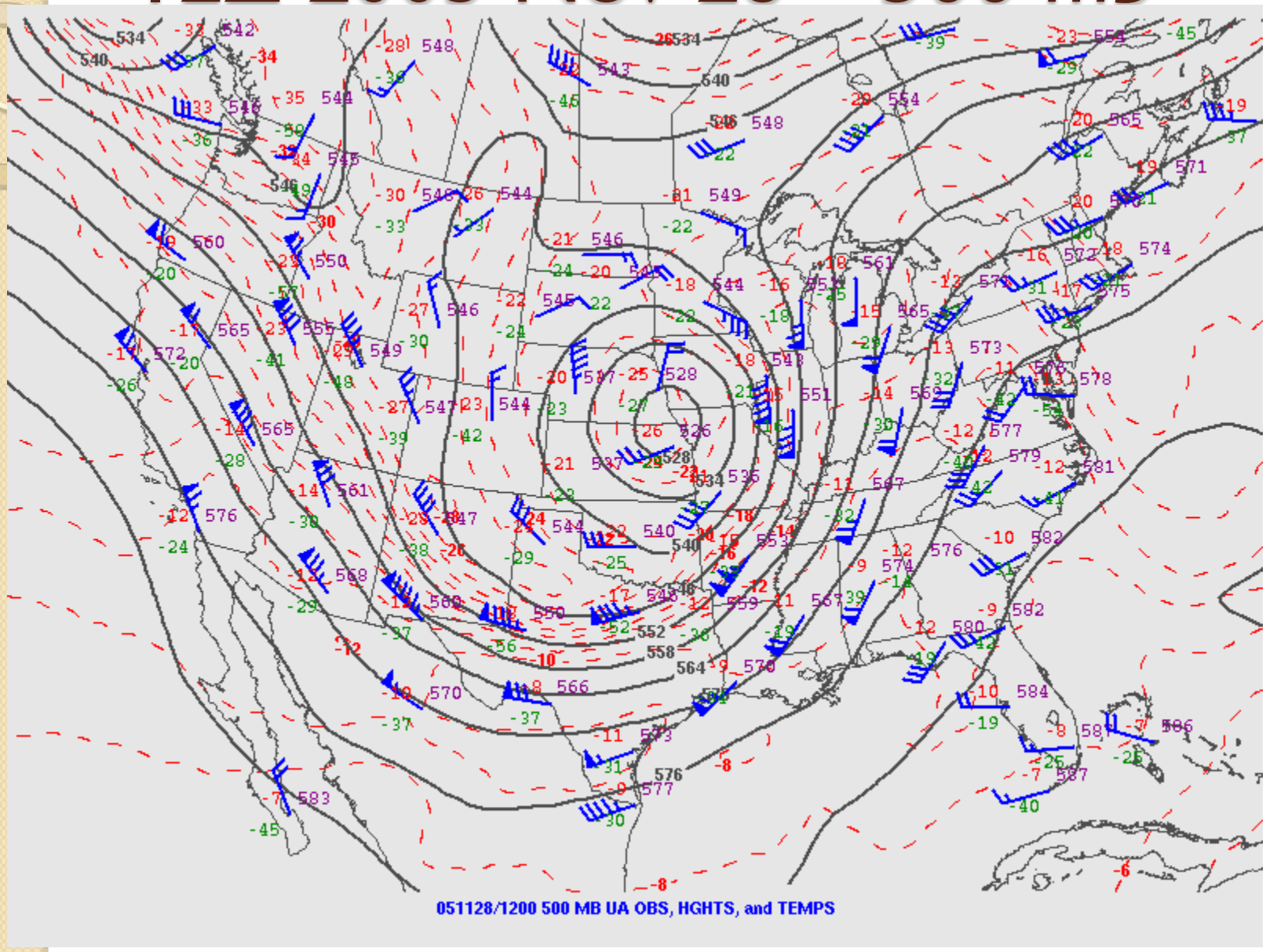
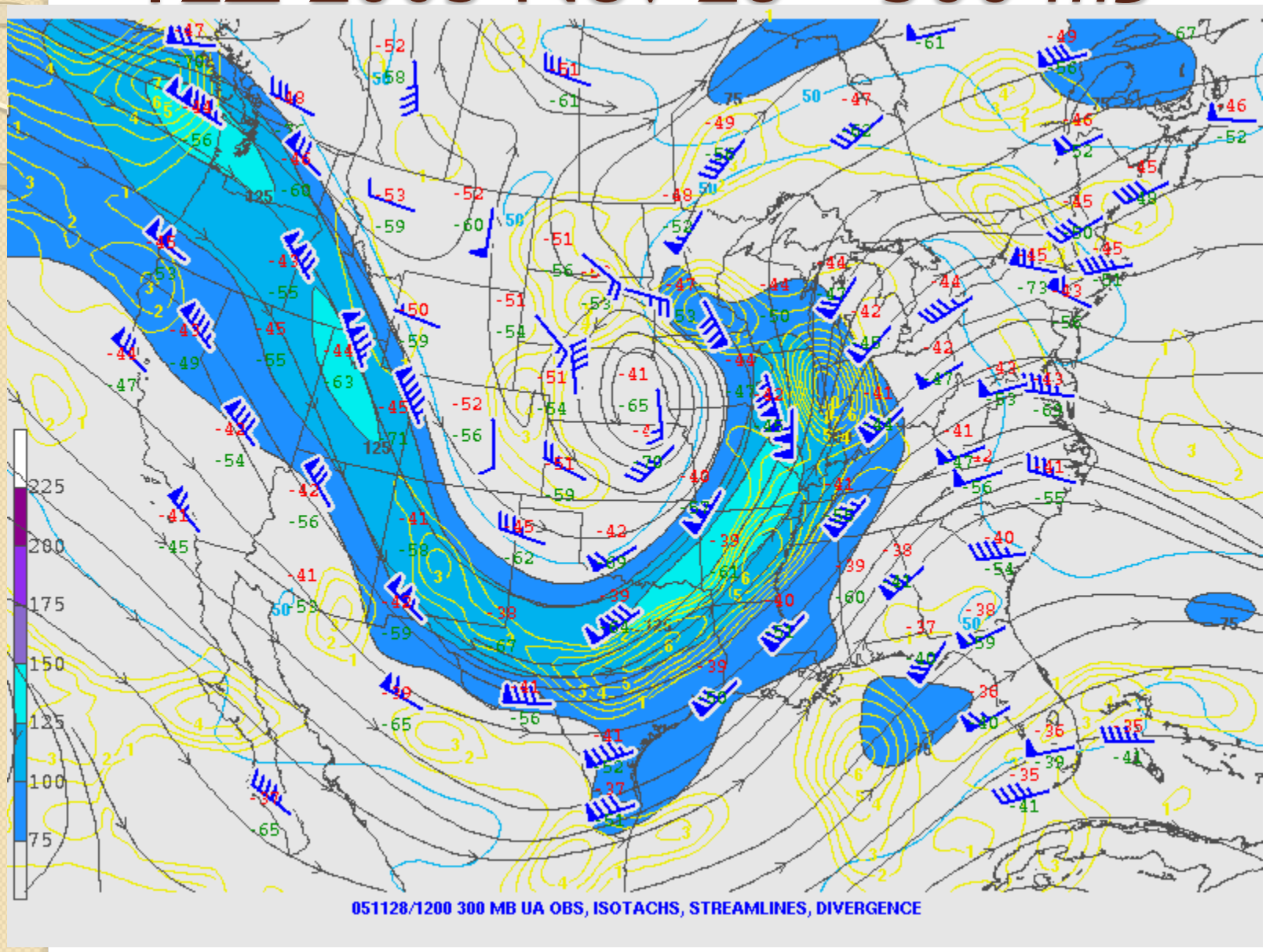


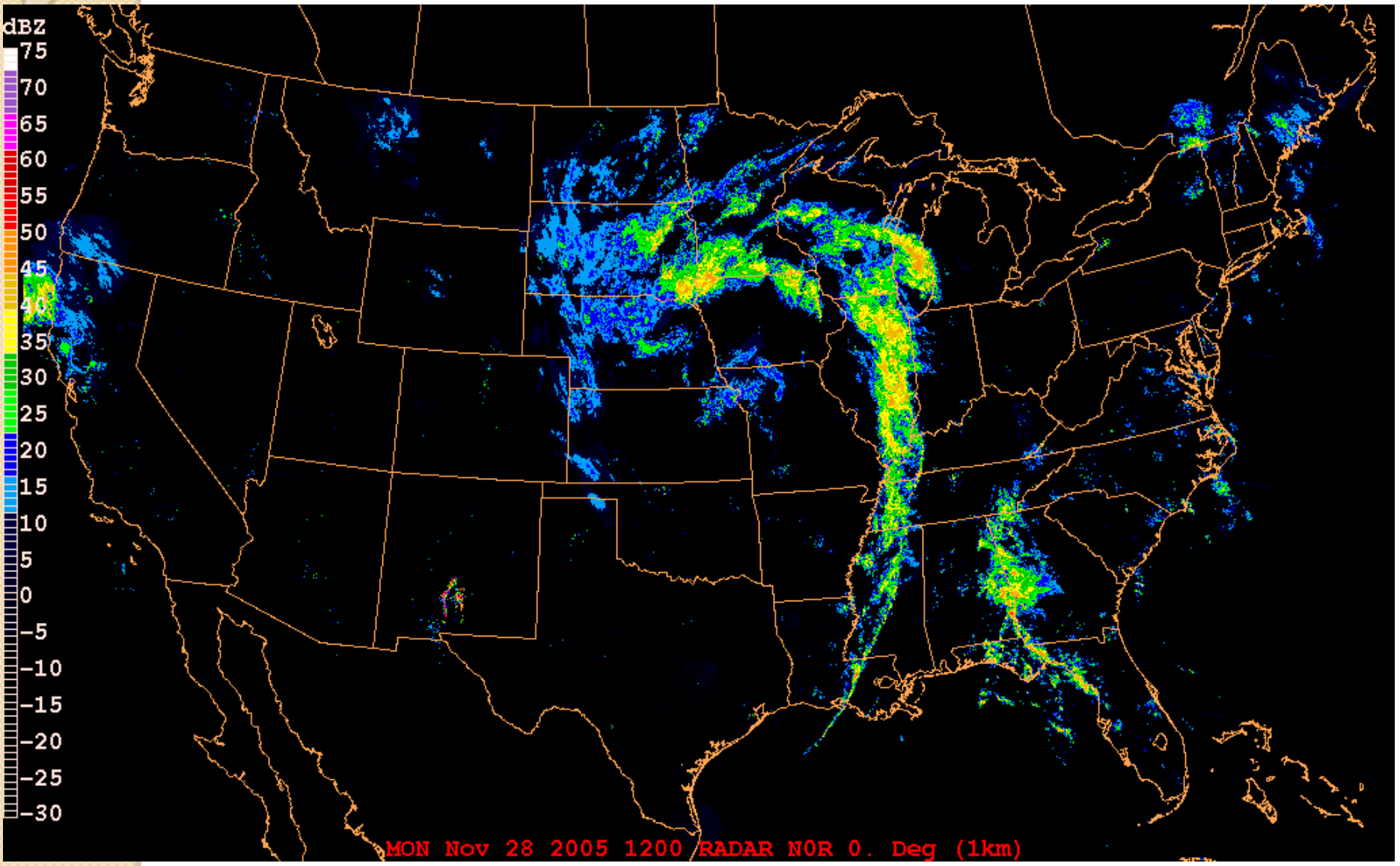
12Z 2005 Nov 28 – *500 mb*



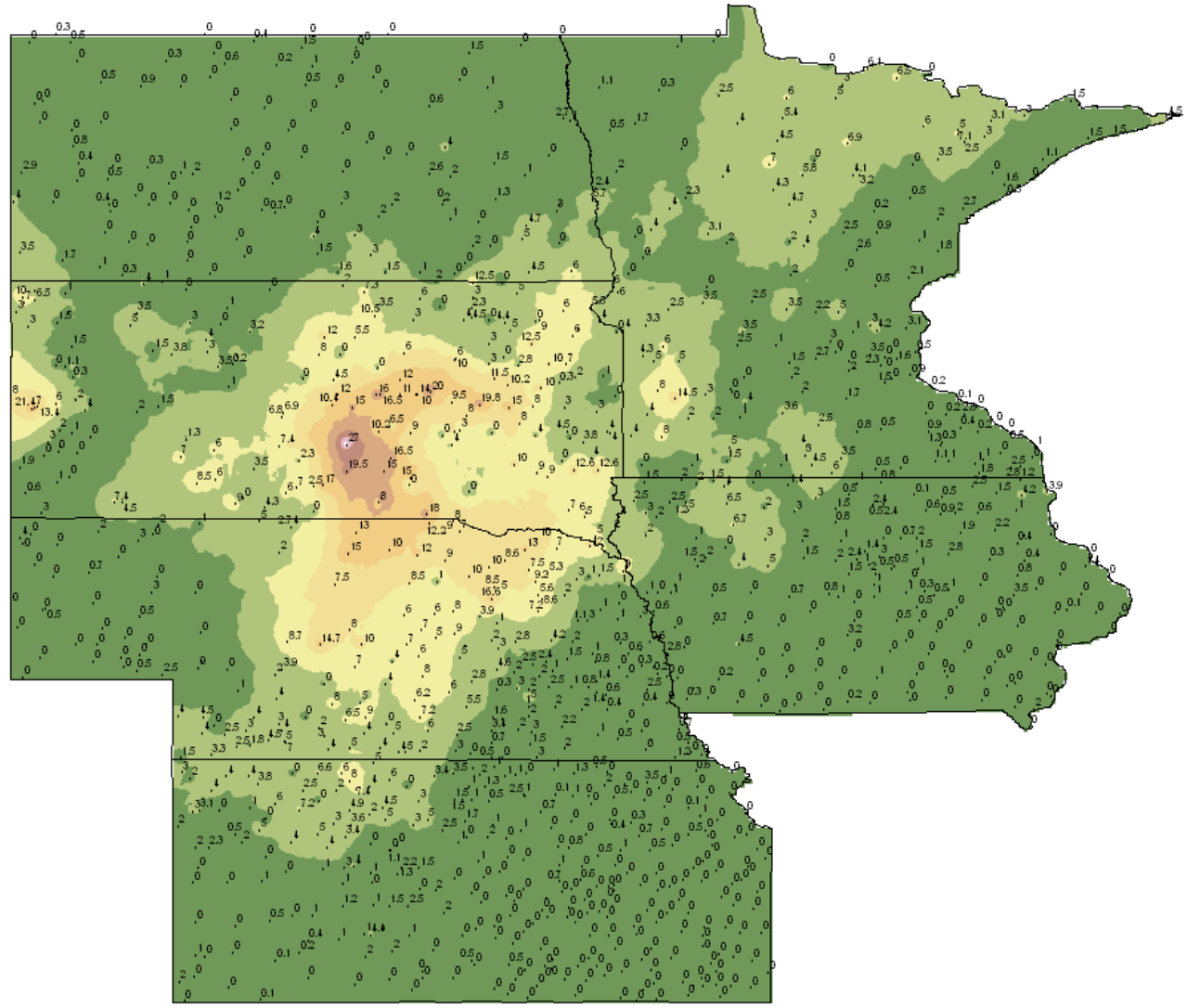
12Z 2005 Nov 28 – *300 mb*



12Z 2005 Nov 28 – *RADAR*



Storm total snow (in.) , 27-30 Nov 2005

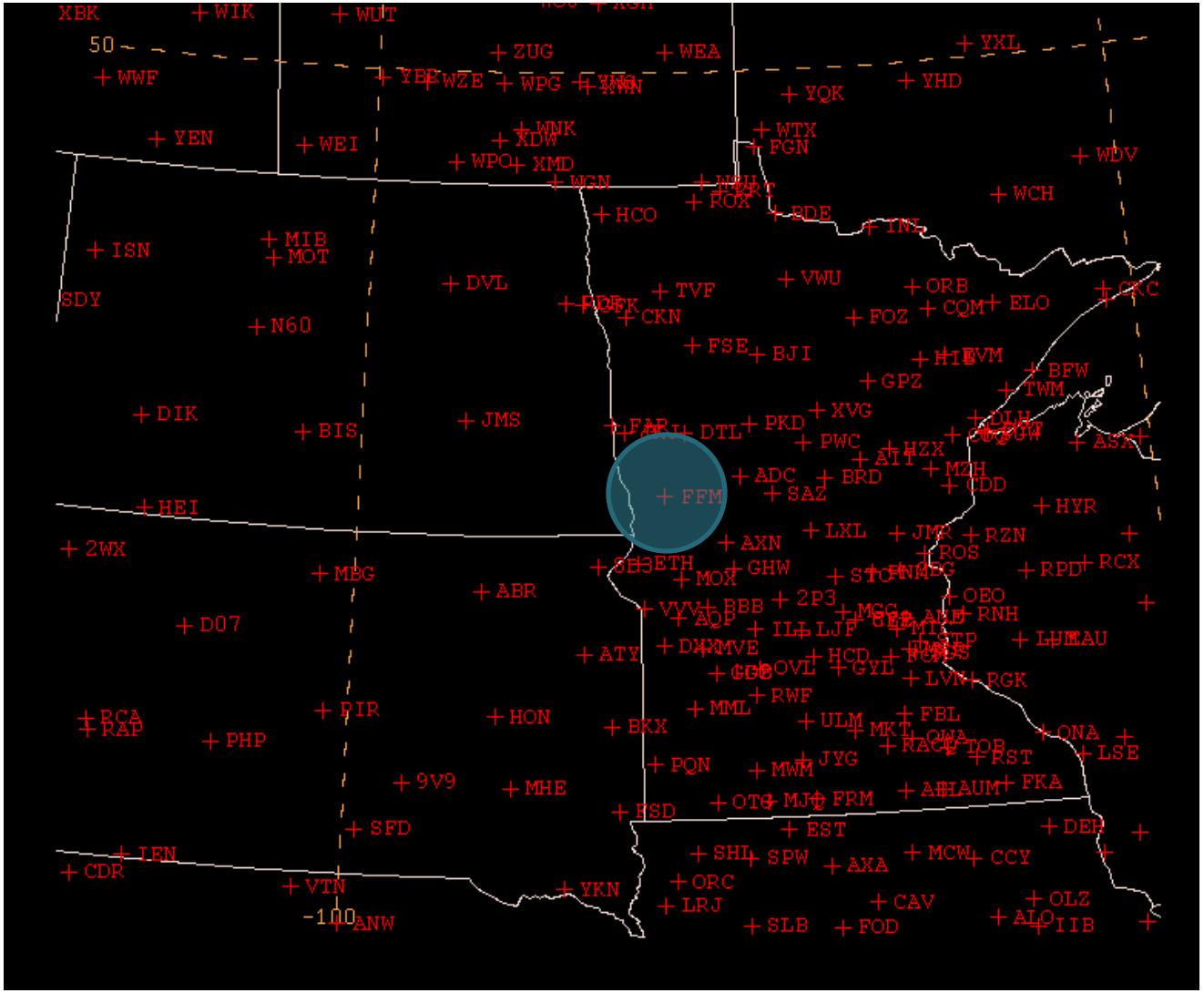


CASE Nov 27-30, 2005 Snowfall Accumulations (in inches)

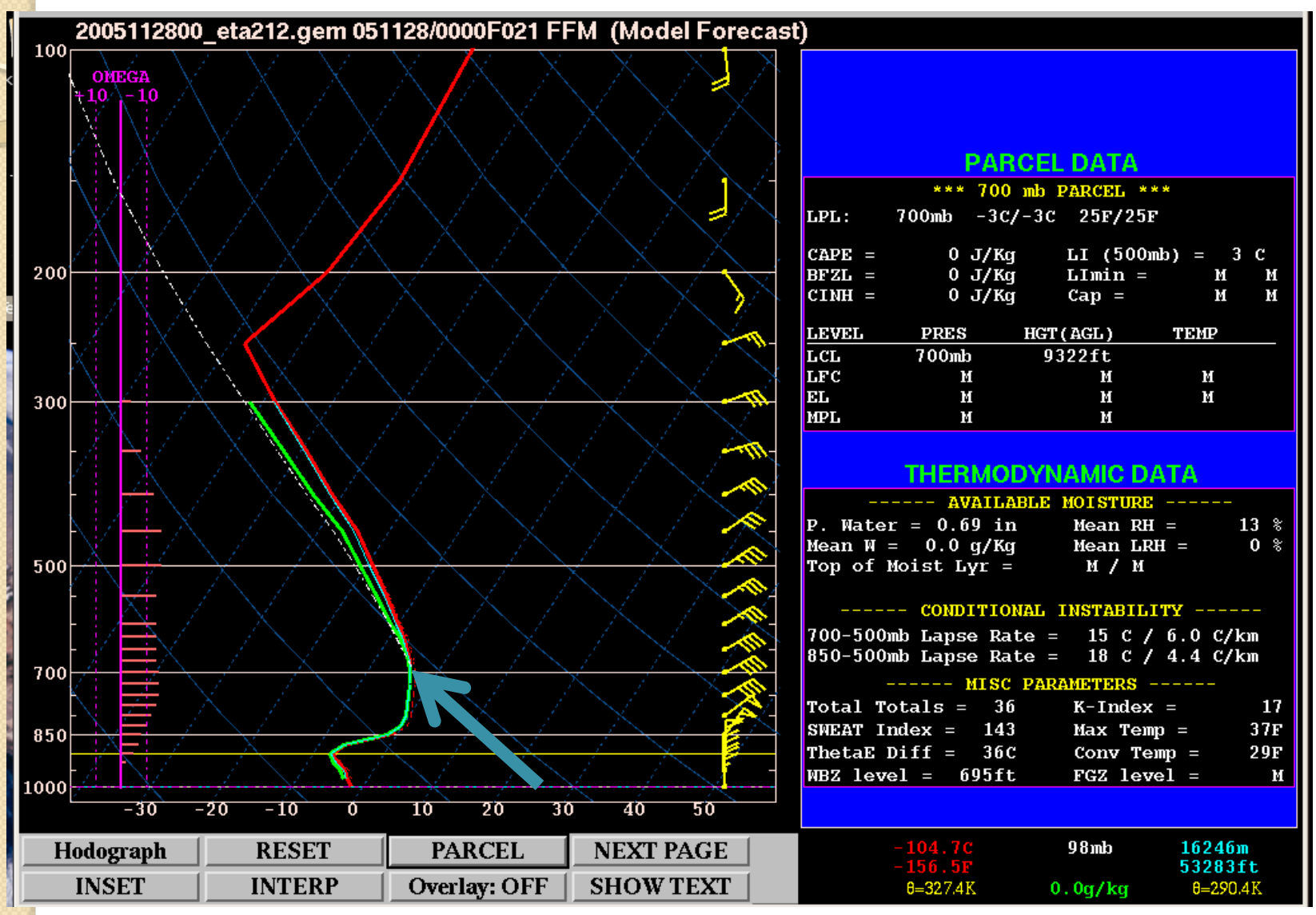
2005 Nov 28 – 2100Z

- Redevelopment of lightning in NE
- Emergence of trowal feature
  - ***And a unique double trowal signature***
- Evolution of meso-β circulations
- Significant banded precipitation underway

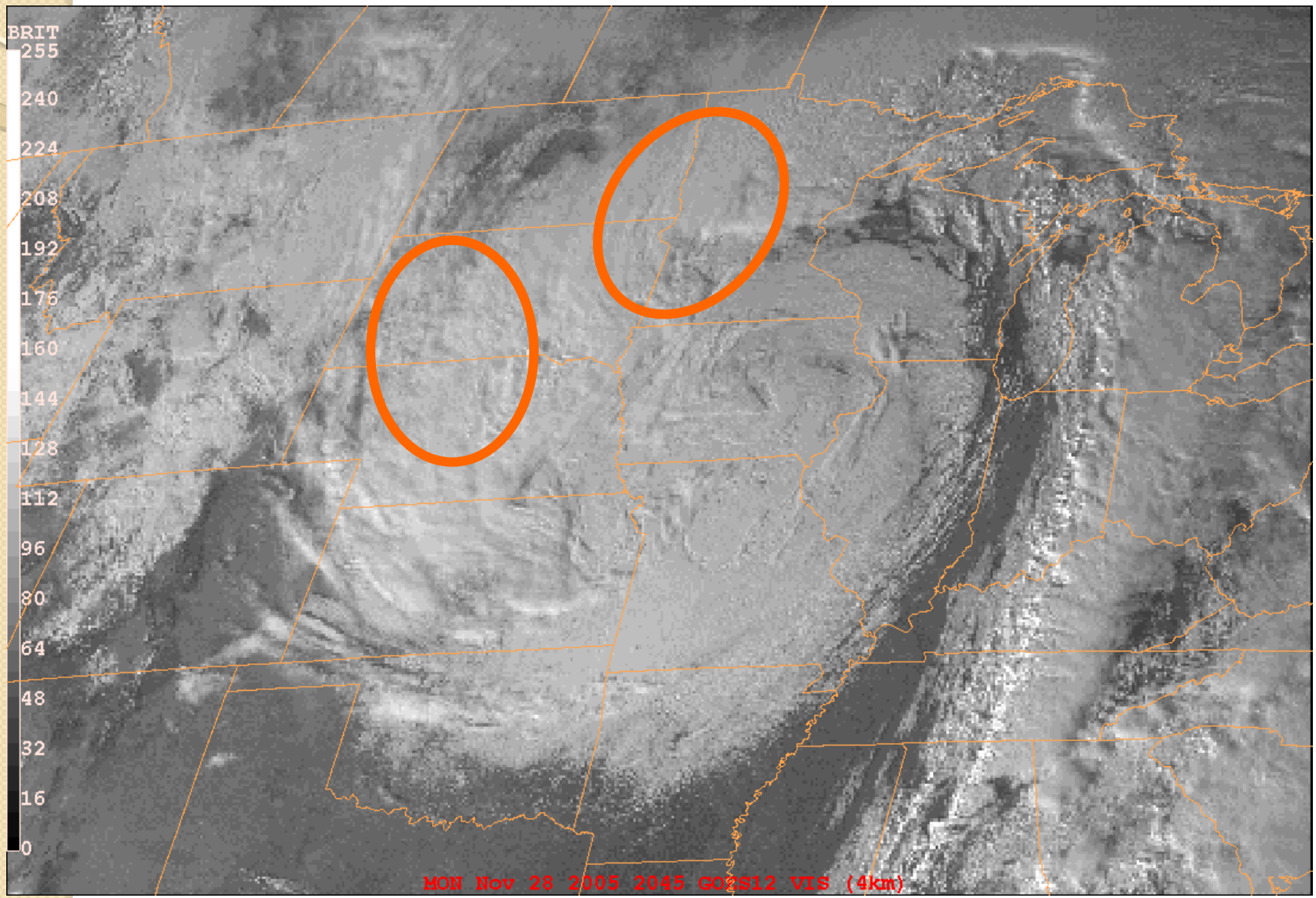
2005 Nov 28 - Fergus Falls, MN



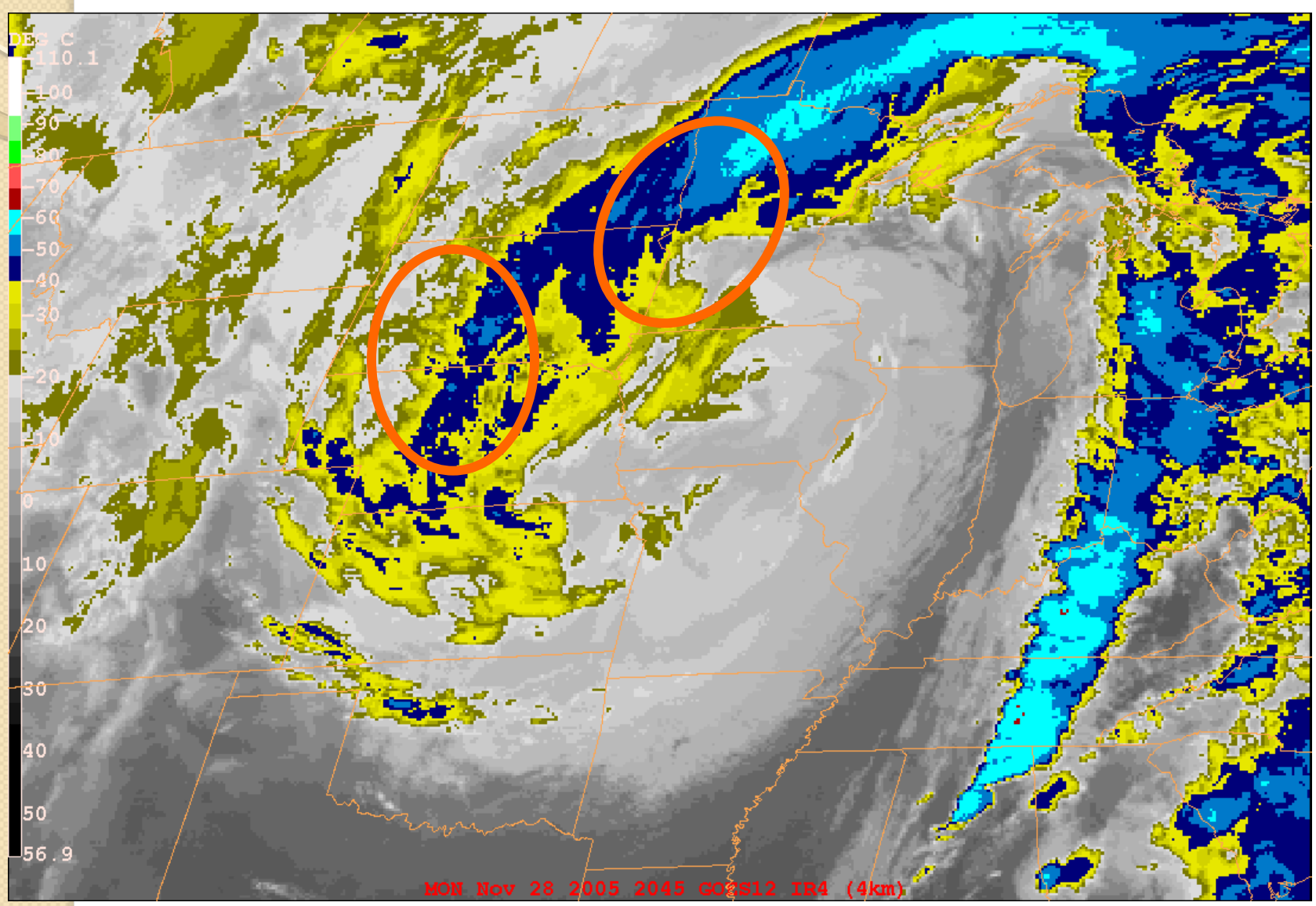
2005 Nov 28 21Z – NAM 21-hr fcst FFM sndg



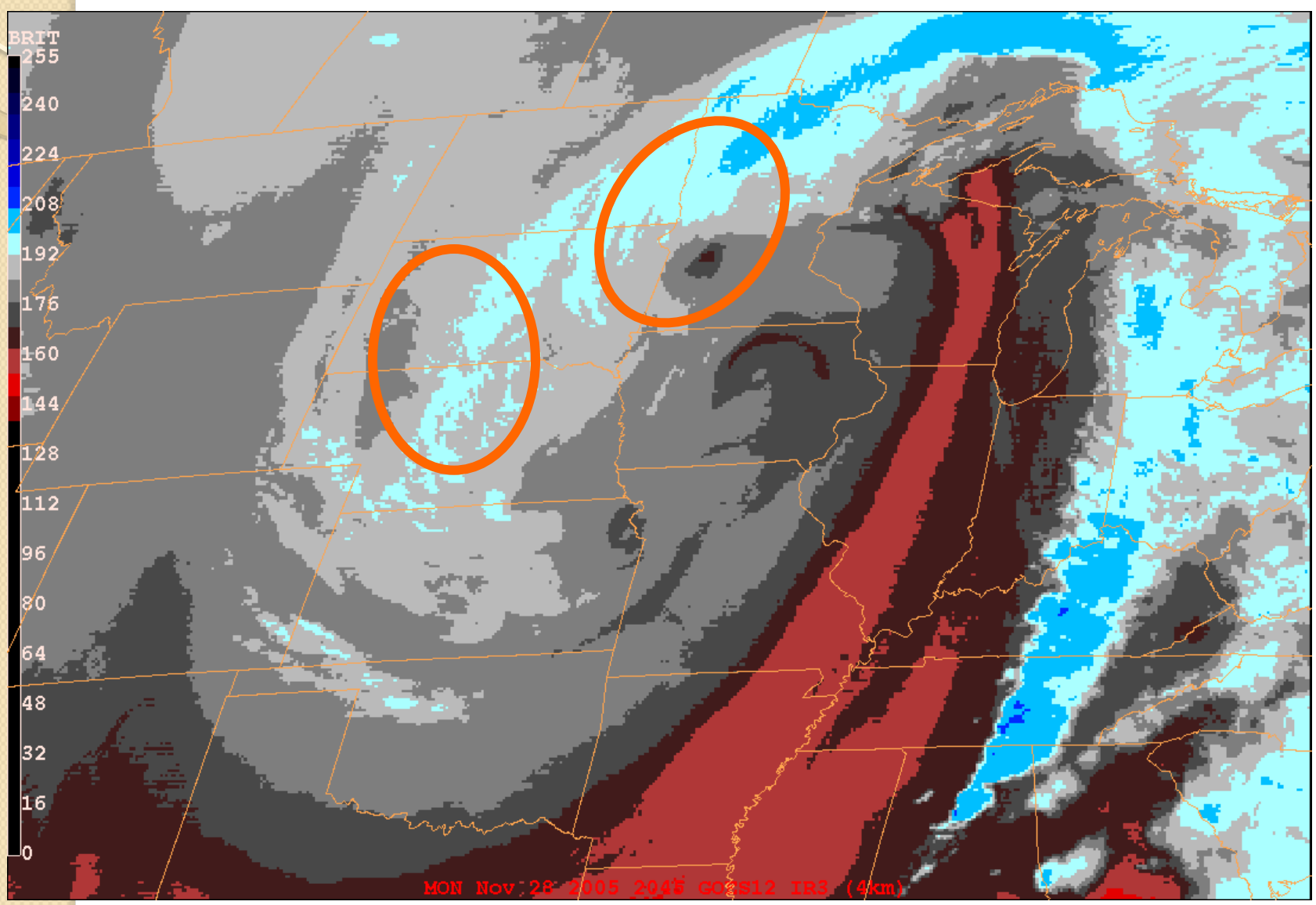
2005 Nov 28 – 21Z VIS Sat



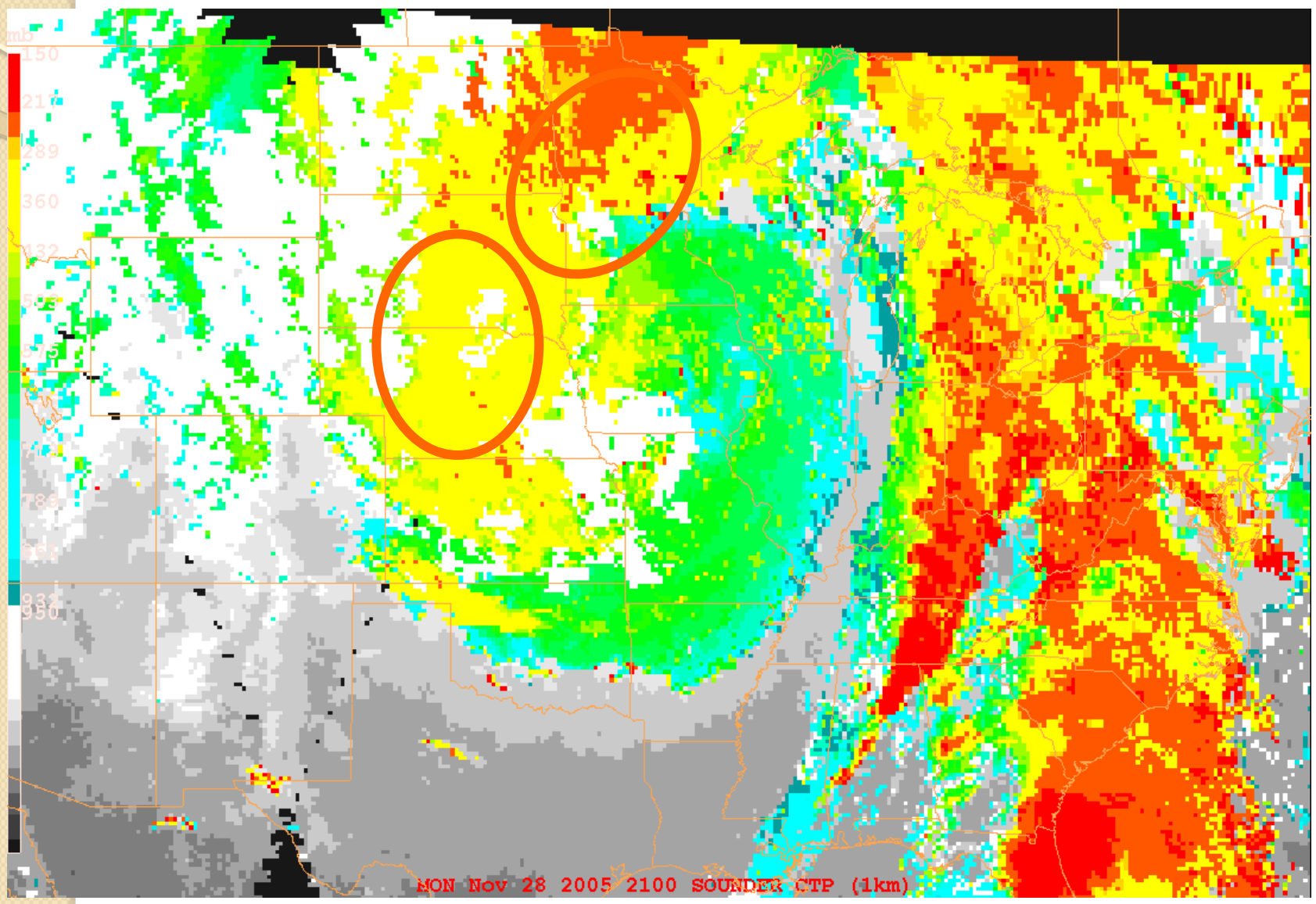
2005 Nov 28 – 21Z IR Sat



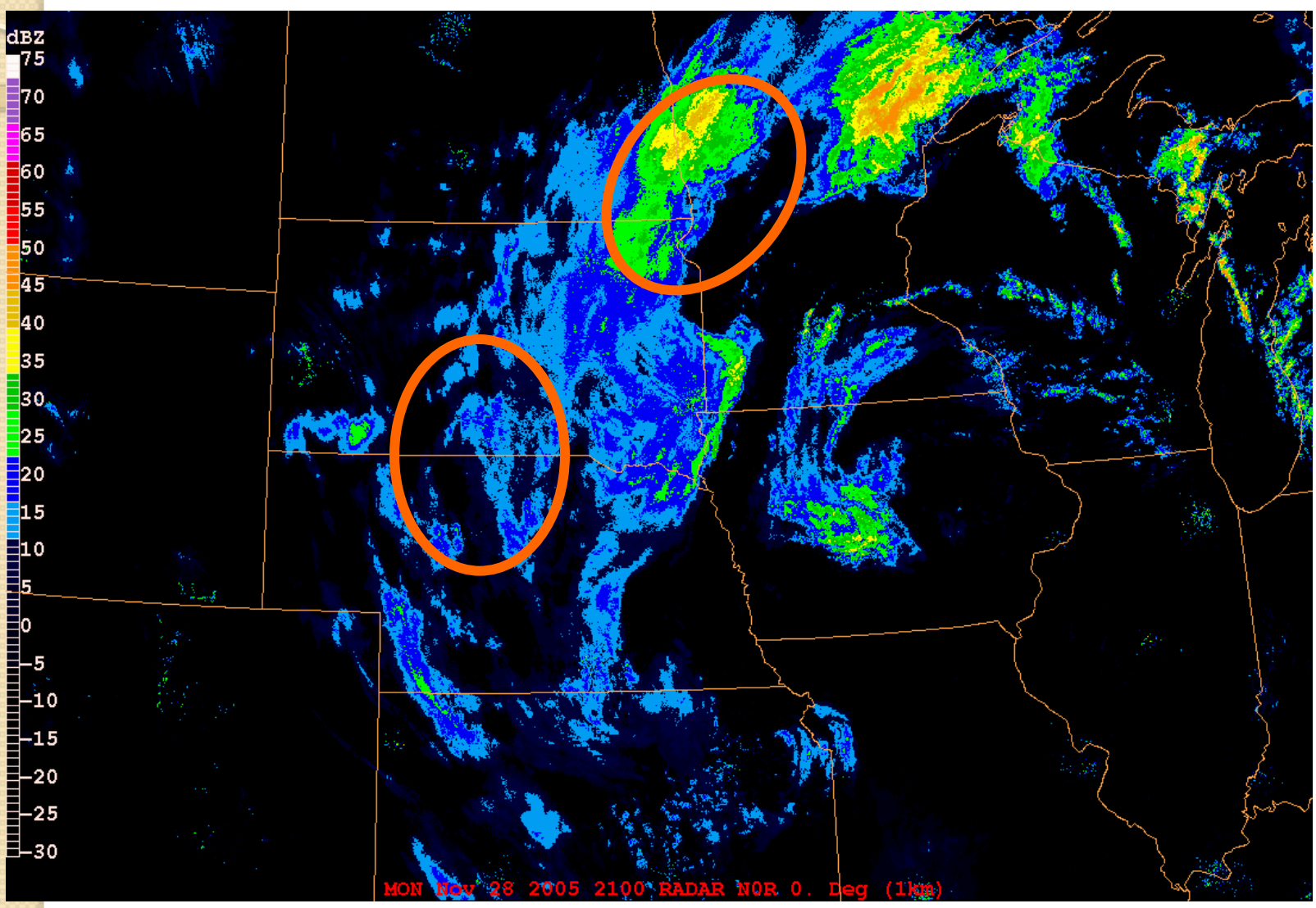
2005 Nov 28 – 21Z WV Sat



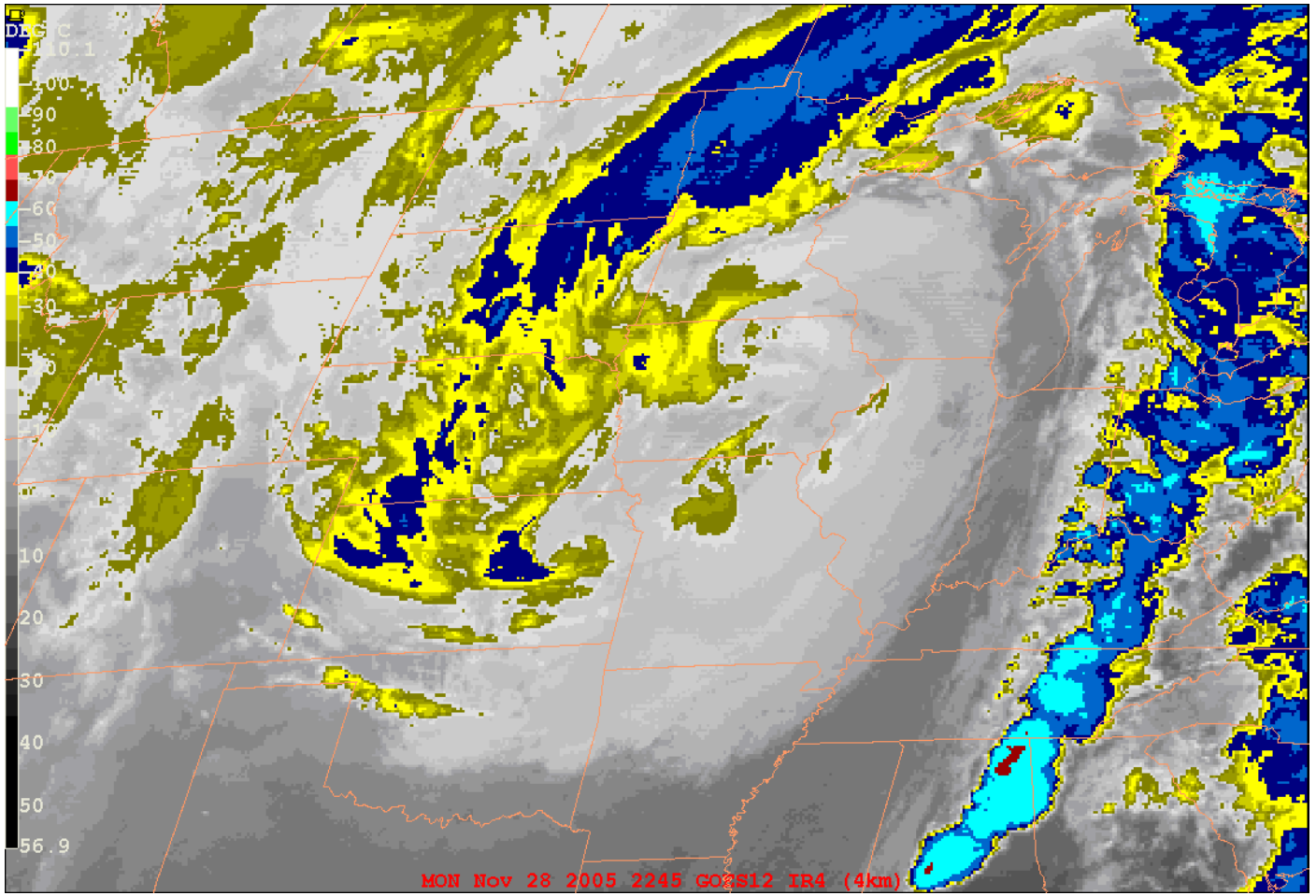
2005 Nov 28 – 21Z Sounder CTP



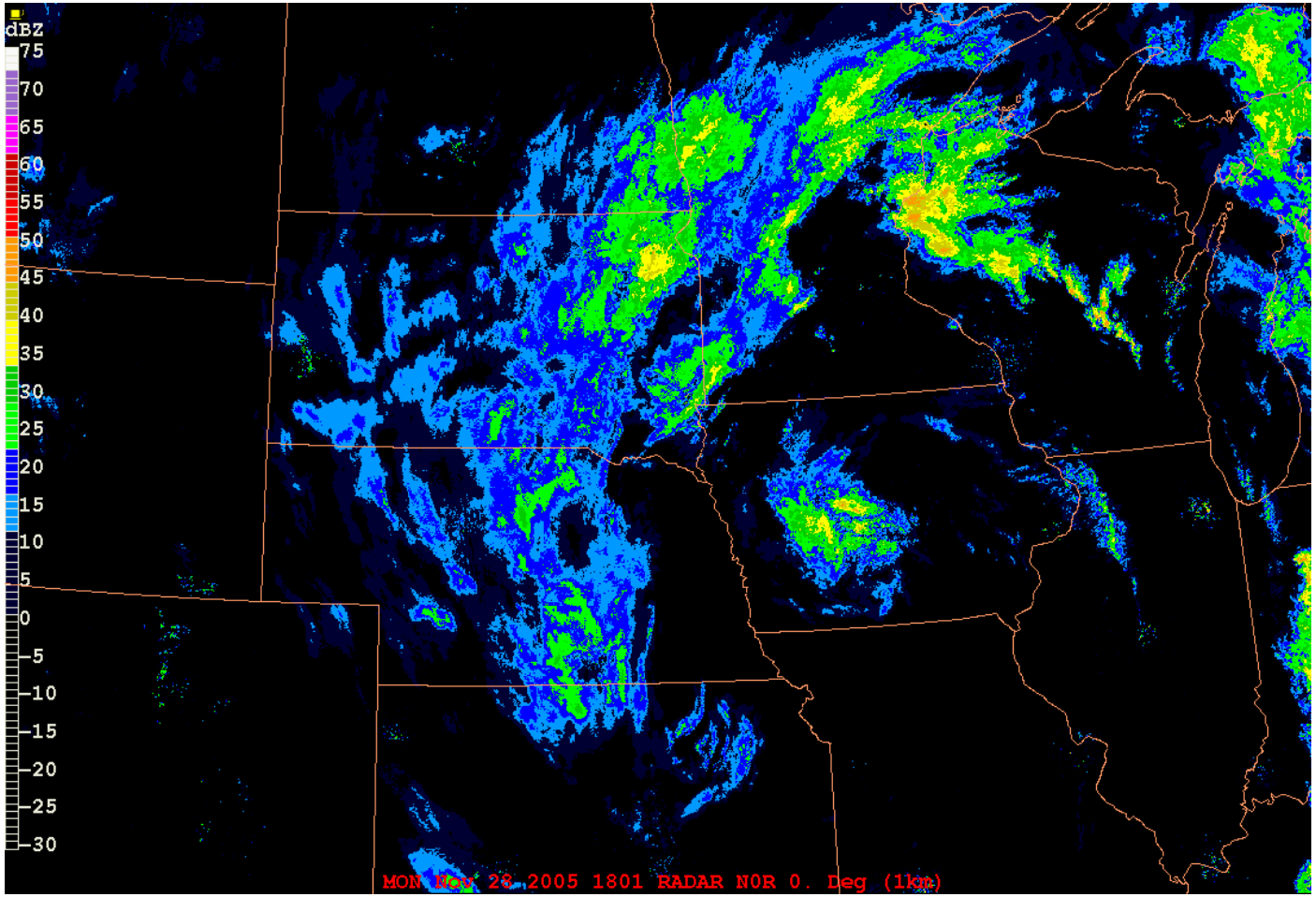
2005 Nov 28 – 21Z RADAR



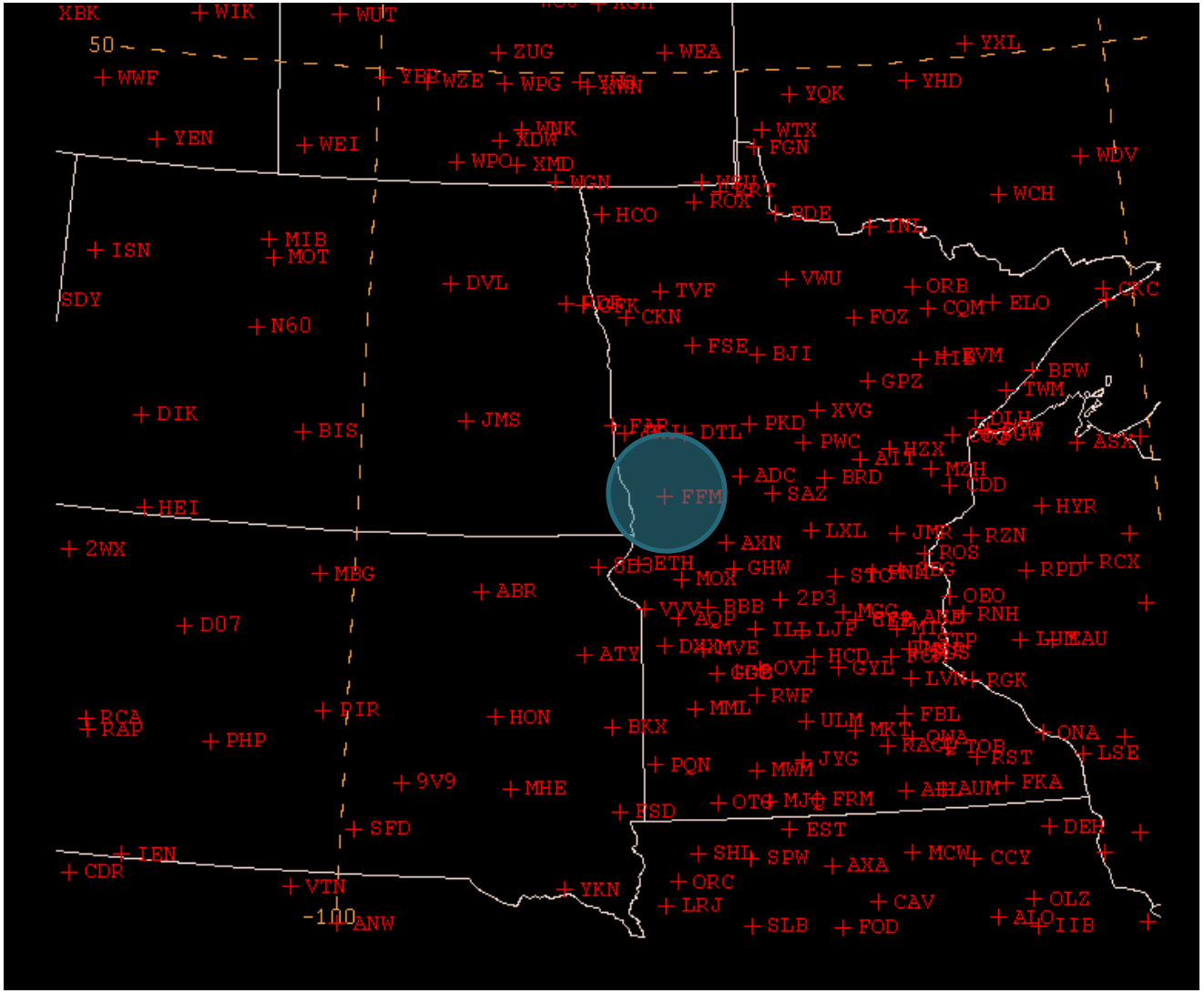
2005 Nov 28 – IR Loop 13Z-23Z



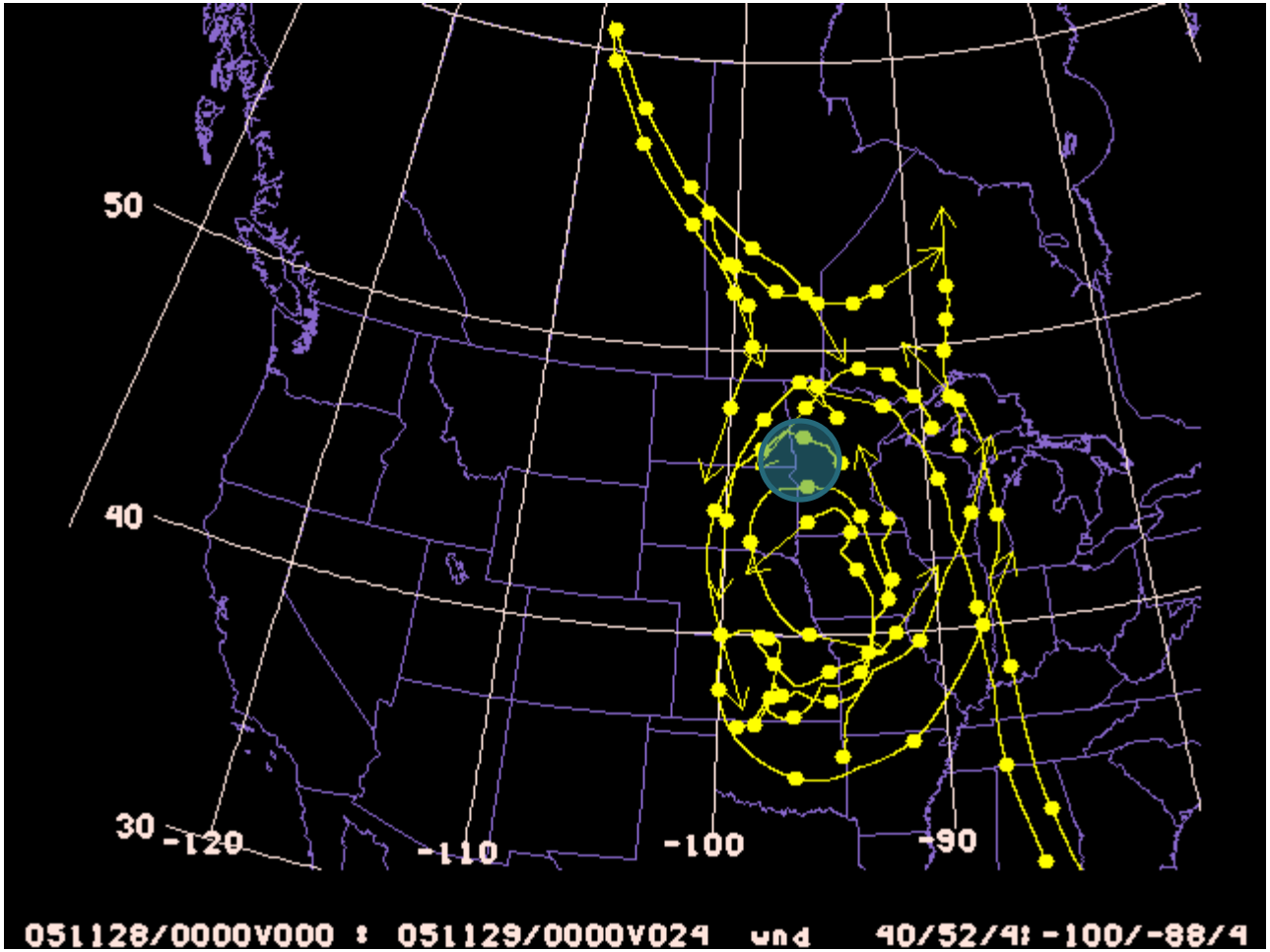
2005 Nov 28 – RADAR Loop 18Z-23Z



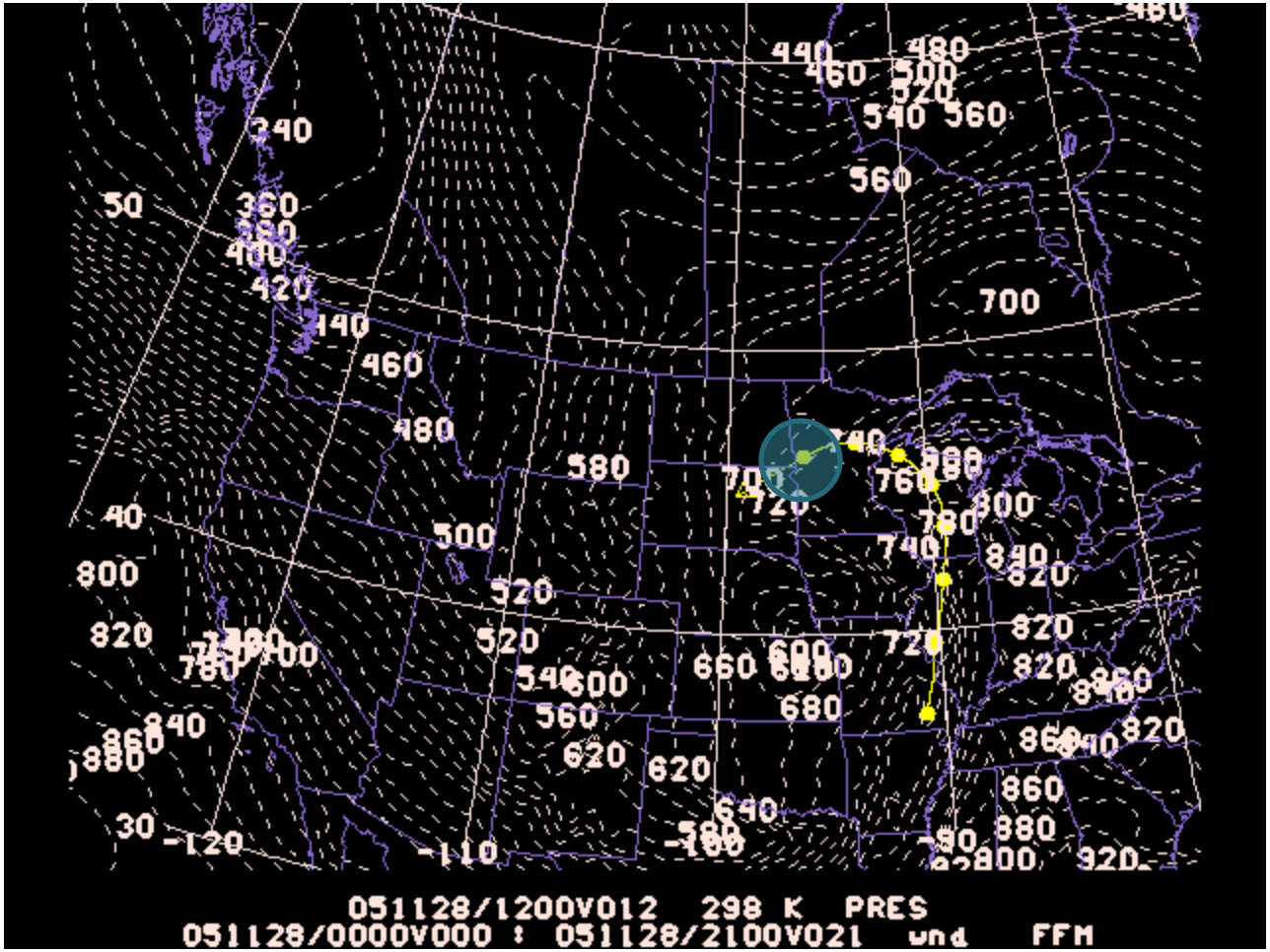
2005 Nov 28 - Fergus Falls, MN



2005 Nov 28 – 295K Trajectory Swarm

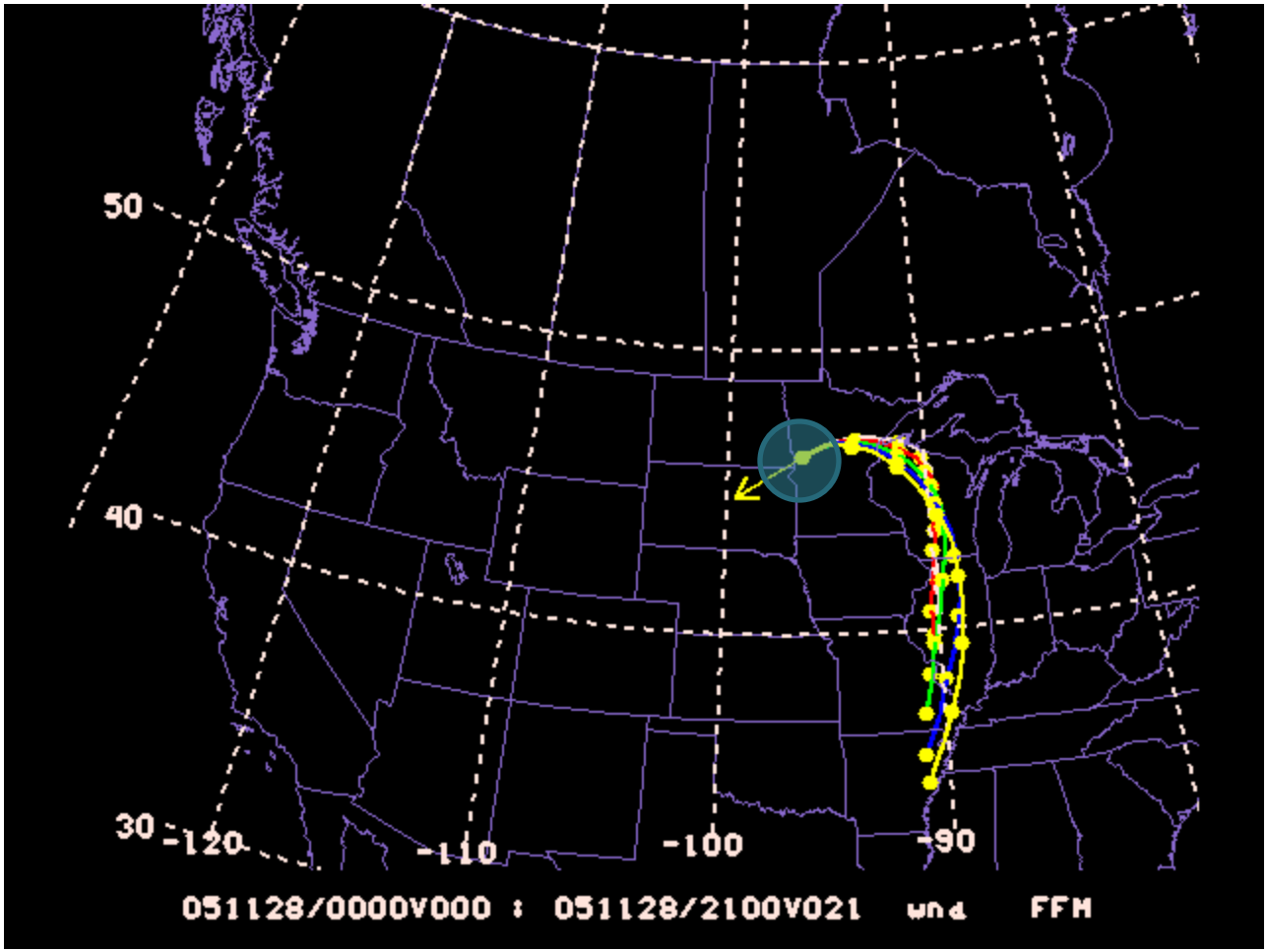


2005 Nov 28 – 21-hr 298K trajectory with pressure at F012



2005 Nov 28 – Vertical airstream structure

294K
white
296K
red
298K
green
300K
blue
302K
gold



Elevated Convection

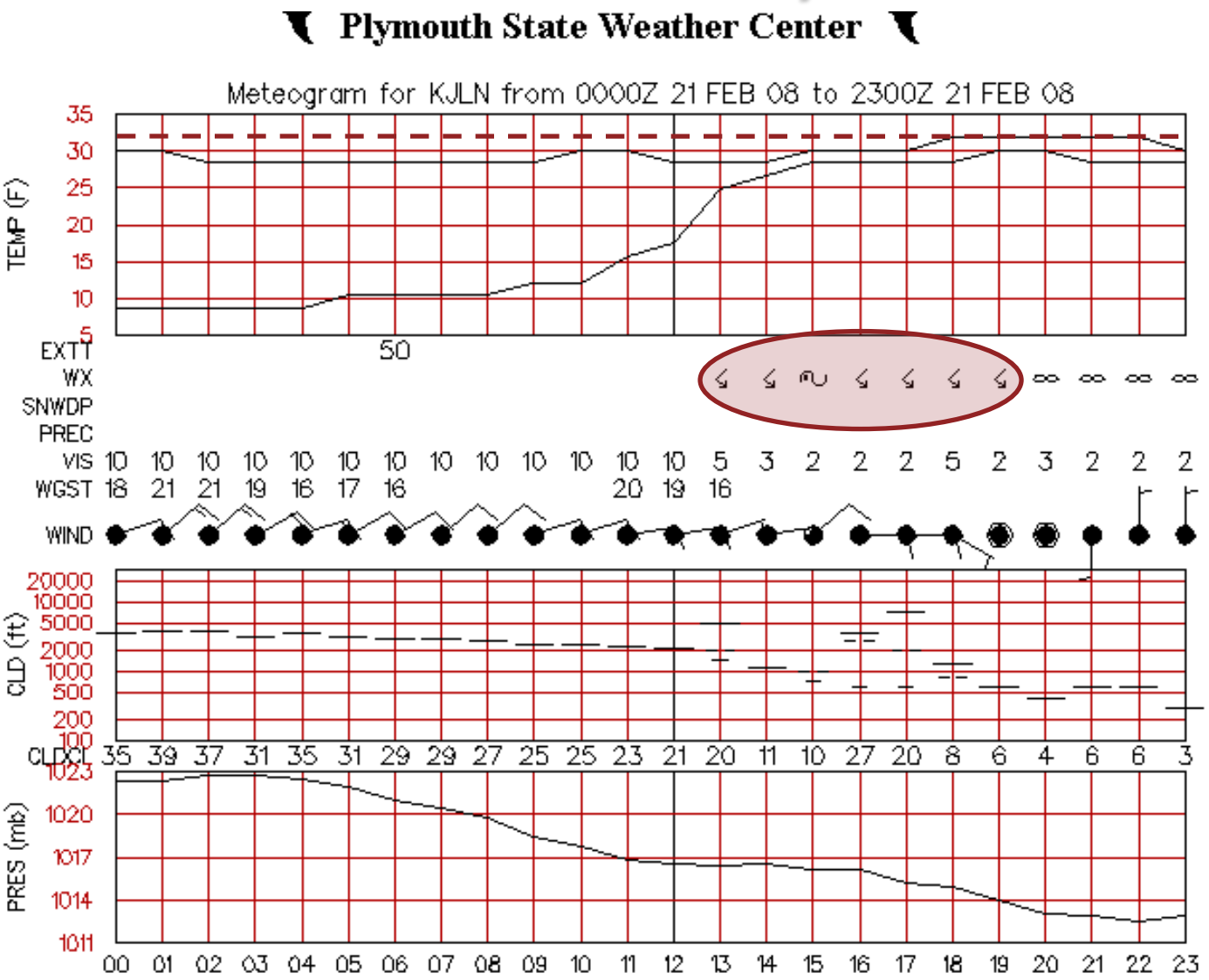
CASE STUDY

21 FEBRUARY 2008 - SW MISSOURI

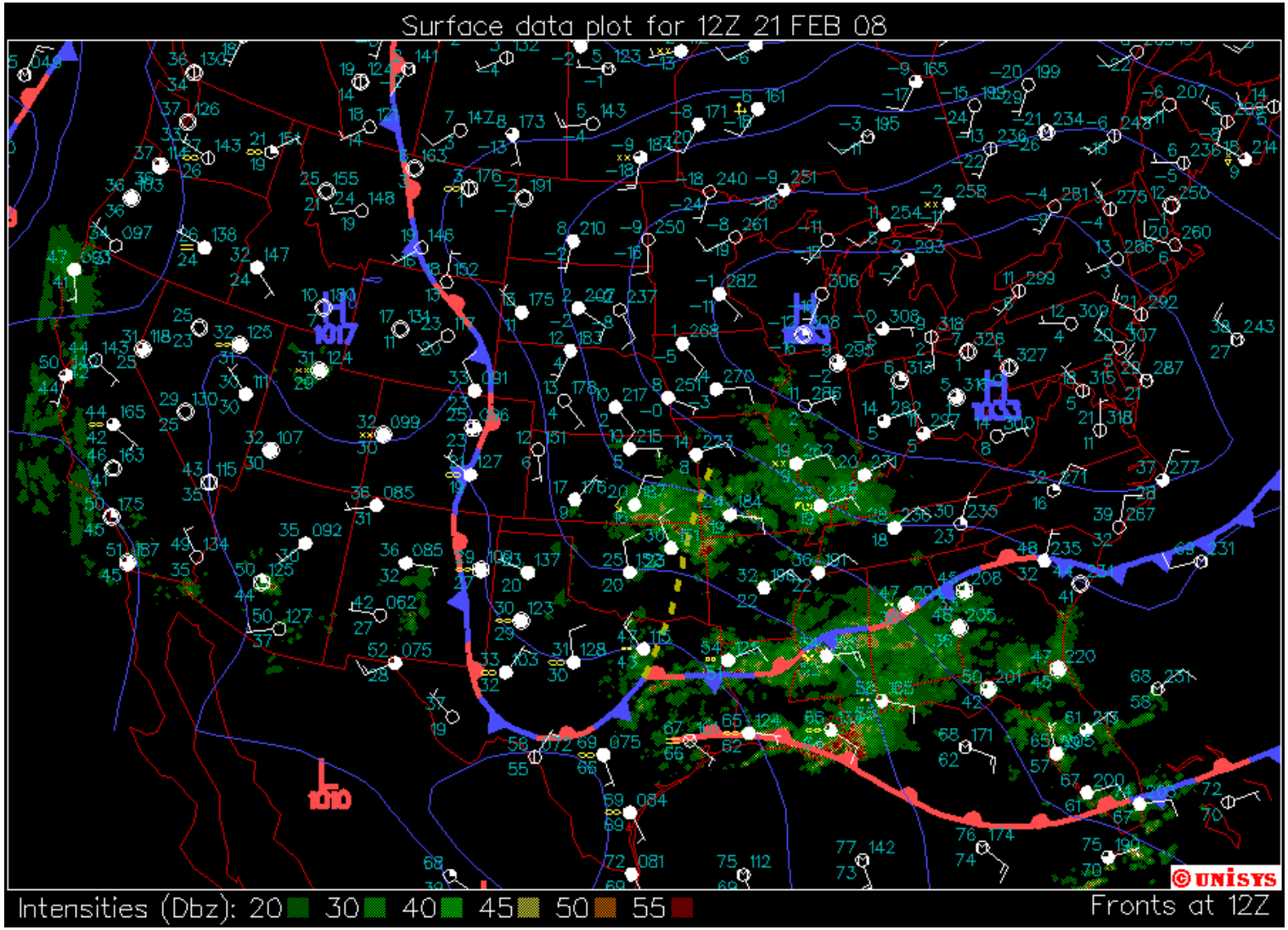
METARS – 21 February 2008

- KJLN 210753Z AUTO 05010KT 10SM OVC027 M02/M12 A3009
- KJLN 210853Z AUTO 07009KT 10SM OVC025 M02/M11 A3006
- KJLN 210953Z AUTO 07010KT 10SM OVC025 M01/M11 A3004
- KJLN 211053Z AUTO 08014G20KT 10SM OVC023 M01/M09 A3001
- KJLN 211251Z 08010G16KT 5SM **TS** -FZRA BR FEW015 BKN020 OVC055 **M02**/M04 A2999
- KJLN 211323Z 08011KT 4SM **TS** FZRA BR OVC013 **M02**/M04 A2997 RMK AO2 PRESFR P0003
- KJLN 211443Z 07010G14KT 1 3/4SM FZRA BR OVC007 M01/M03 A2998
- KJLN 211551Z 09009KT 3SM **TS** -FZRA BR FEW006 BKN027 OVC035 **M01**/M02 A2999 RMK AO2 TSB02 P0014
- KJLN 211639Z 10008KT 2 1/2SM **TS** FZRA BR SCT006 BKN020 OVC070 **M01**/M02 A2998
- KJLN 211728Z 10009KT 3SM TS -FZRA BR BKN006 OVC017 00/M02 A2994

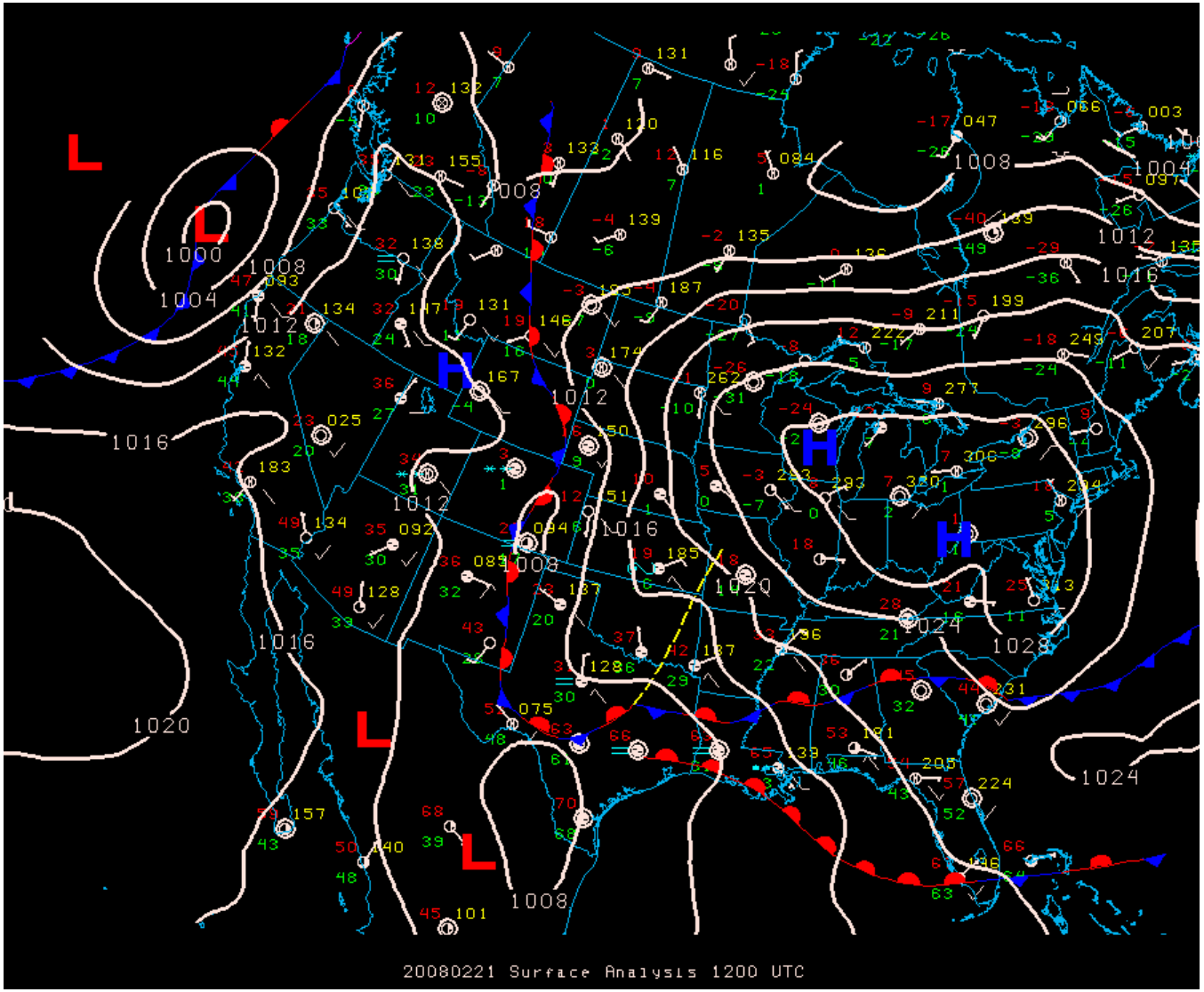
METARS – 21 February 2008



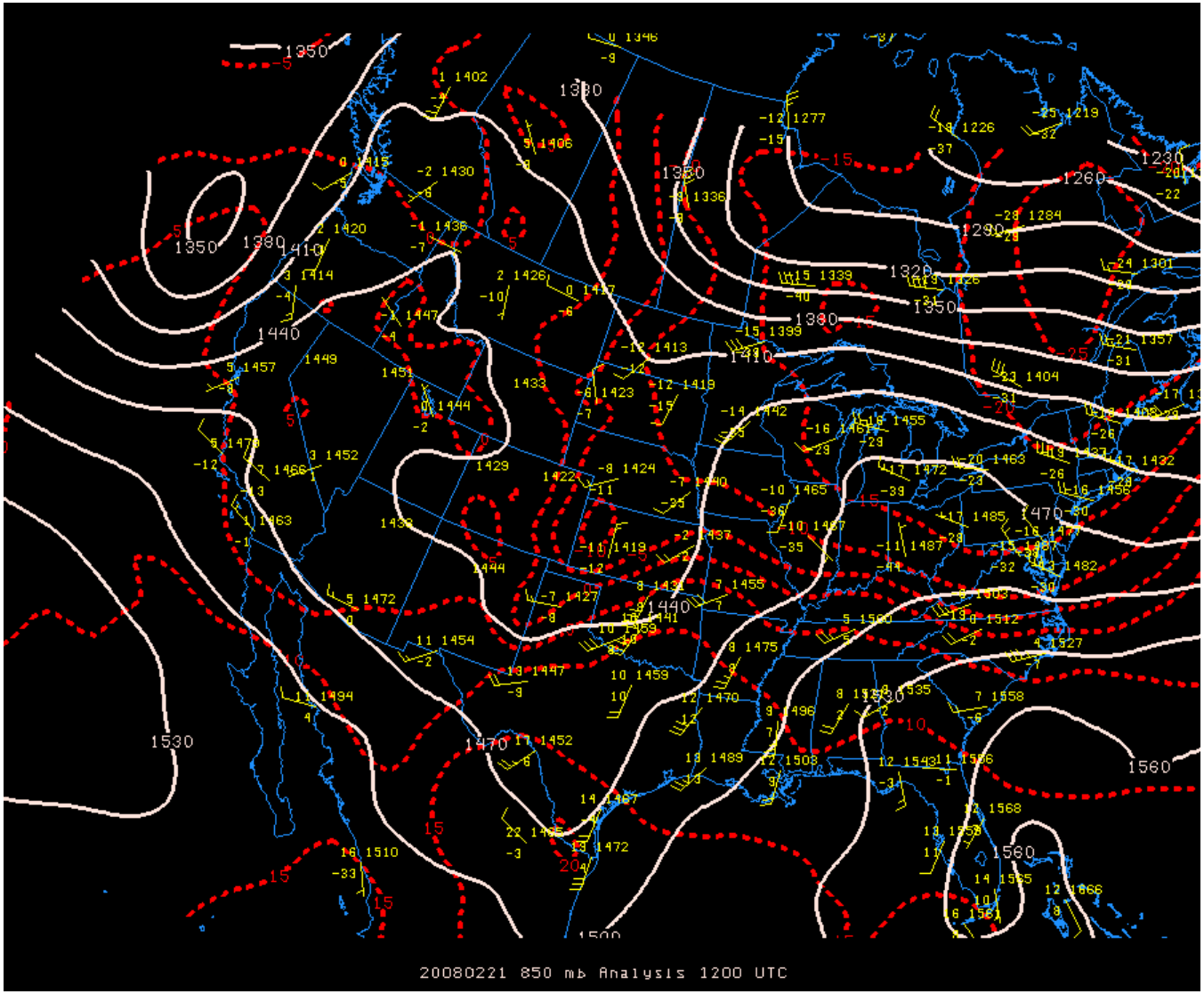
Surface – 12Z 21 February 2008



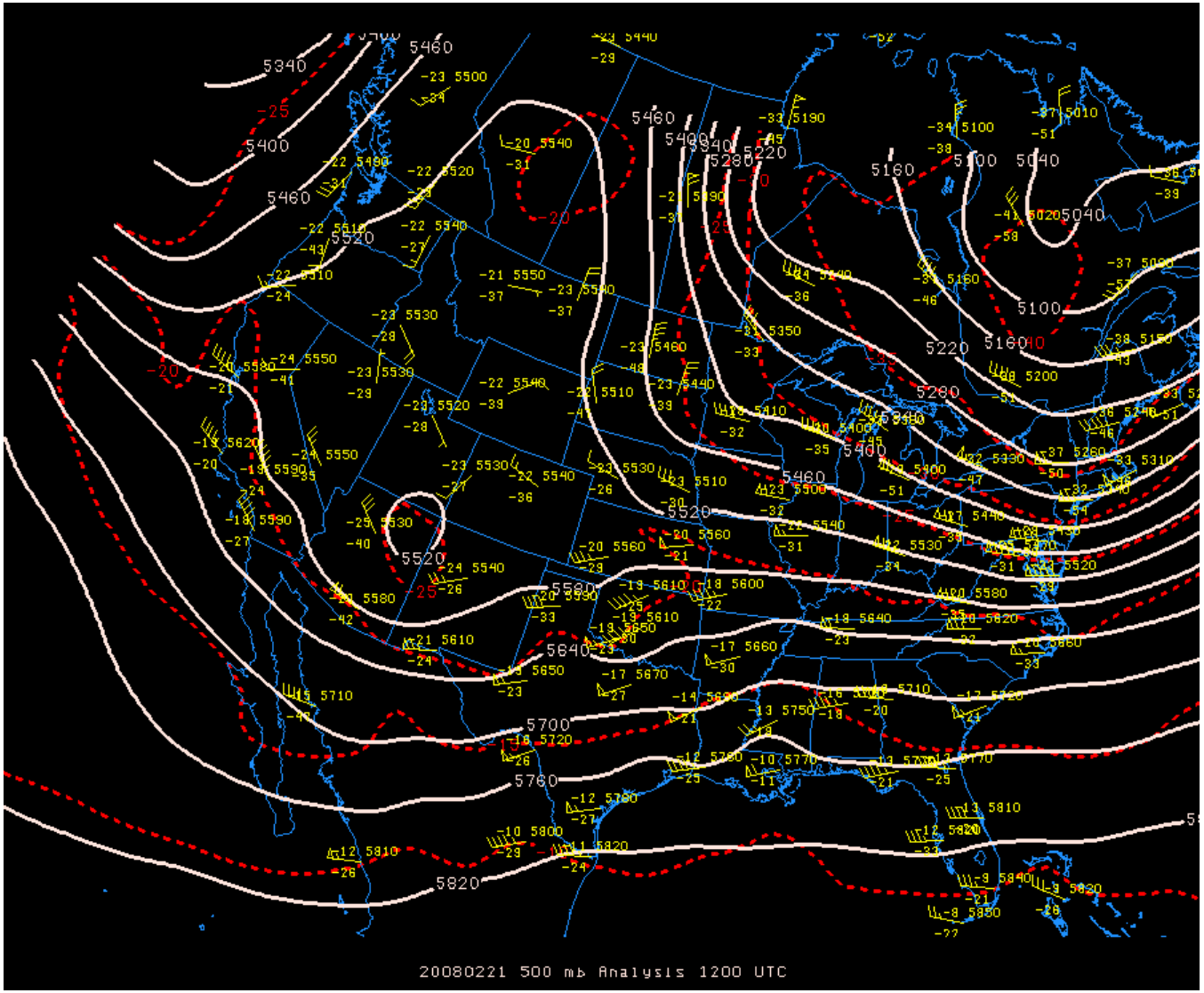
Surface – 12Z 21 February 2008



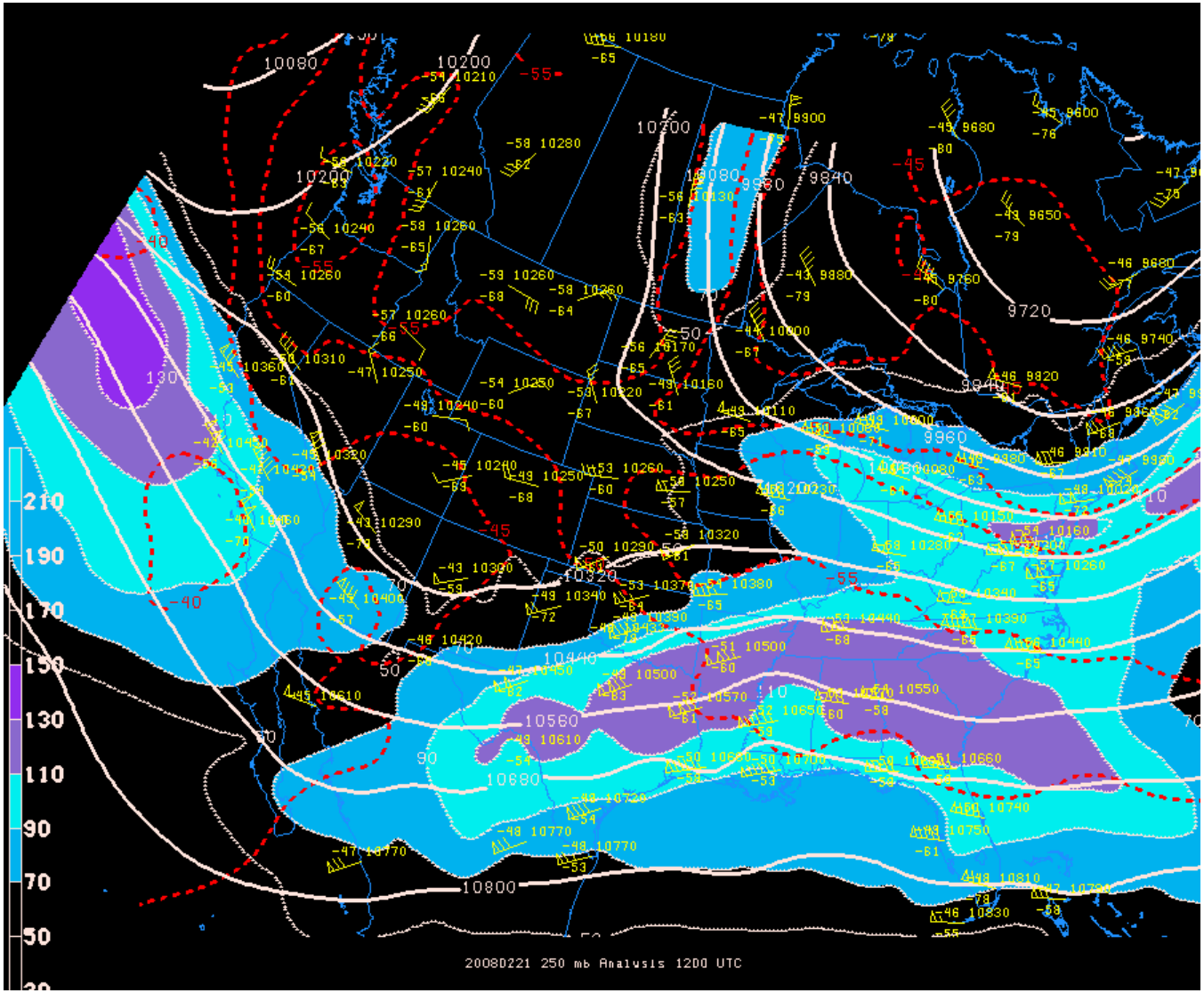
850 mb – 12Z 21 February 2008



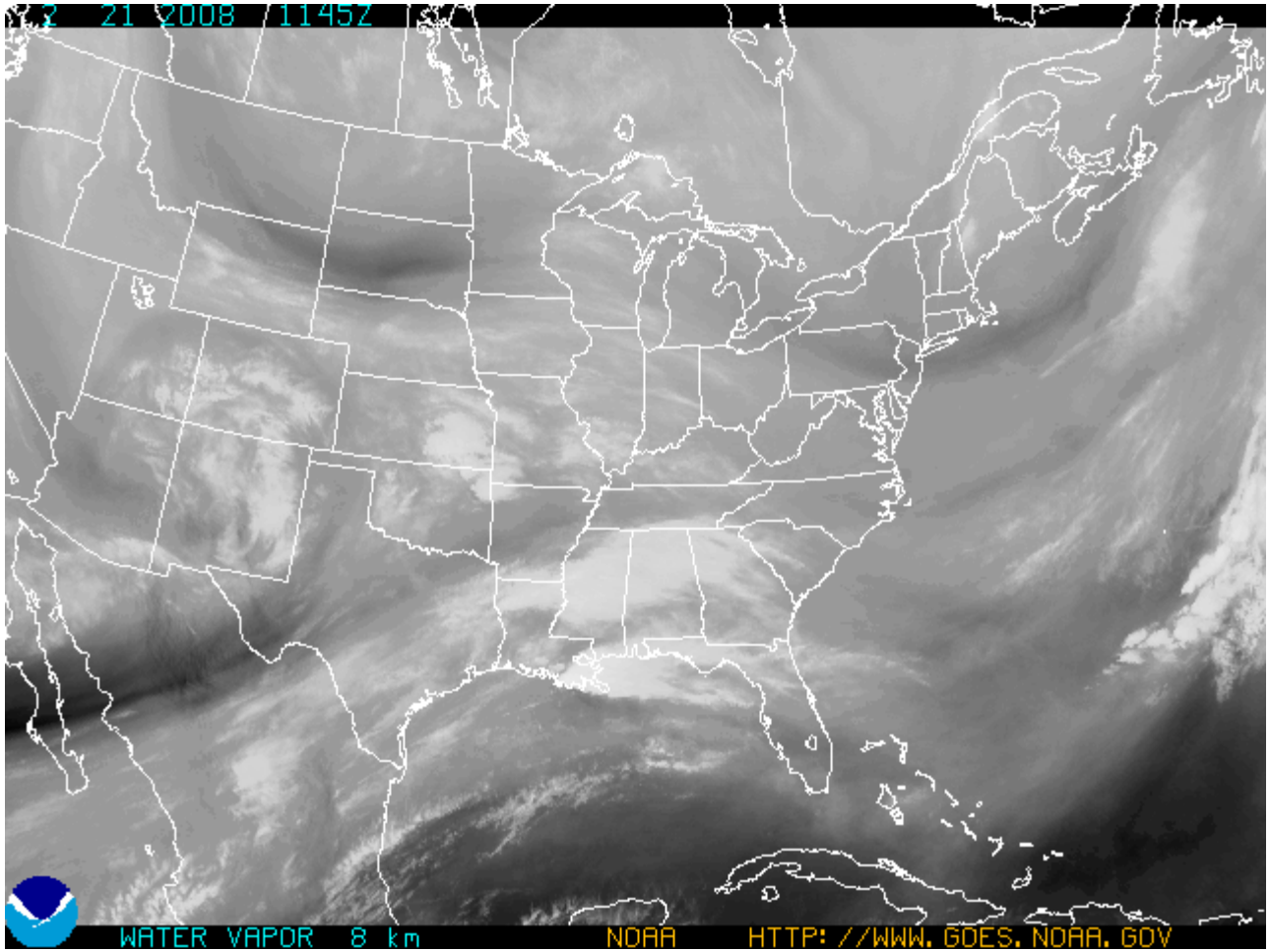
500 mb – 12Z 21 February 2008



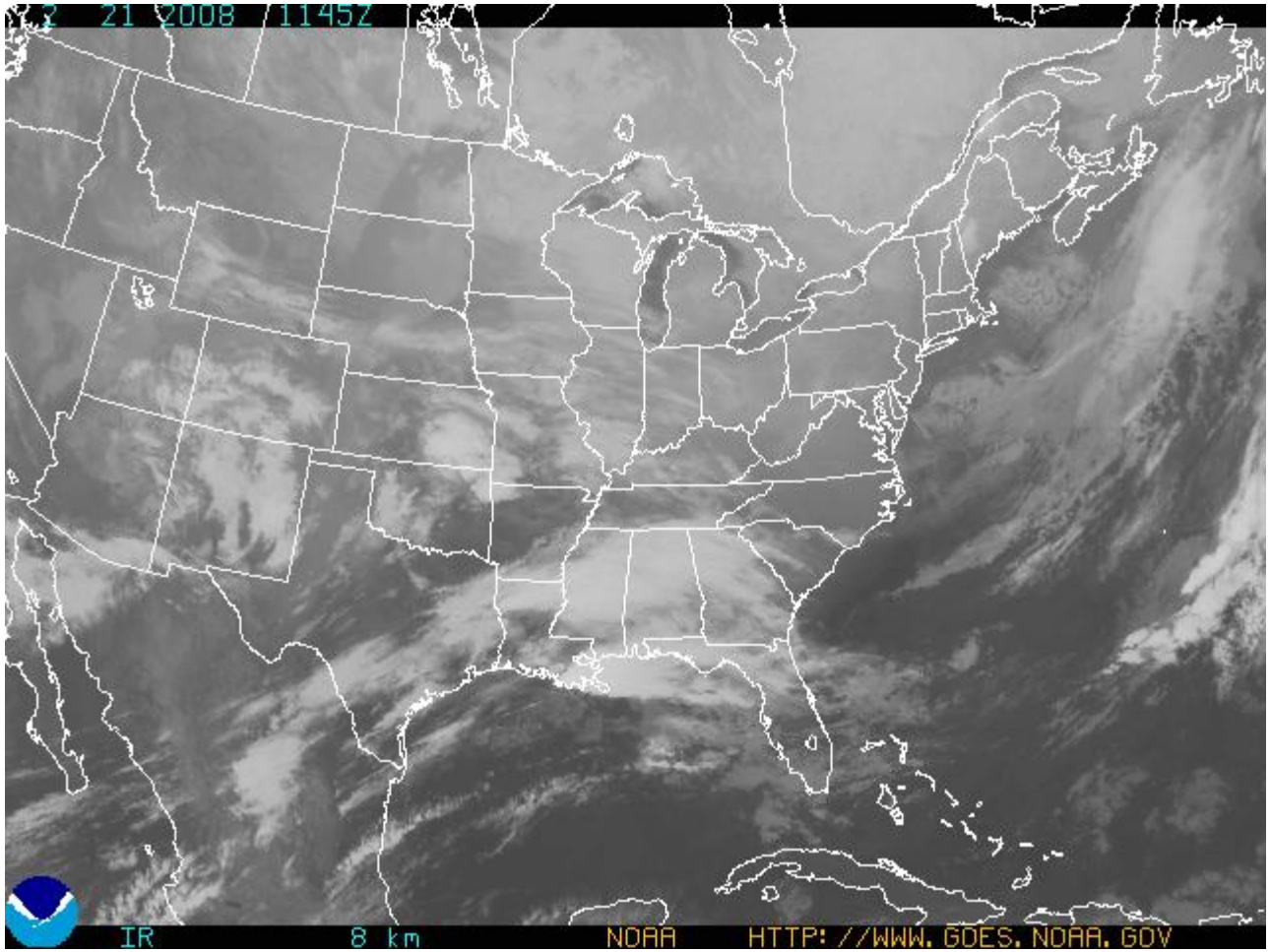
250 mb – 12Z 21 February 2008



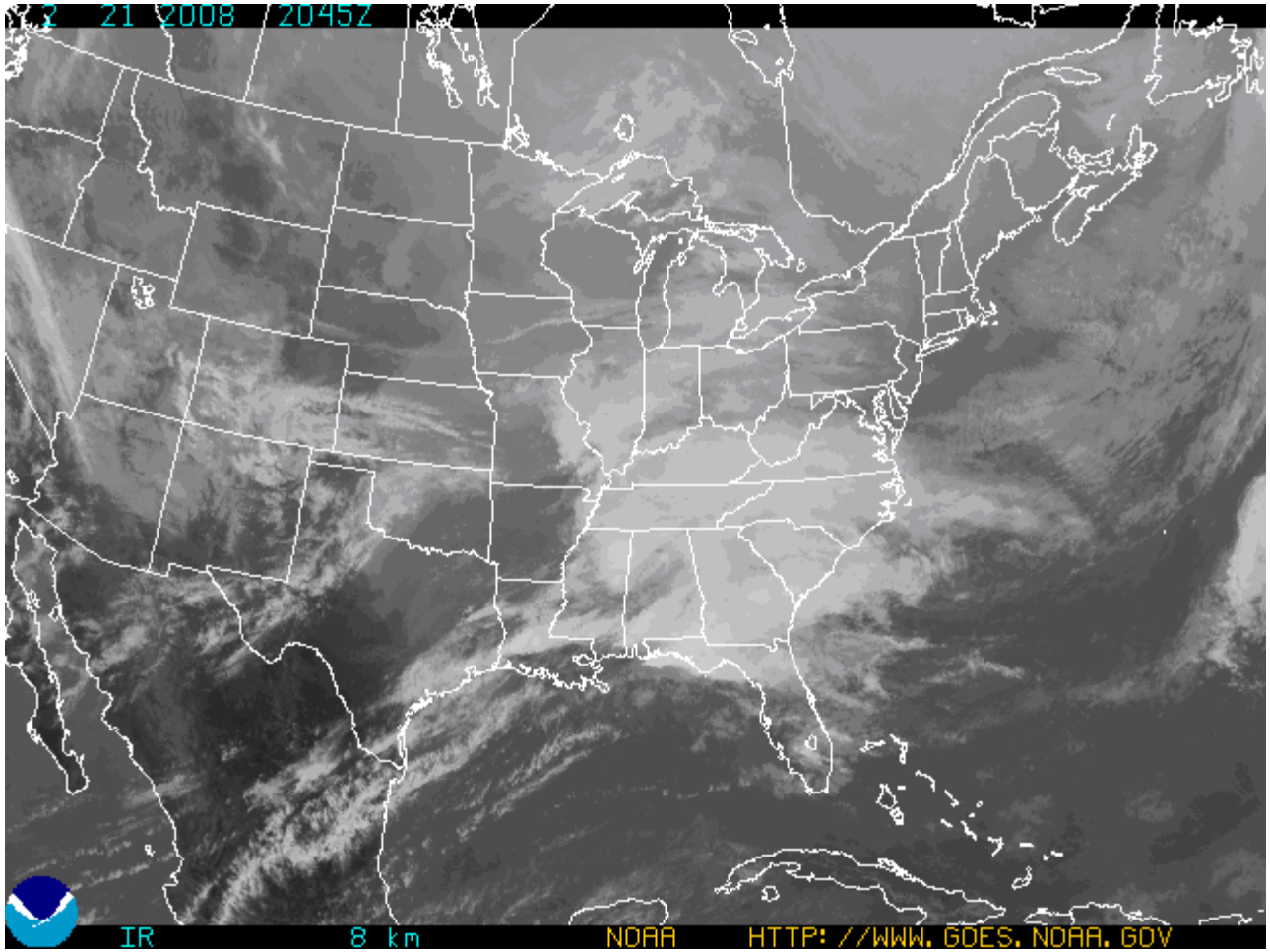
WV – 12Z 21 February 2008



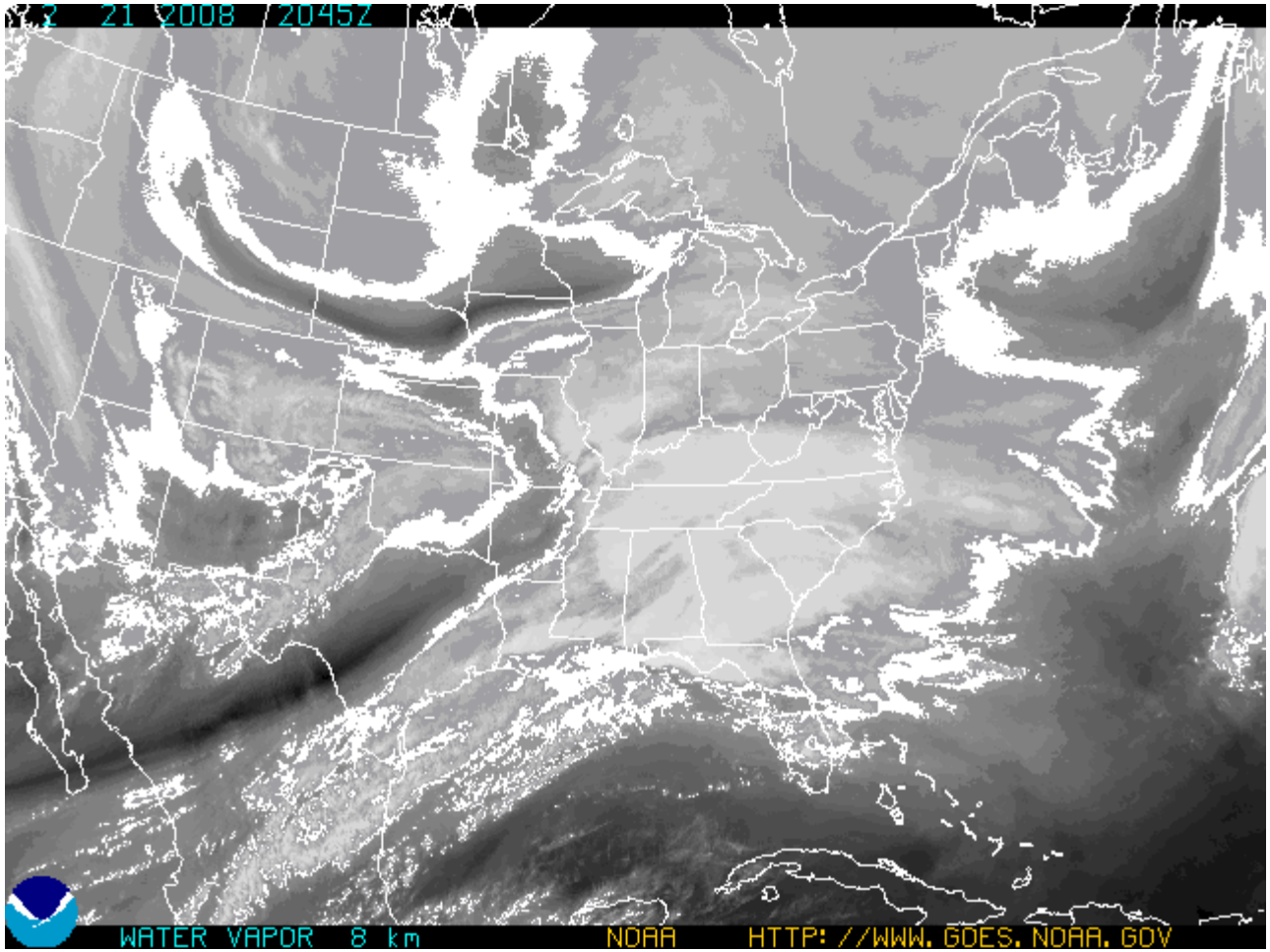
IR – 12Z 21 February 2008



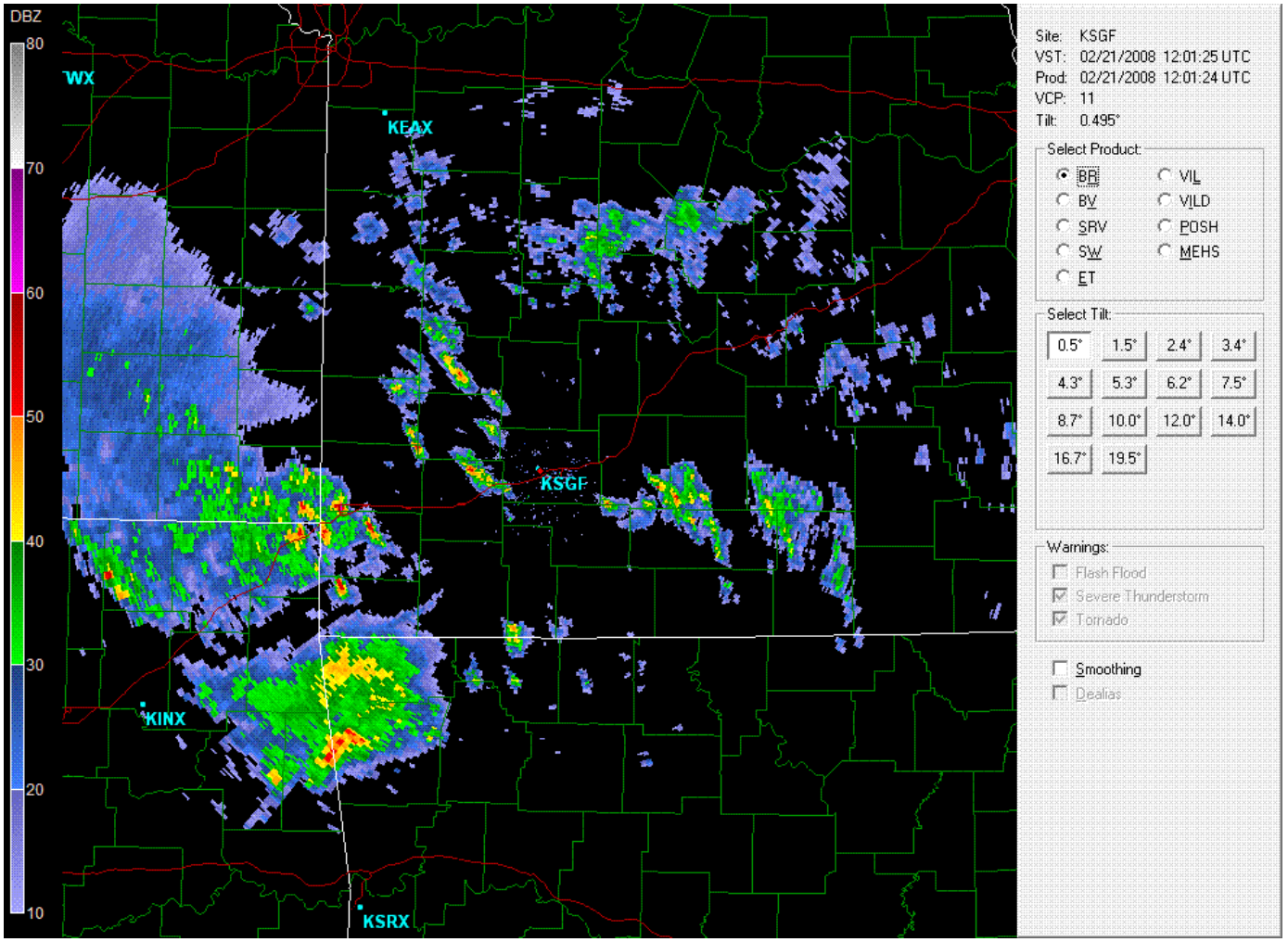
IR – 21 February 2008



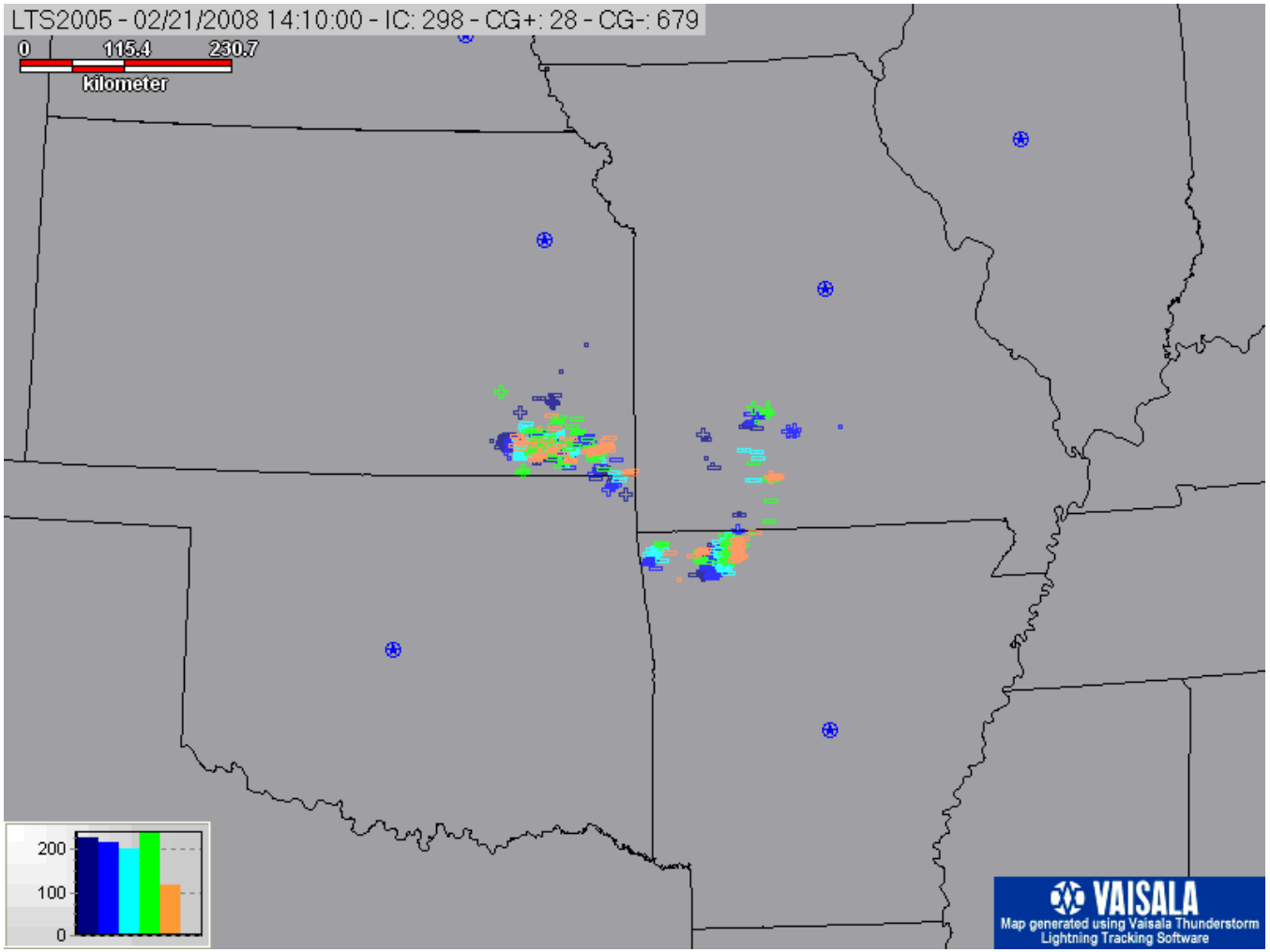
WV – 21 February 2008



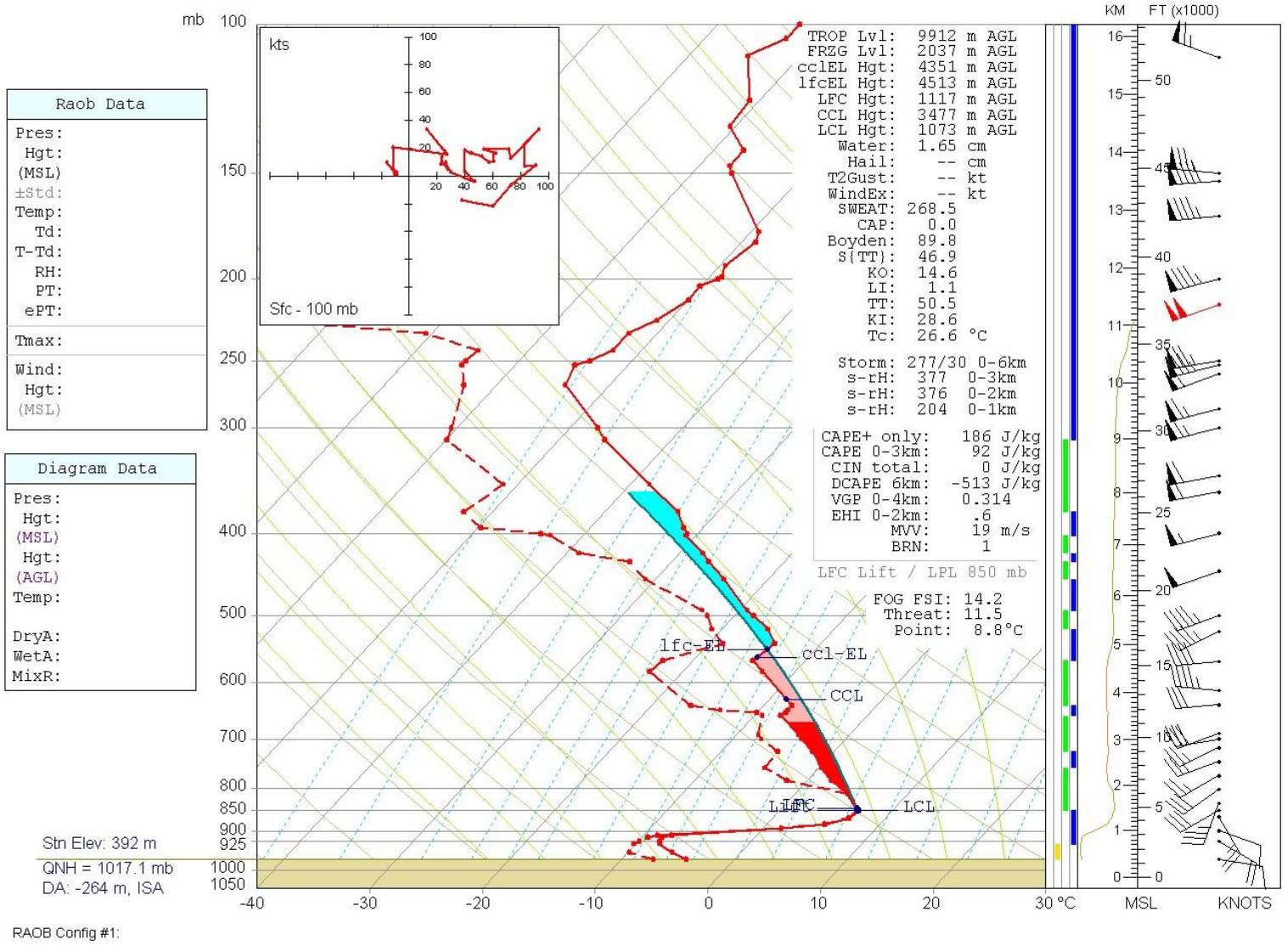
SGF 88D – 21 February 2008



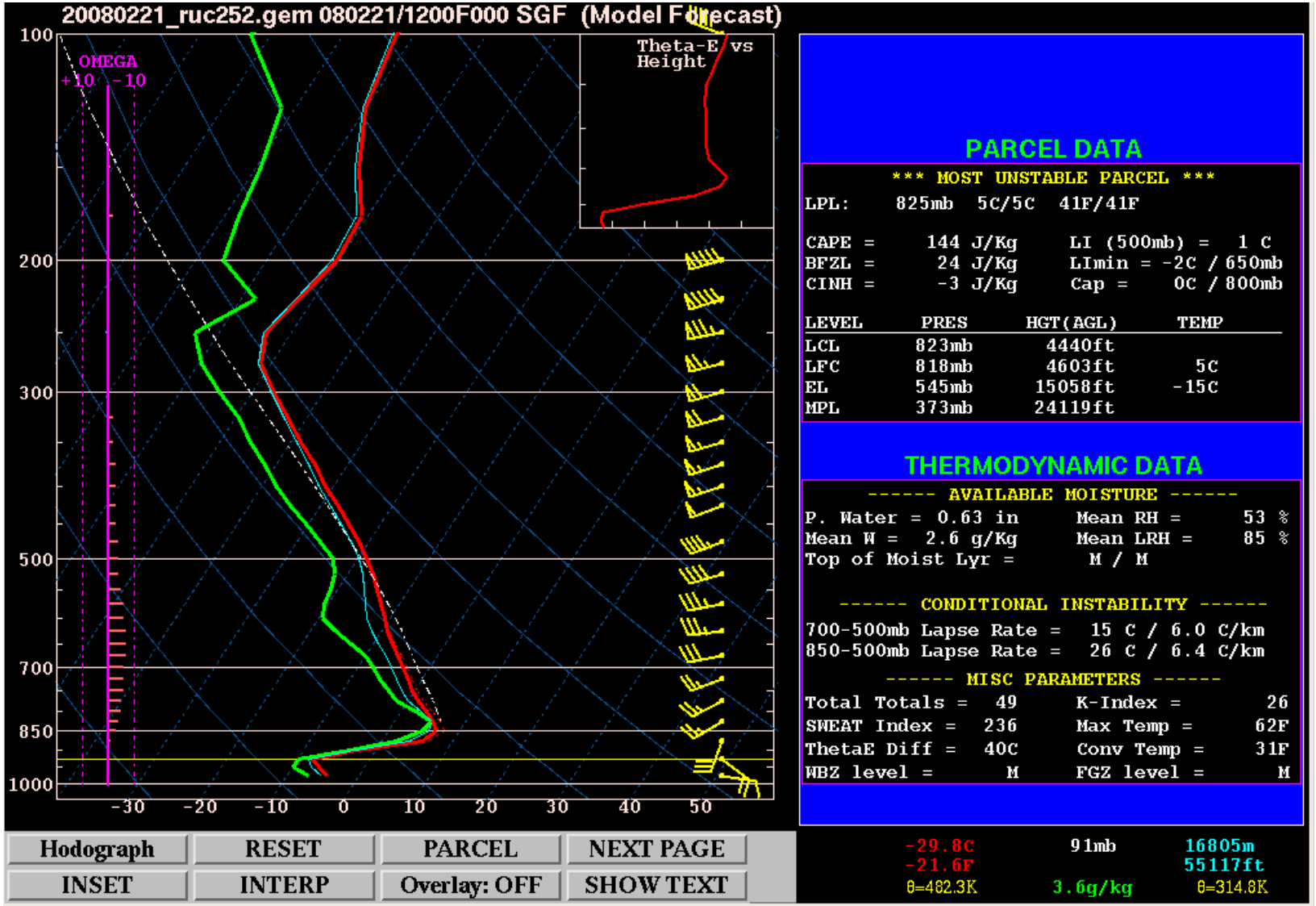
NLDN – 21 February 2008



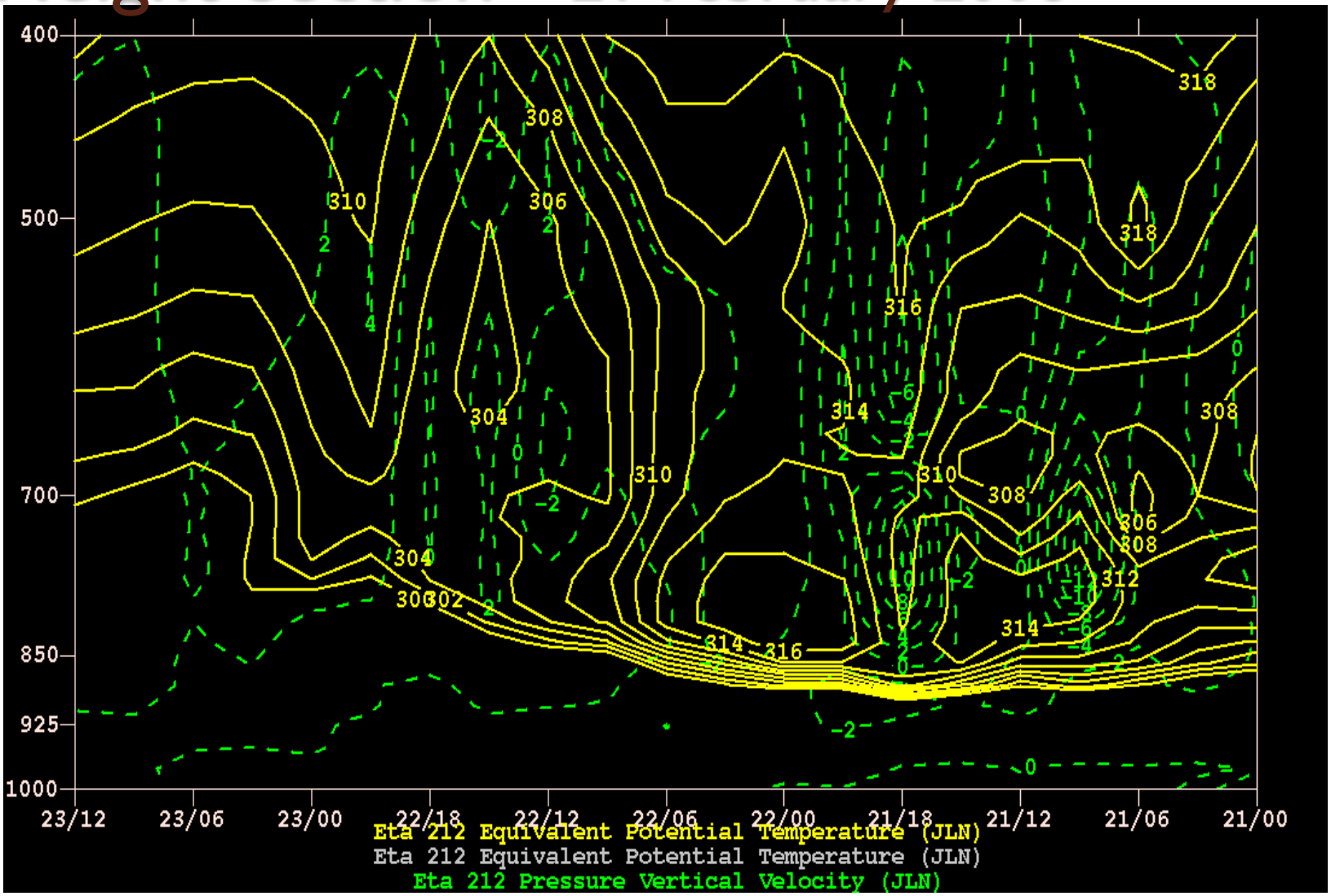
SGF sounding (OBS)
12Z - 21 February 2008



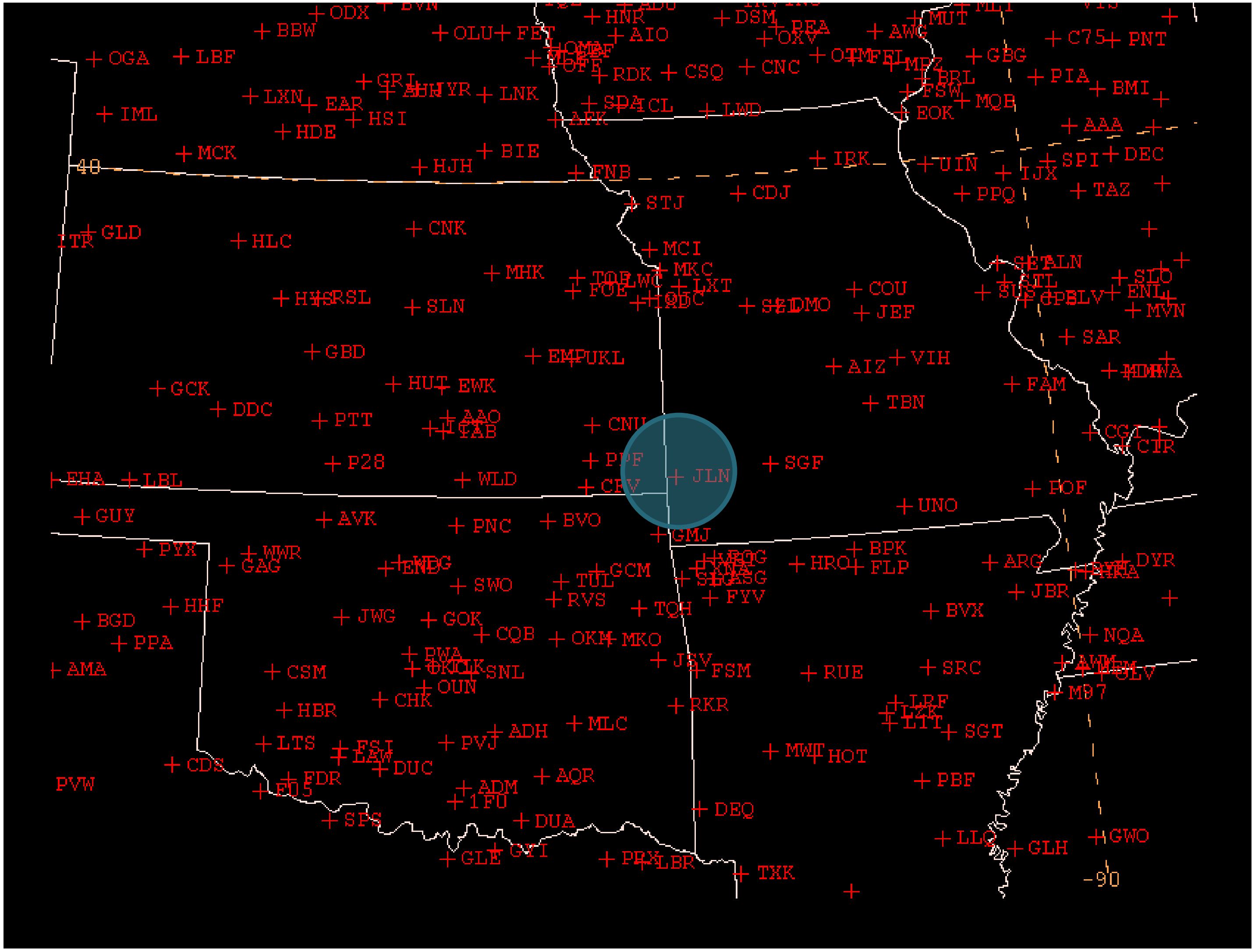
SGF sounding (RUC)
12Z - 21 February 2008



NAM Forecast - JLN Time Height Section - 21 February 2008



JLN



ODX
BBW
OLU
HNR
DSM
AWG
MUT
C75
PNT
OGA
LBF
AIO
OXV
GBG
RDK
CSQ
CNC
PIA
GRI
LNK
BRL
BMI
LXN
EAR
HSI
FSW
MQB
IML
EOK
HDE
AAA
MCK
BIE
IRK
UIN
SPI
DEC
40
HJH
FNB
IJX
STJ
CDJ
PPQ
TAZ
GLD
HLC
CNK
MCI
MHK
MKC
LXT
COU
SLN
JEF
MVN
SAR
GBD
AIZ
VIH
GCK
HUT
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FAM
DDC
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GUY
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BVO
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ADH
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HOT
PVW
FDR
AQR
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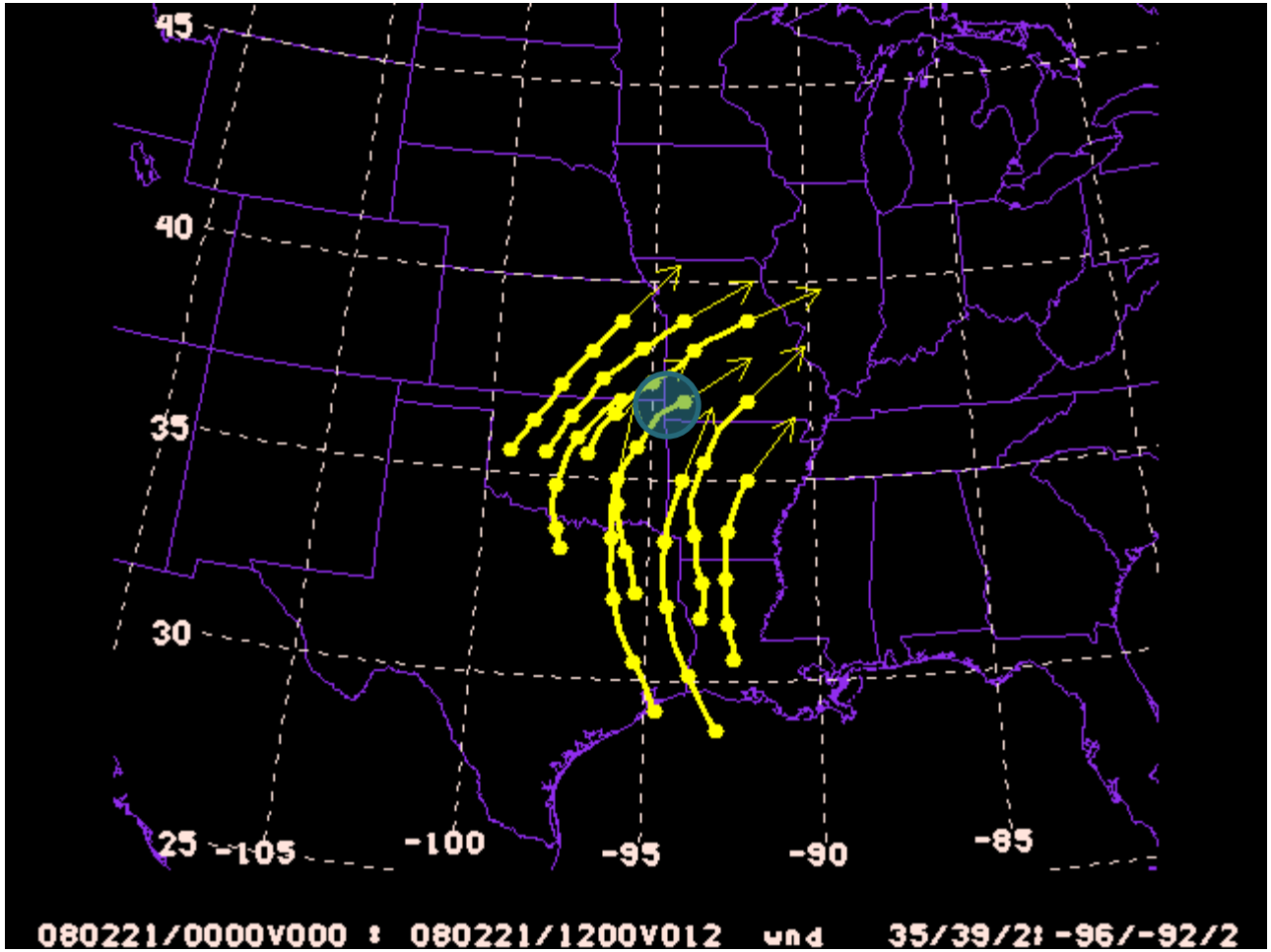
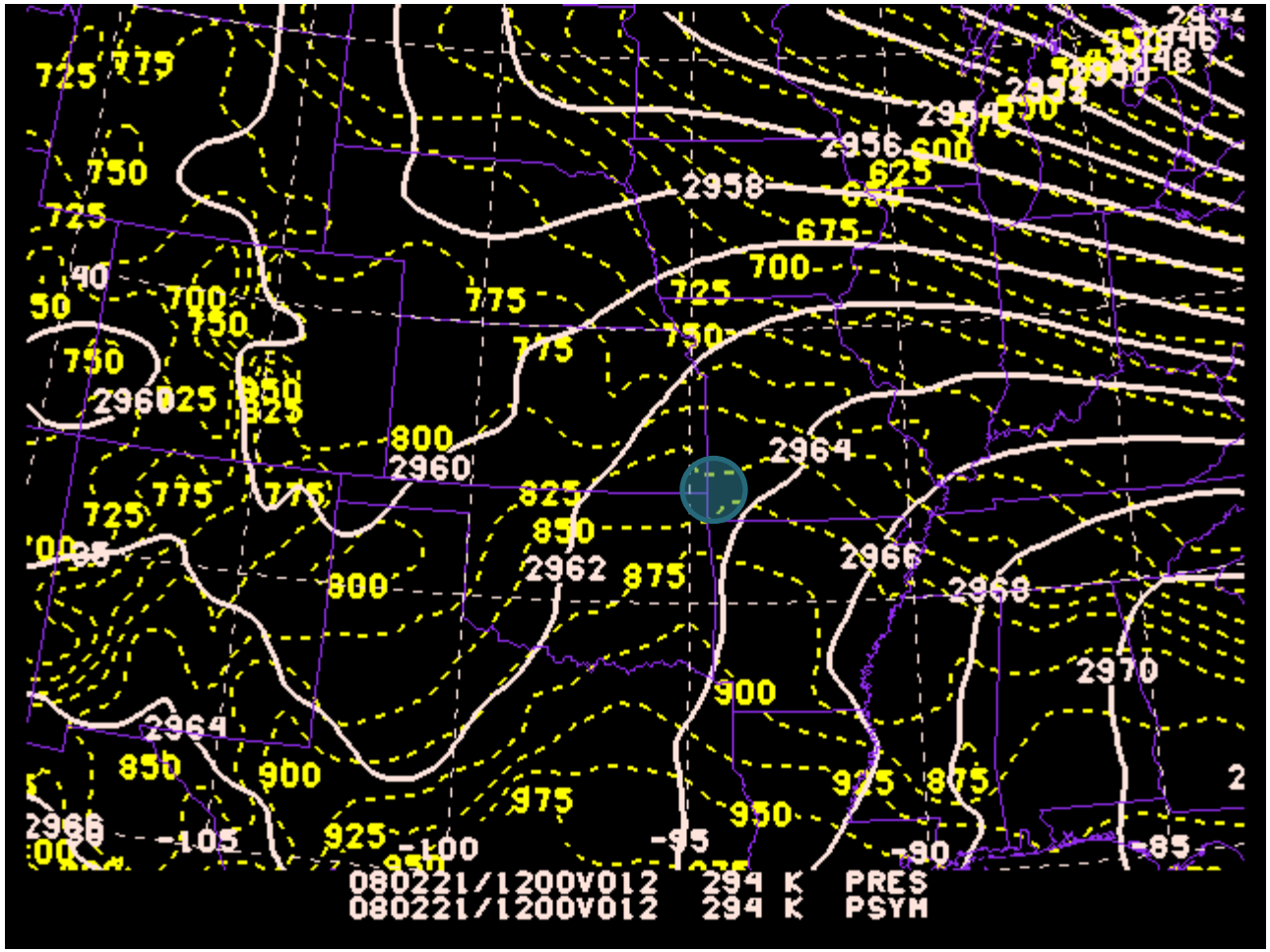
-90

NAM-WRF – 294K Trajectory swarm
F000-F012 from 00Z 21 February 2008 run

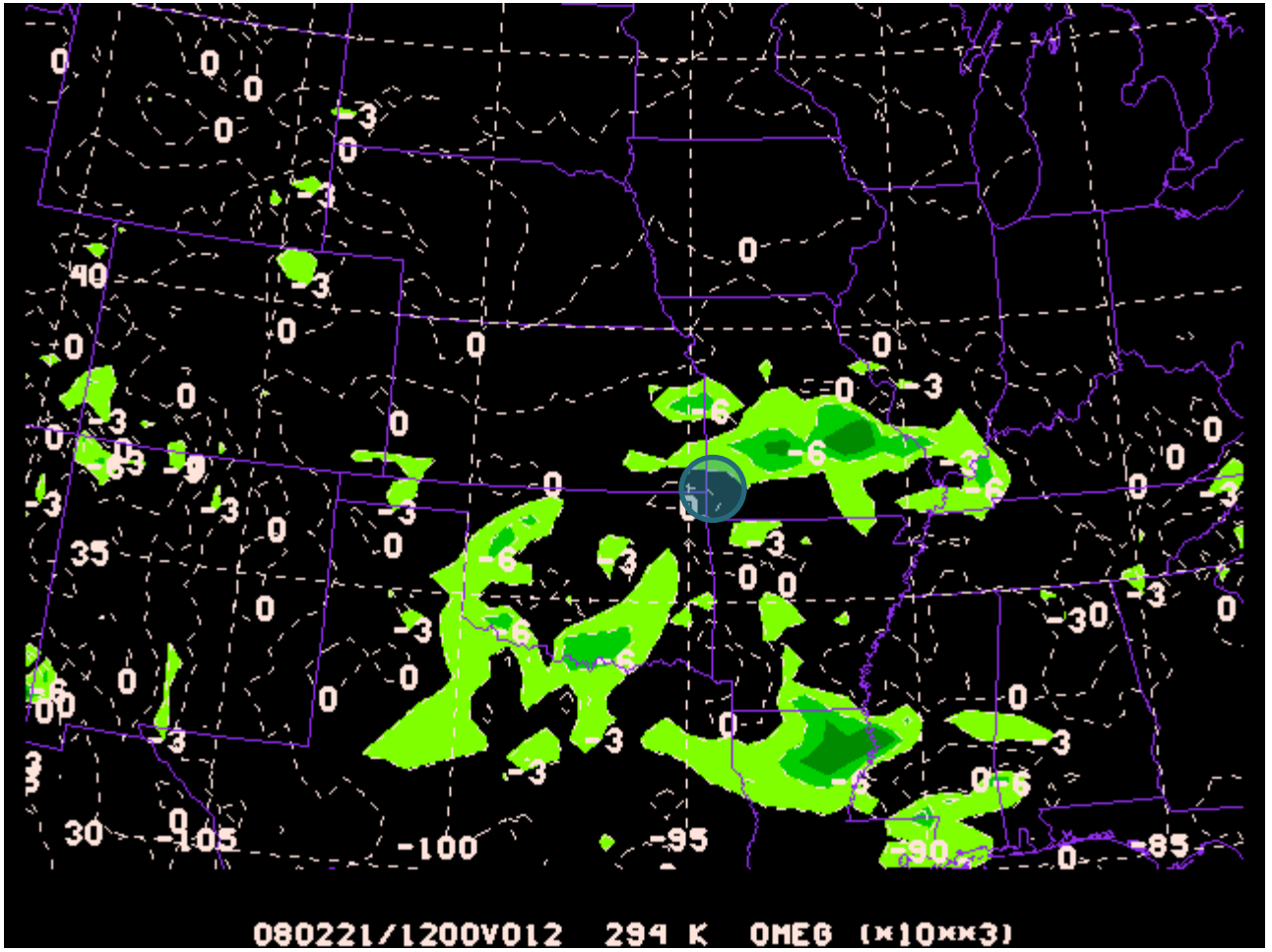


NAM-WRF Forecast 294K

p and Ψ, F012 from 00Z 21 February 2008

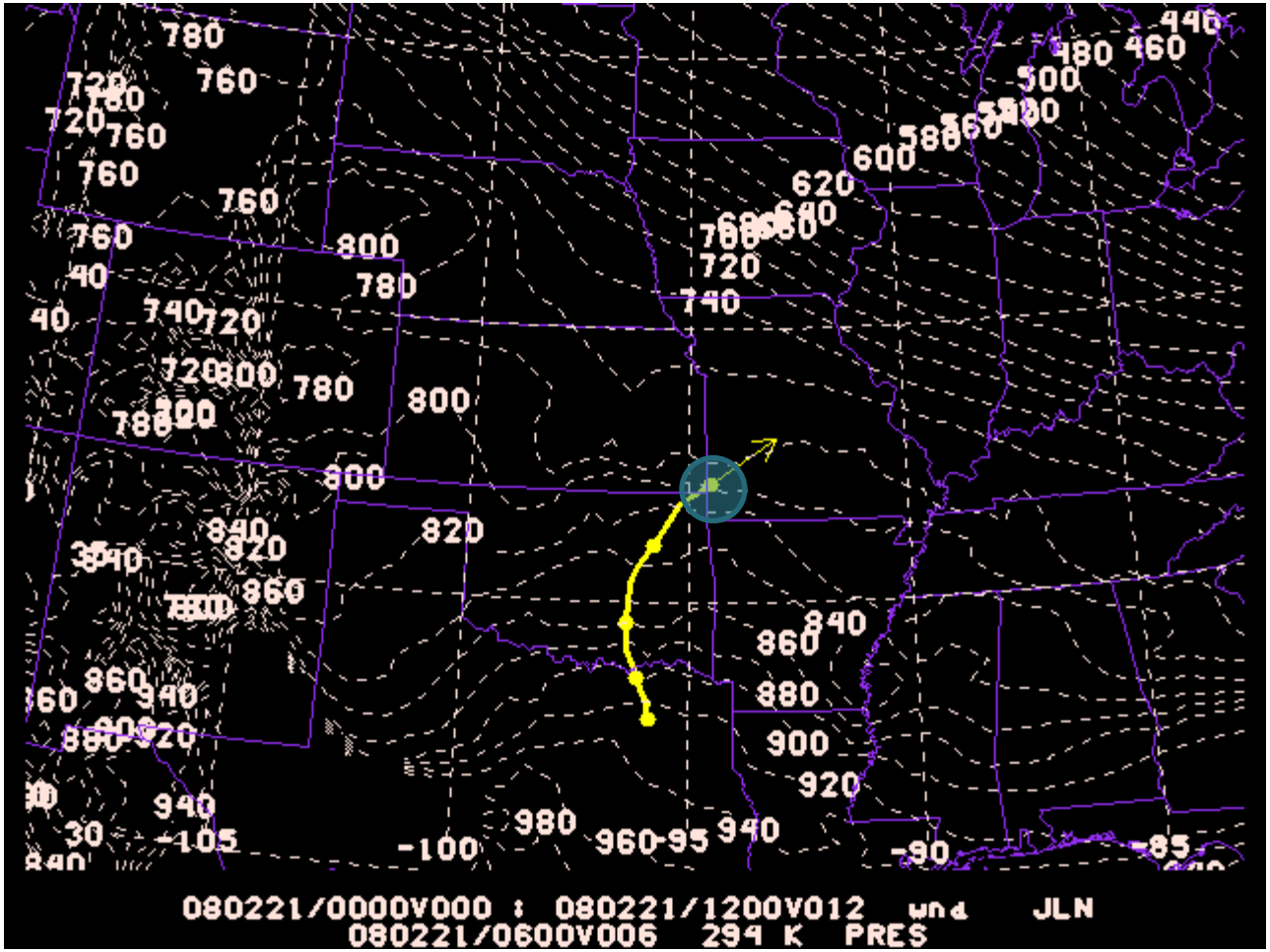


NAM-WRF Forecast 294K
ω, F012 from 00Z 21 February 2008



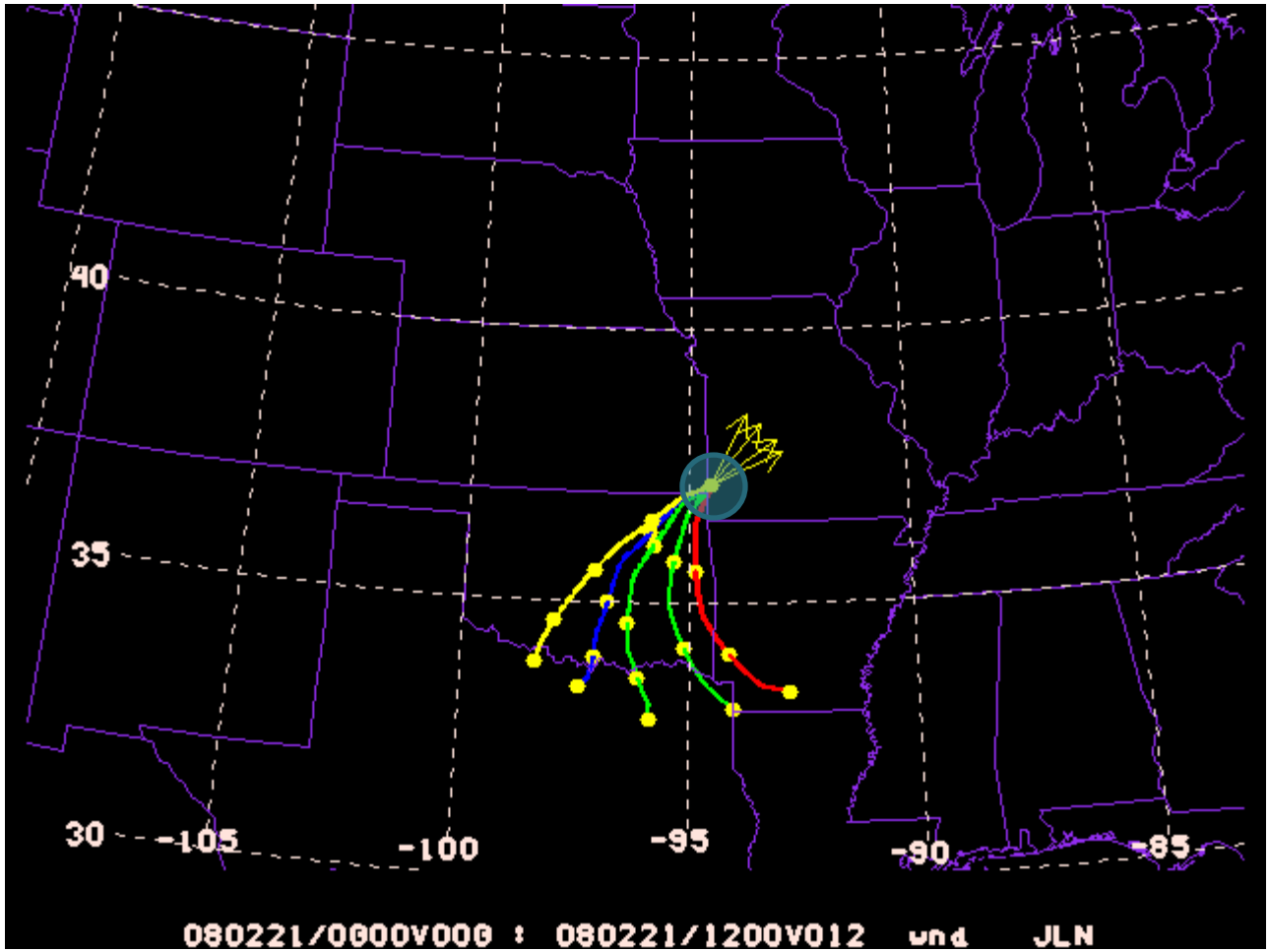
NAM-WRF Trajectory – 294K

F000-F012 from 00Z 21 February 2008 run



NAM-WRF Vertical airstream structure F000-F012 from 00Z 21 February 2008 run

290K
red
(9 hr)
292K
green
(9 hr)
294K
green
296K
blue
298K
gold



Summary

- Subtle differences can influence trajectory
  - Horizontal location
  - Vertical location
  - Time period of trajectory

- Parcel "crashes" not always a bad thing
  - Help to define origins of air feeding convection

Thank you!

- Comments?
- Questions?
- Crisiticism?

marketp@missouri.edu

http://weather.missouri.edu