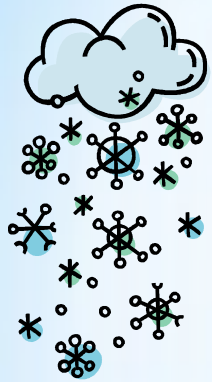
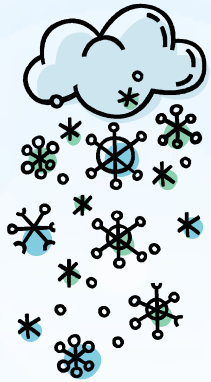
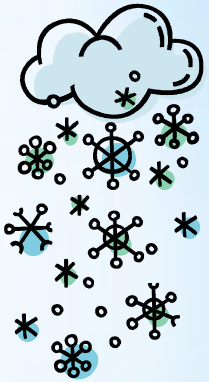




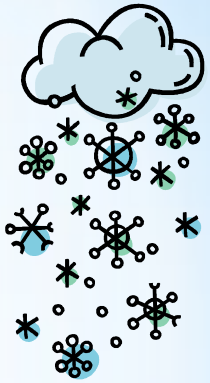
February 29th Winter Event

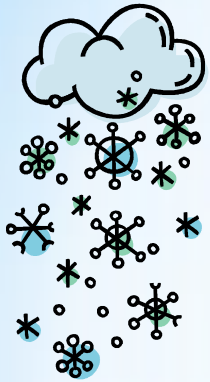
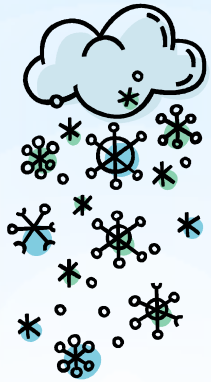
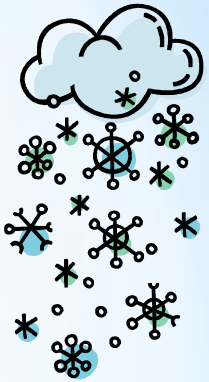
Presented By

Jane Marie and Keith

What are we Talking About

- Event Overview
- Synoptic Analysis and Model Comparison
- Isentropic Analysis
- Frontogenesis
- Cross Sections
- Soundings/Snow Ratios
- Remote Sensing Imagery and Observations
- How Did We Do?
- What DSS Did We Provide?
- Conclusions



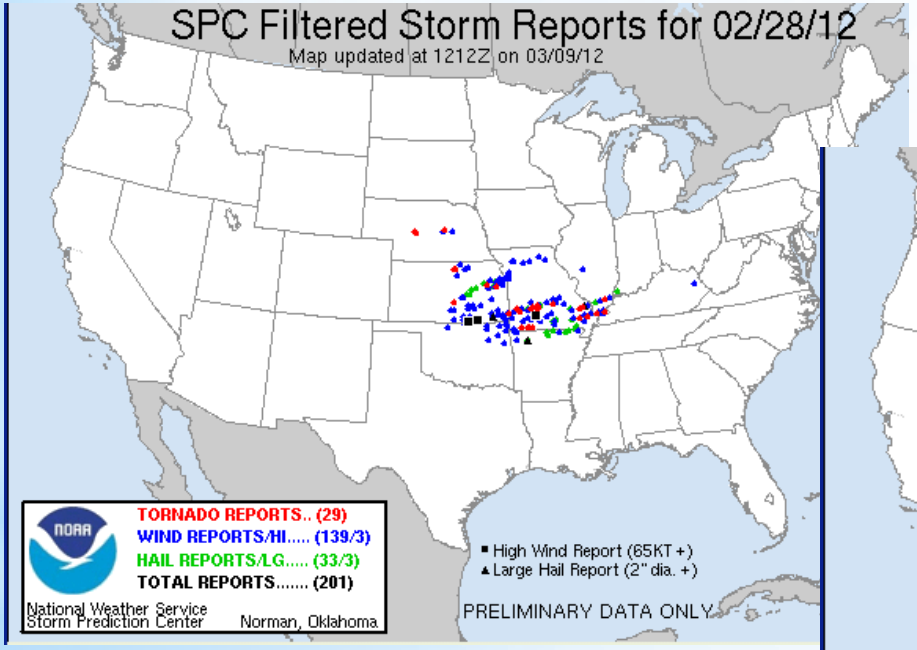
Event Overview

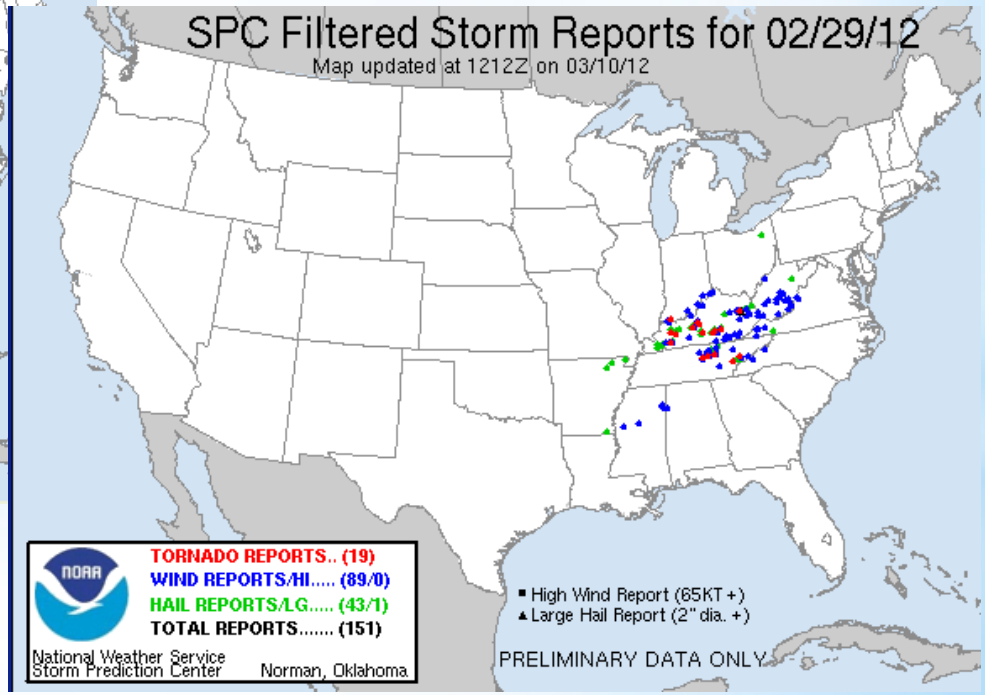
* A deepening low pressure system moving to the northeast across the plains produced a strong cold front with an influx of warm moisture ahead of it. This spawned a line of severe weather affecting the Central Plains eastward to the Ohio River Valley, blizzard conditions across South Dakota, and widespread rain and snow across the Upper Great Lakes Region.

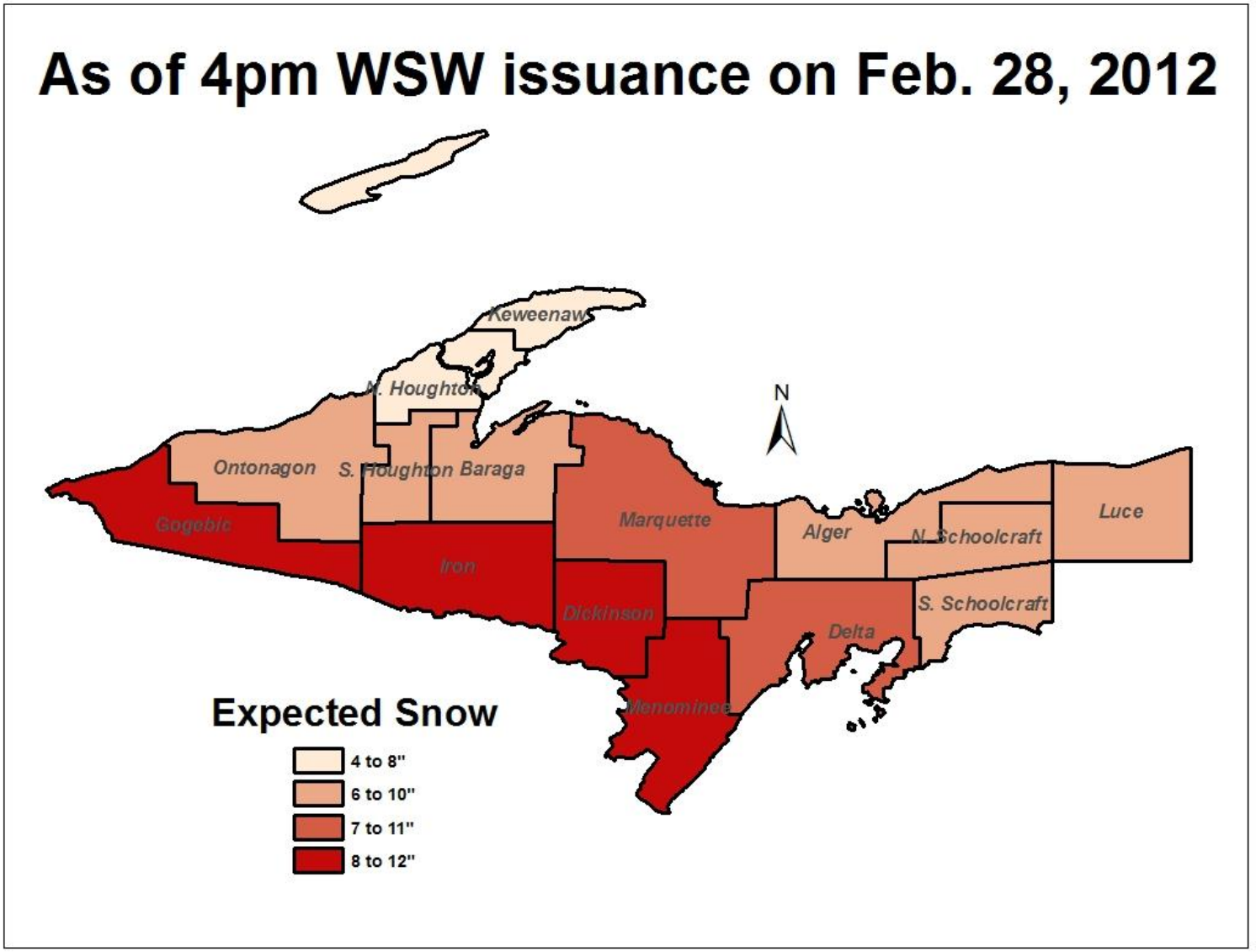
* As the system stalled out over Minnesota, a snow band set up across the Upper Michigan/Wisconsin border, bringing heavy snow for much of the day in this location. The snow band would eventually moved northward across the remainder of Upper Michigan as system finally progressed eastward.

* Models had a fairly good handle on the event, helping forecasters to prepare and ultimately make a good assessment of the storm to come.

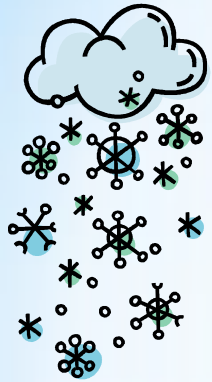
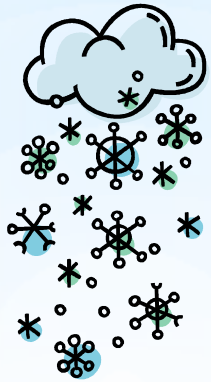
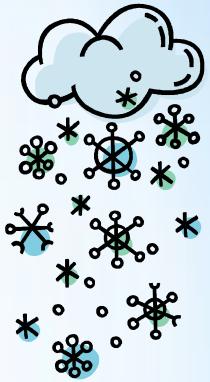
* http://linux1.oax.noaa.gov/php/mesoanalysis2/anis/index.php?year=2012&month=02&day=29&hour=23&sector=19&product=rgnlrad&duration=24



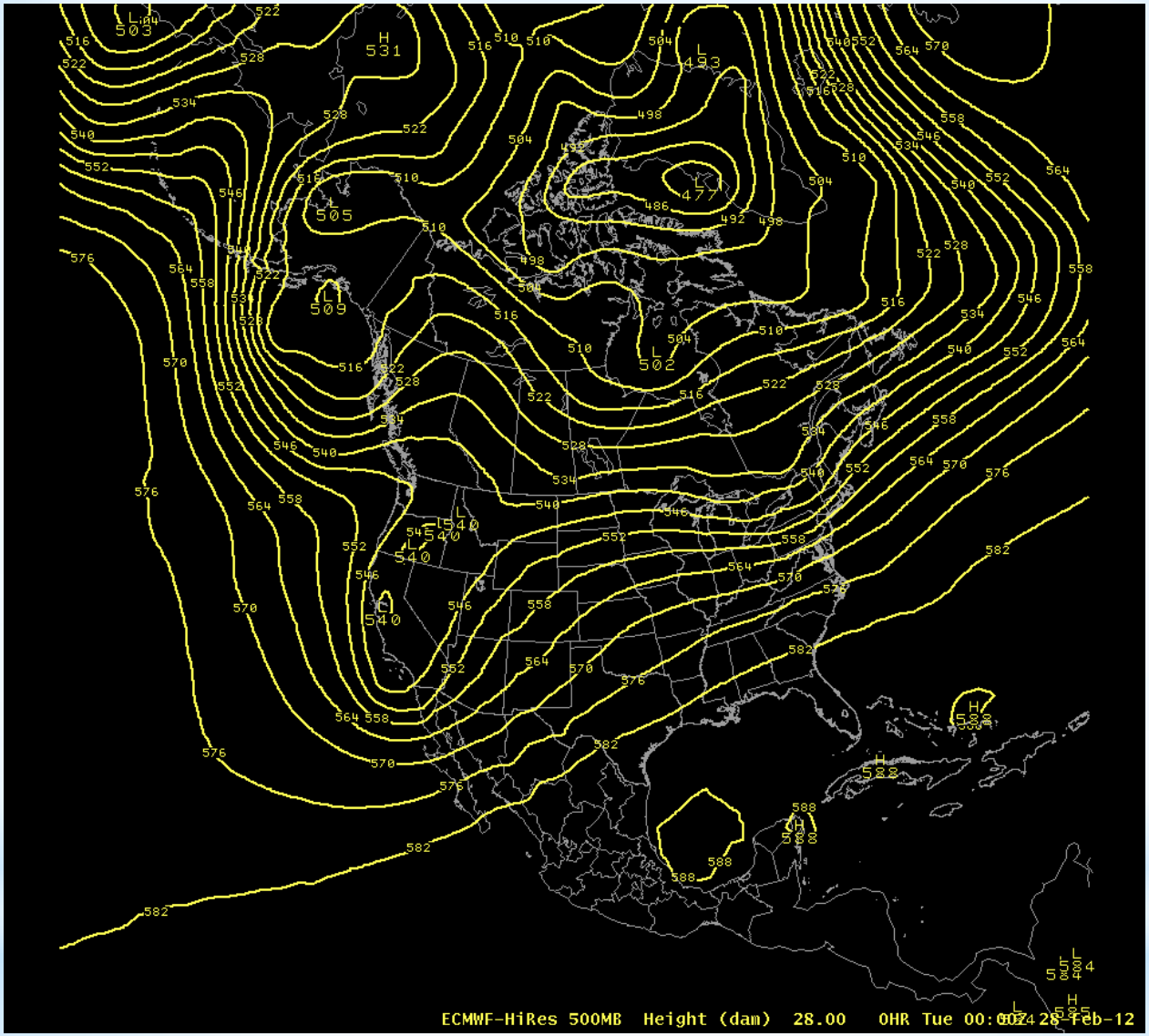




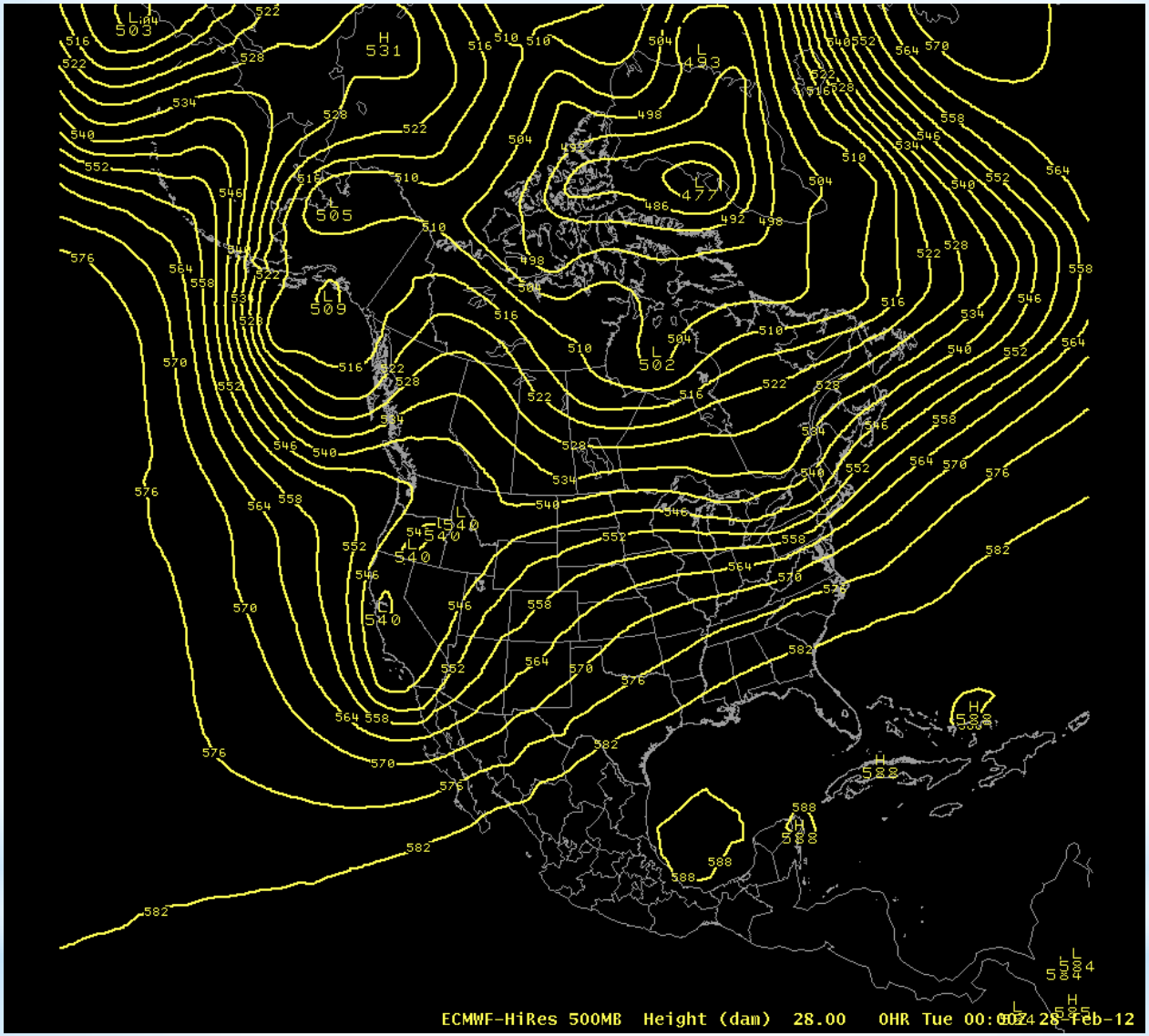
*Forecasted snow totals

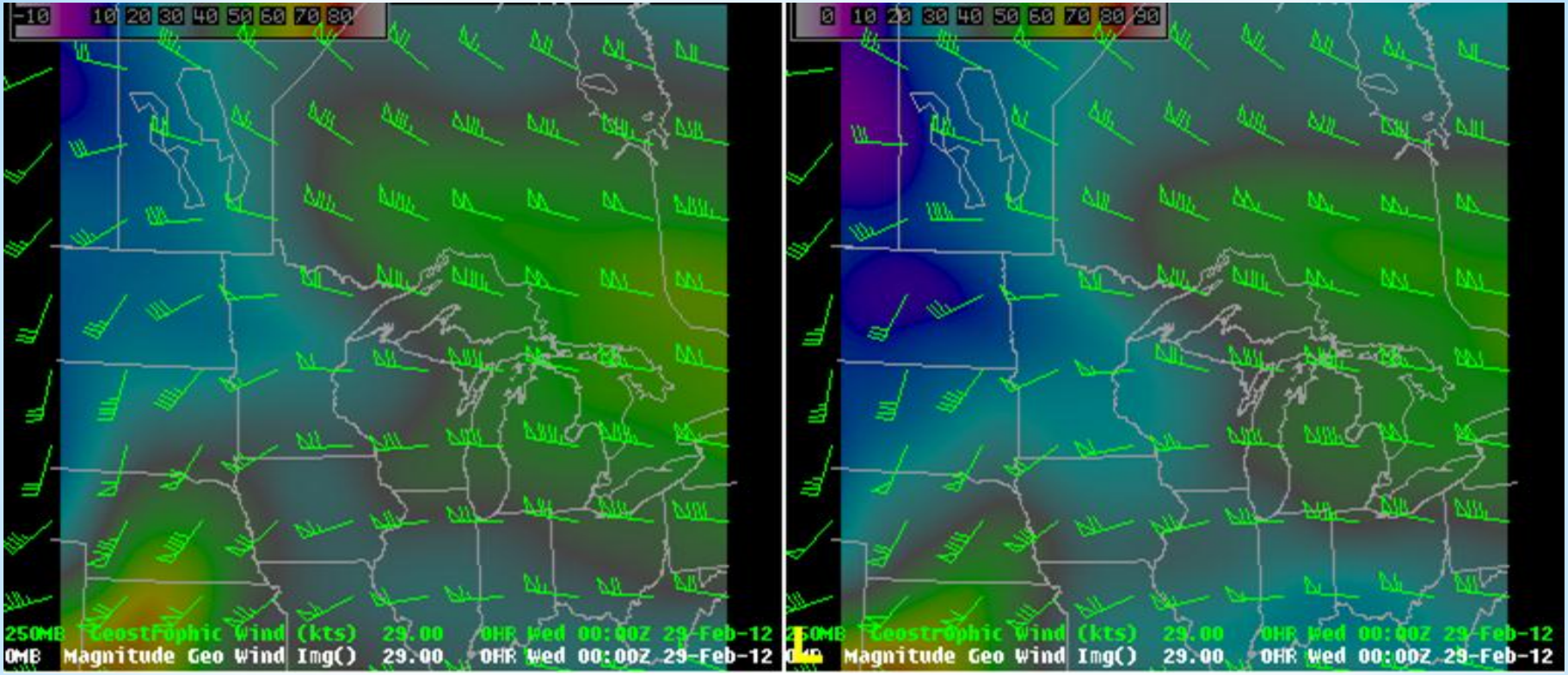
Synoptic Analysis and Model Comparison



500mb N. America Overview

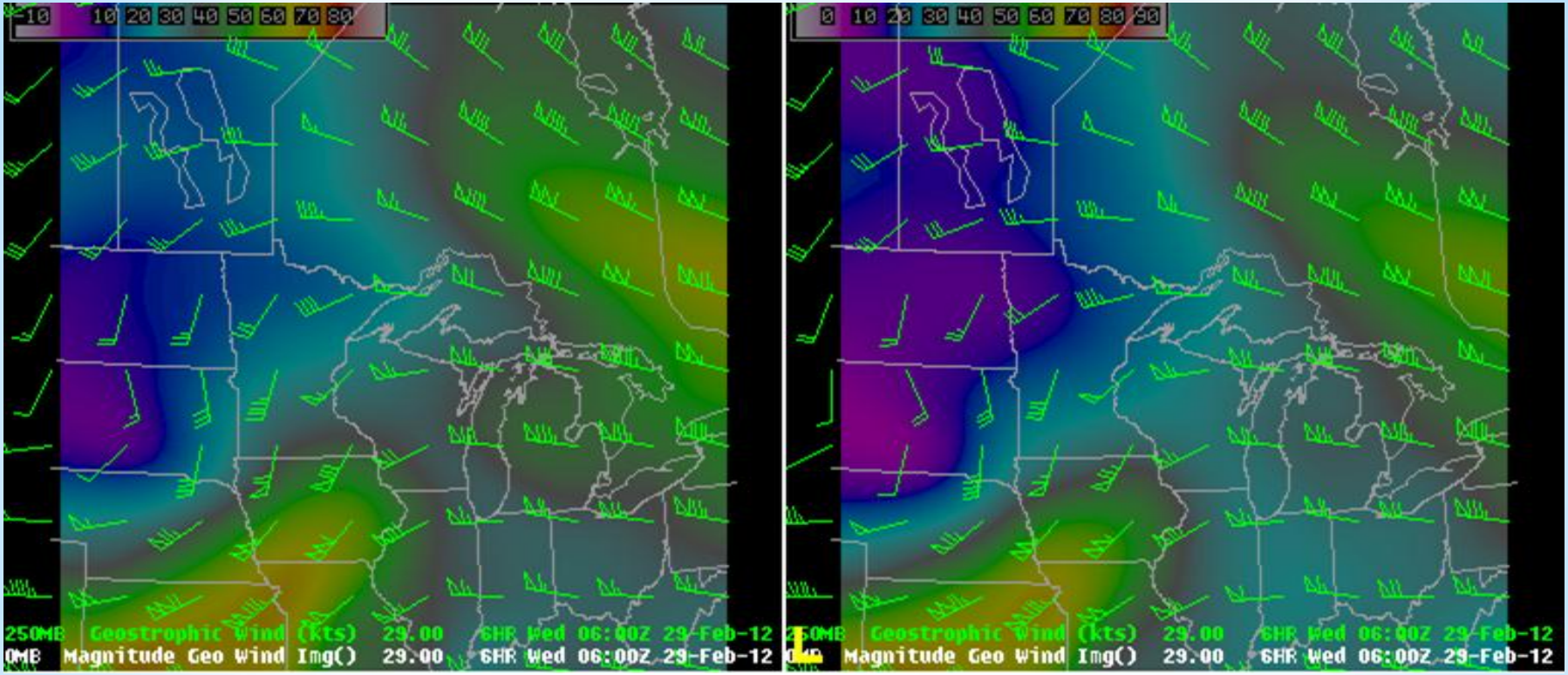


500mb N. America Overview



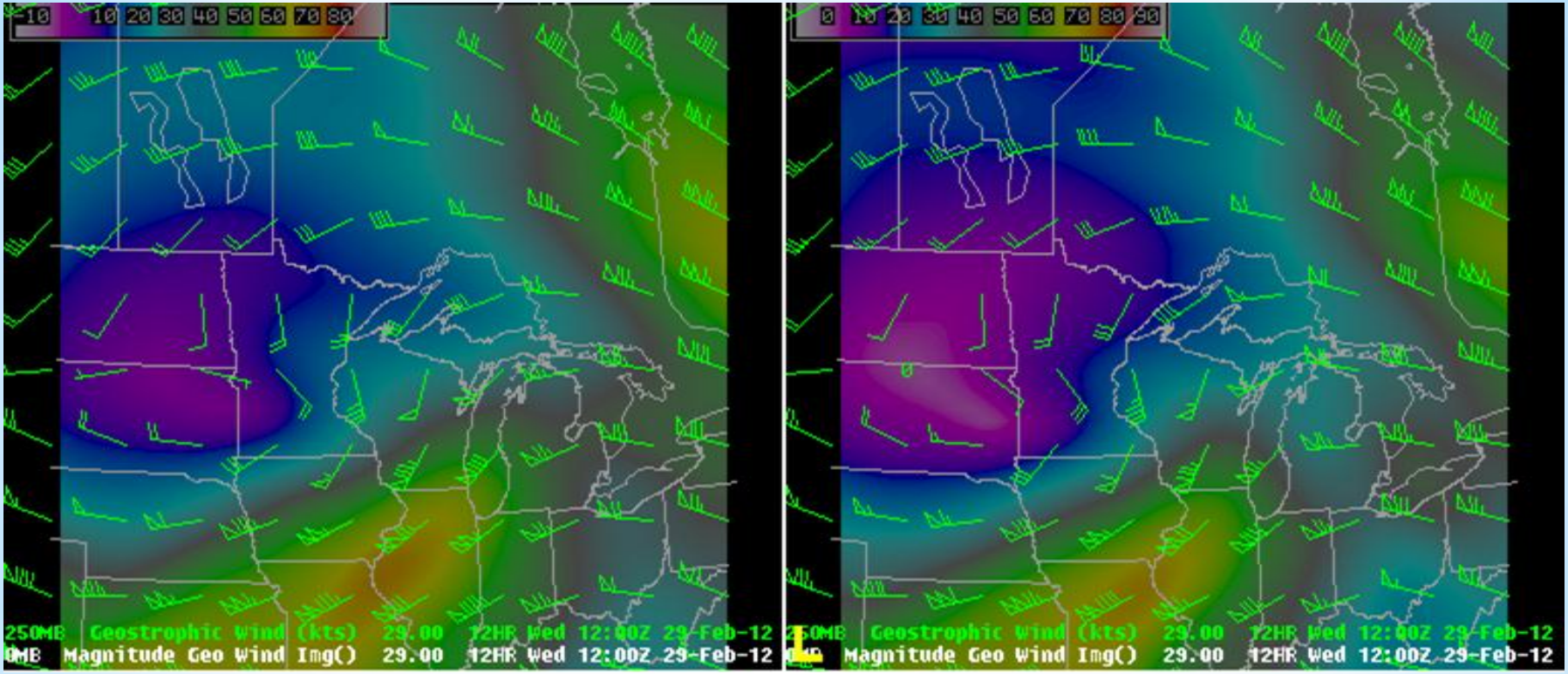
*250 MB - Jet Stream

* 0Z model run Feb. 29
GFS = Left, NAM = Right



* Upper Michigan becomes oriented between the left exit region of the southern jet and the right entrance region of the northern jet. Coupled jet situation = enhanced precipitation (snow) potential.

* 06Z Wed Feb. 29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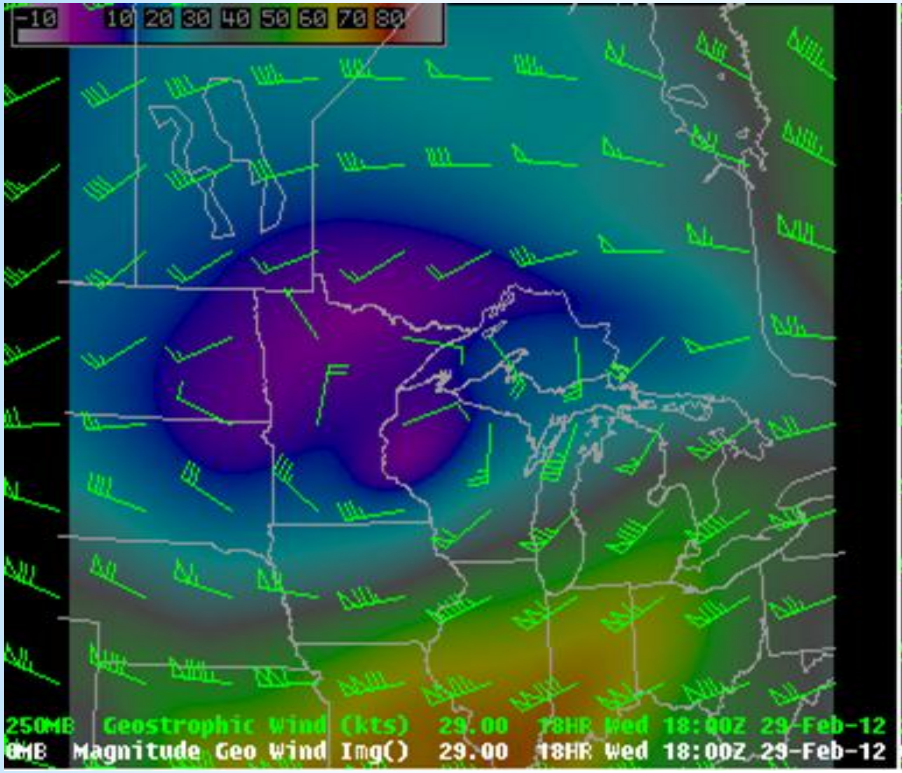
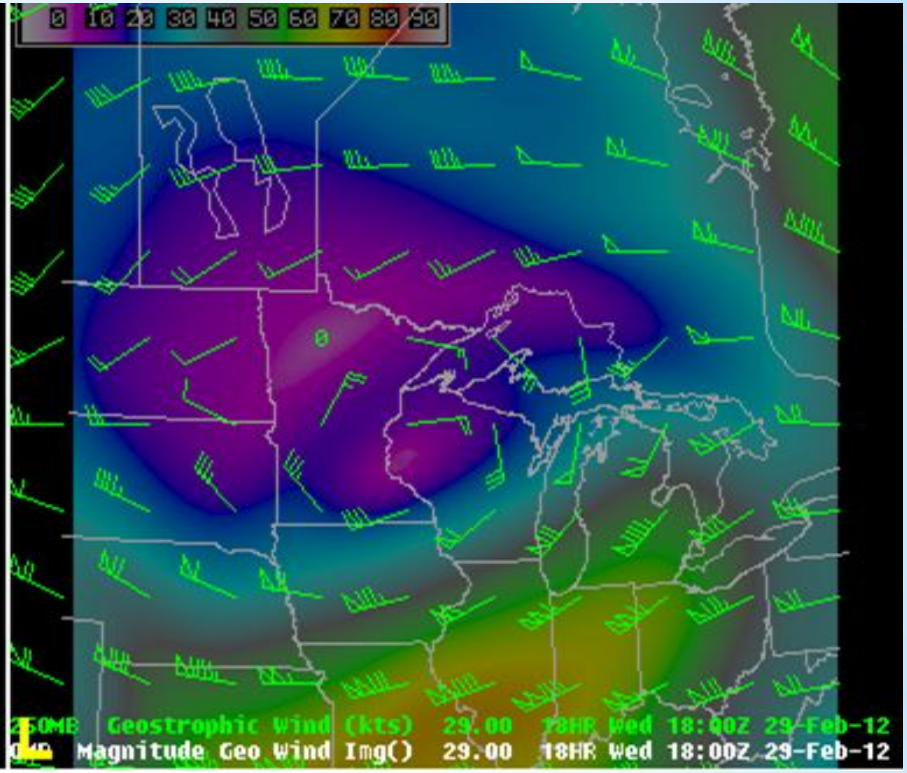
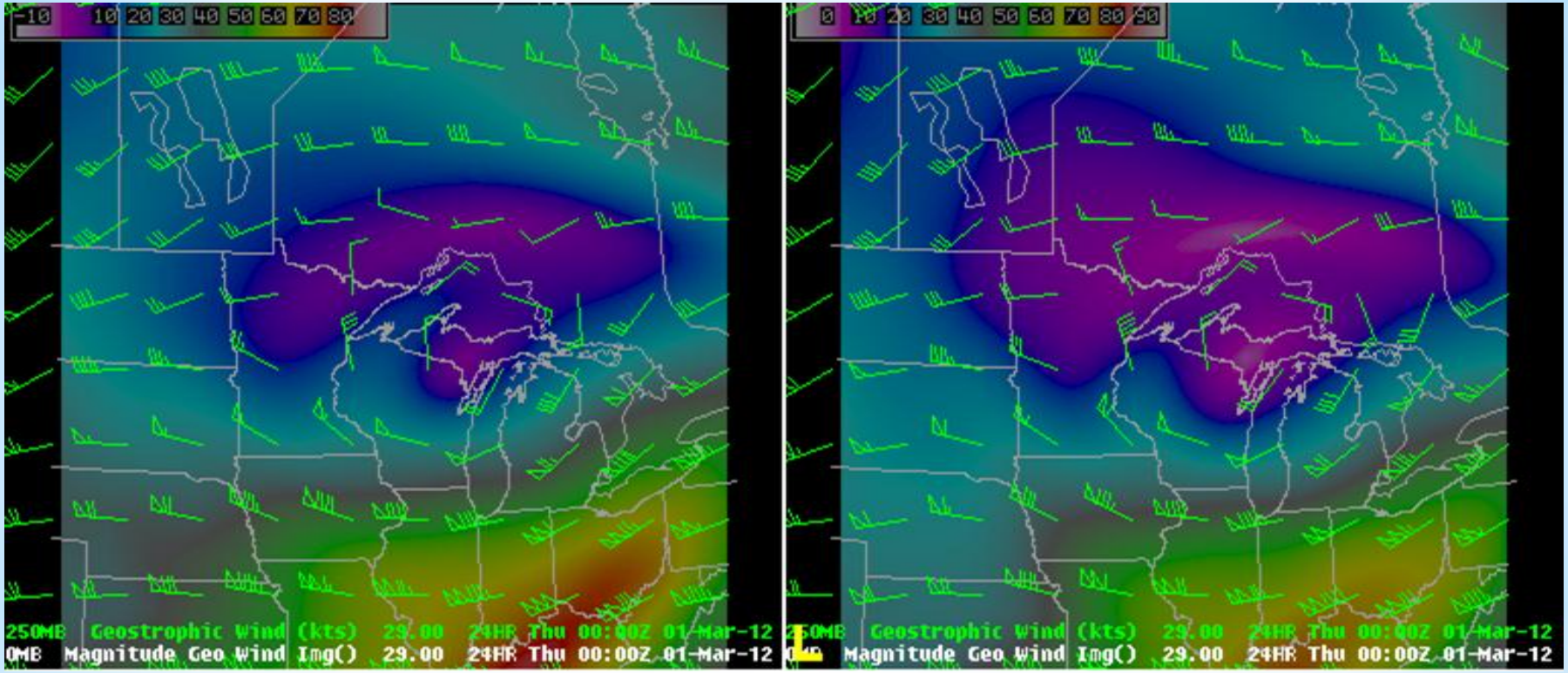
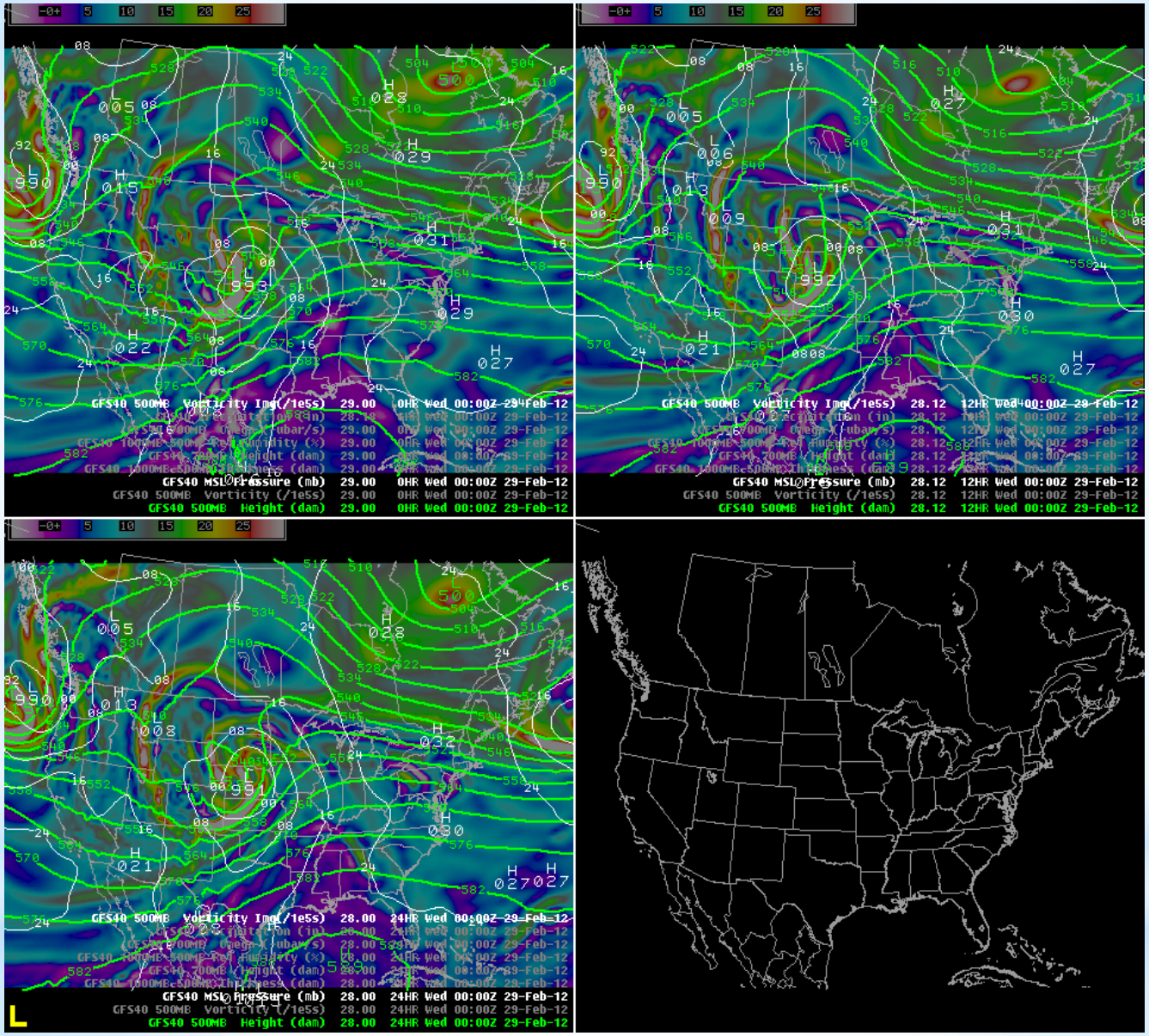
250MB Geostrophic Wind (kts) 29.00 12HR Wed 12:00Z 29-Feb-12
0MB Magnitude Geo Wind Img() 29.00 12HR Wed 12:00Z 29-Feb-12
0 10 20 30 40 50 60 70 80 90
250MB Geostrophic Wind (kts) 29.00 12HR Wed 12:00Z 29-Feb-12
Magnitude Geo Wind Img() 29.00 12HR Wed 12:00Z 29-Feb-12


-10 10 20 30 40 50 60 70 80
250MB Geostrophic Wind (kts) 29.00 18HR Wed 18:00Z 29-Feb-12
0MB Magnitude Geo Wind Img() 29.00 18HR Wed 18:00Z 29-Feb-12

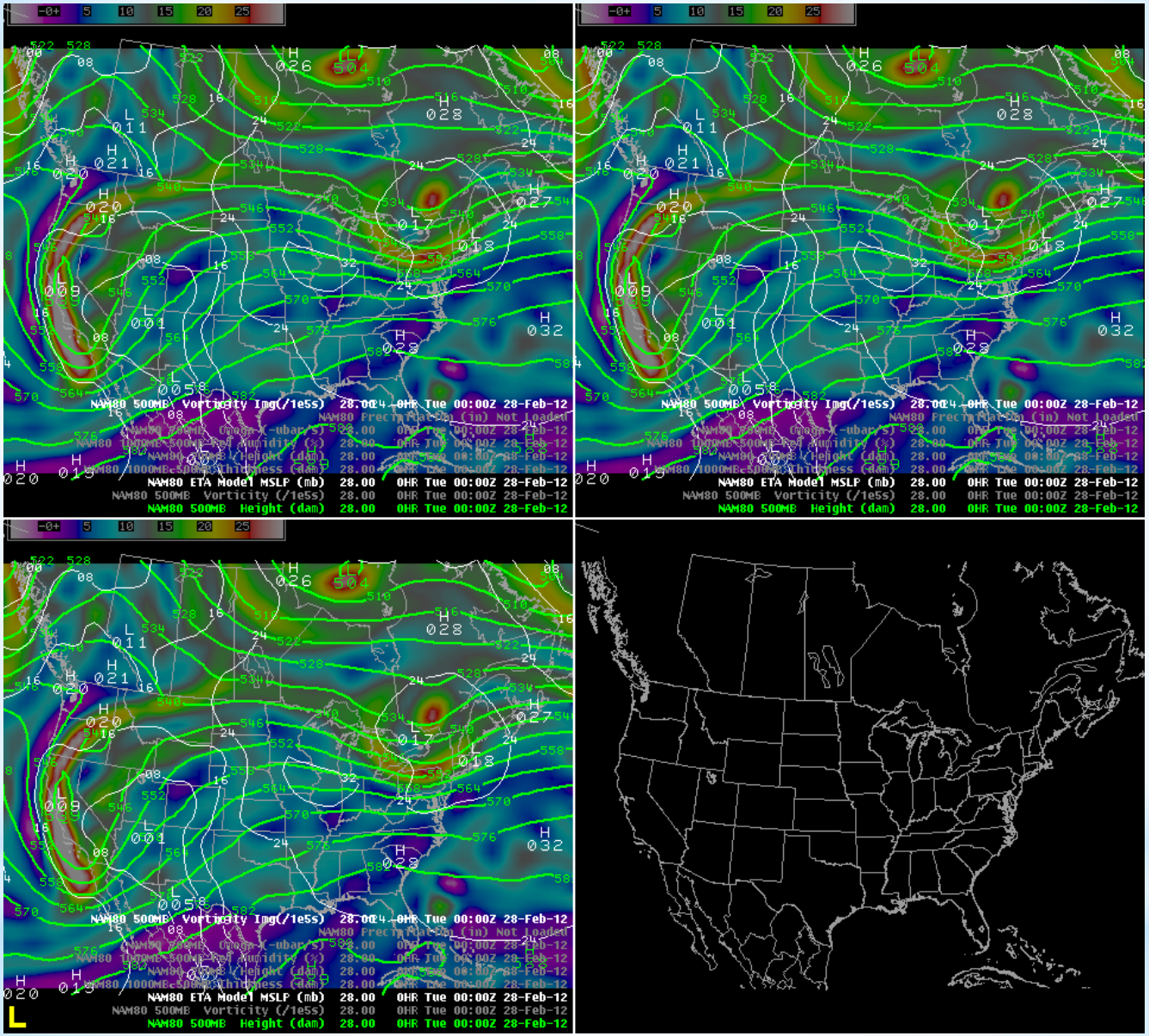

0 10 20 30 40 50 60 70 80 90
250MB Geostrophic Wind (kts) 29.00 18HR Wed 18:00Z 29-Feb-12
Magnitude Geo Wind Img() 29.00 18HR Wed 18:00Z 29-Feb-12



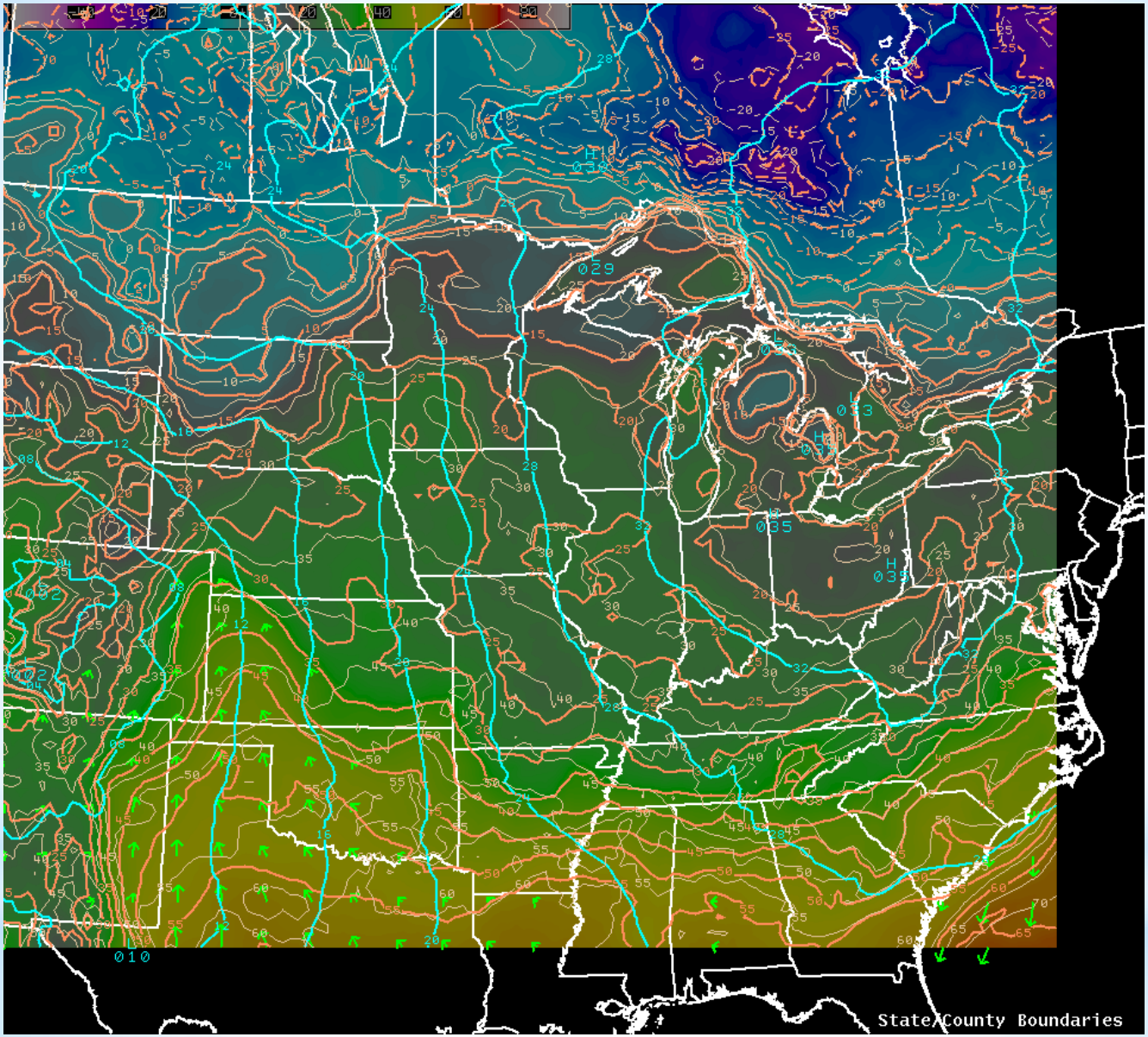
* Coupled jet moves to the east during the course of the day, leaving Upper Michigan with very light winds aloft.



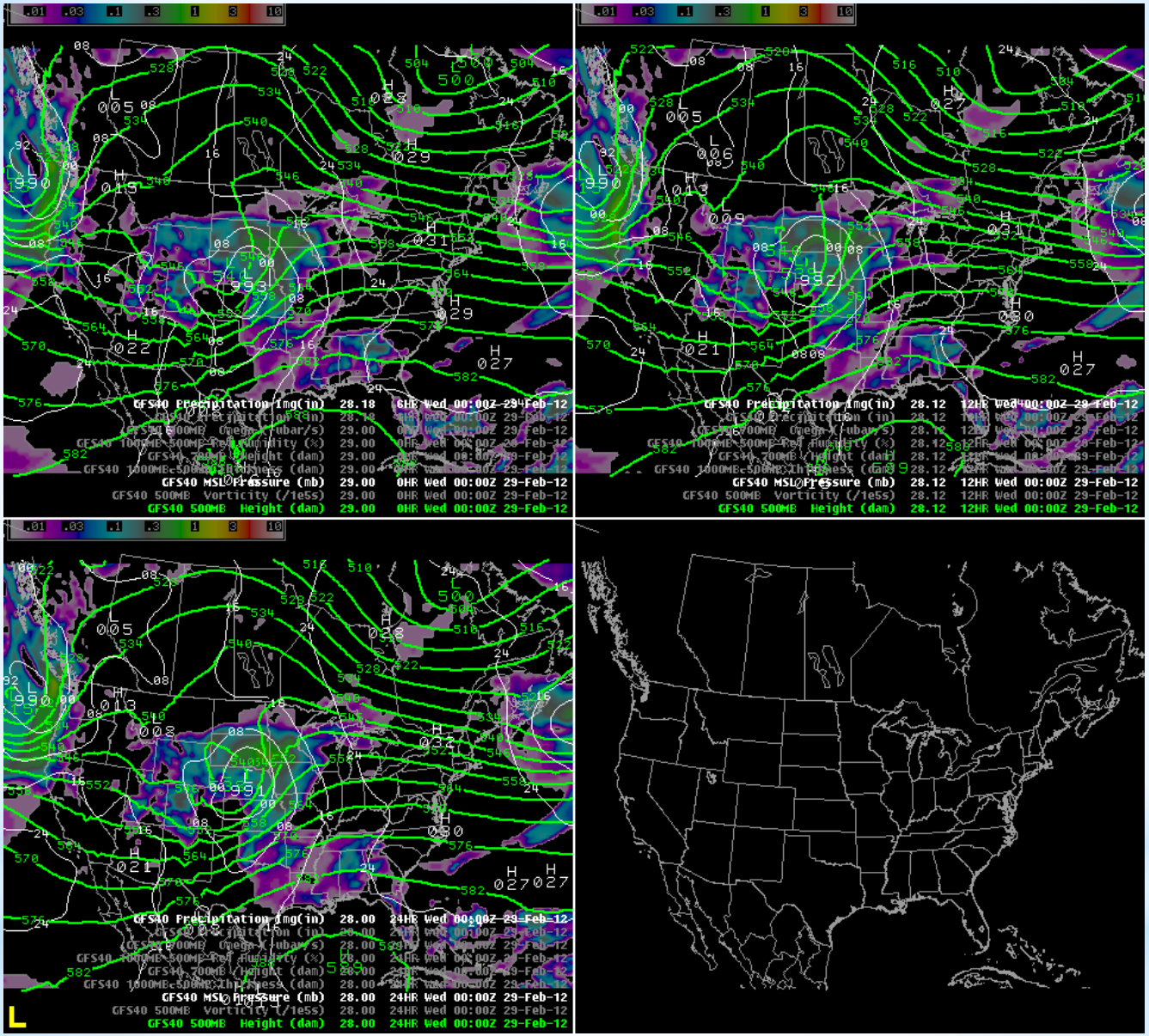
* GFS 500Mb and Vorticity Comparison



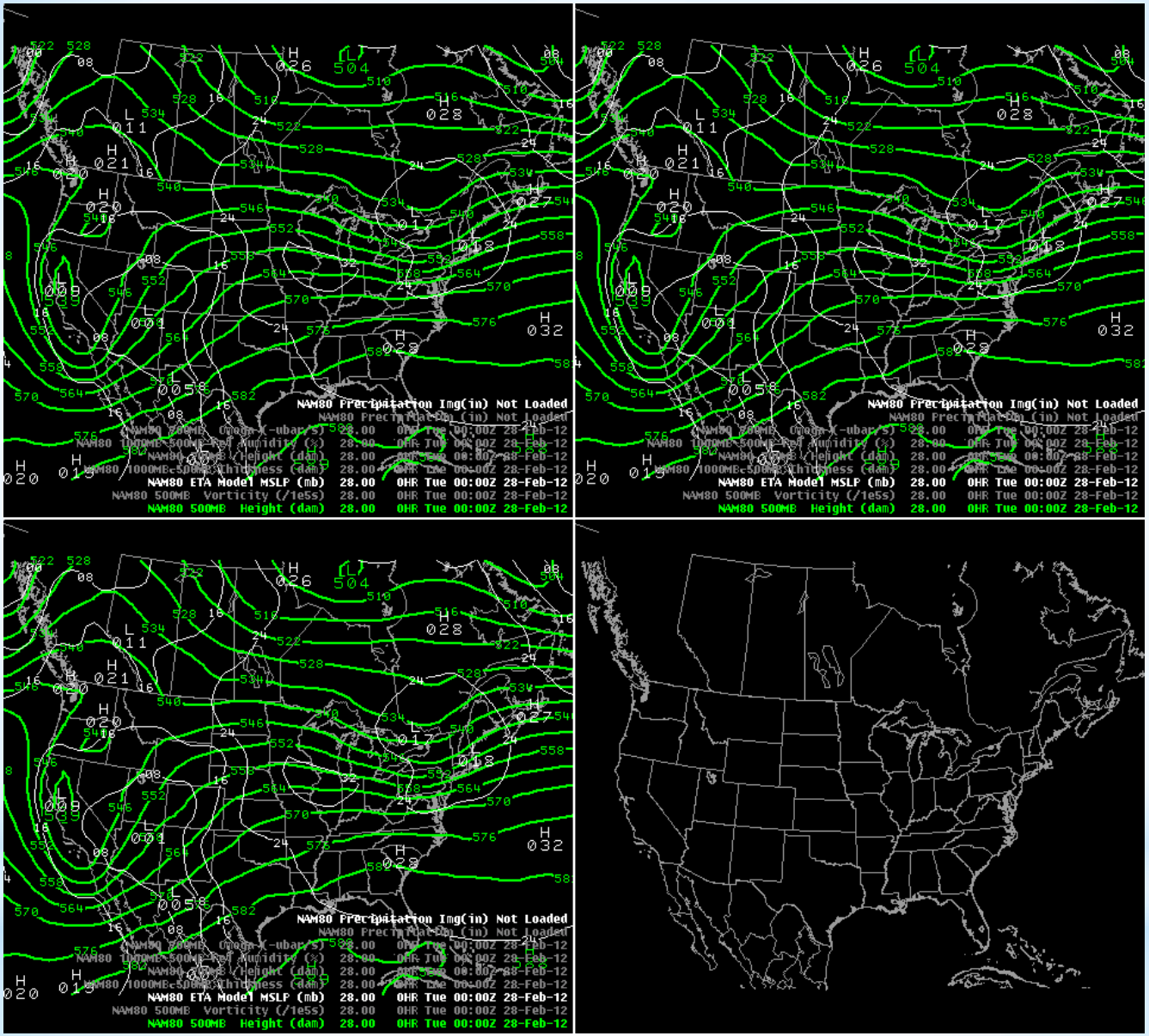
* NAM 500Mb and Vorticity Comparison



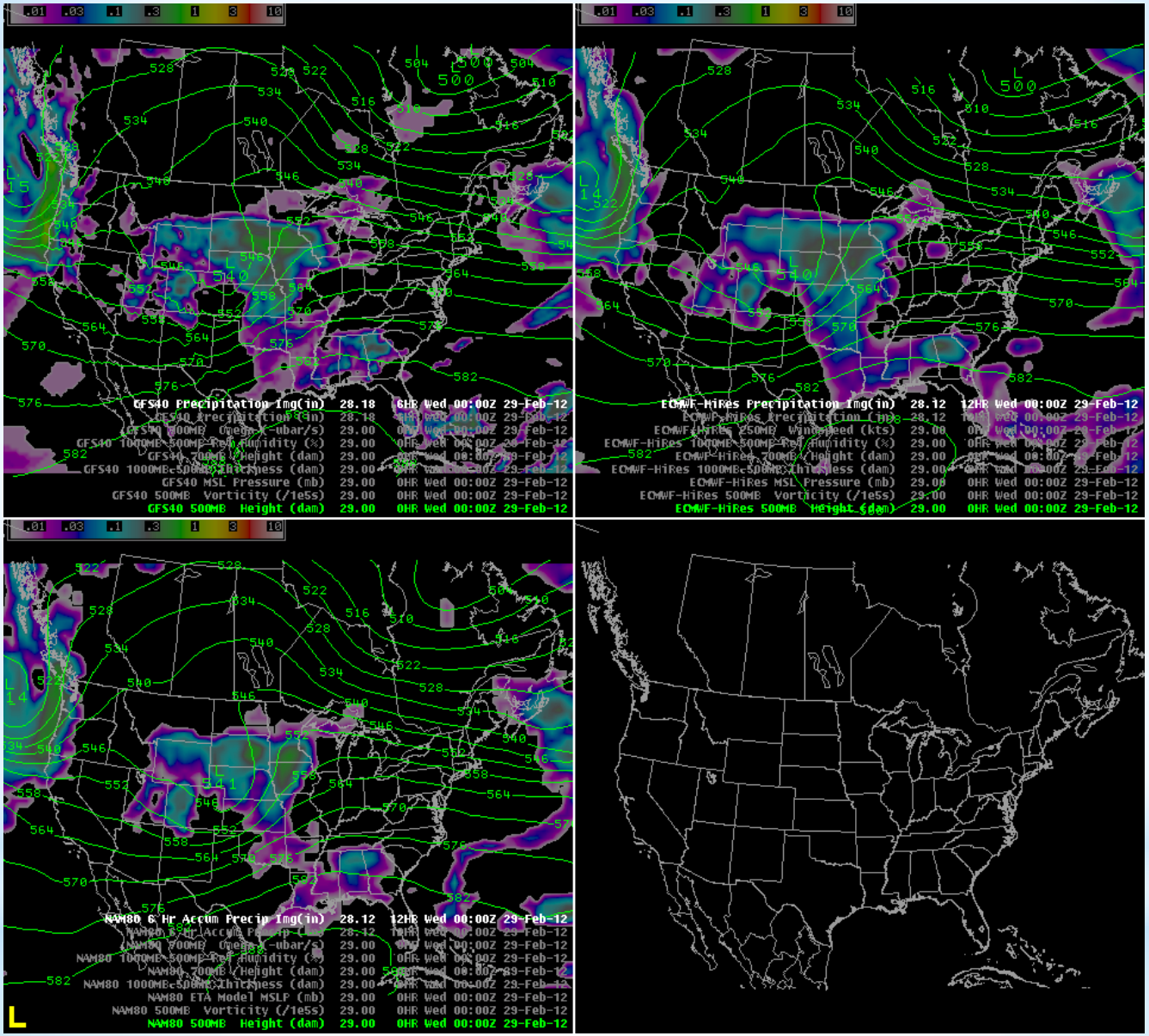
* NAM20 - 12Z Feb 29th - 18Z March 1st



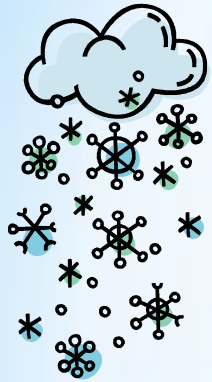
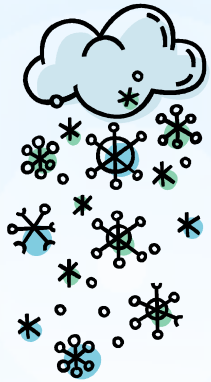
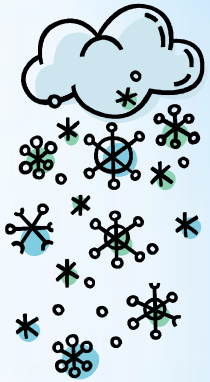
* GFS Forecasted Precip Comparison



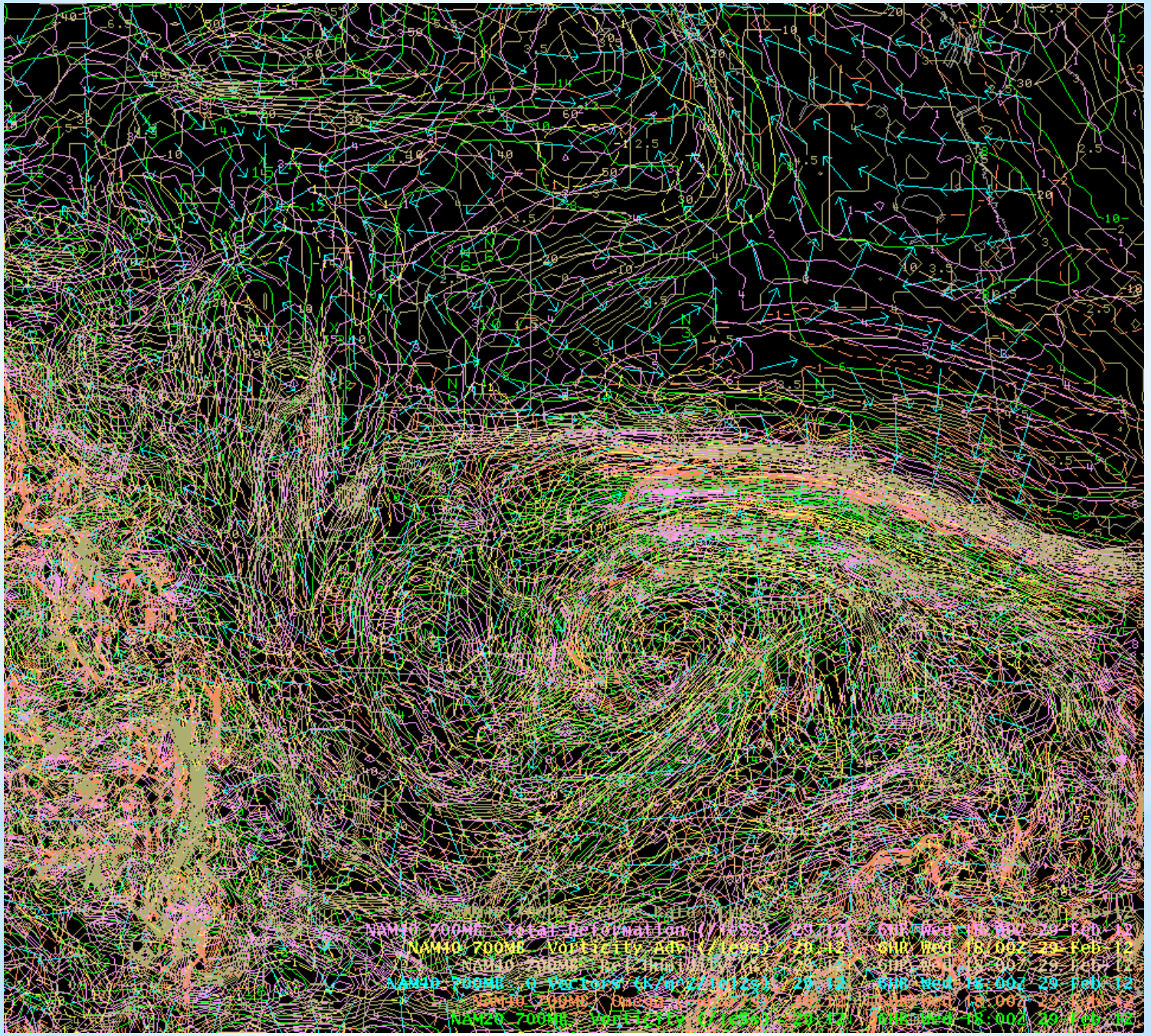
* NAM Forecasted Precip Comparison



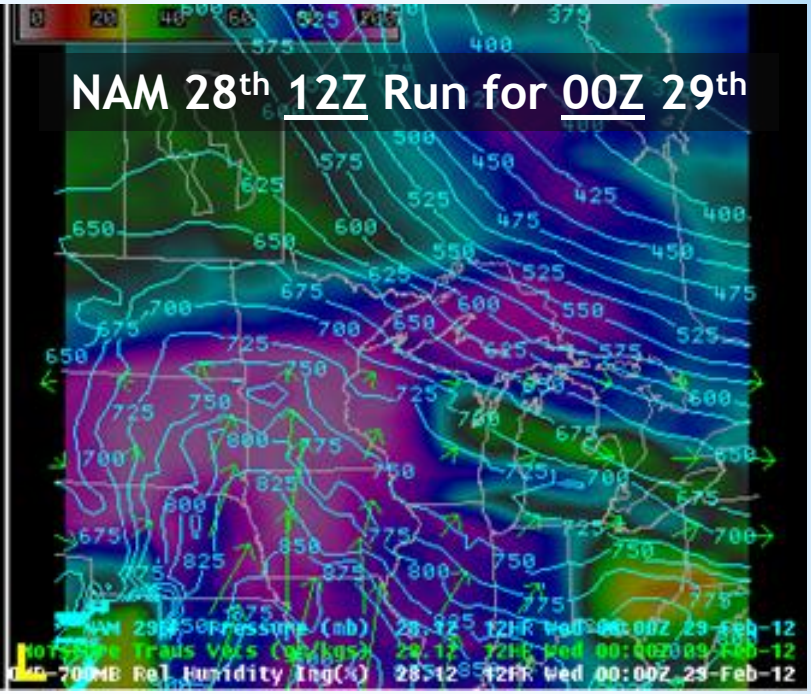
* Model Comparison Forecasted Precip

Isentropic Analysis


NAM10 700MB Total Deformation (/1e9s) 29.12 CHR Wed 18/00Z 29 Feb 12
NAM10 700MB Vorticity Adv (/1e9s) 29.12 CHR Wed 18/00Z 29 Feb 12
NAM10 700MB Vorticity (/1e9s) 29.12 CHR Wed 18/00Z 29 Feb 12

GFS 28th 12Z Run for 00Z 29th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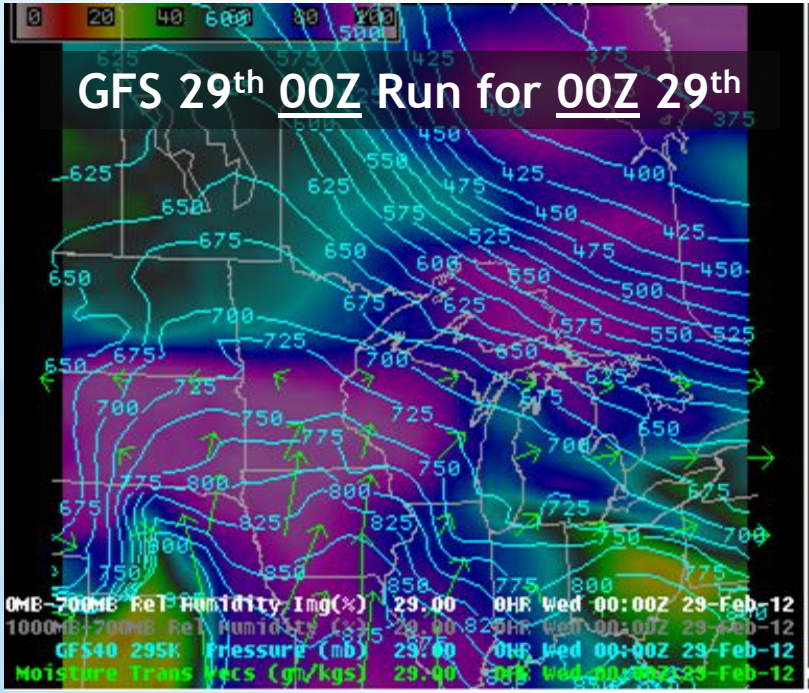
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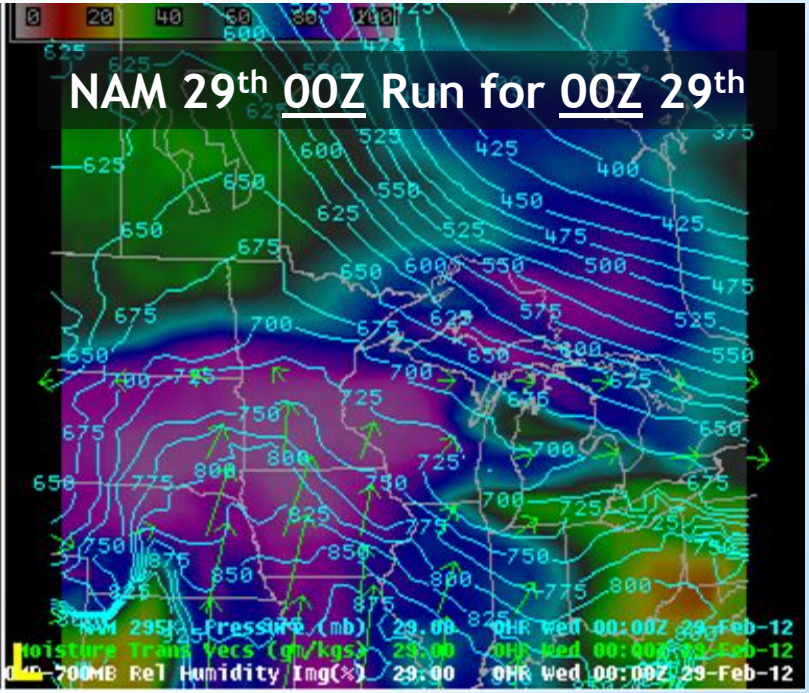
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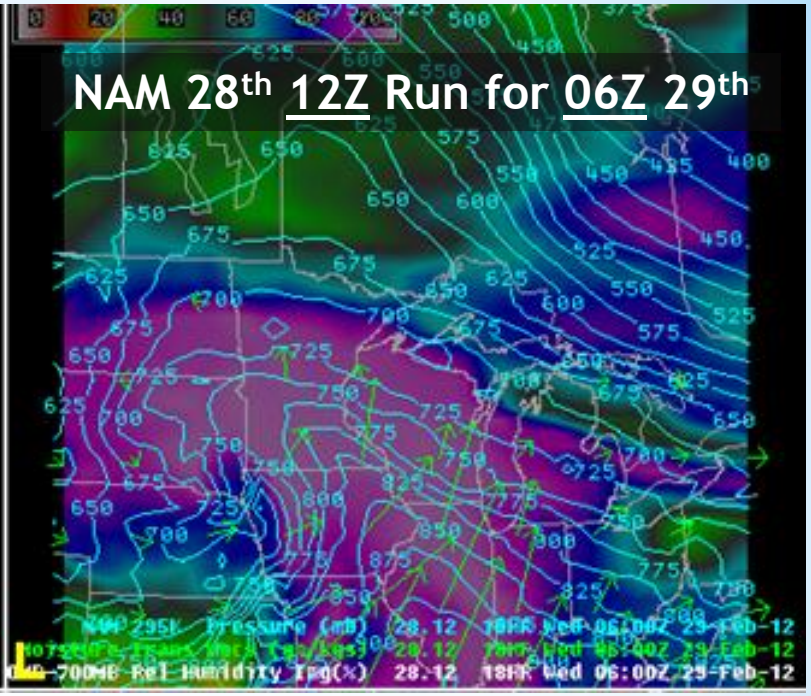
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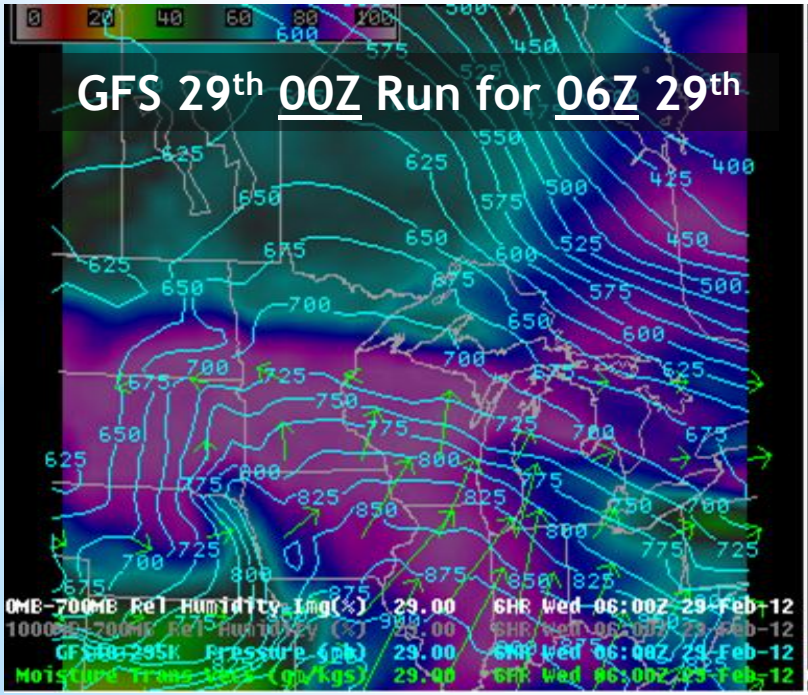
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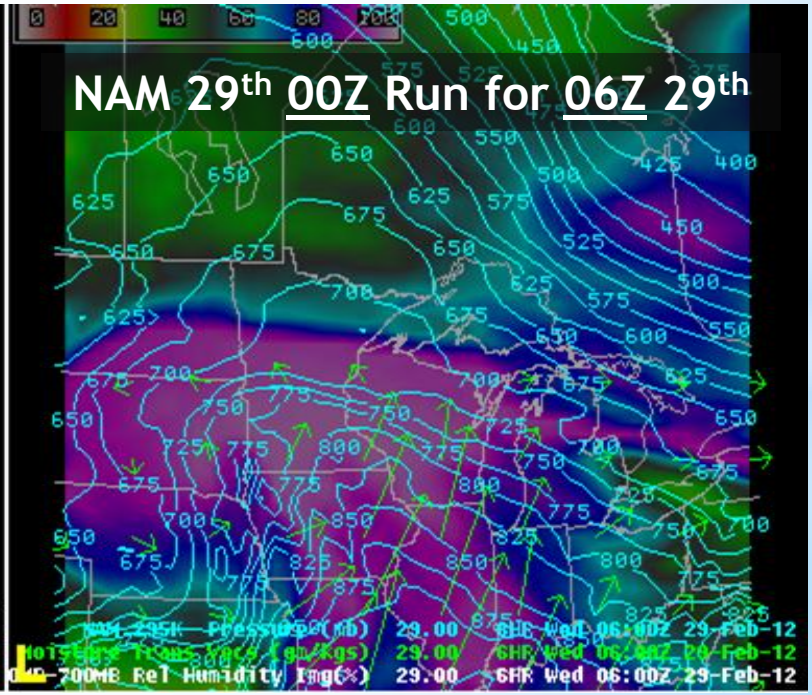
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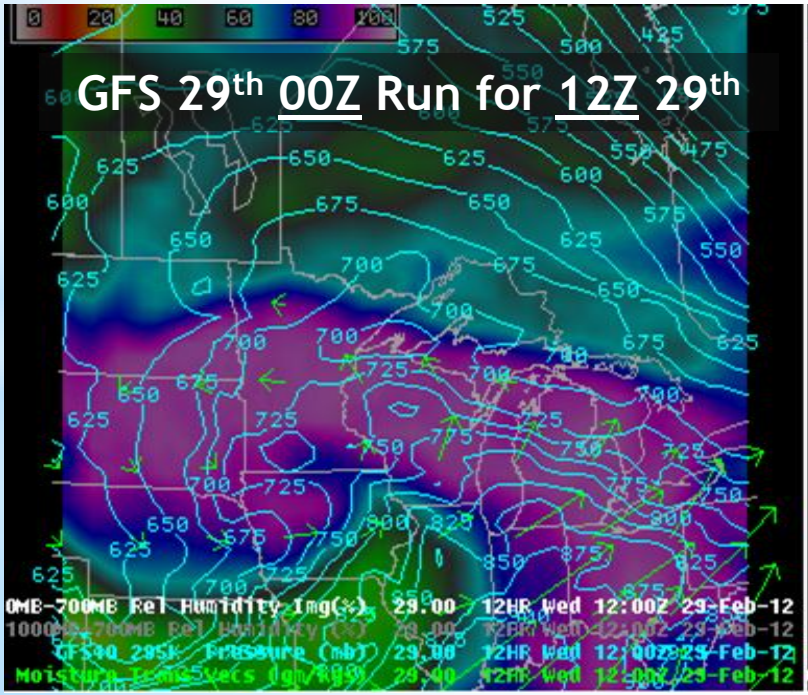
GFS 28th 12Z Run for 12Z 29th

NAM 28th 12Z Run for 12Z 29th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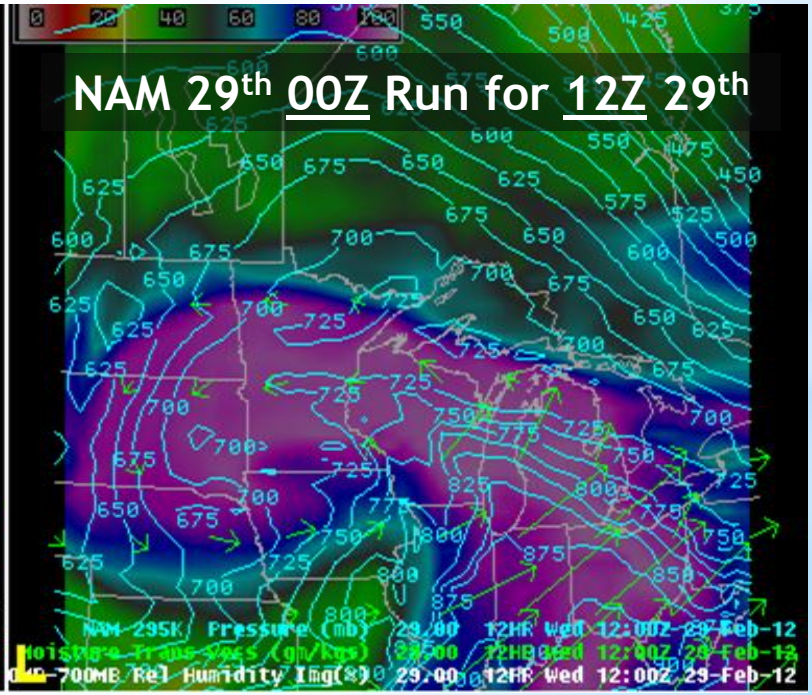
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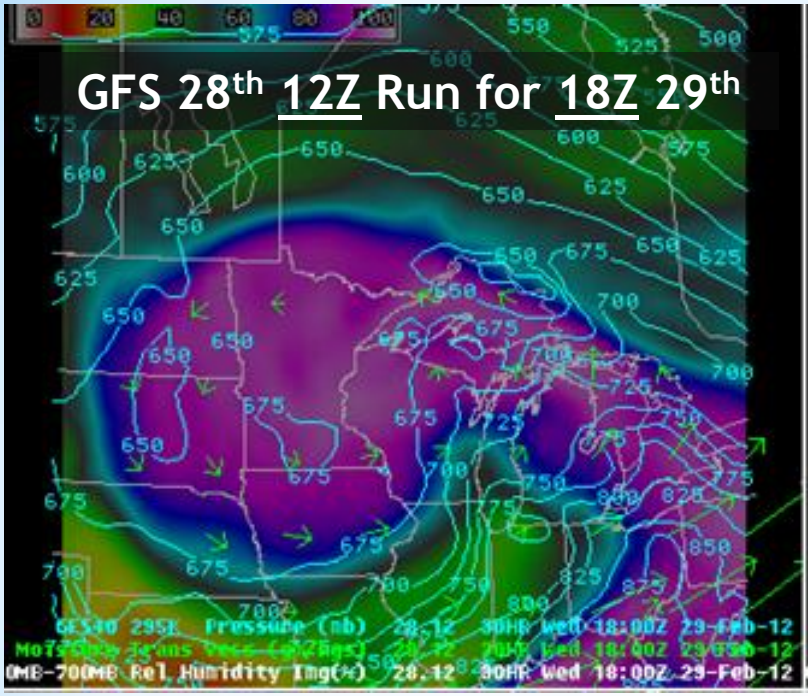
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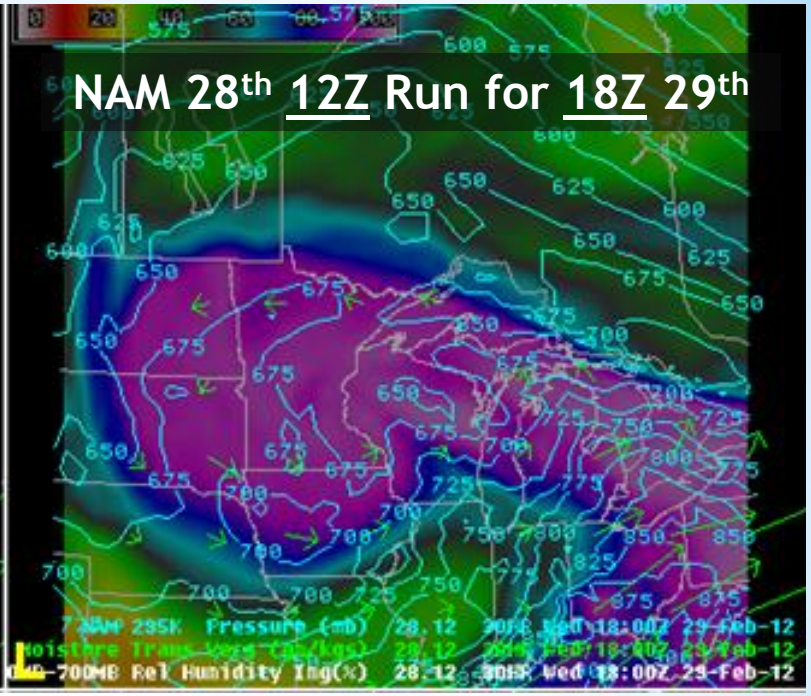
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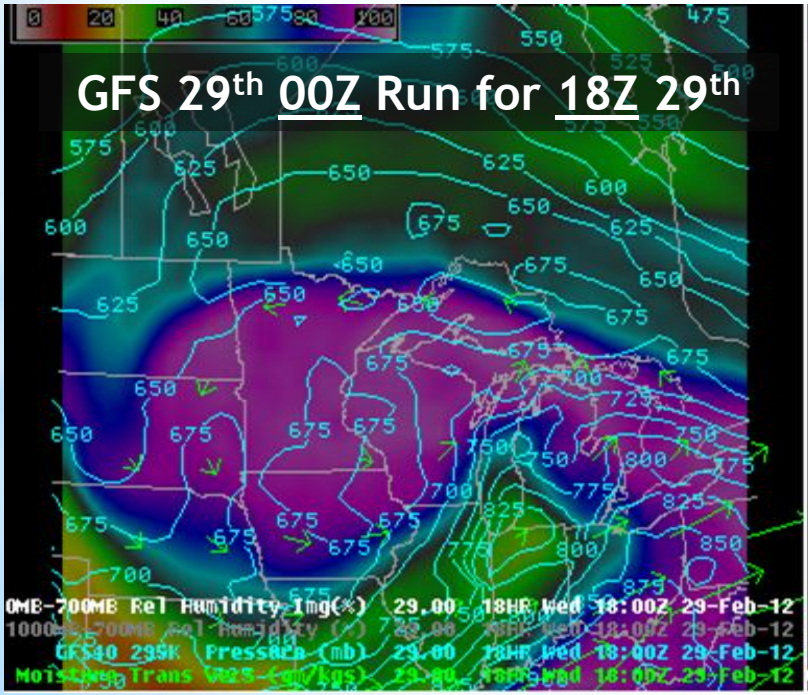
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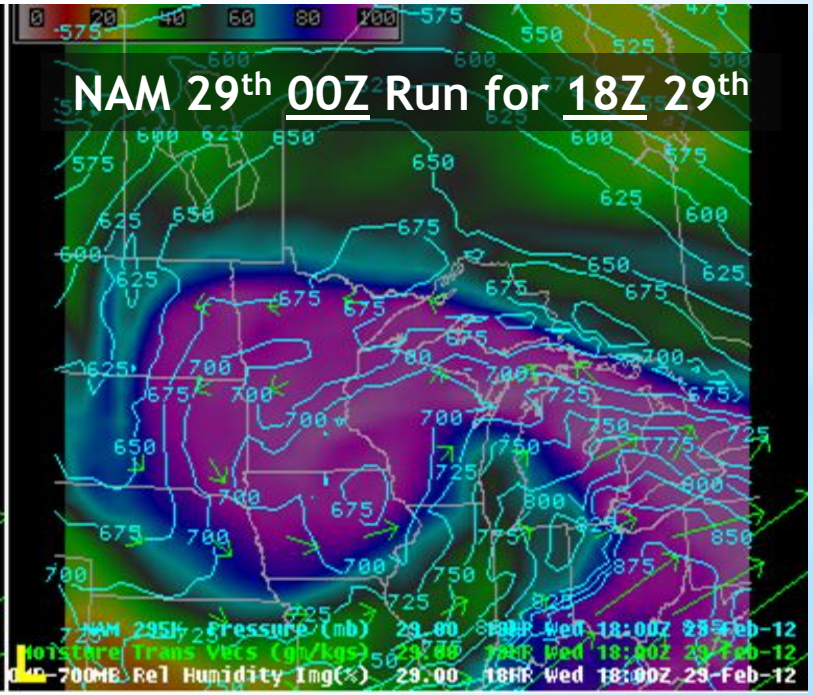
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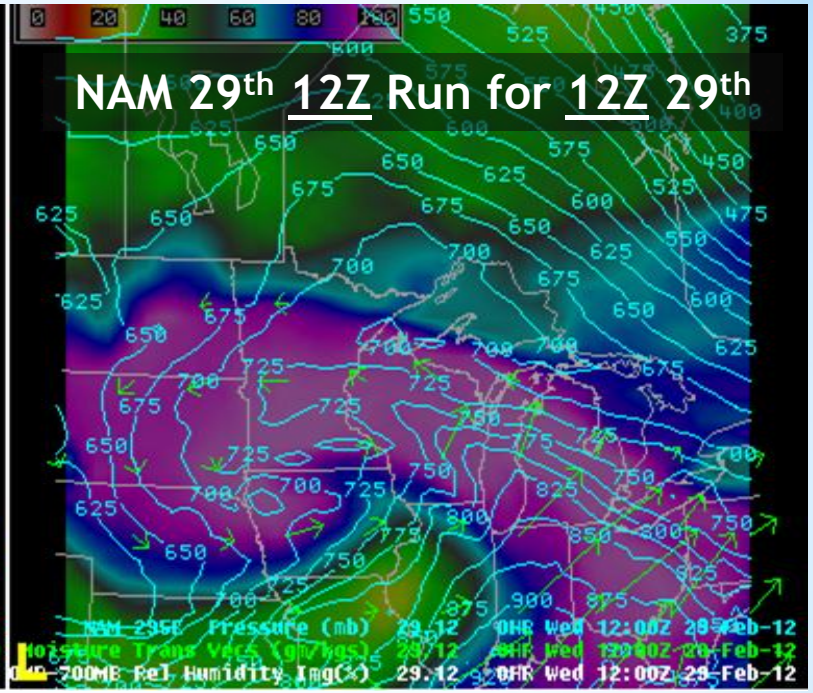
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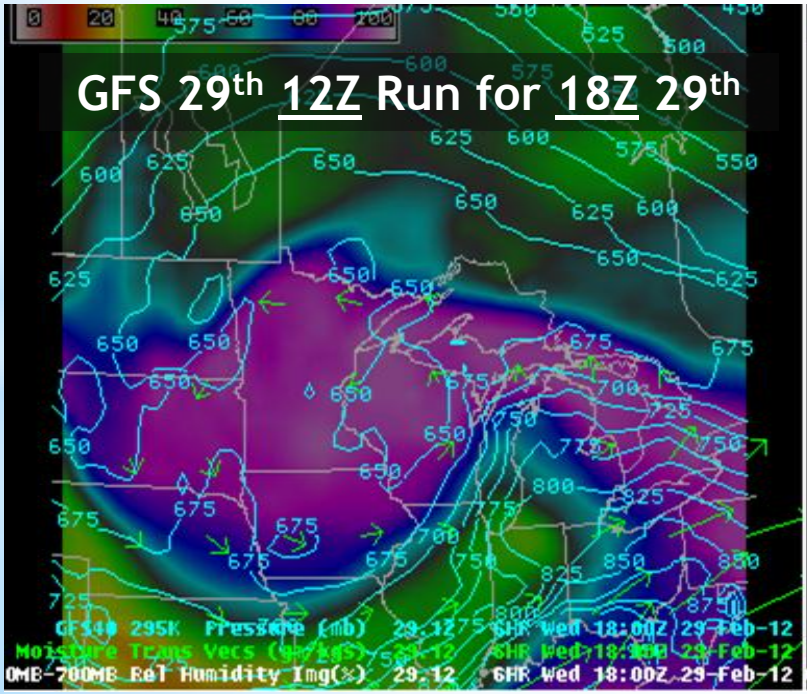
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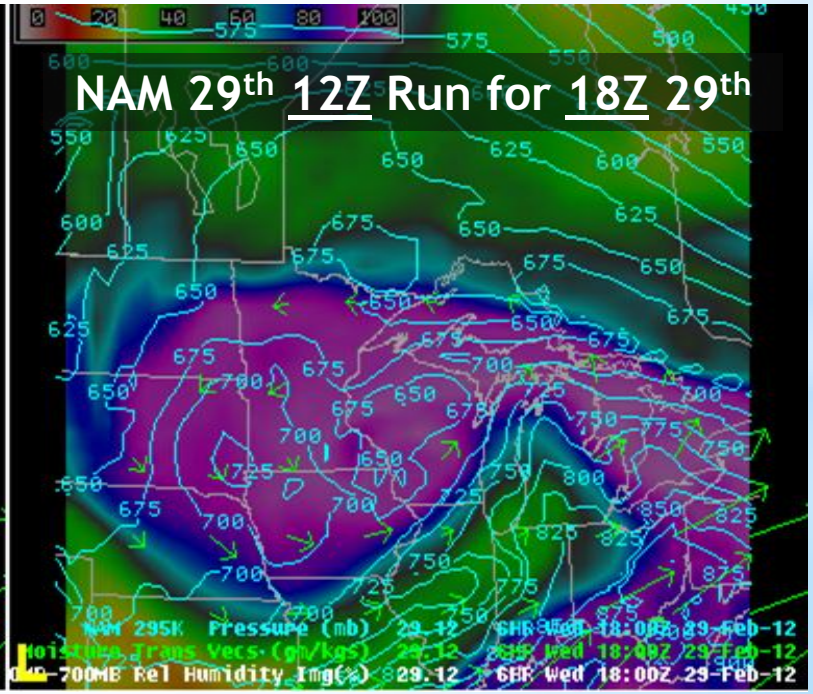
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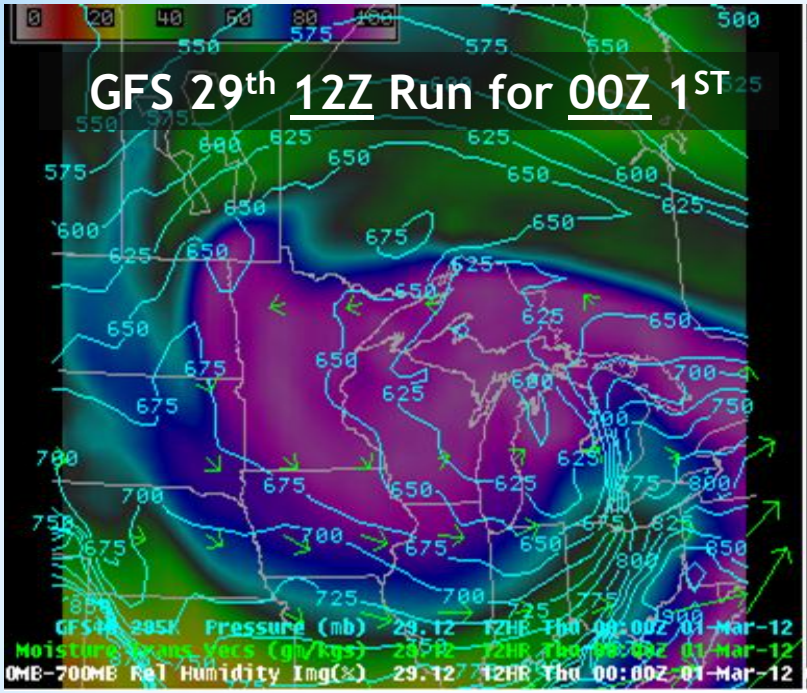
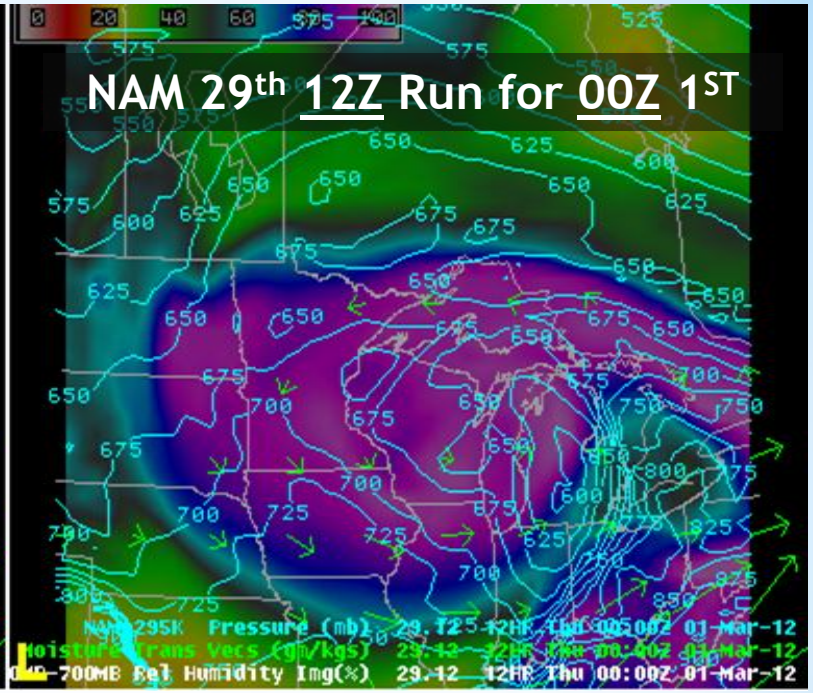
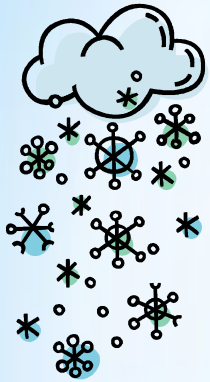
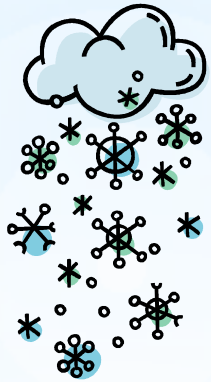
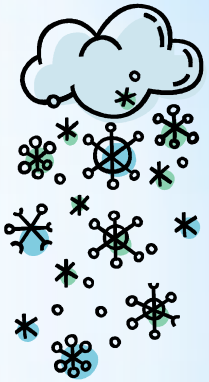
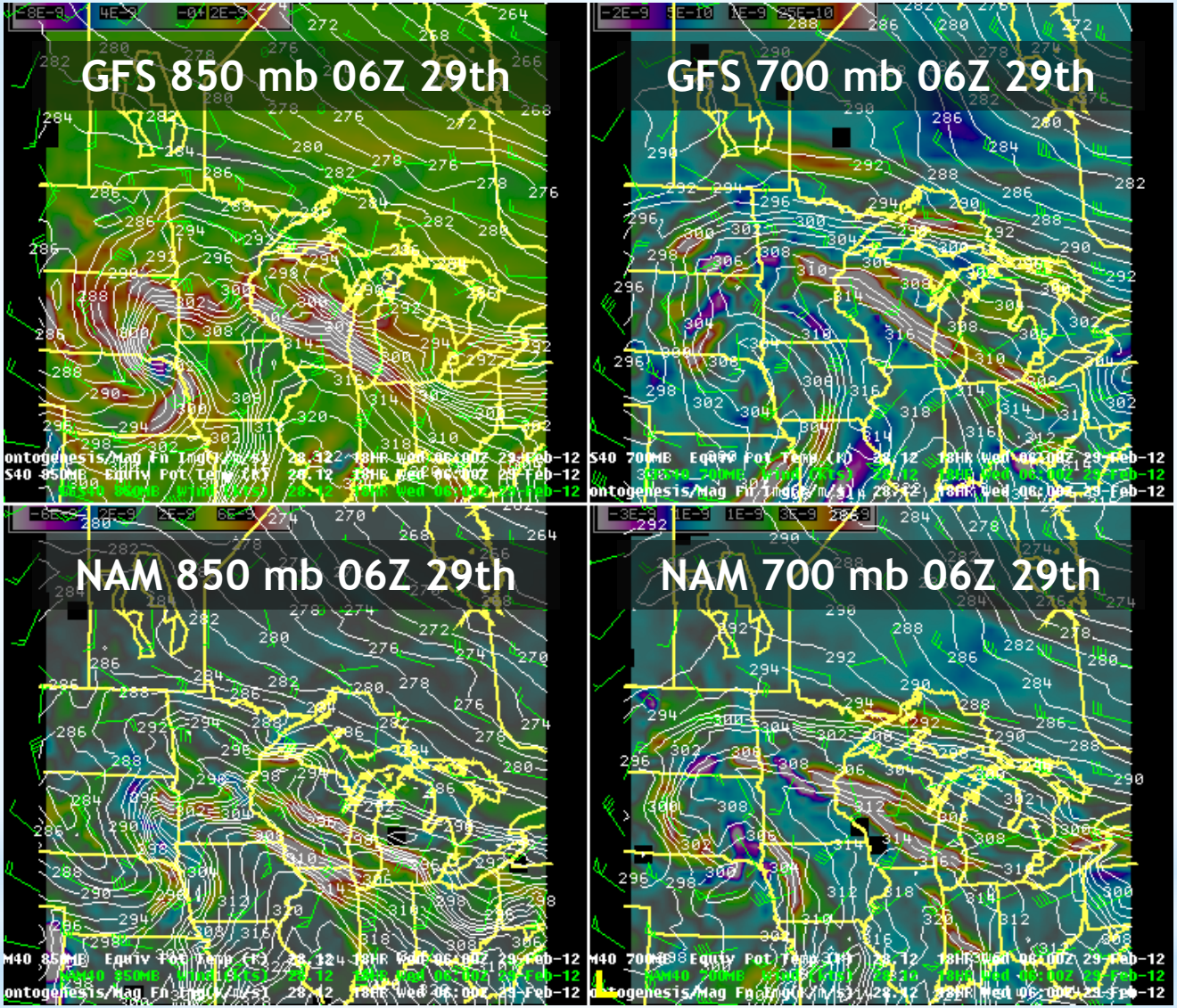




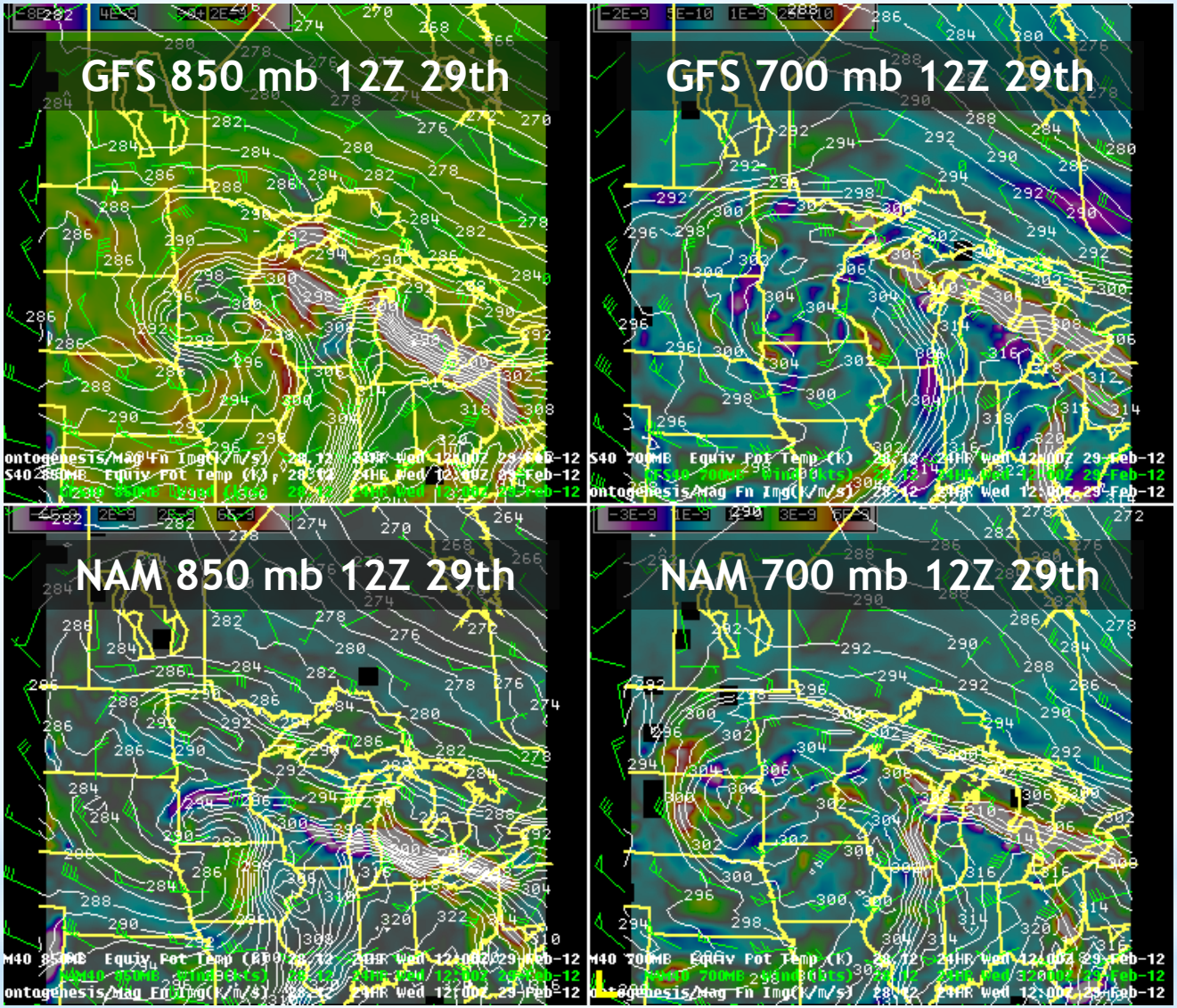
* 00Z 29th Models in good agreement with Isentropic upglide ahead of the system
* Stronger upglide with more moisture around 06Z-12Z 29th
* Best upglide ends/shifts east of the area by 18Z 29th

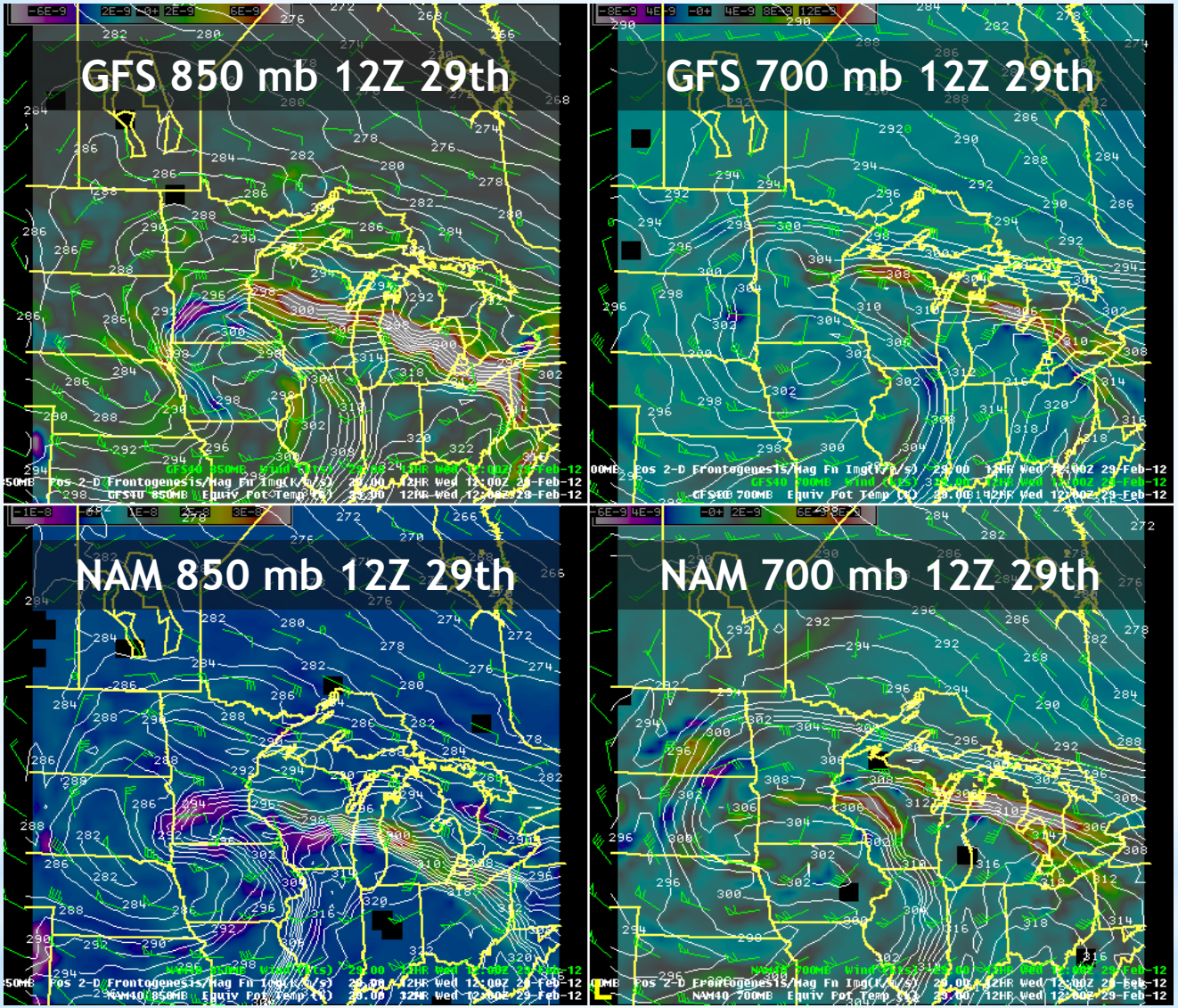
Frontogenesis


GFS 850 mb 06Z 29th
GFS 700 mb 06Z 29th
NAM 850 mb 06Z 29th
NAM 700 mb 06Z 29th

*12Z Run 28th


GFS 850 mb 12Z 29th
GFS 700 mb 12Z 29th
NAM 850 mb 12Z 29th
NAM 700 mb 12Z 29th

*12Z Run 28th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GFS 700 mb 12Z 29th
NAM 850 mb 12Z 29th
NAM 700 mb 12Z 29th

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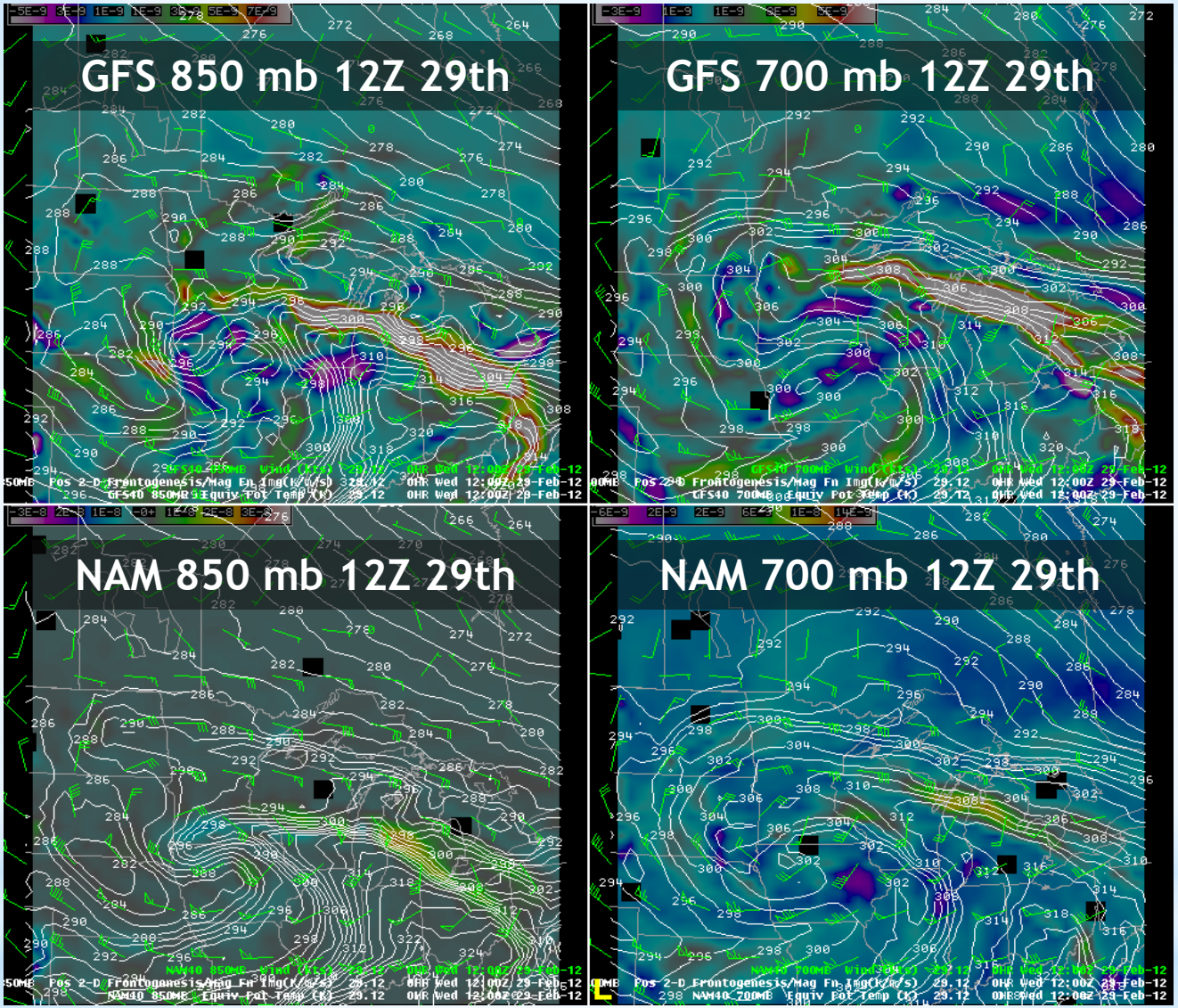
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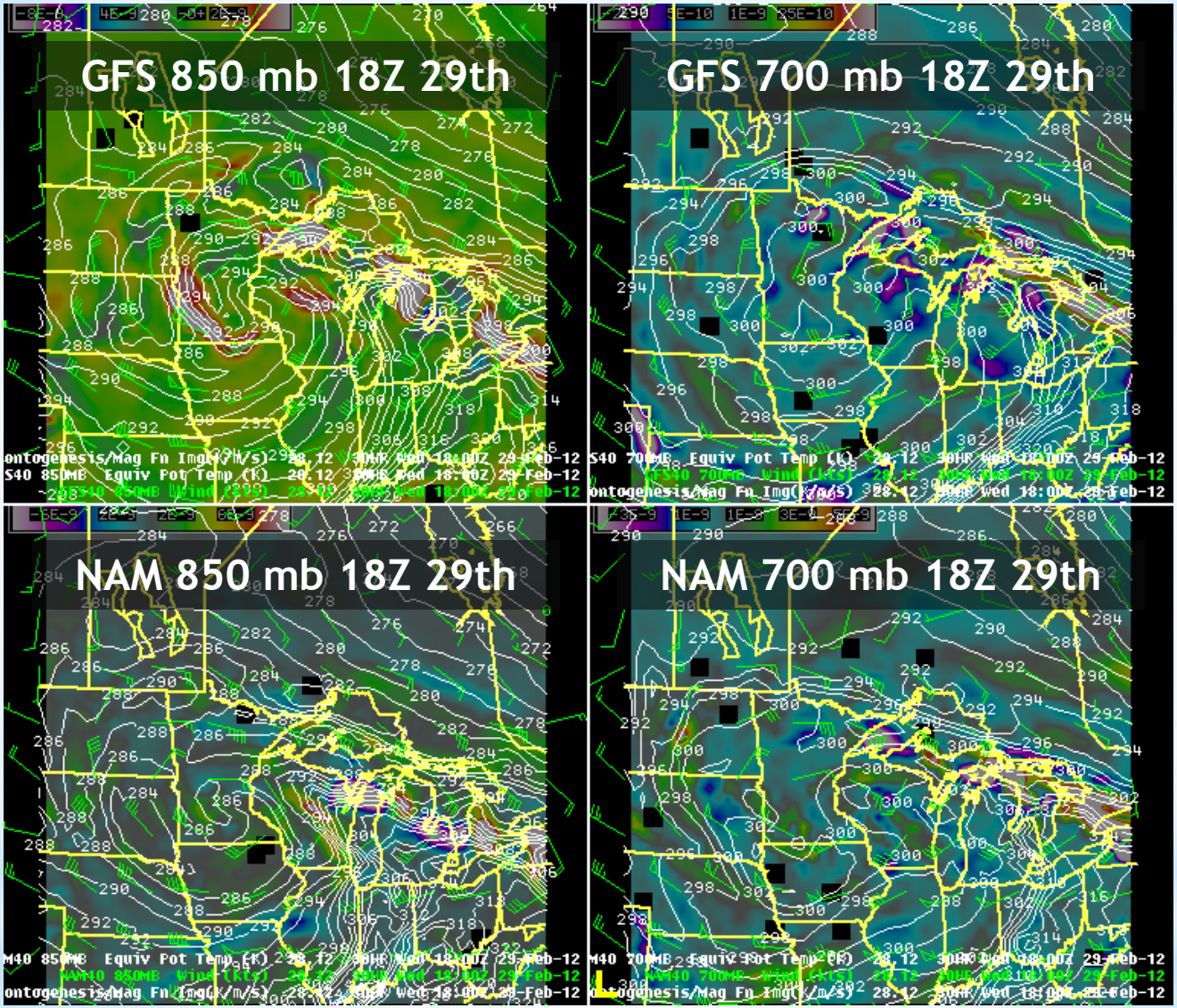
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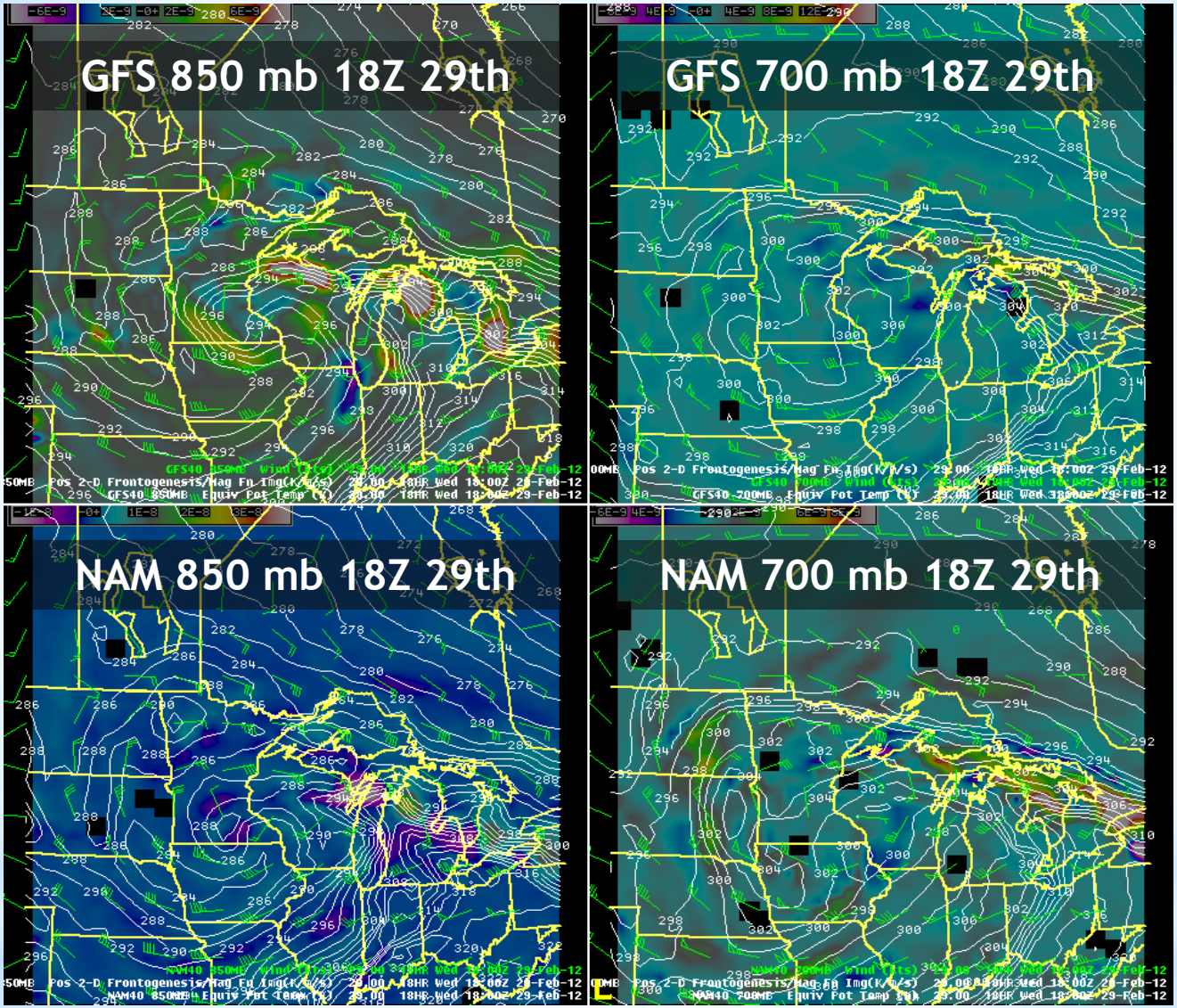
*12Z Run 28th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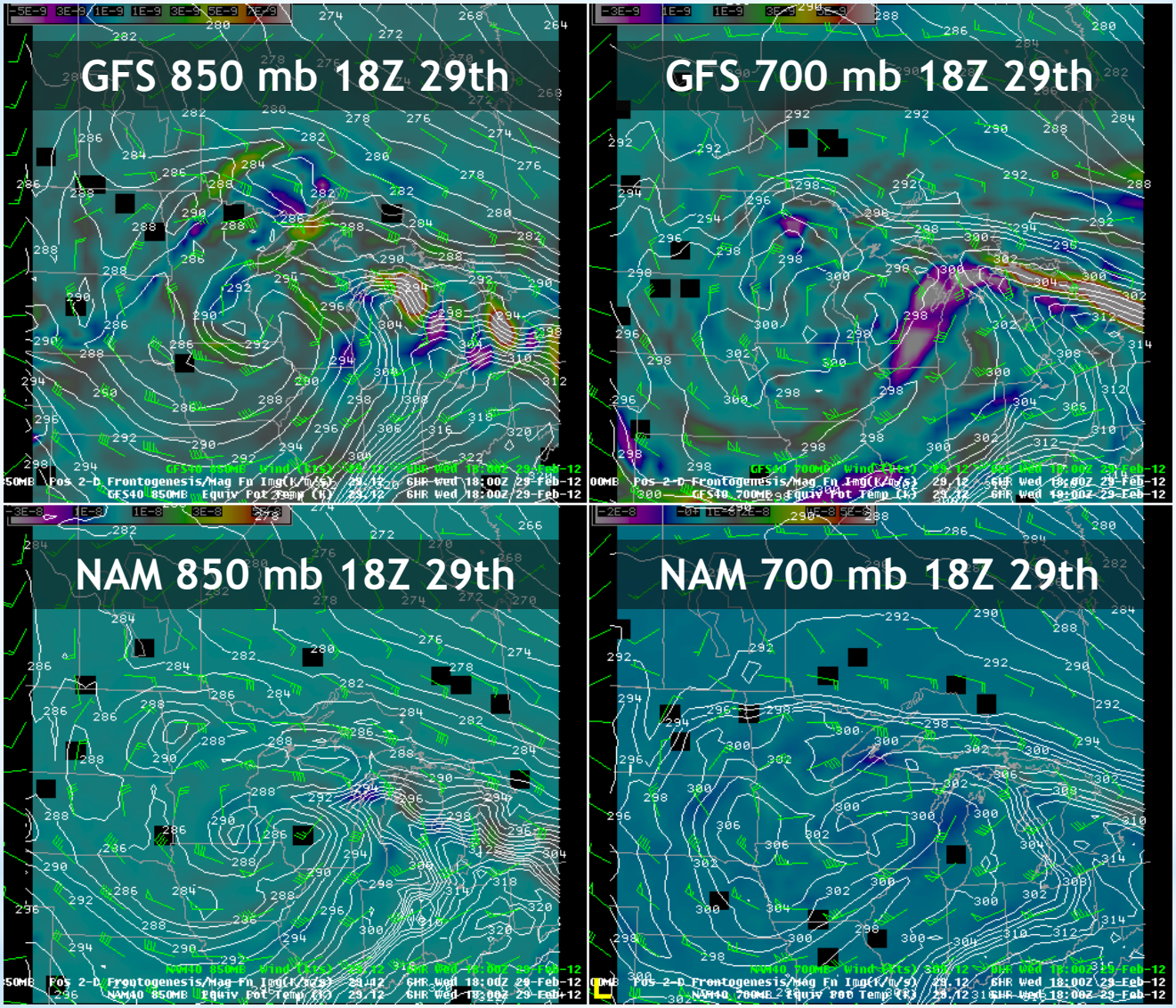
*00Z Run 29th

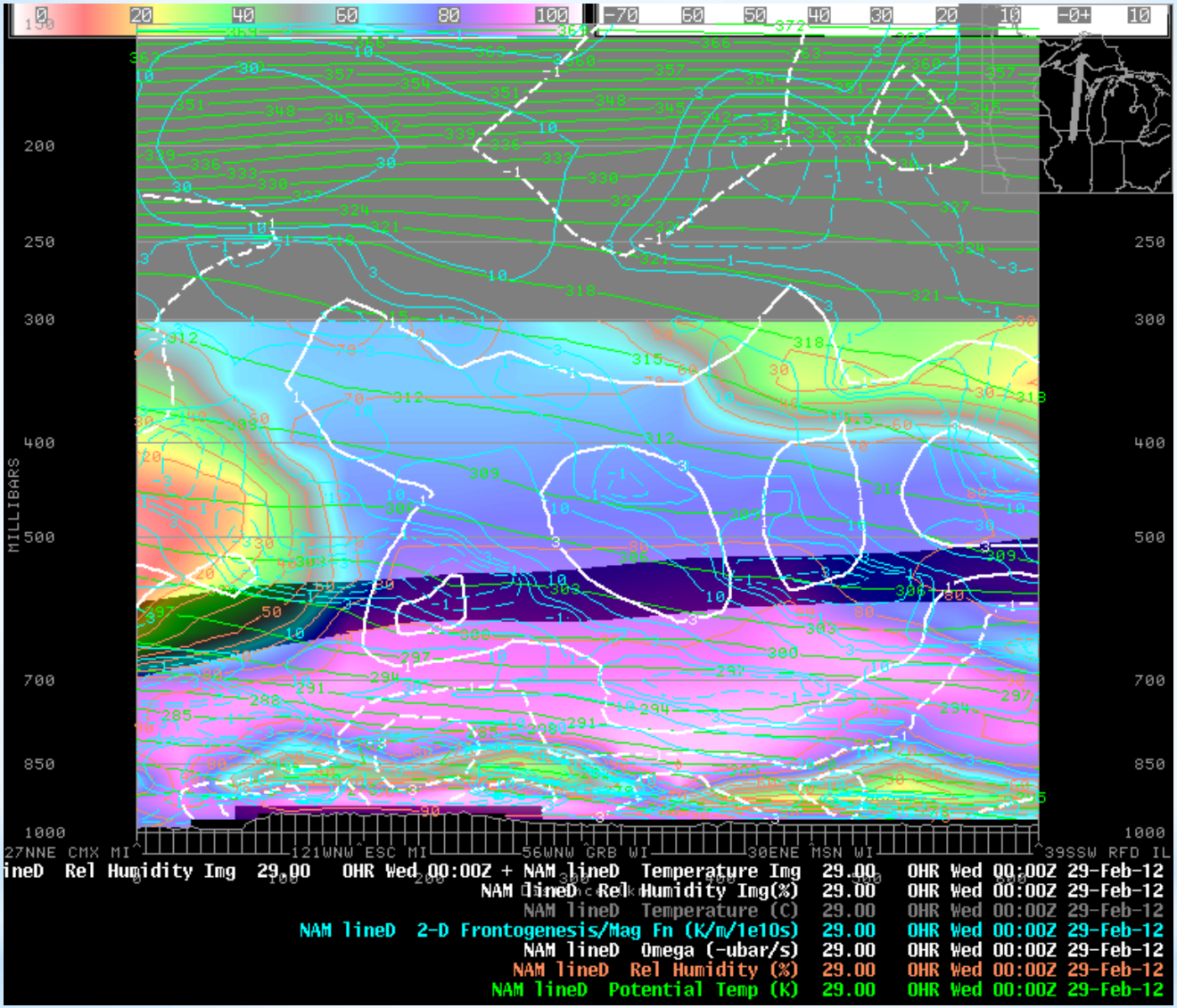

GFS 850 mb 18Z 29th
GFS 700 mb 18Z 29th
NAM 850 mb 18Z 29th
NAM 700 mb 18Z 29th

*12Z Run 29th

Frontogenesis

- Models in good agreement with low and mid level F-Gen over northern WI and southern Upper MI
- TROWAL can be noted on the both the 850mb and 700mb Theta-E surfaces…with axis over the WI-Upper Peninsula border
- These features…coupled with isentropic upglide and high RH values support increased snowfall rates/totals

Cross Section Time



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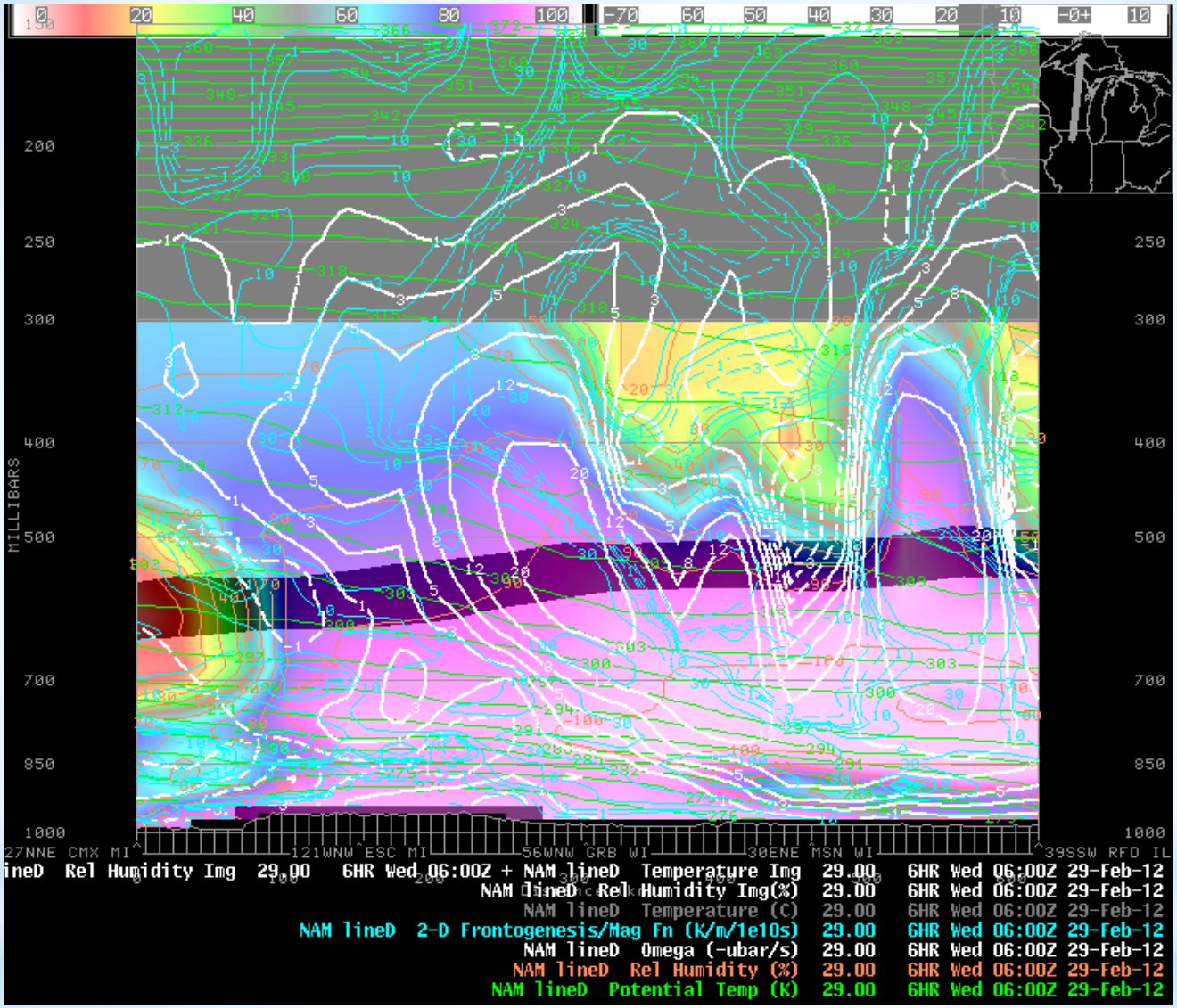

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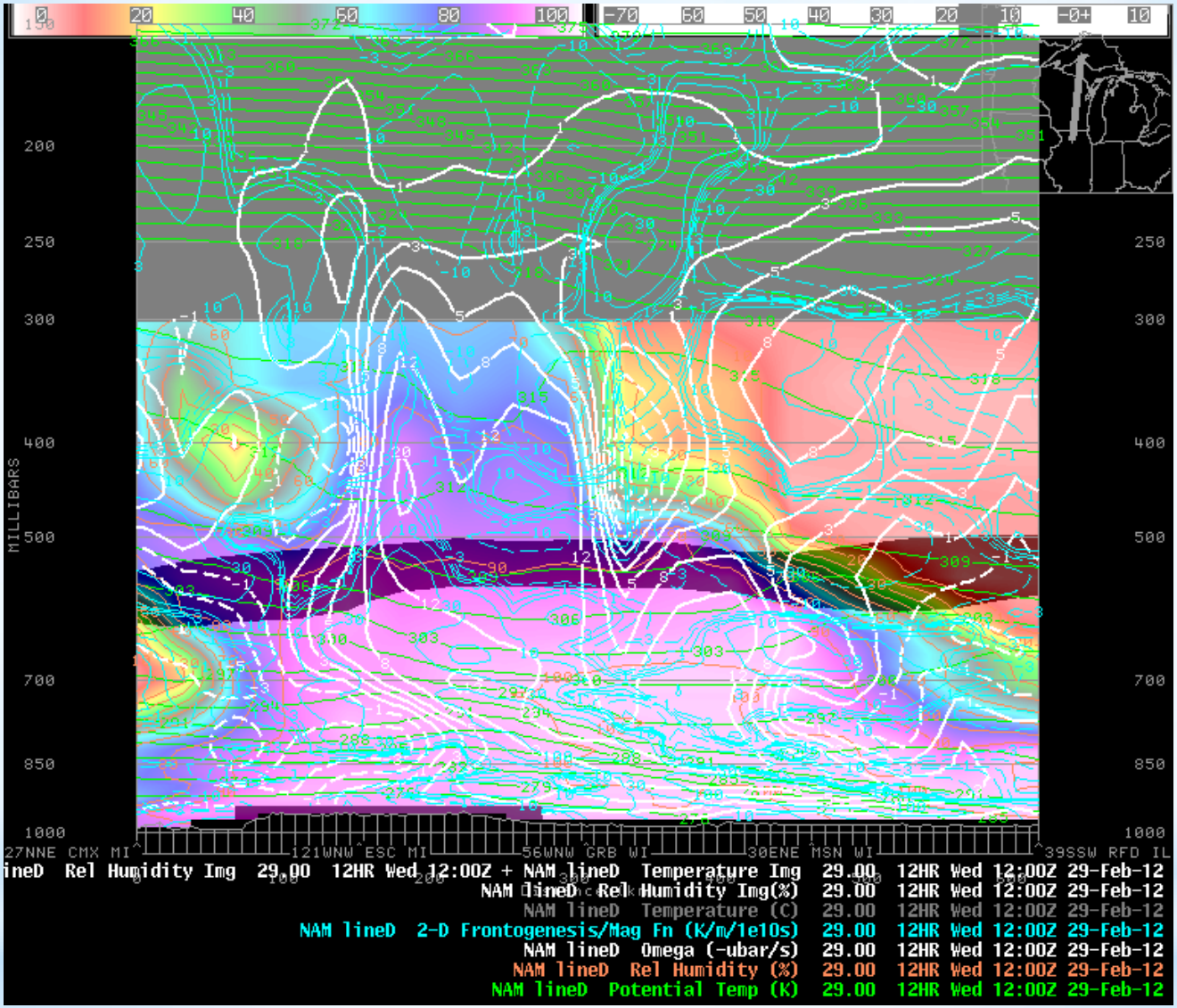

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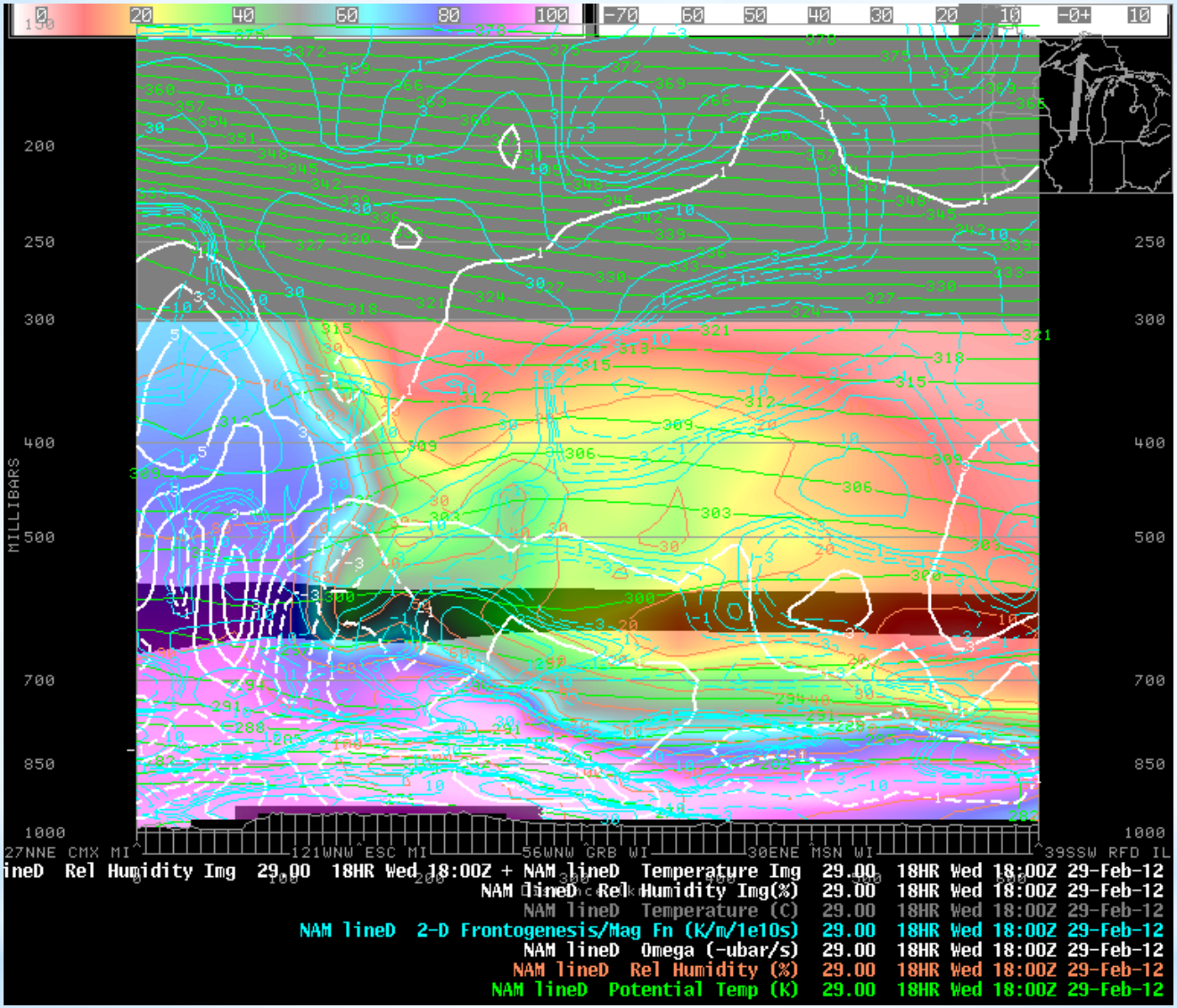

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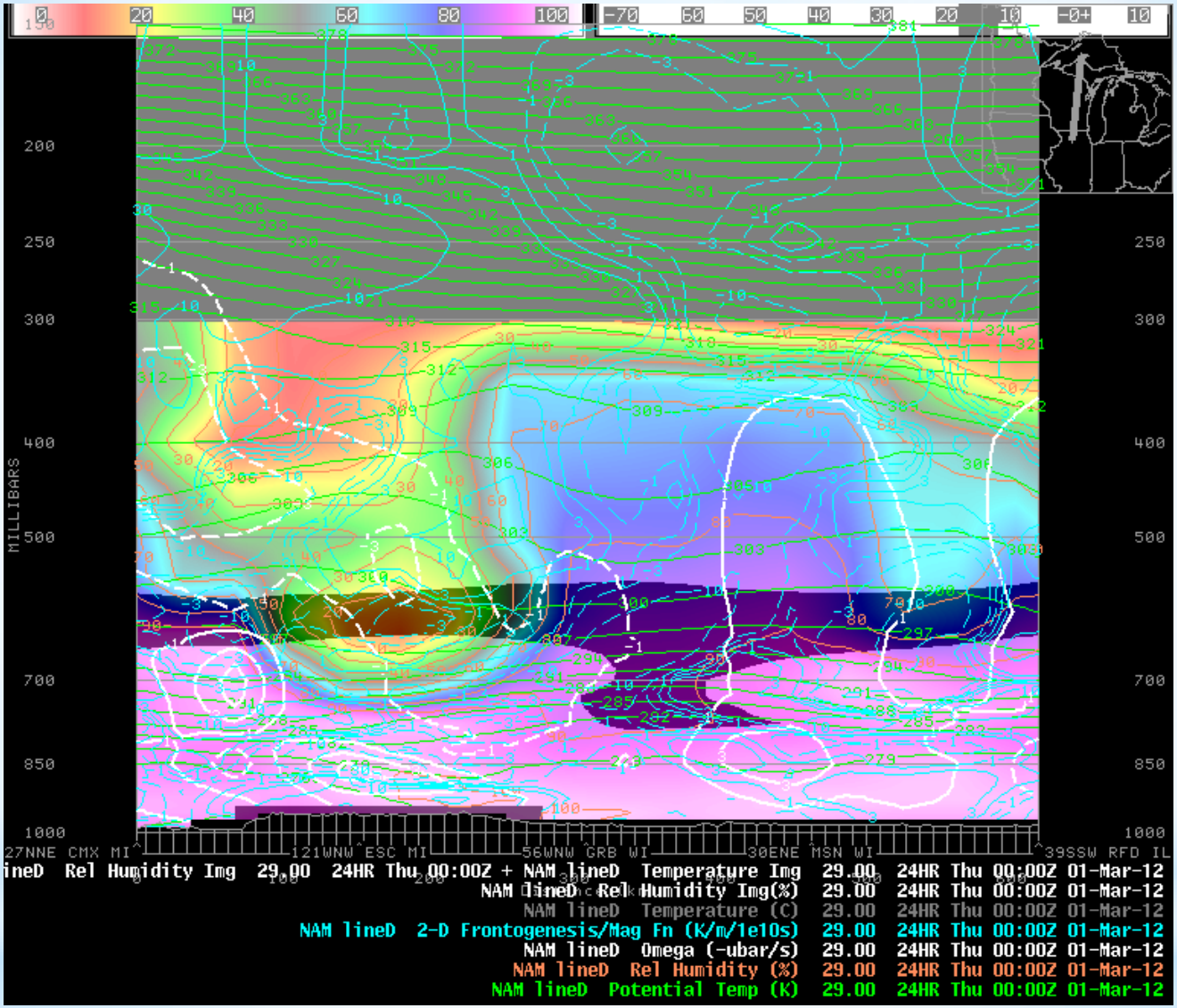

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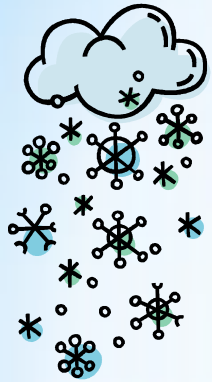
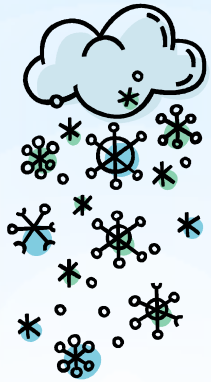
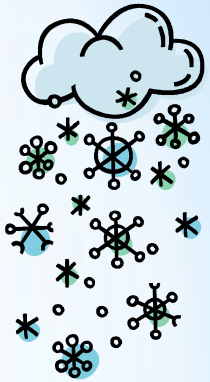
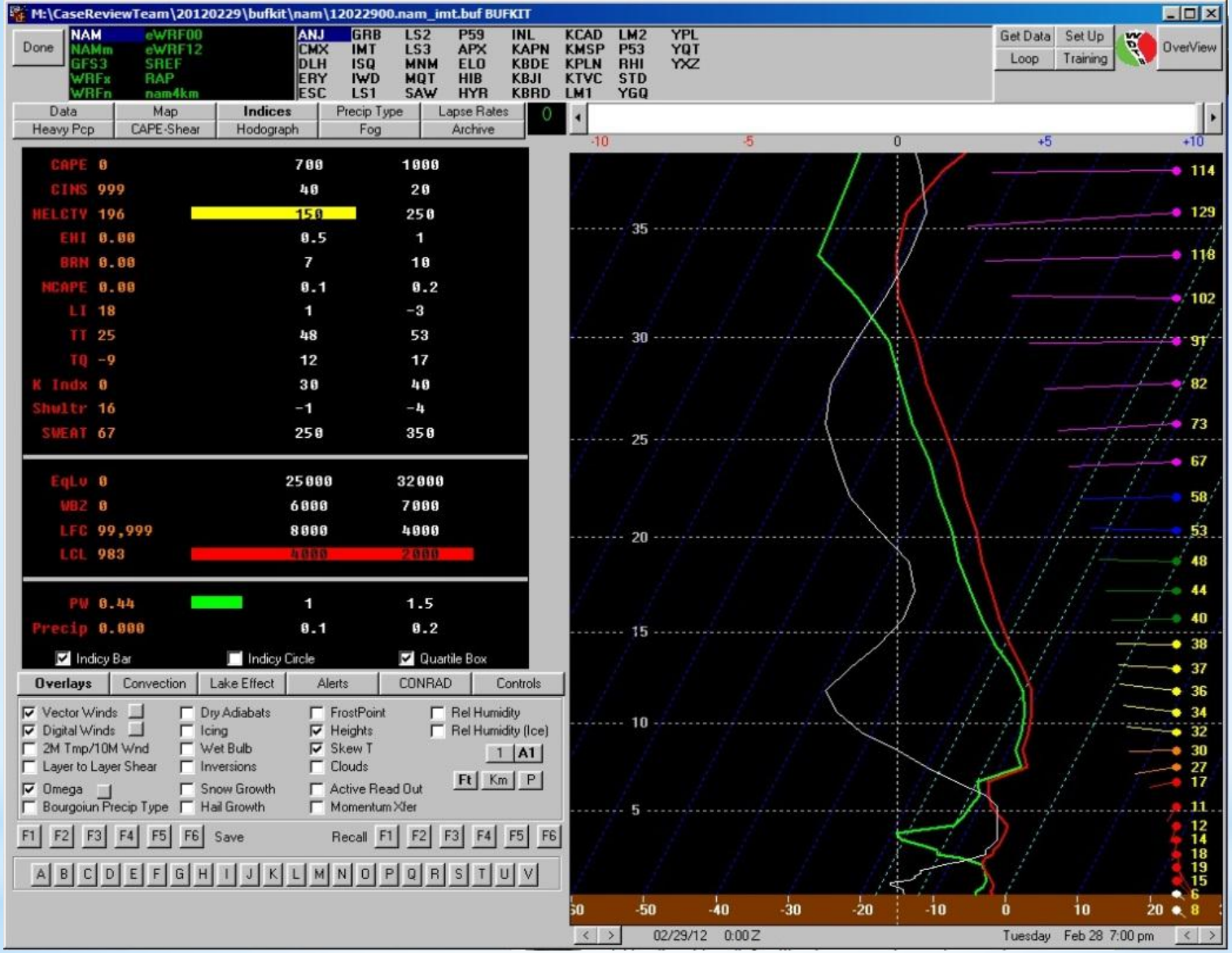




Forecast Soundings



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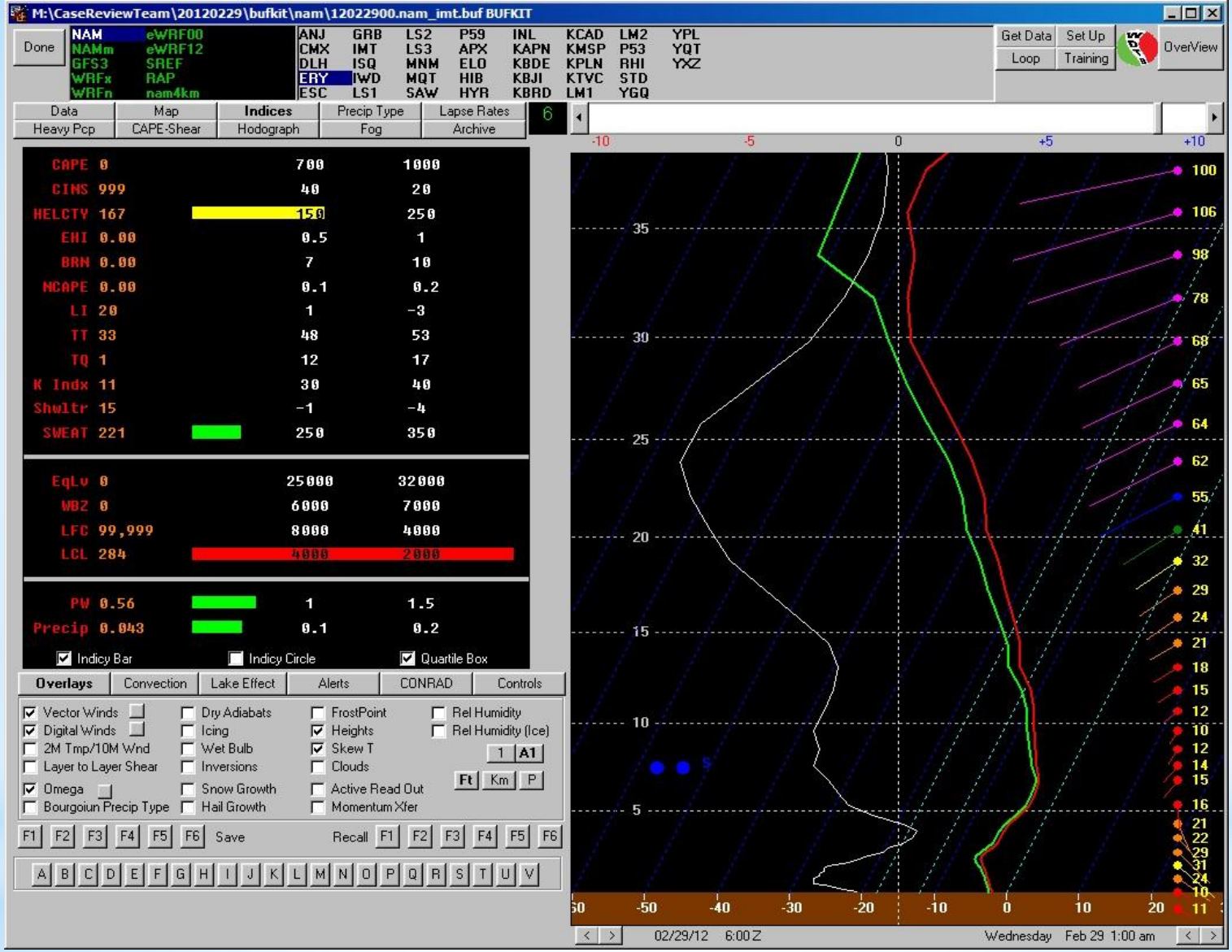

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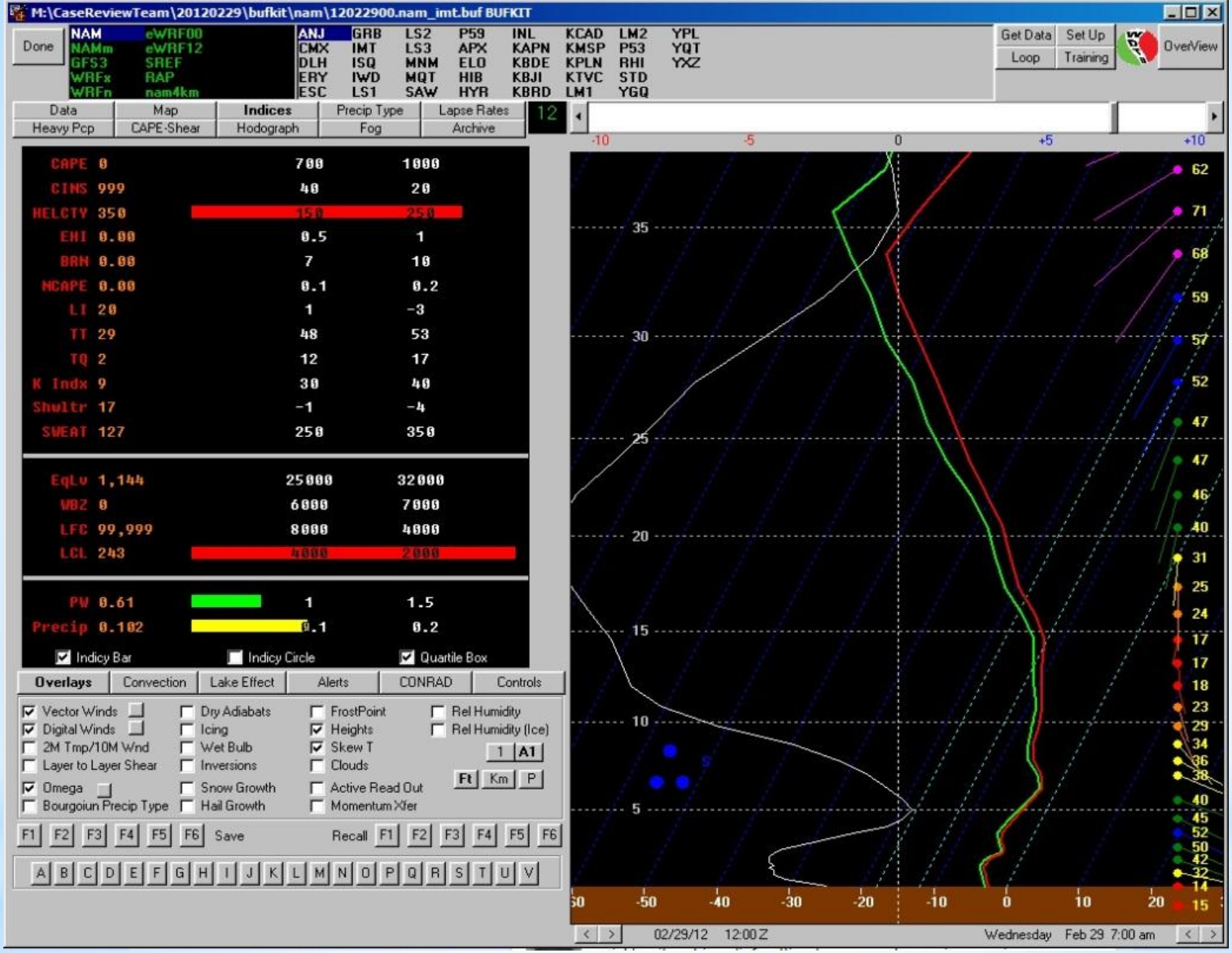

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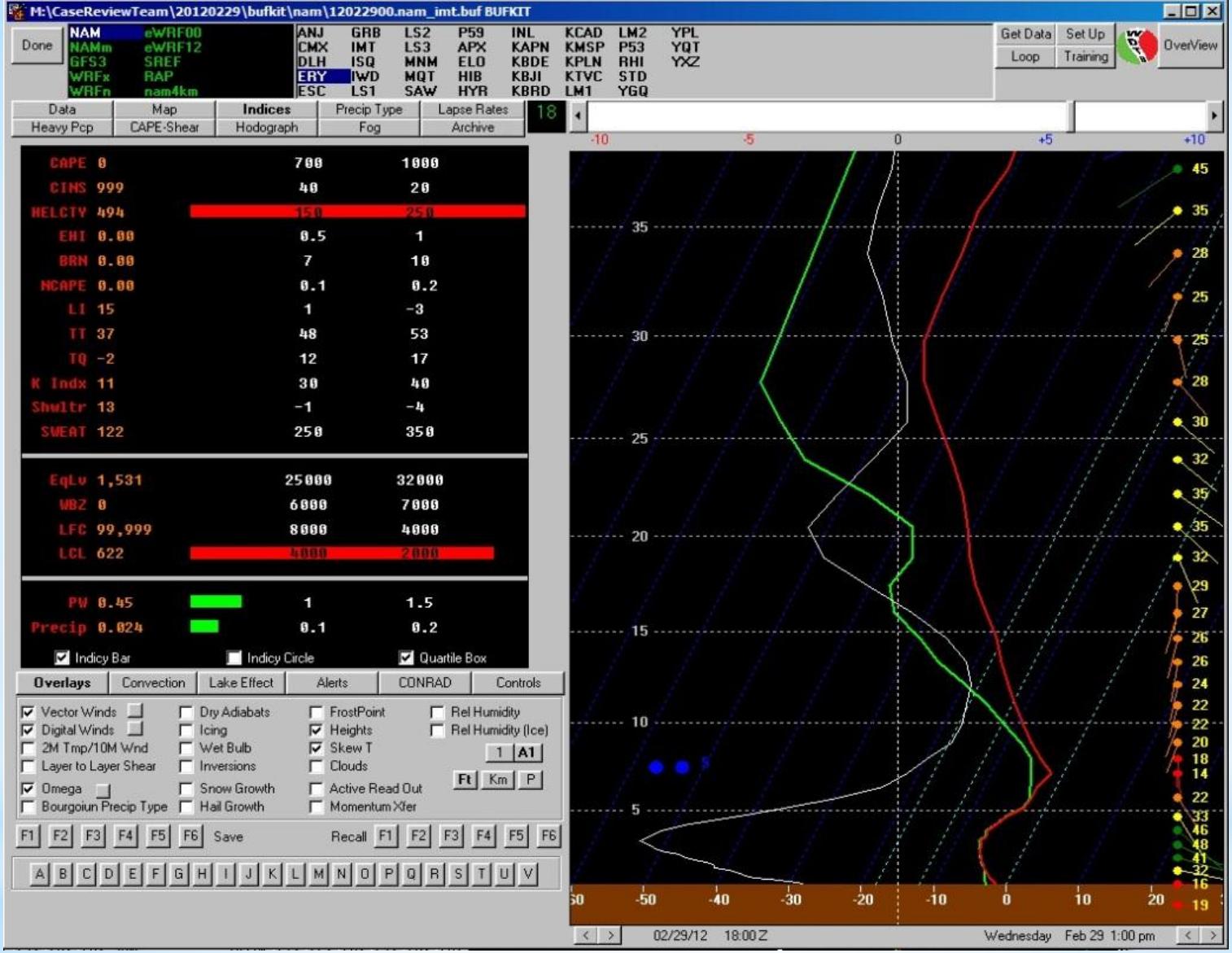

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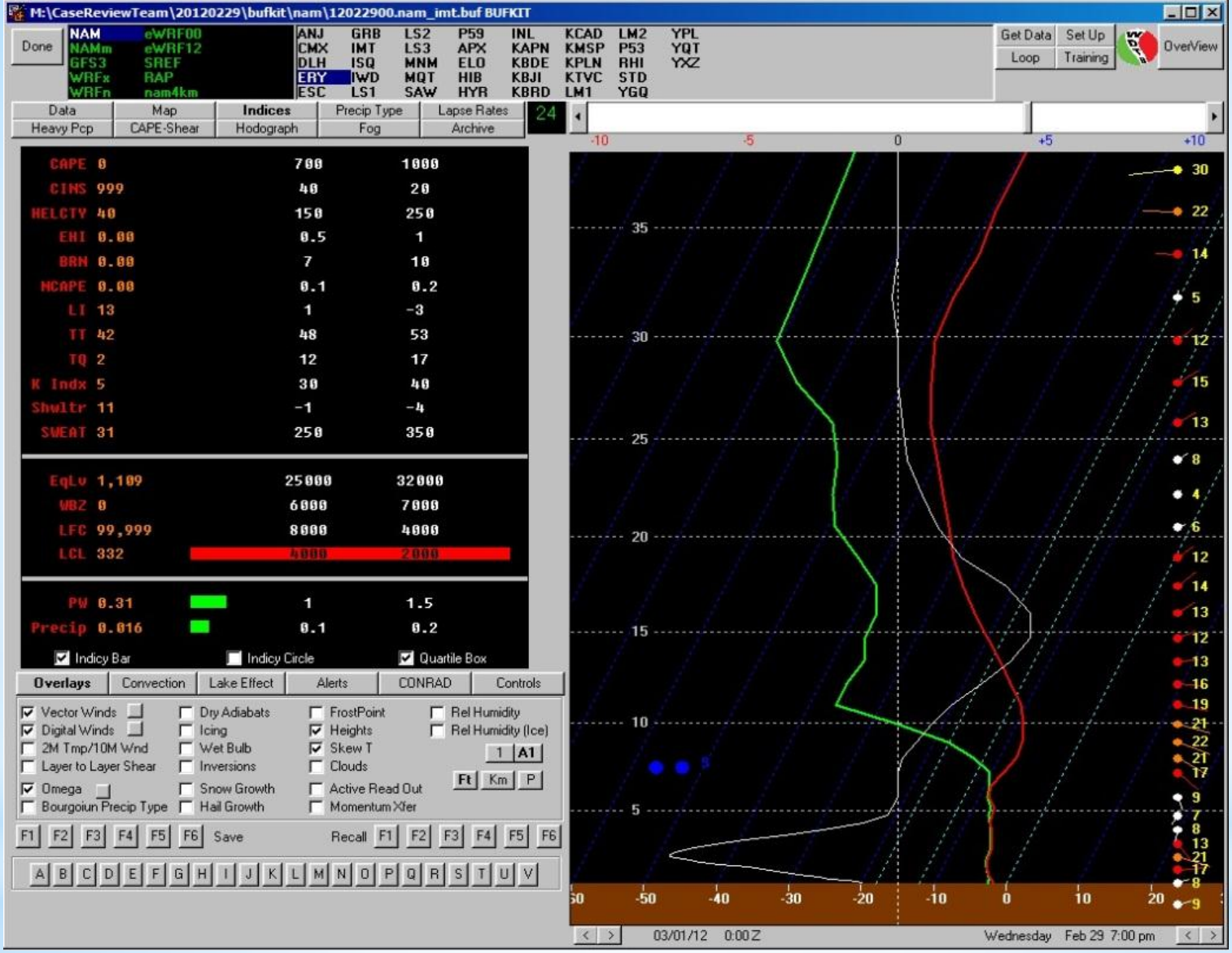

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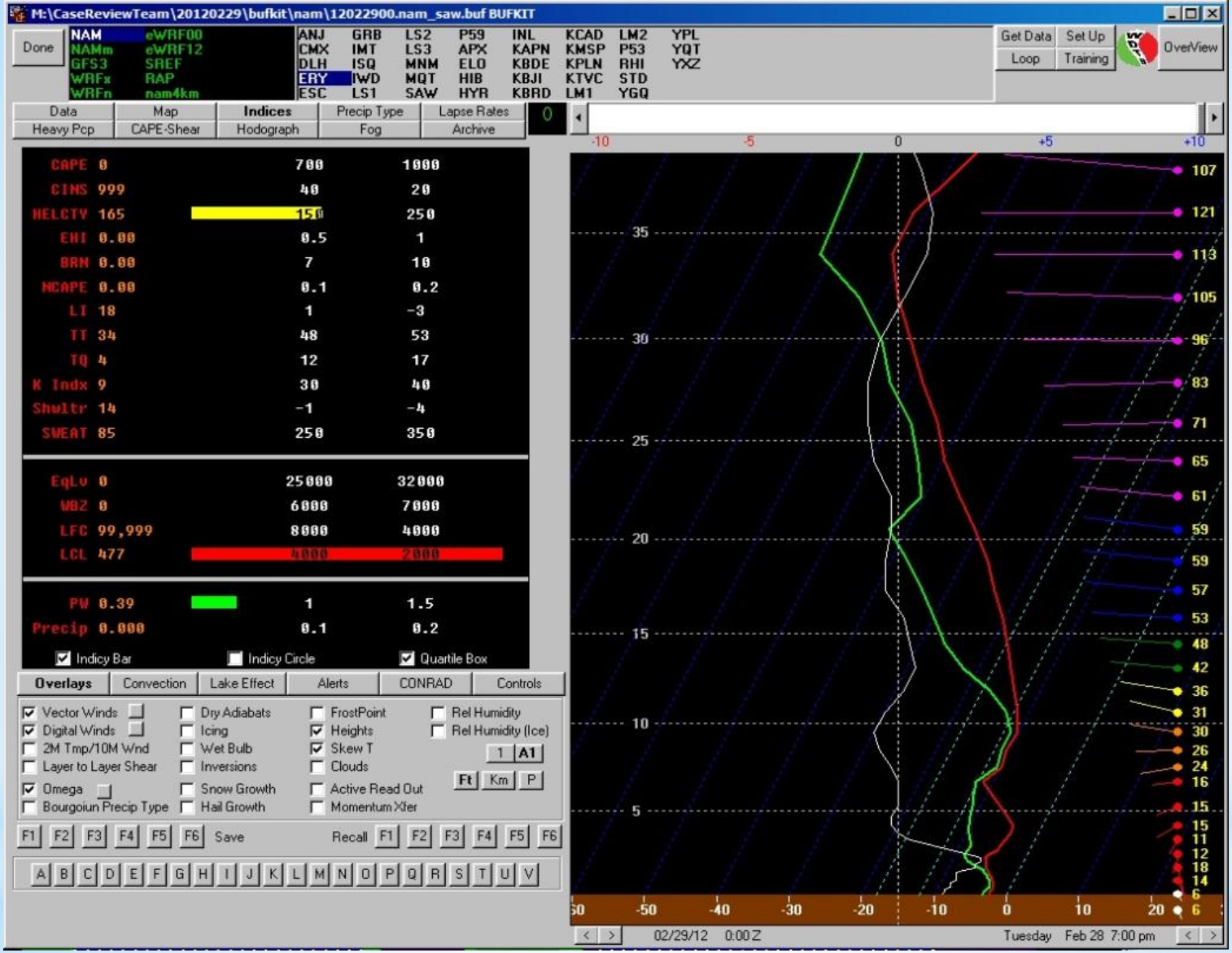

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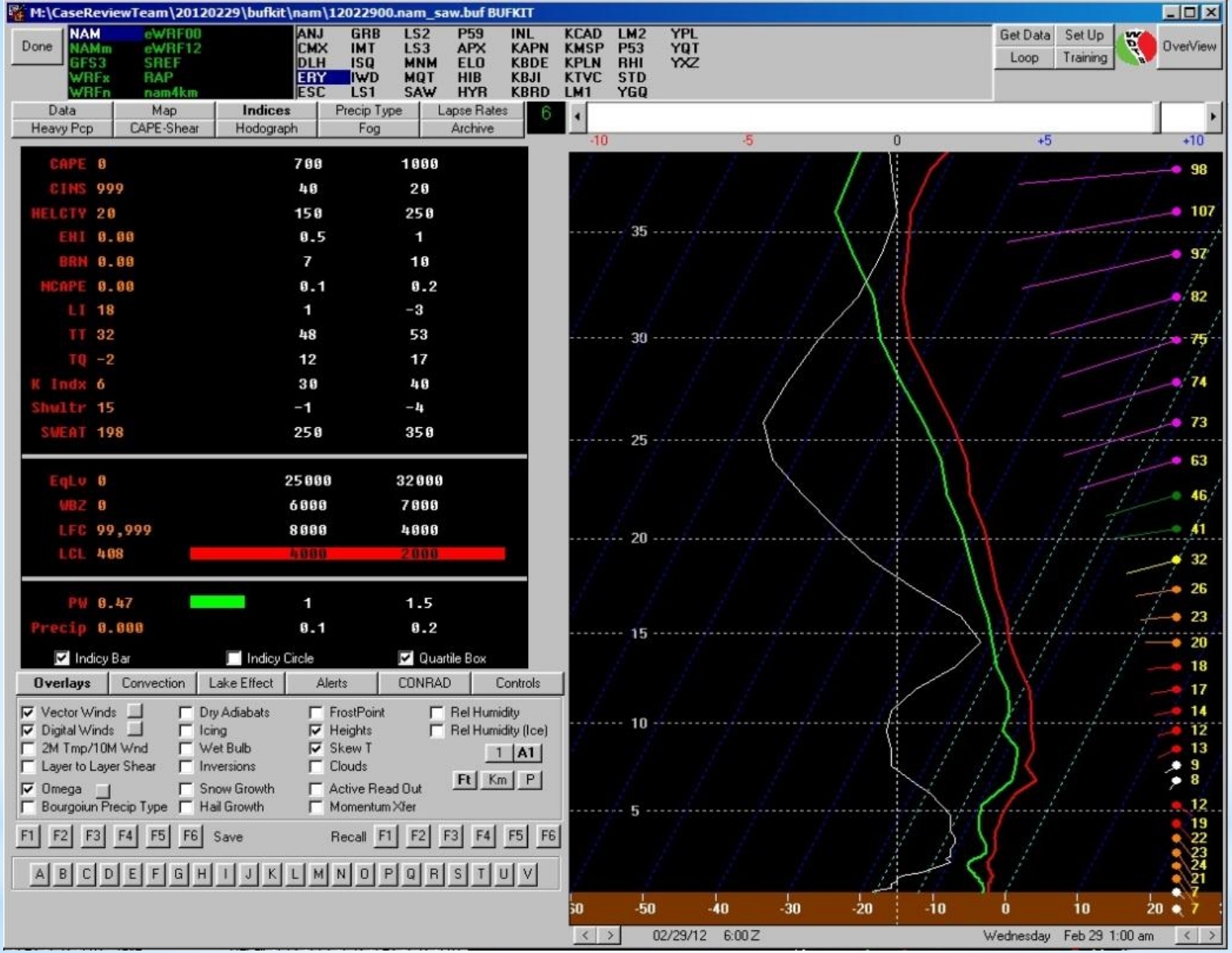

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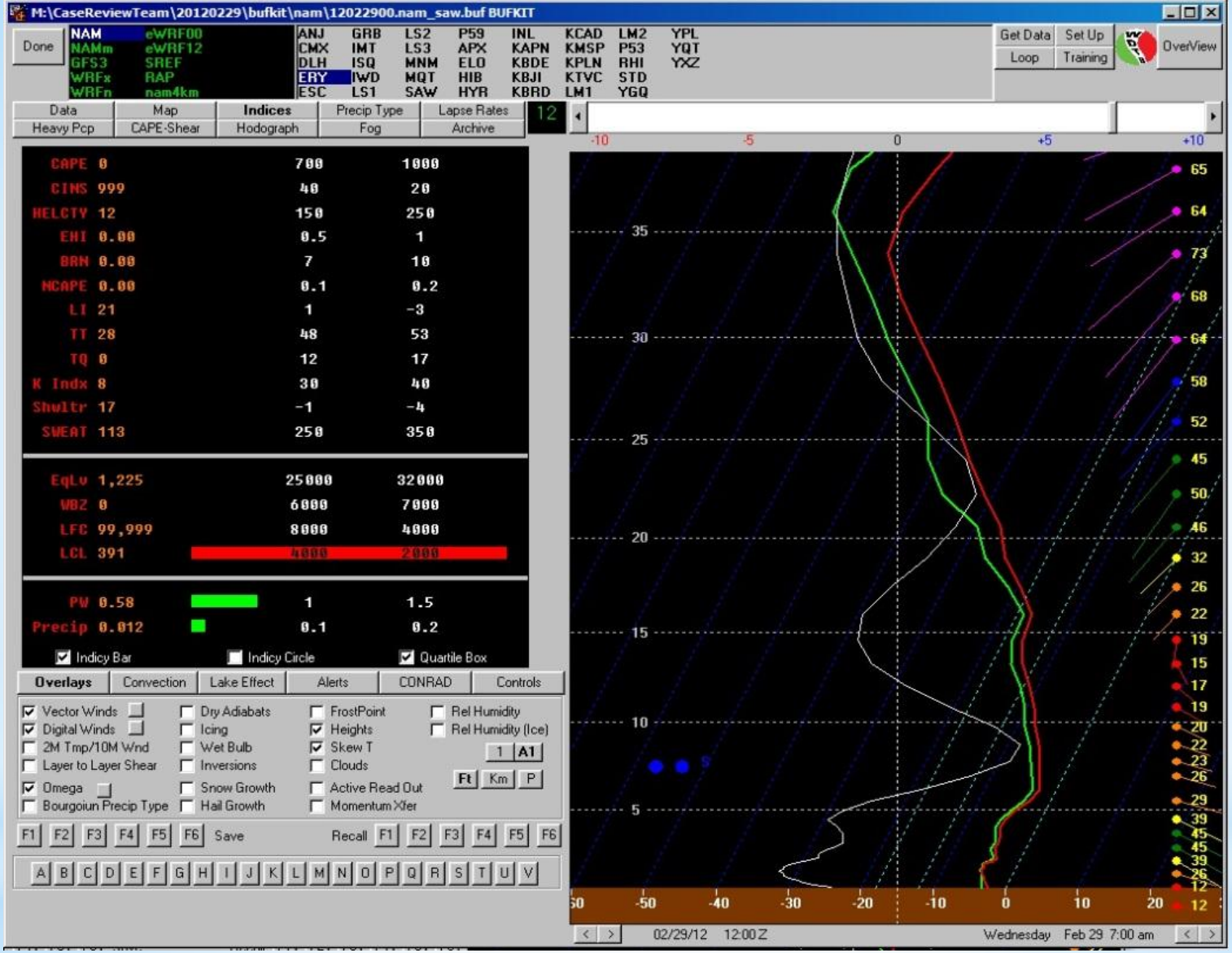

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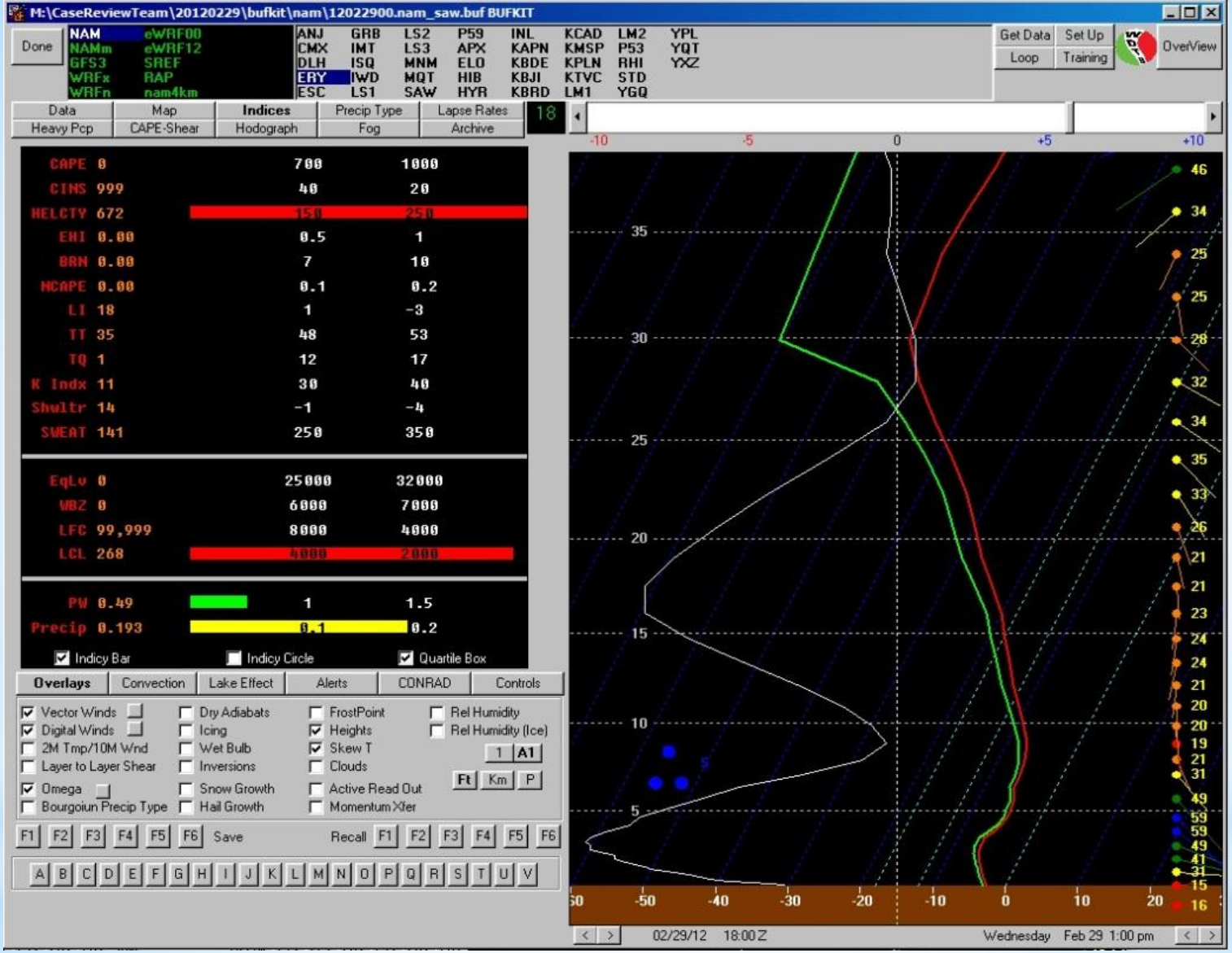

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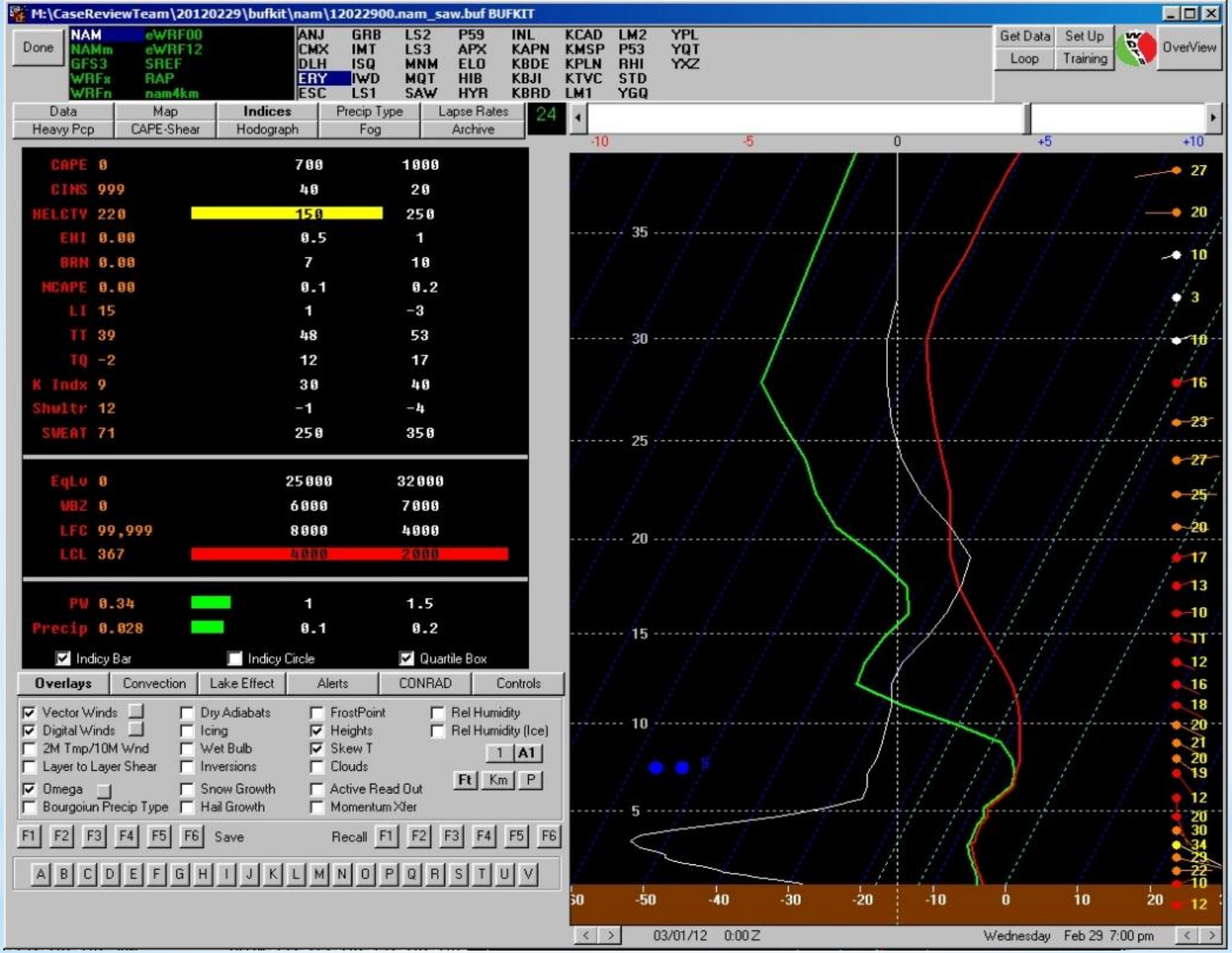

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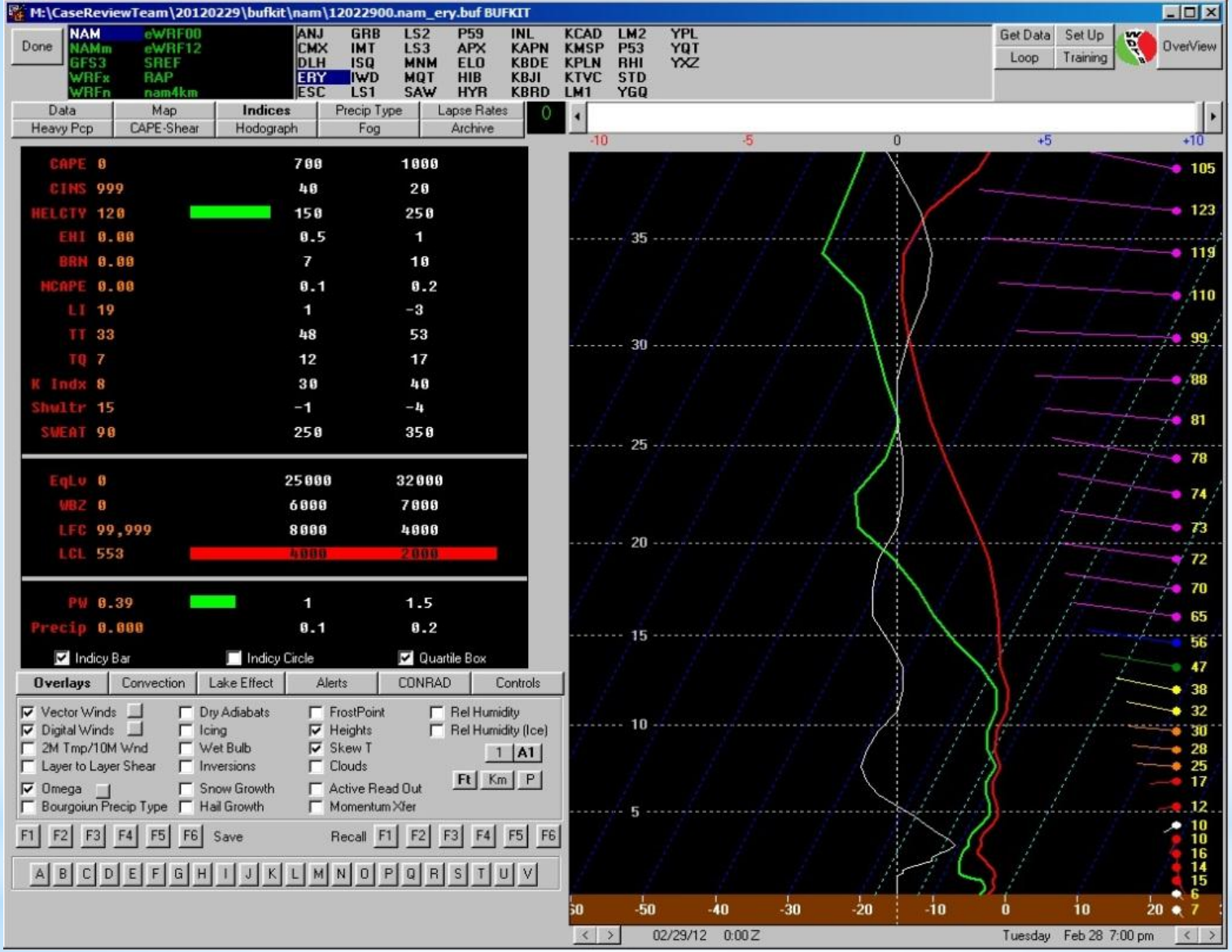

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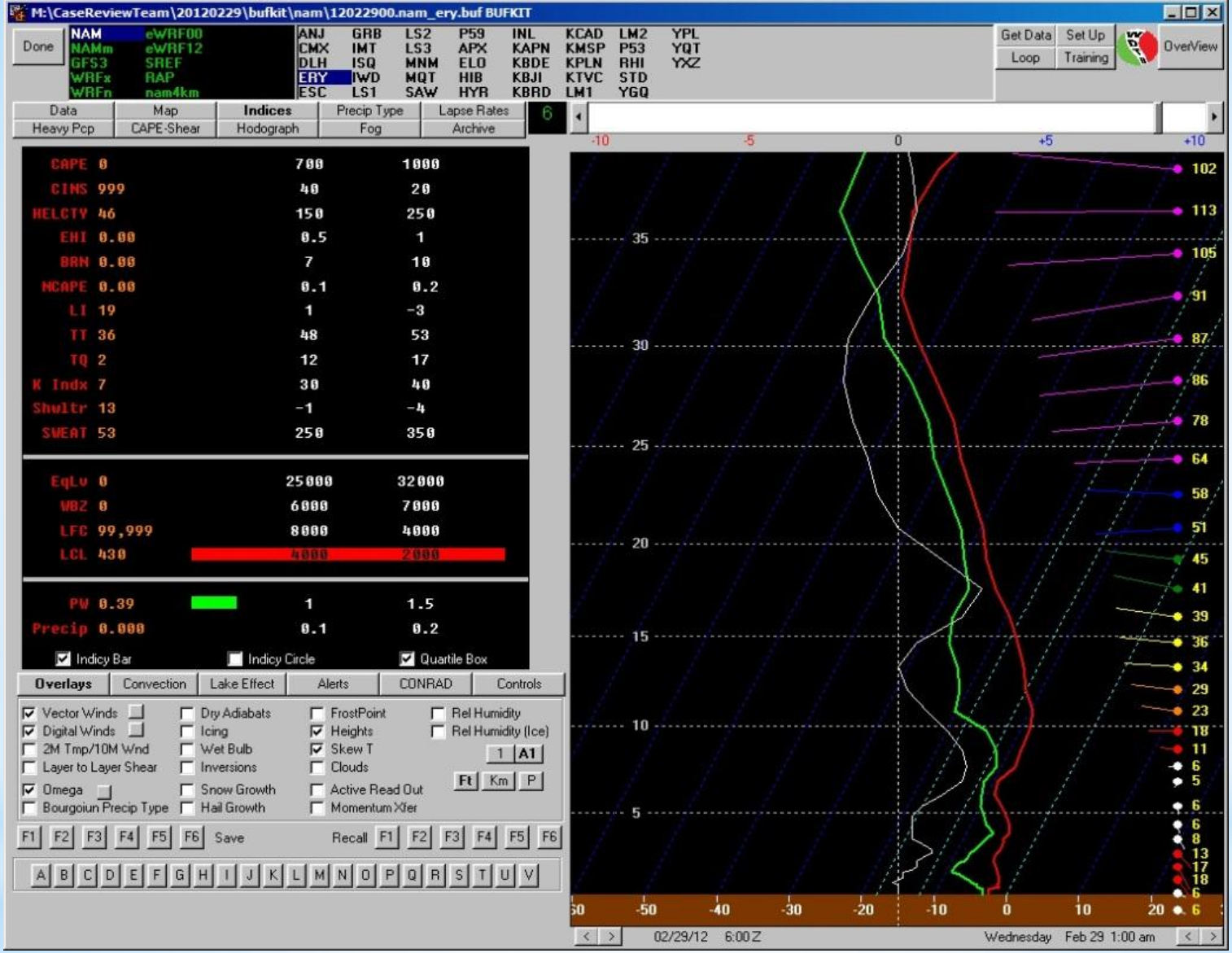

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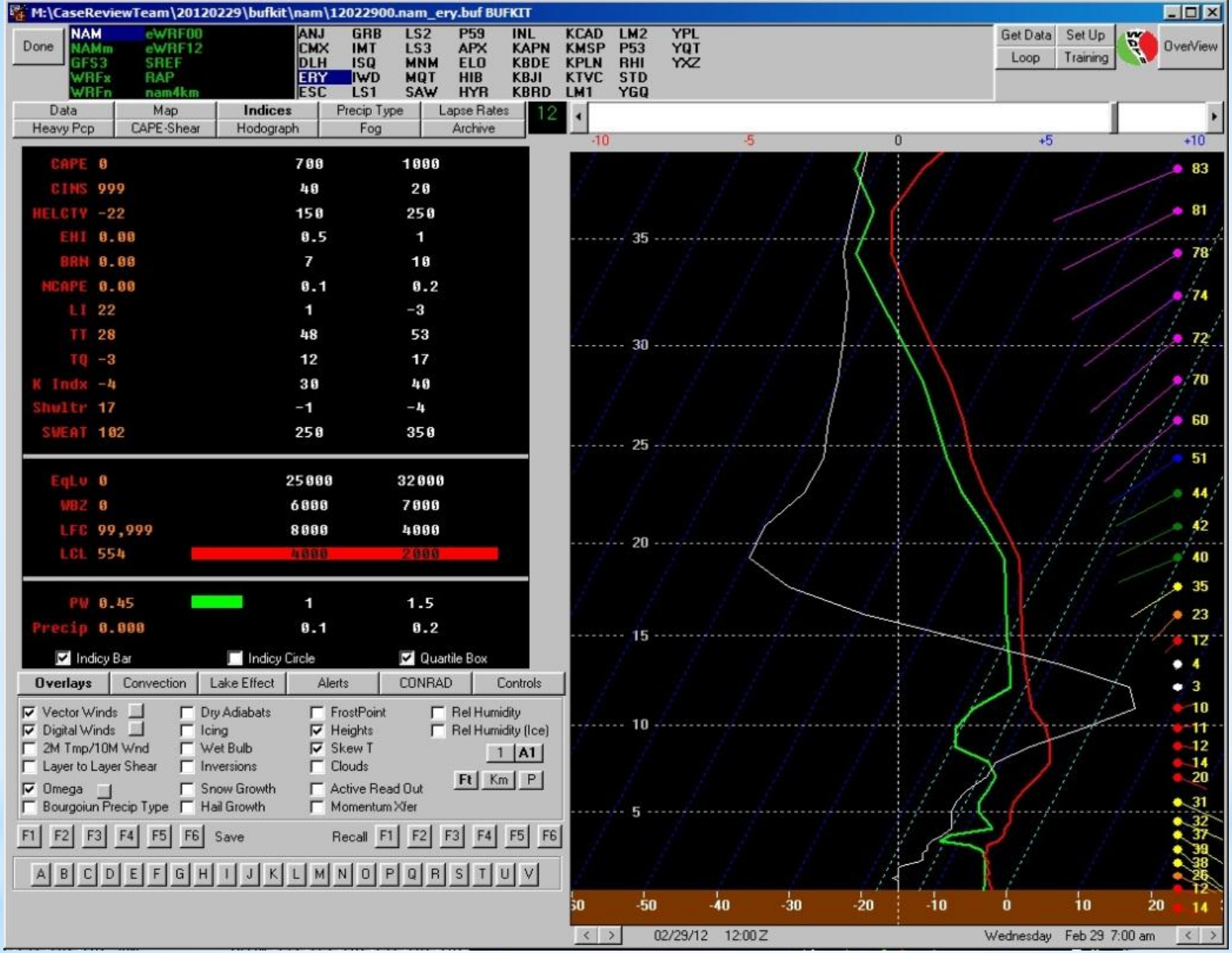

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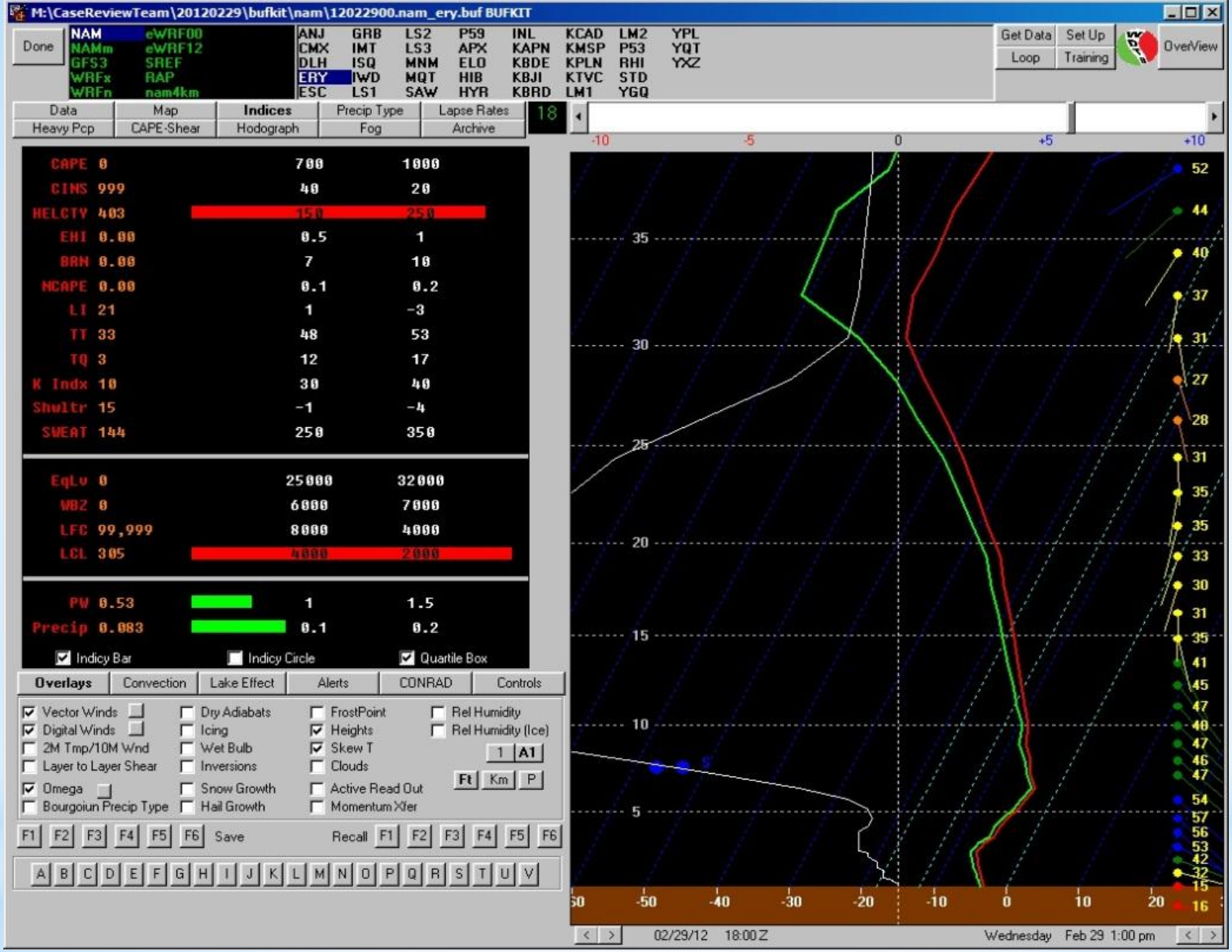

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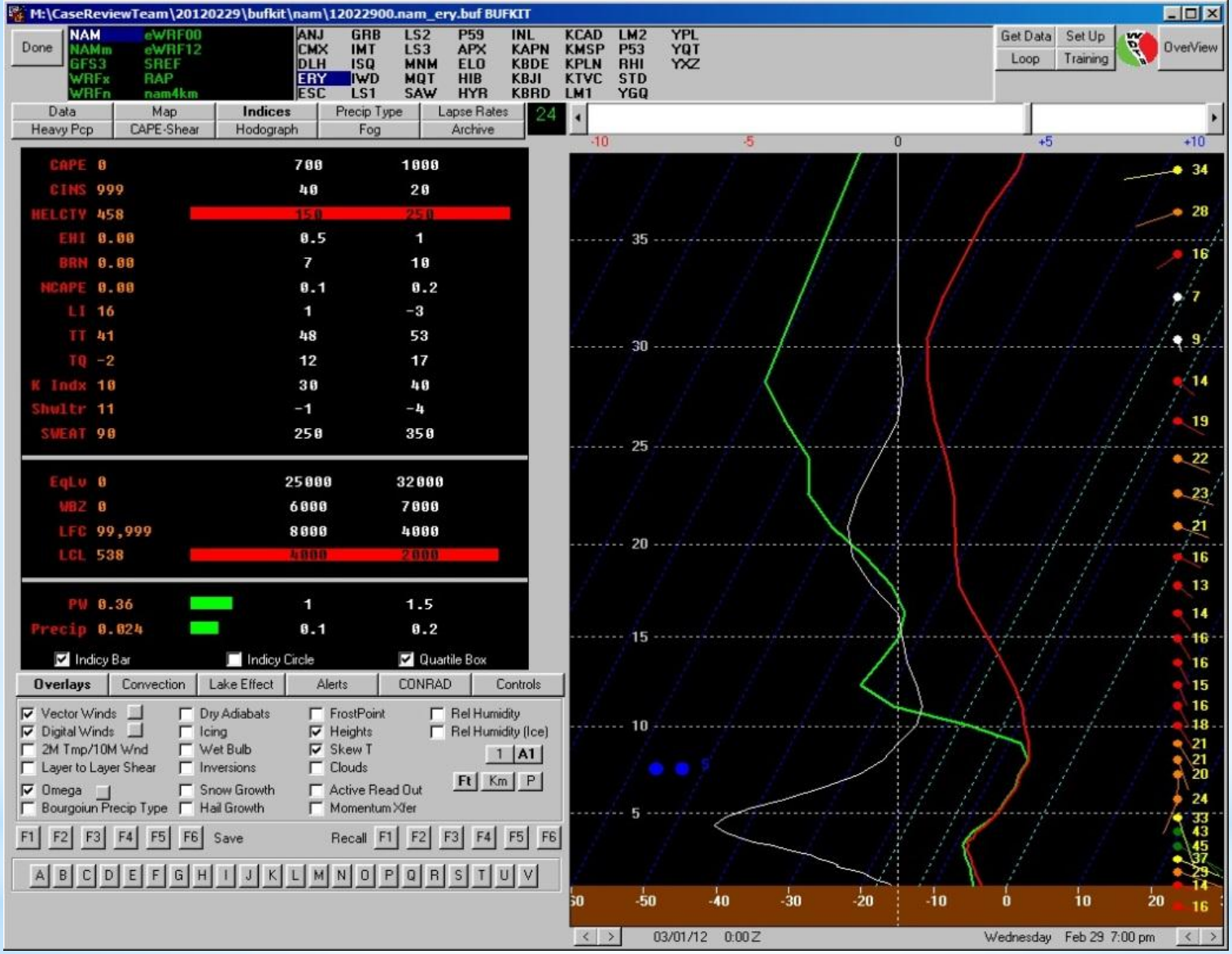
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WRFn nam4km
ANJ GRB LS2 P59 INL KCAD LM2 YPL
CMX IMT LS3 APX KAPN KMSP P53 YQT
DLH ISQ MNM ELO KBDE KPLN RHI YXZ
ERY IWD MQT HIB KBJI KTVC STD
ESC LS1 SAW HYR KBRD LM1 YGQ
Get Data
Set Up
Loop
Training
OverView
Data
Map
Indices
Precip Type
Lapse Rates
Heavy Pcp
CAPE-Shear
Hodograph
Fog
Archive
24
CAPE 0 700 1000
CINS 999 40 20
HELCTY 458 150 250
EHI 0.00 0.5 1
BRN 0.00 7 10
MCAPE 0.00 0.1 0.2
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WBZ 0 6000 7000
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Precip 0.024 0.1 0.2
Indicy Bar
Indicy Circle
Quartile Box
Overlays
Convection
Lake Effect
Alerts
CONRAD
Controls
Vector Winds
Digital Winds
2M Tmp/10M Wnd
Layer to Layer Shear
Omega
Bourgoiun Precip Type
Dry Adiabats
Icing
Wet Bulb
Inversions
Snow Growth
Hail Growth
FrostPoint
Heights
Skew T
Clouds
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-10 -5 0 +5 +10
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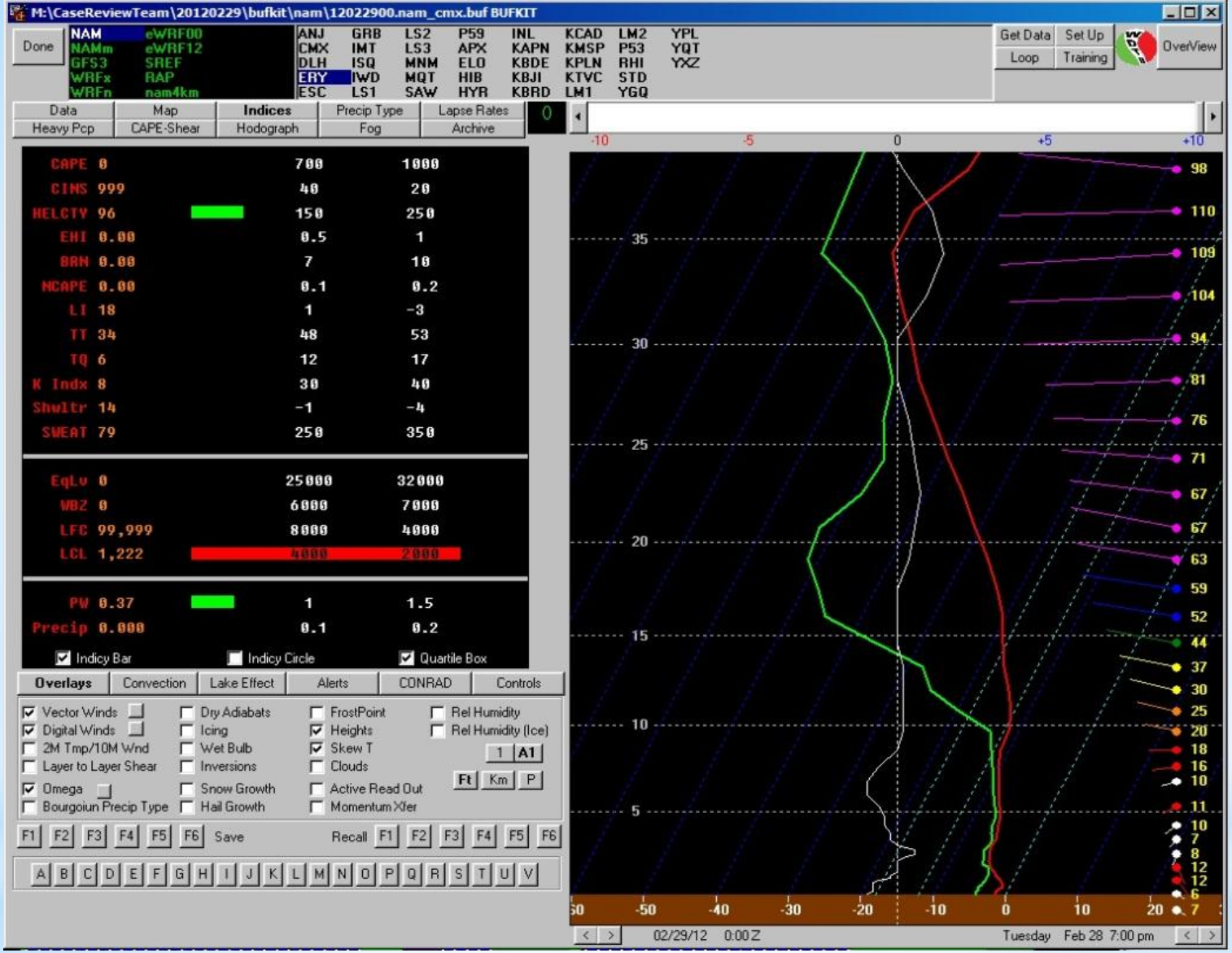
03/01/12 0:00Z
Wednesday Feb 29 7:00 pm

*00Z Run 29th



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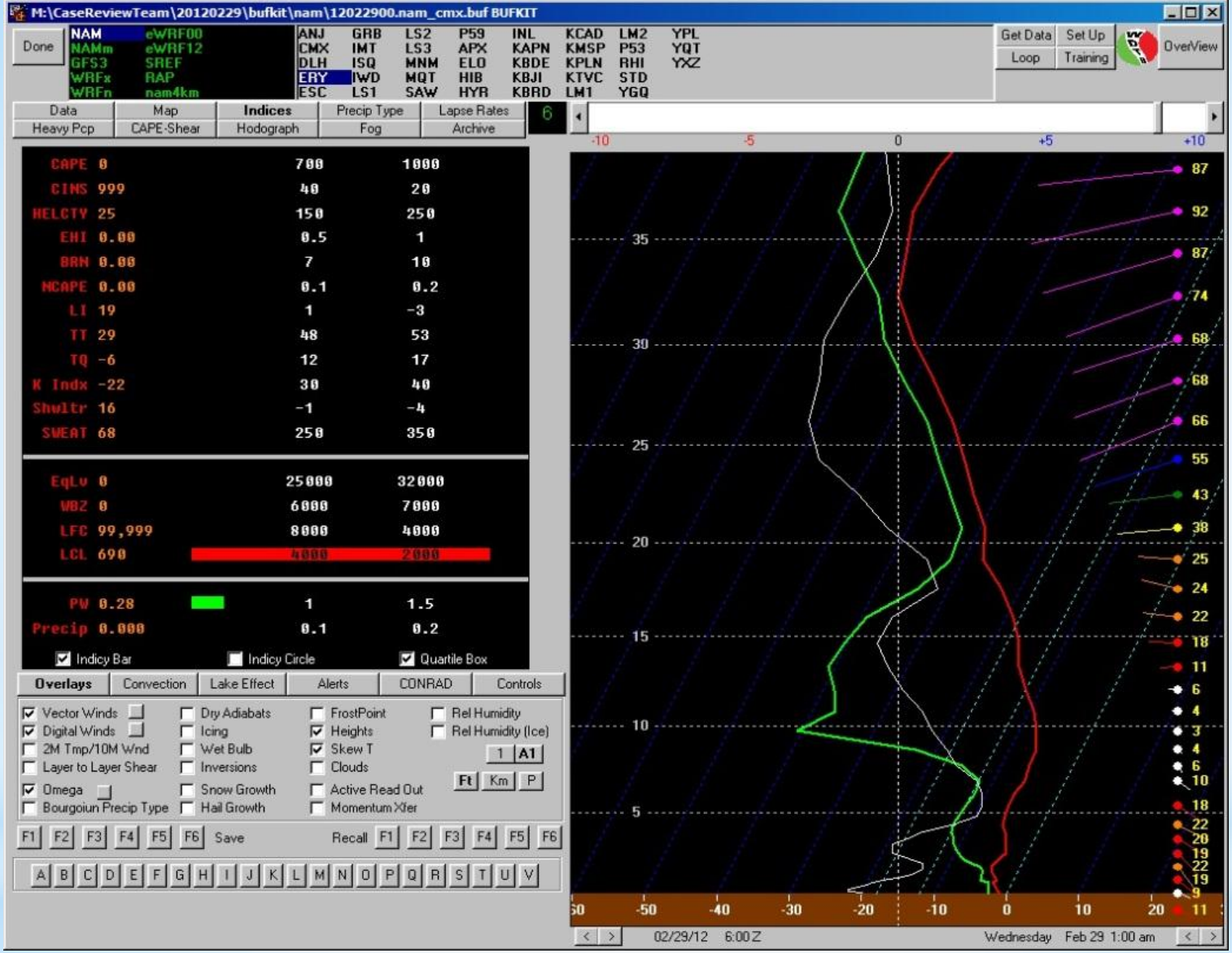

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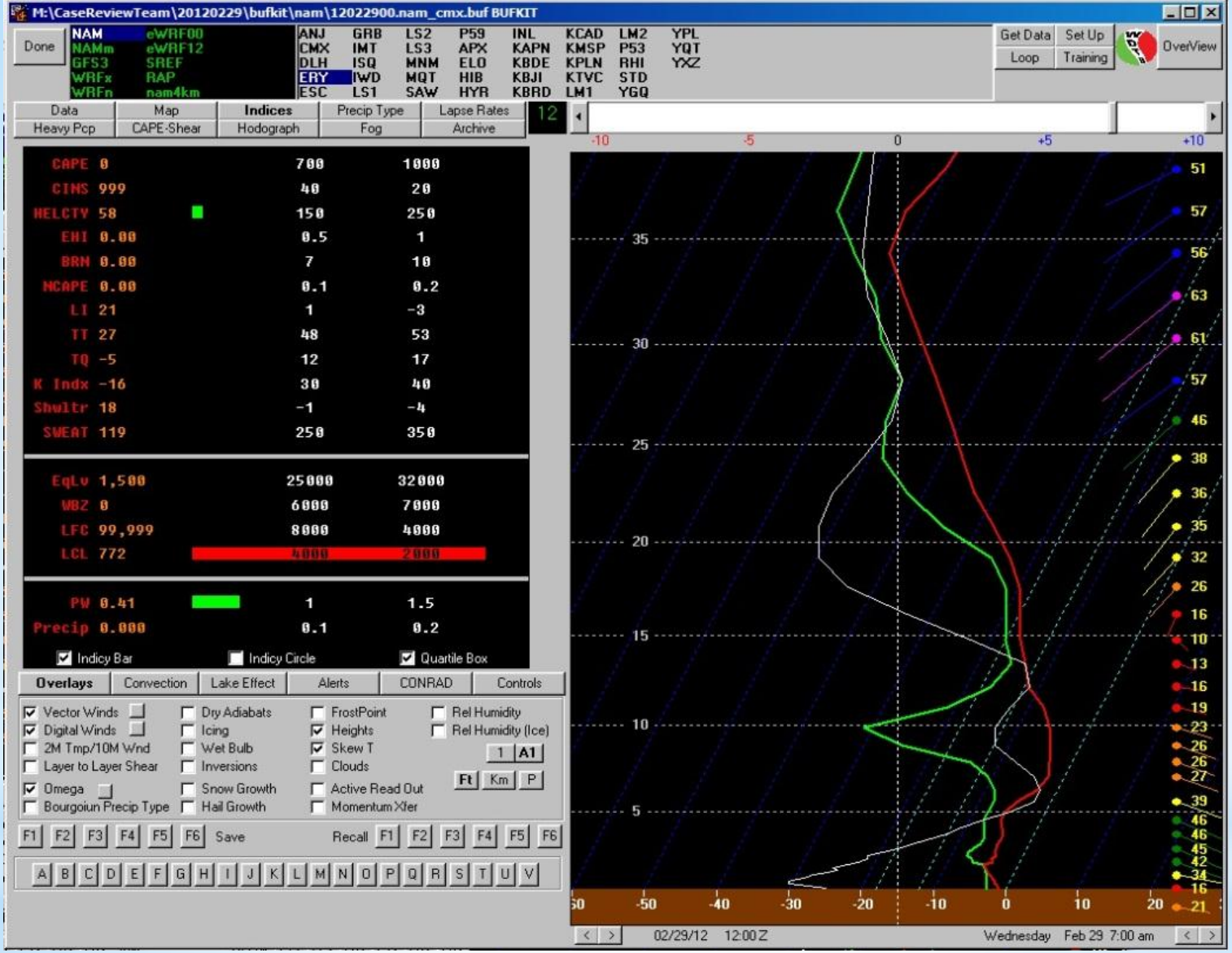

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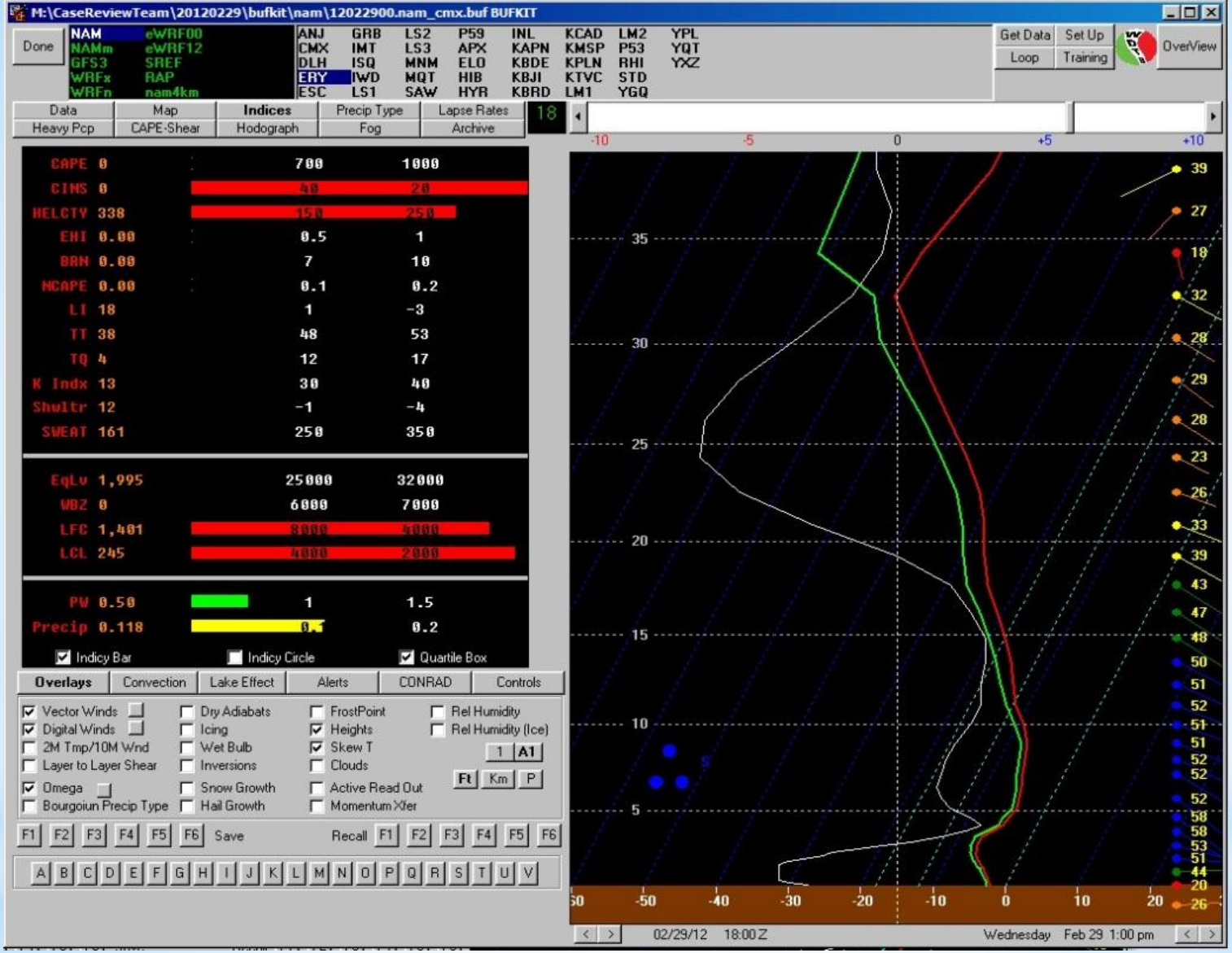

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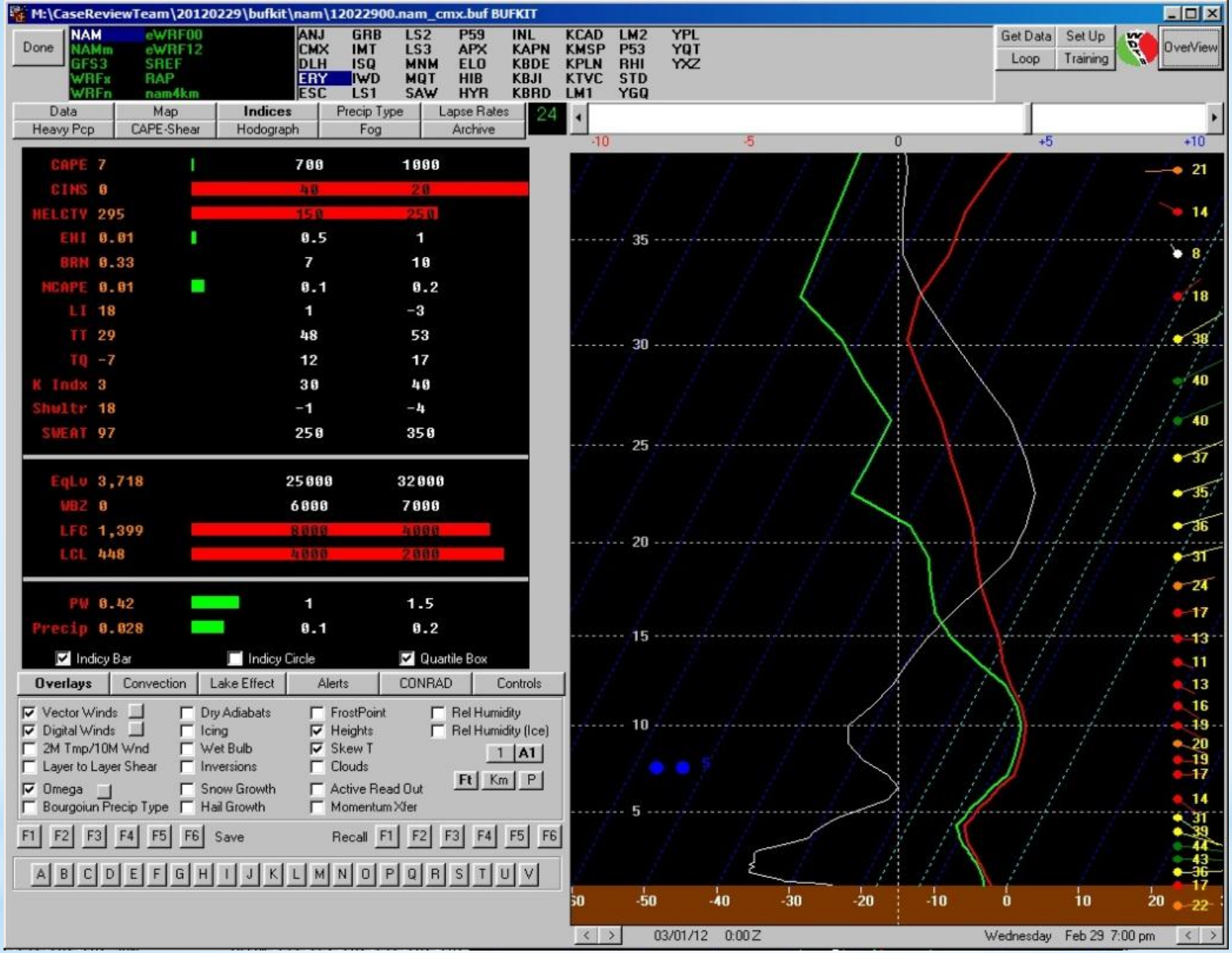

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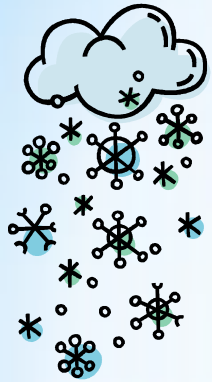
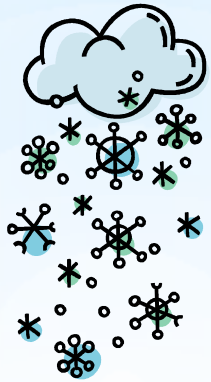
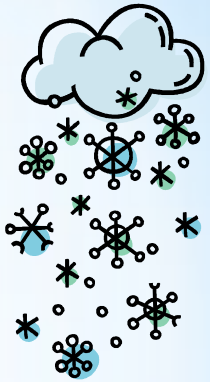
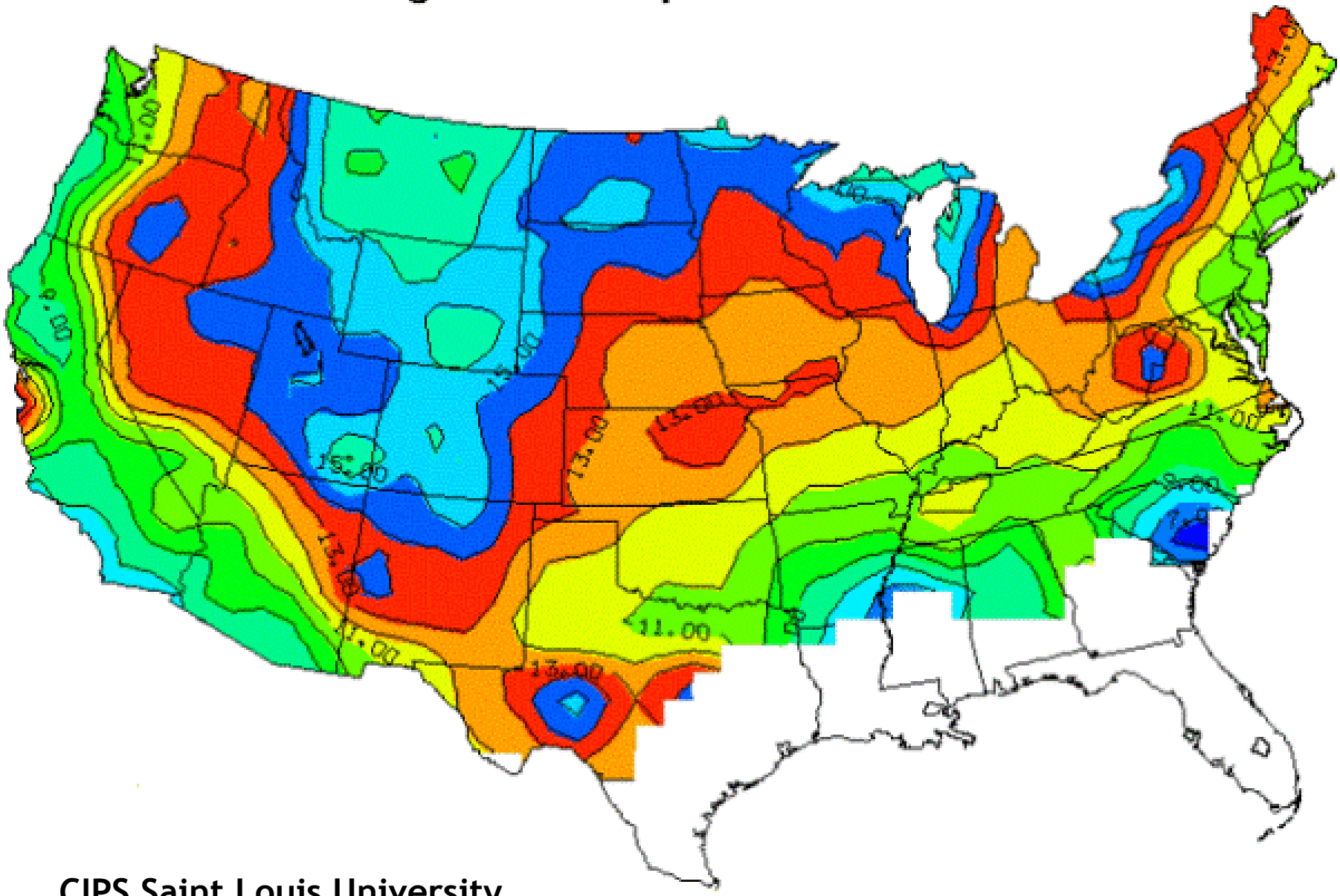




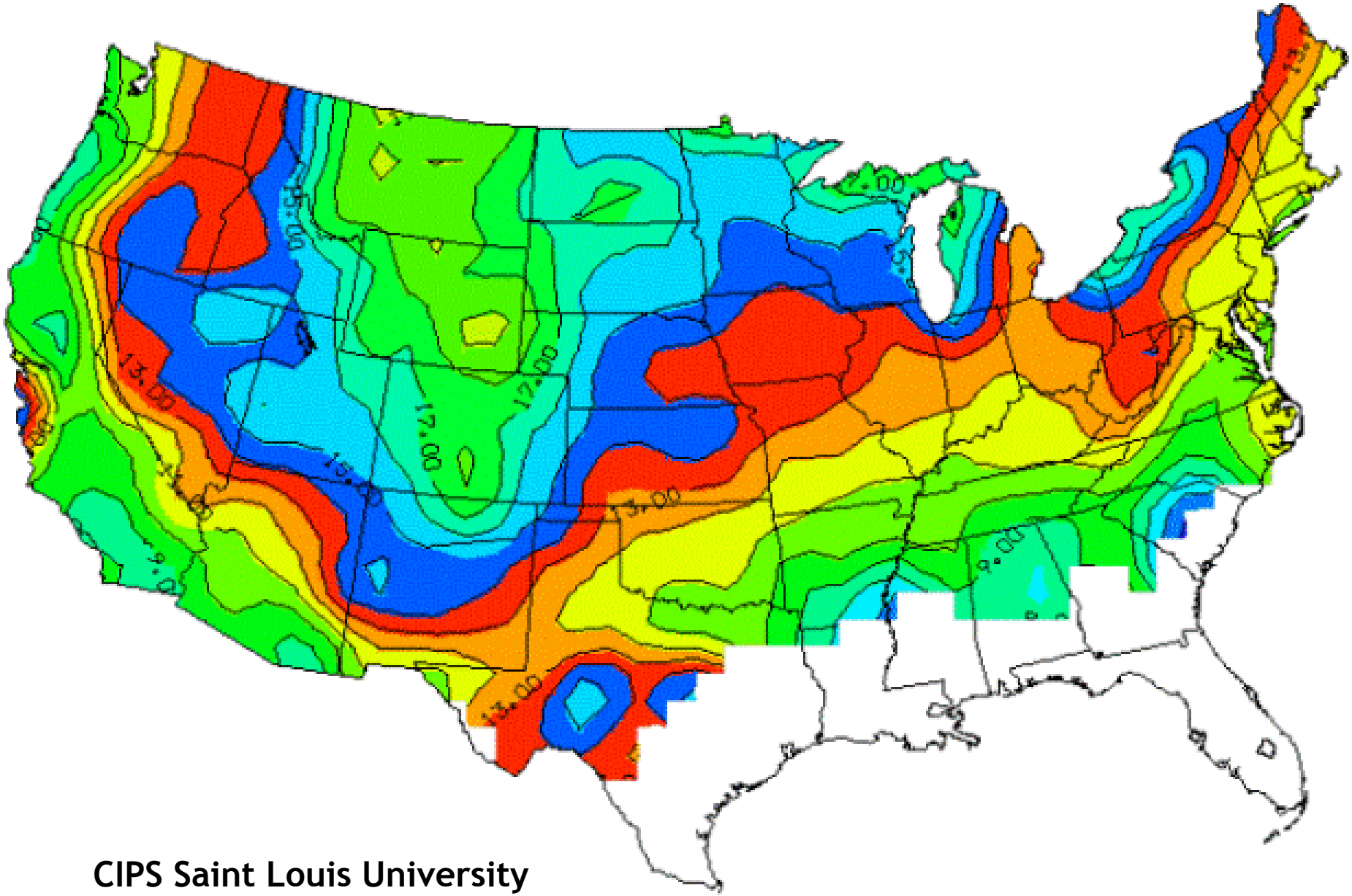
Snow Ratios

Average Snow to Liquid Ratios 1971-2000

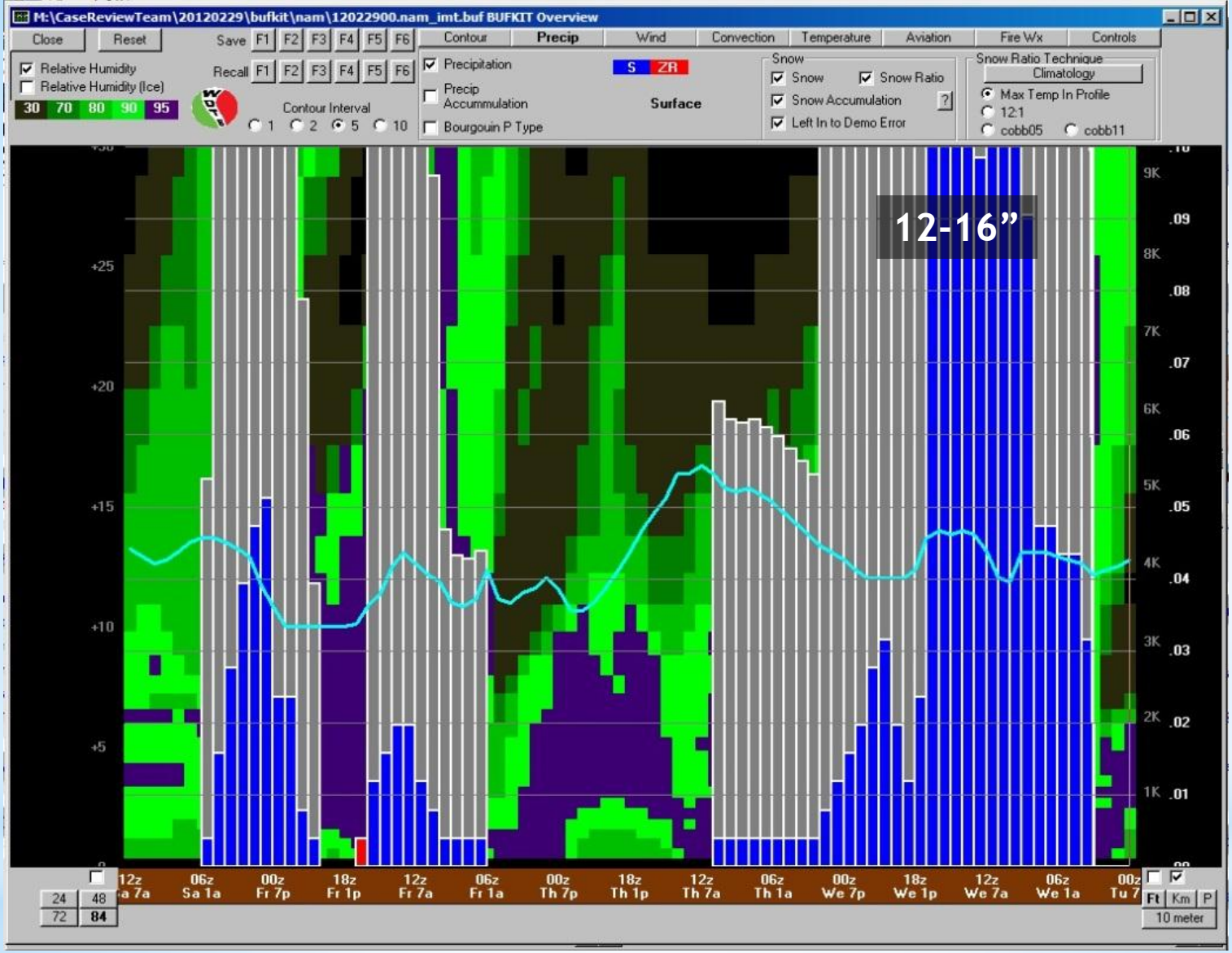


CIPS Saint Louis University

Average Snow to Liquid Ratios (1971-2000) for December, January, February



CIPS Saint Louis University



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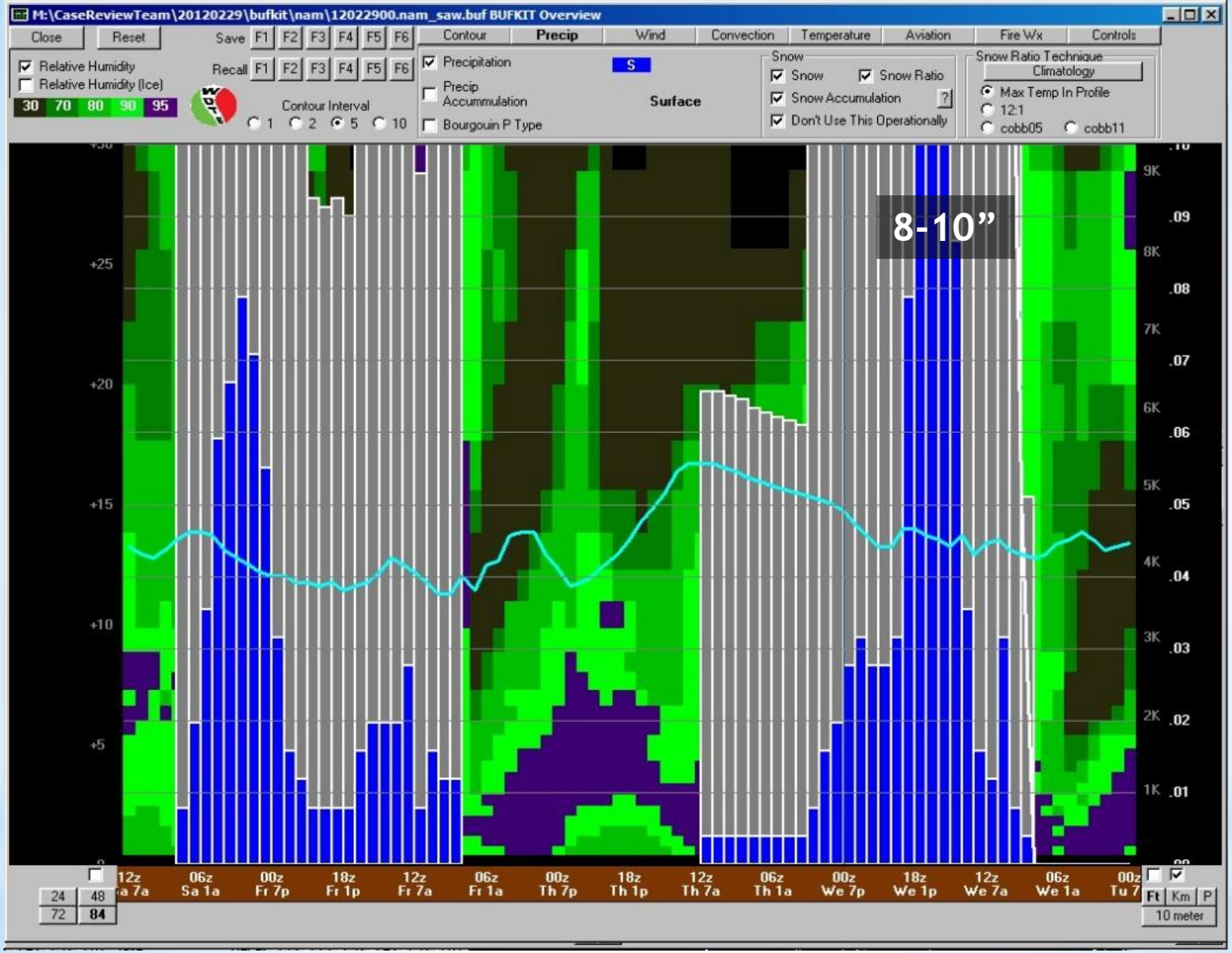

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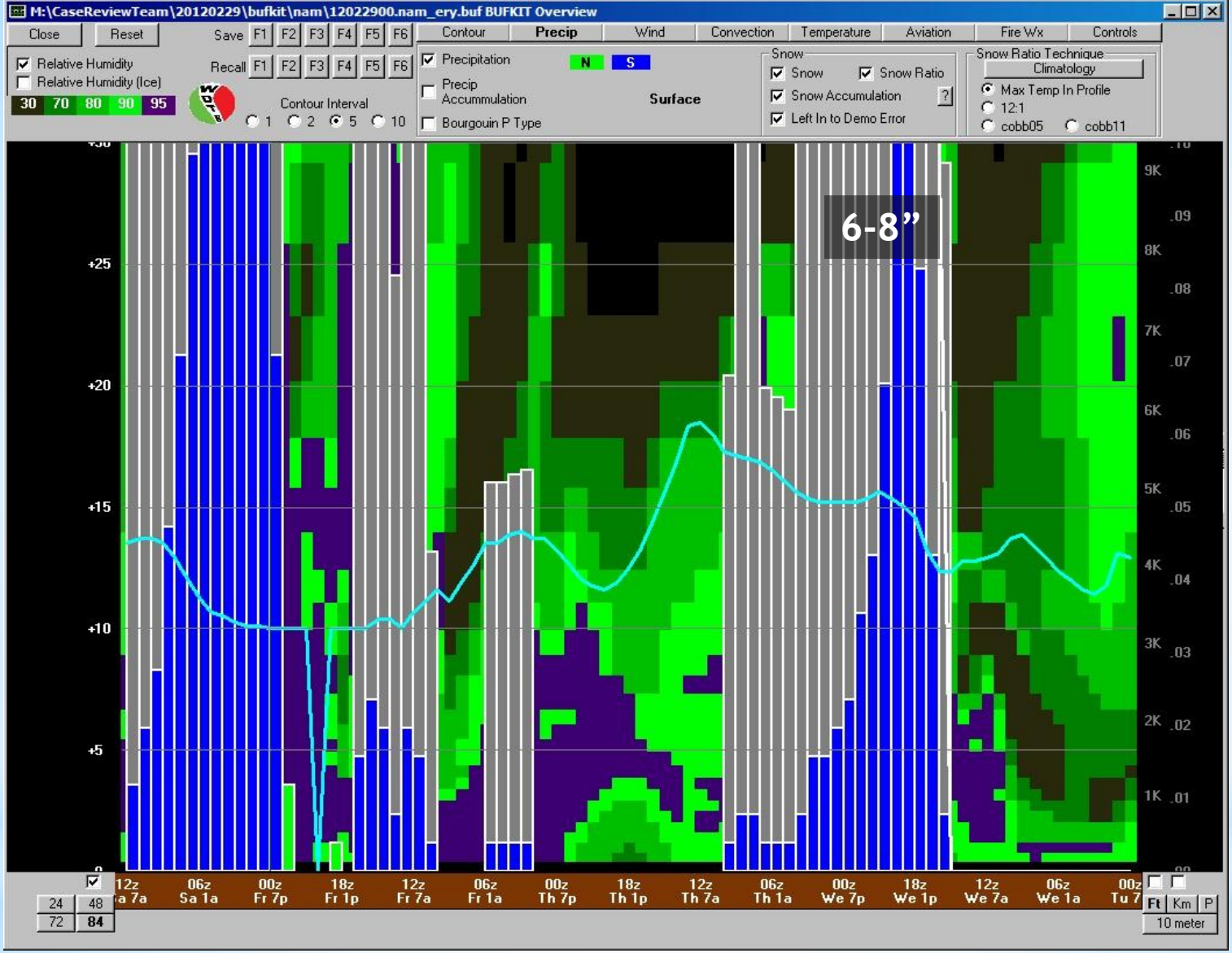

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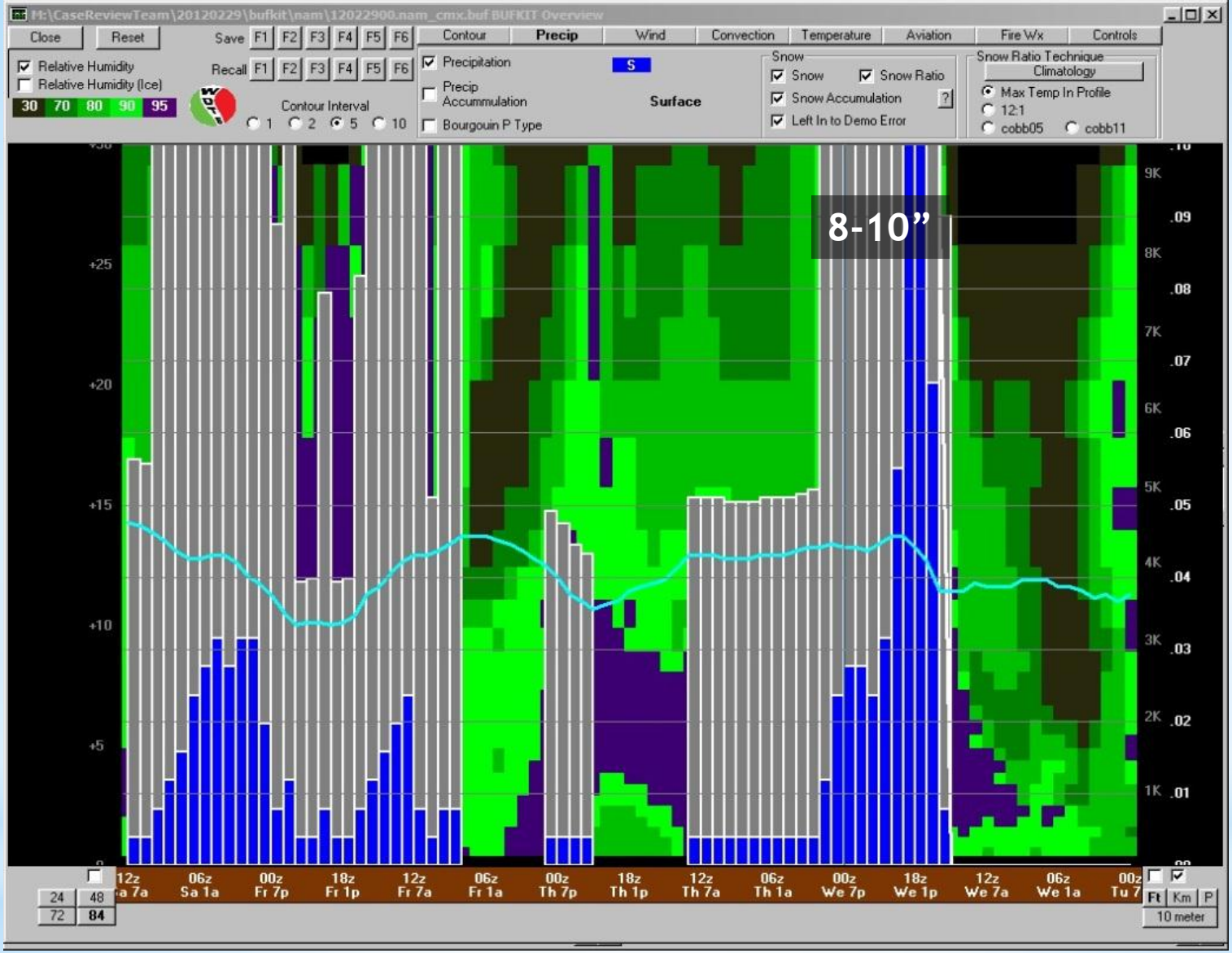

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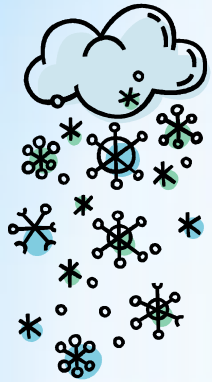
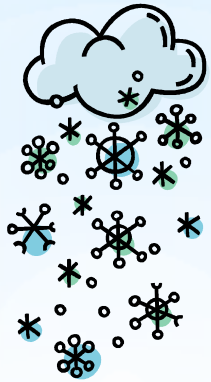
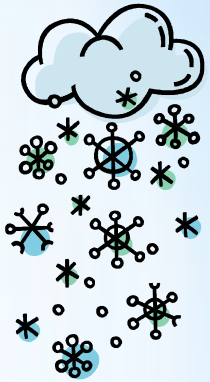
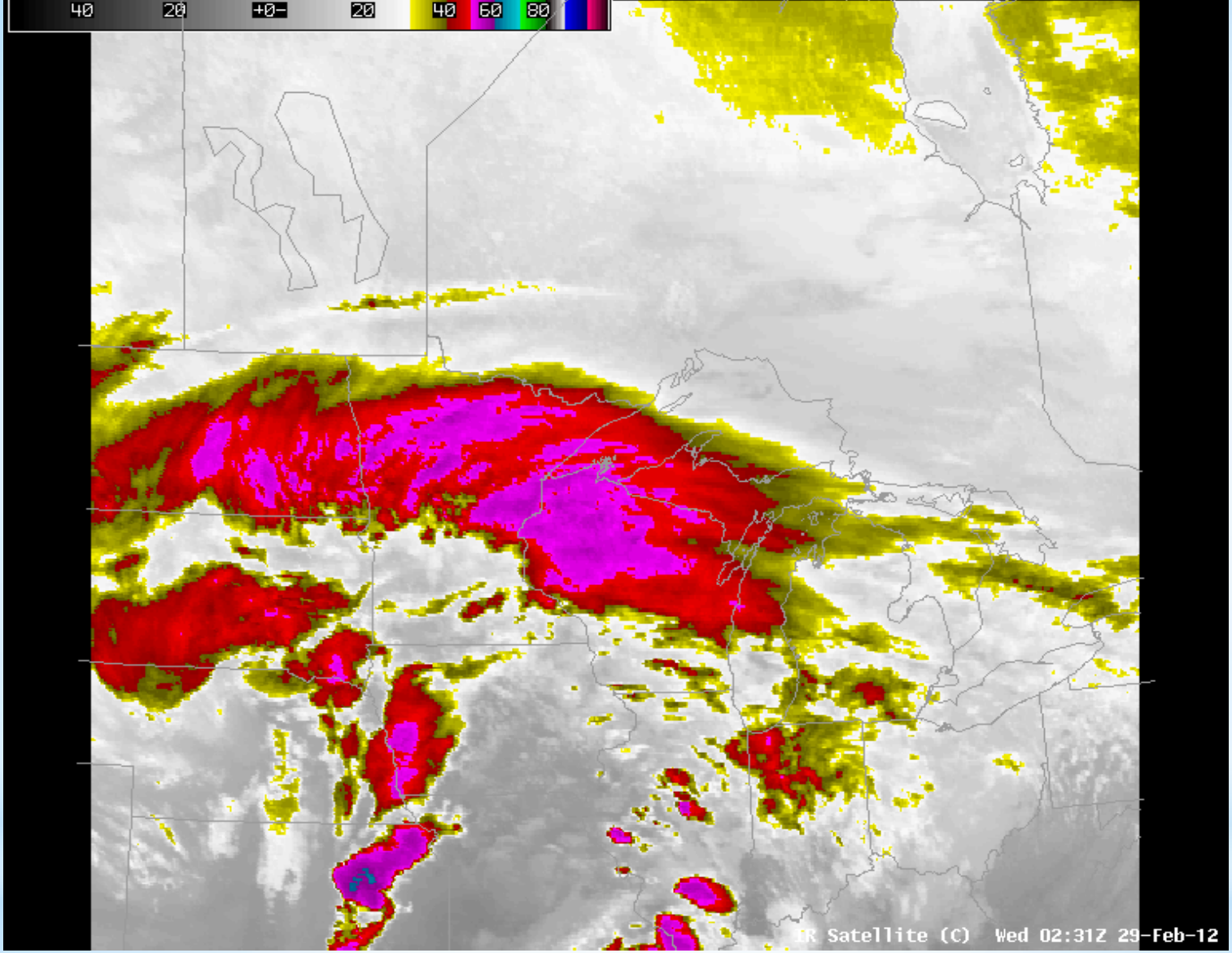
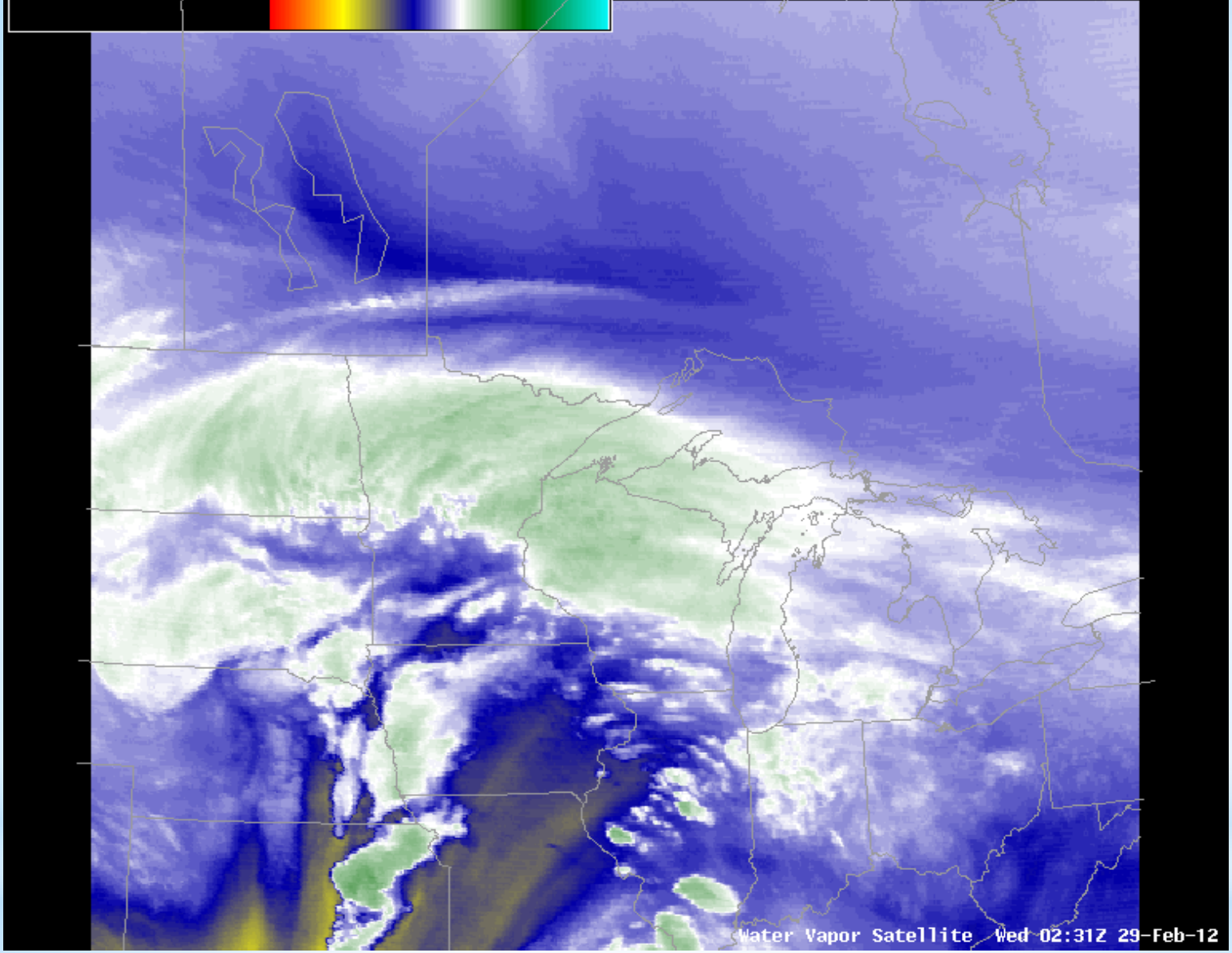




Remote Sensing Imagery and Observations



*IR 02Z 29th-18Z 29th



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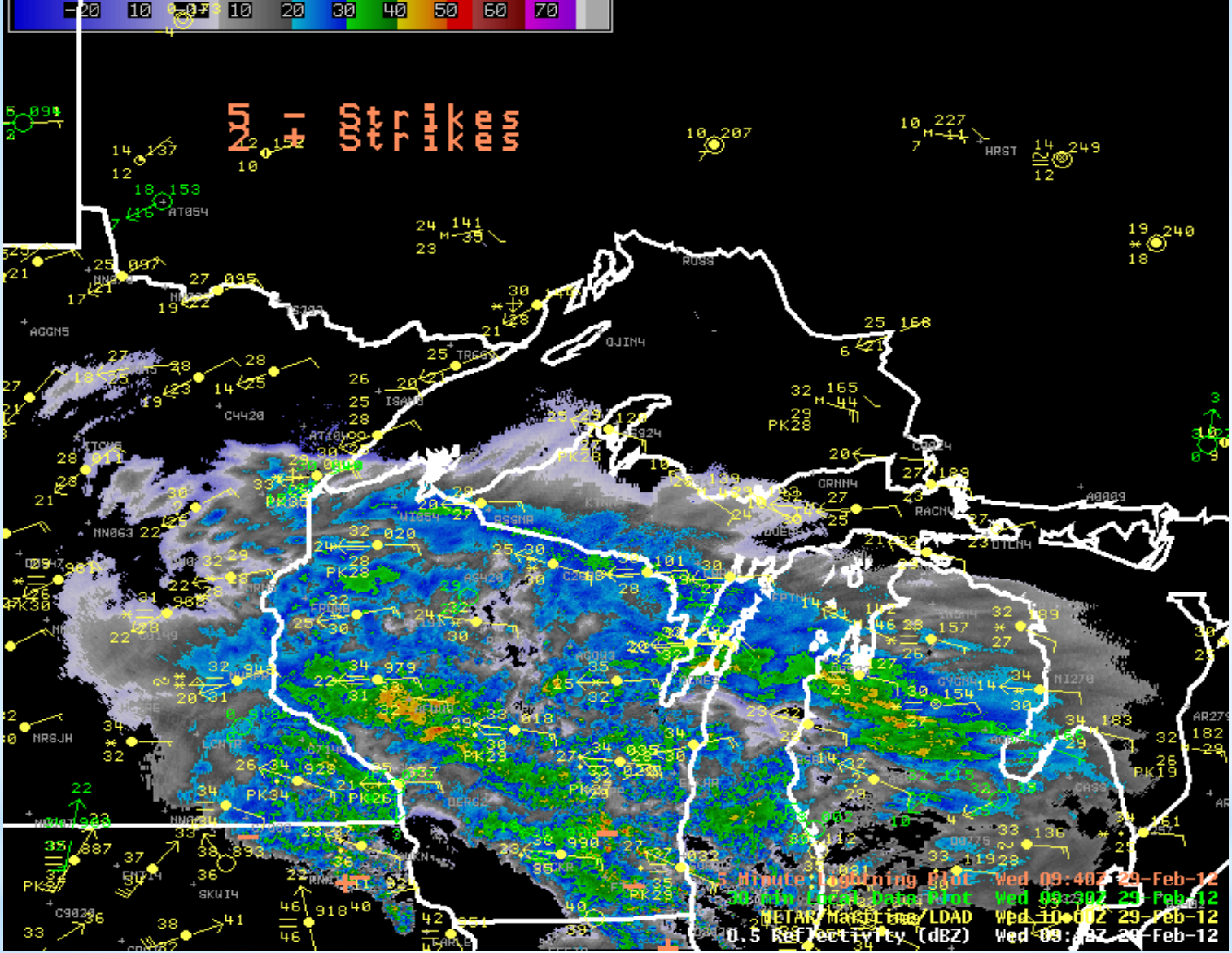
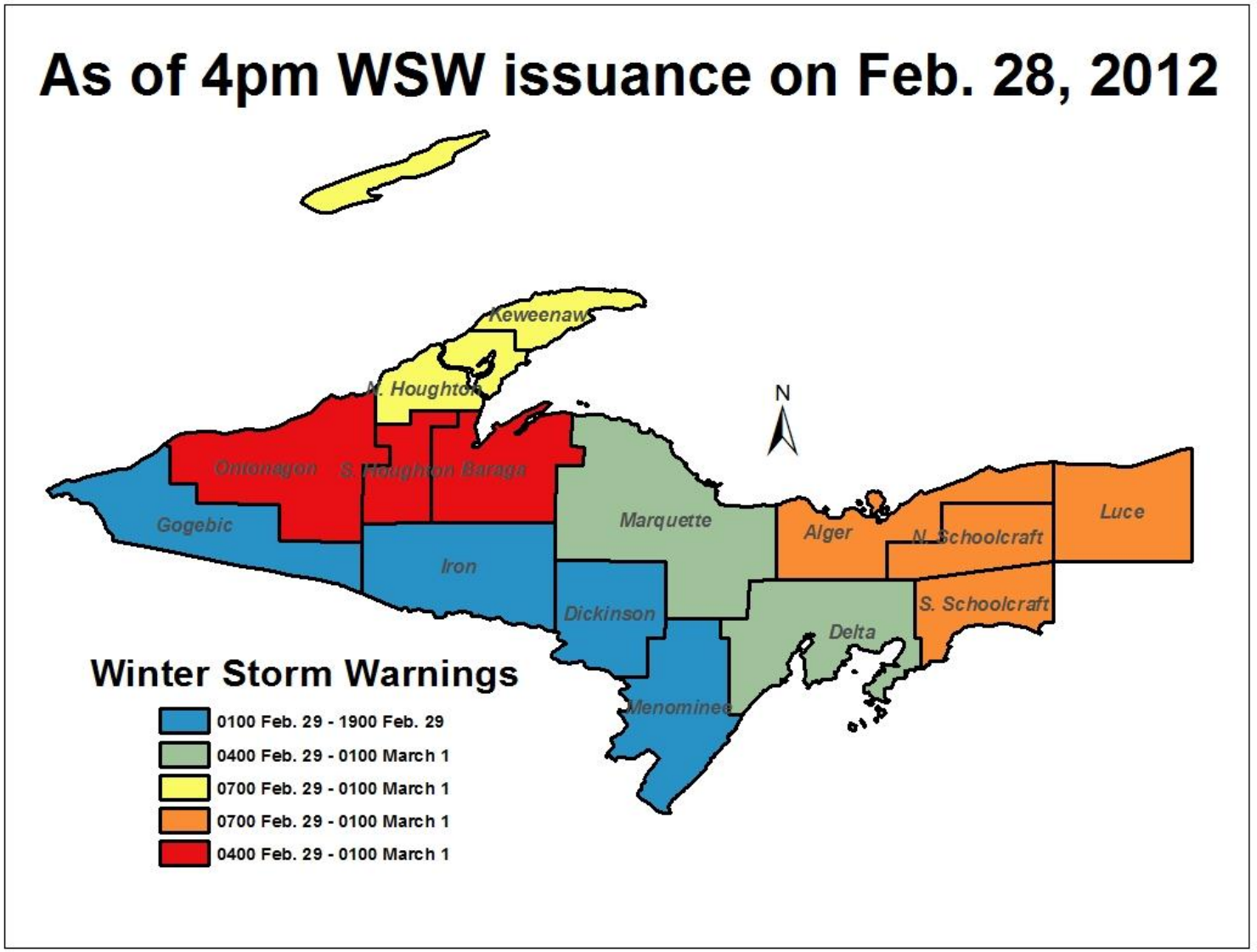


* Radar Imagery10Z 29th-16Z 29th

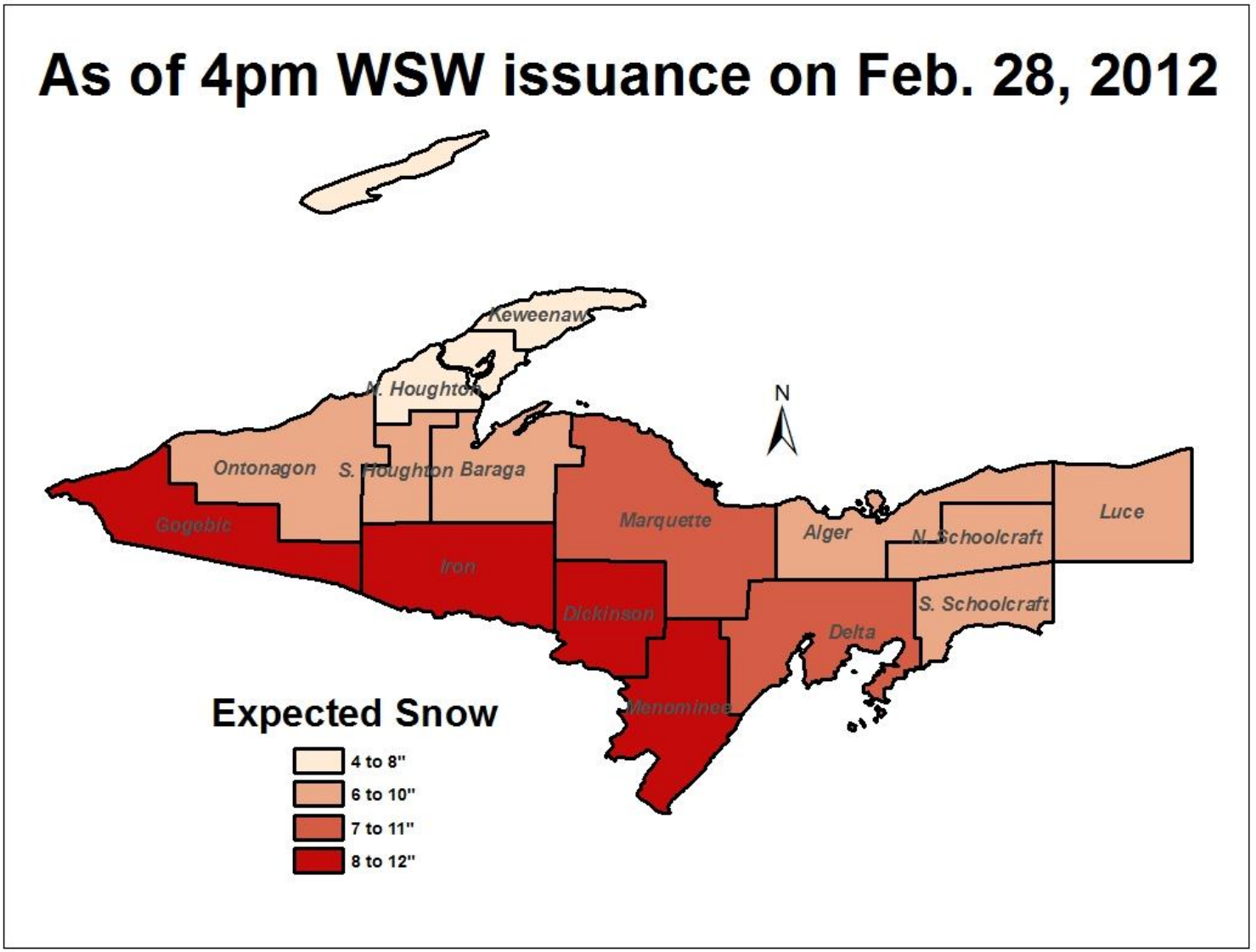
How Did We Do?

Watches 2 days ahead

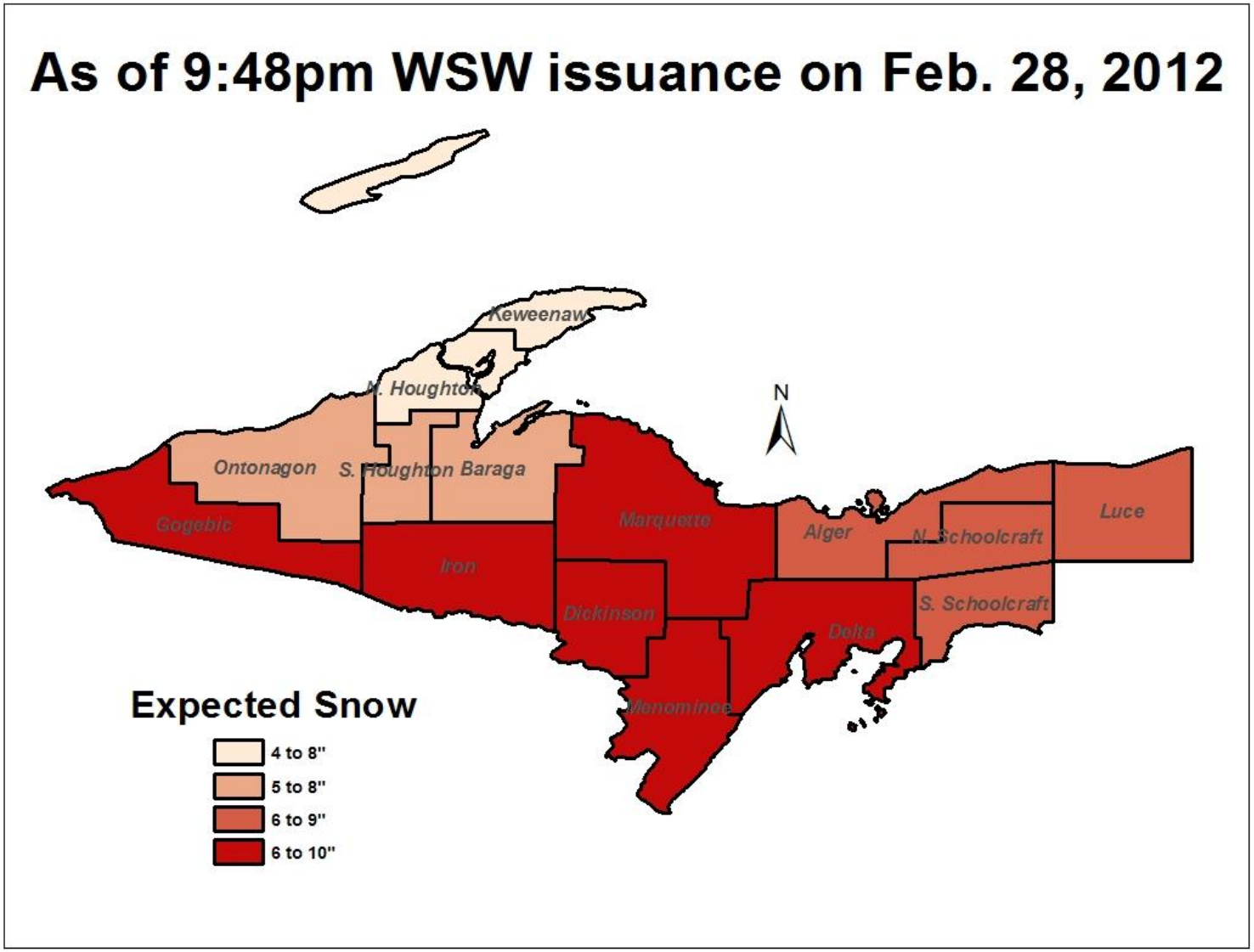
* Watches for the south-central counties (Iron, Dickinson, Menominee) went out during the early morning hours of Feb. 27 (Midnight shift).
* Ongoing winter storm warnings and winter storm advisories for Lake Effect Snow may have prevented new headlines for going up for the northern counties during the morning of Feb. 27.
* All counties were within the watch by the afternoon forecast package at 4pm on Feb. 27.
* **All watches were upgraded to warnings during the next midnight shift, by 5am Feb. 28**


As of 4pm WSW issuance on Feb. 28, 2012
Keweenaw
N. Houghton
Ontonagon
S. Houghton
Baraga
Gogebic
Iron
Marquette
Dickinson
Menominee
Delta
Alger
N. Schoolcraft
S. Schoolcraft
Luce
N
Winter Storm Warnings
0100 Feb. 29 - 1900 Feb. 29
0400 Feb. 29 - 0100 March 1
0700 Feb. 29 - 0100 March 1
0700 Feb. 29 - 0100 March 1
0400 Feb. 29 - 0100 March 1

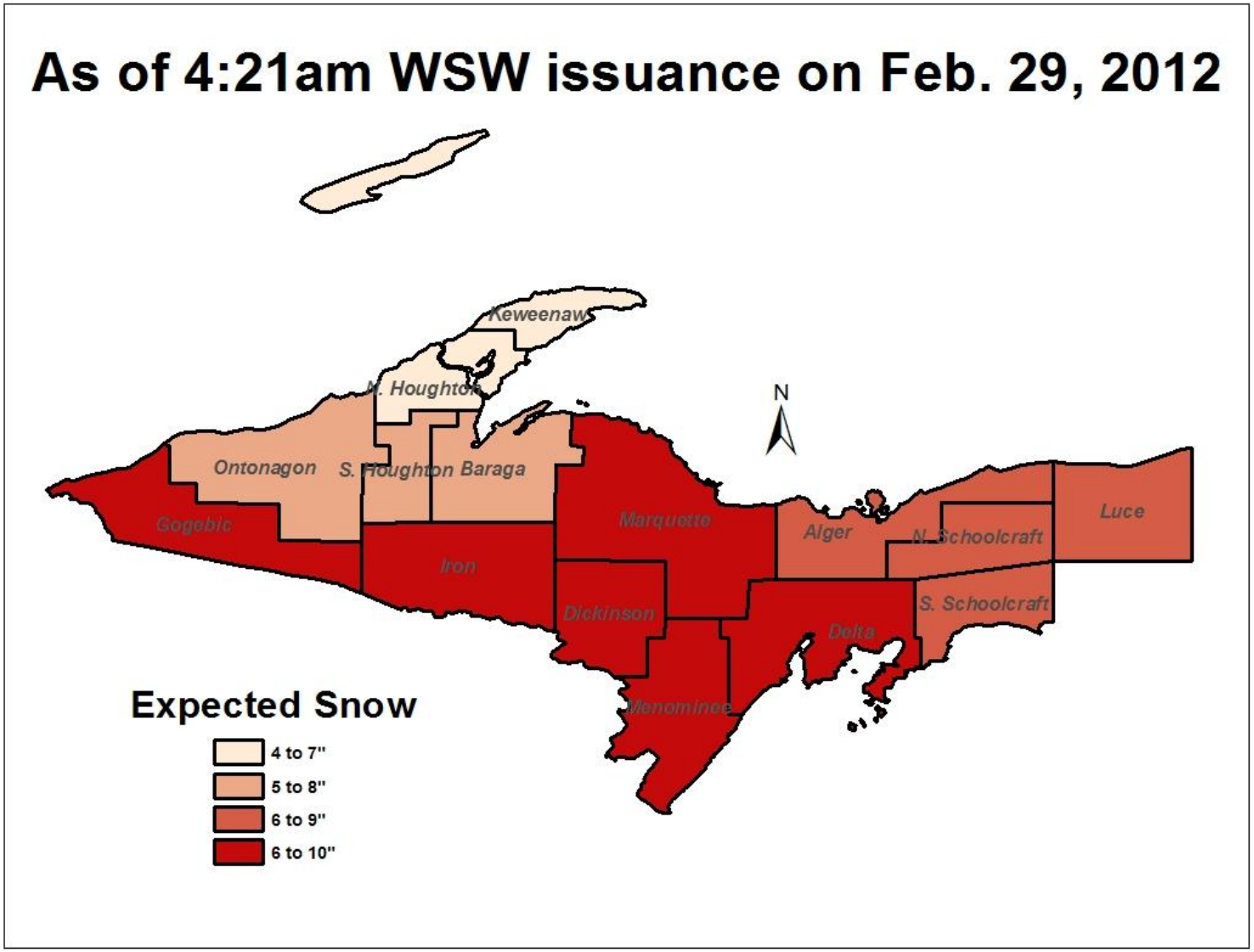
*Warnings


As of 4pm WSW issuance on Feb. 28, 2012
Keweenaw
N. Houghton
Ontonagon
S. Houghton
Baraga
Gogebic
Iron
Marquette
Alger
N. Schoolcraft
Luce
Dickinson
Delta
S. Schoolcraft
Menominee
N
Expected Snow
4 to 8"
6 to 10"
7 to 11"
8 to 12"

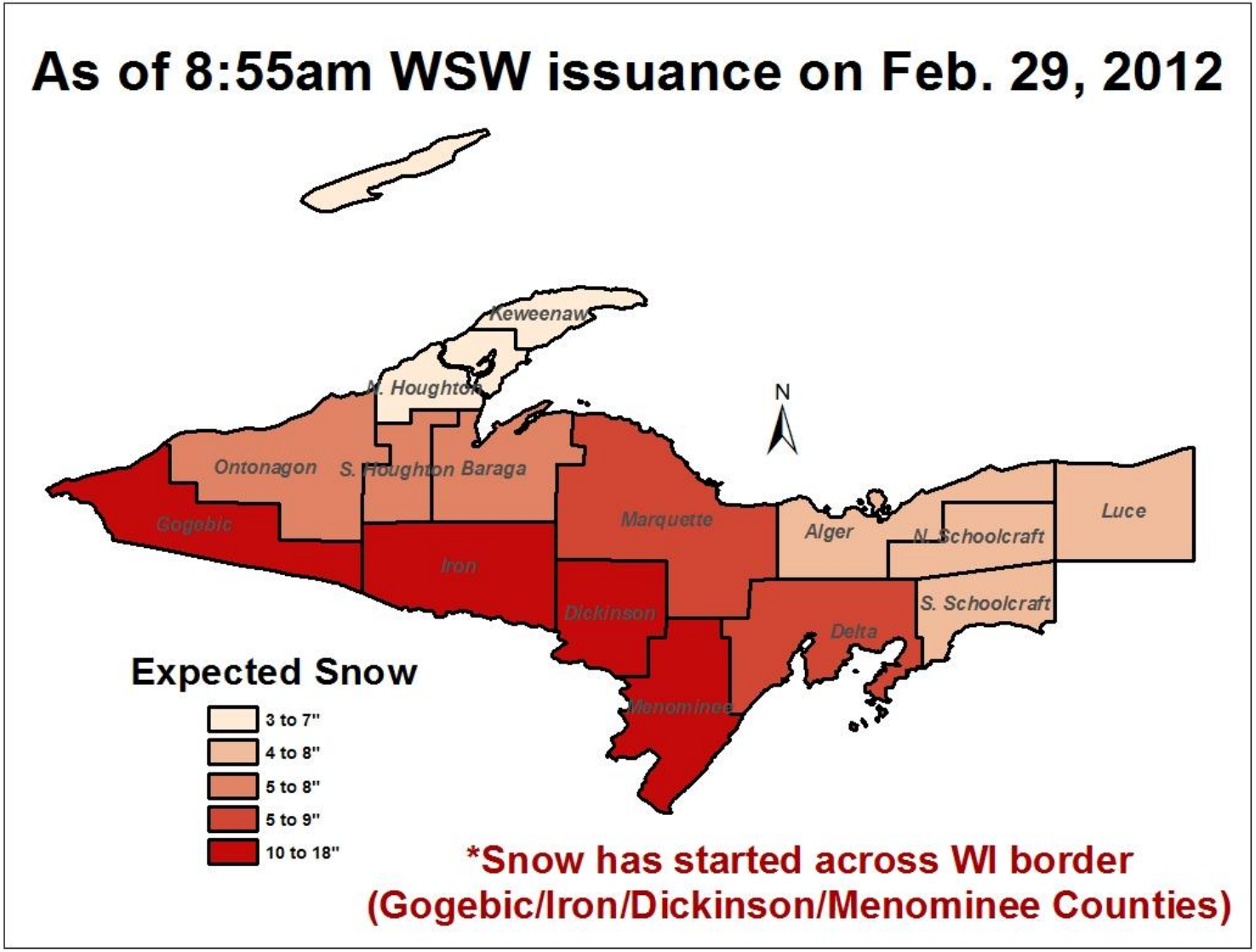
*Warnings



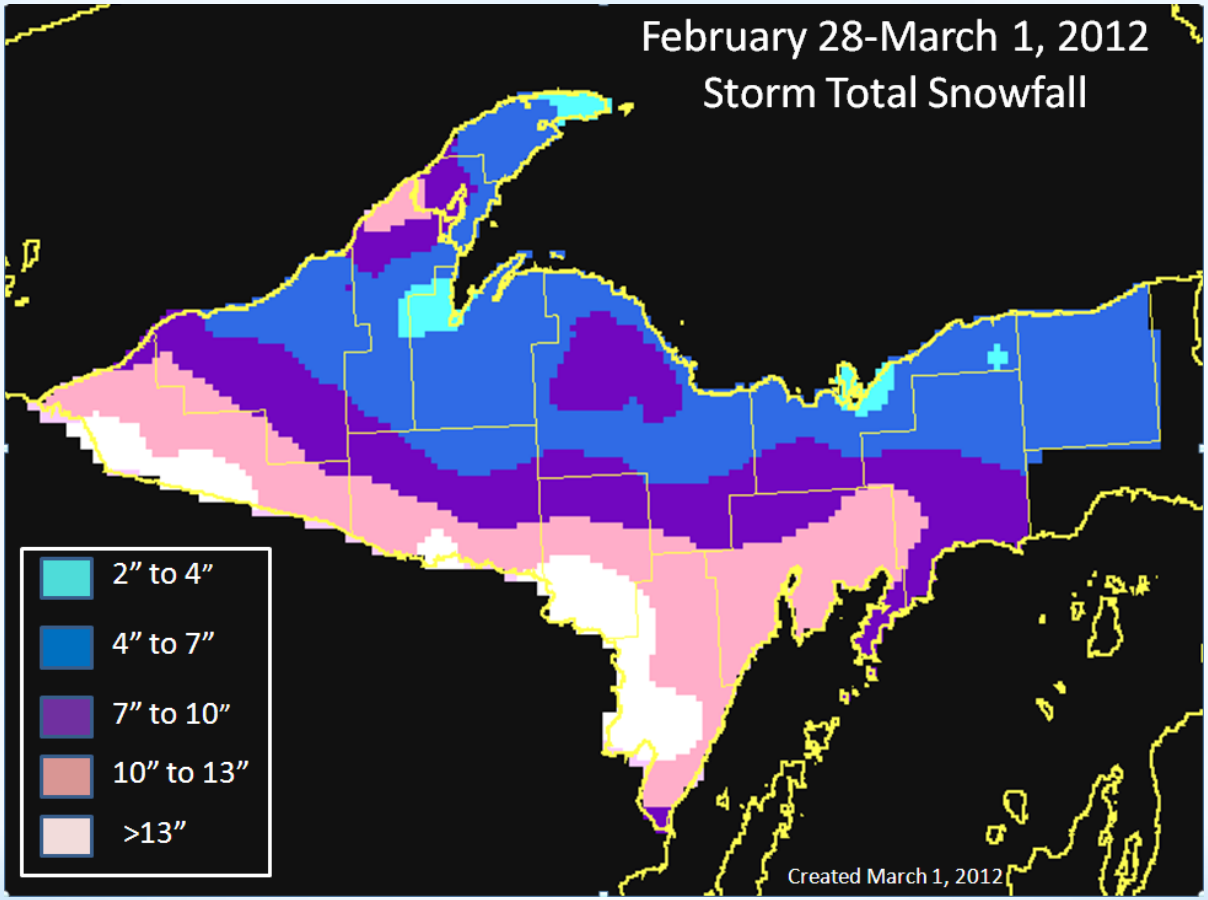
*Warnings Cont.



*Warnings Cont.



*Warnings Cont.



*What really happened

How did we do?

* Overall we did a good job. Heaviest totals were expected over the WI/Upper MI border, and though forecasted totals were slightly underdone, overall idea was there.
* The WI/Upper MI border also had the most lead time, with watches being issued for the south-central counties by 5am Feb. 27.
* Only 2 counties did not verify…
  * Luce (cancelled at 14Z on the 29th)
  * Keweenaw

How did we do? Cont.

* Reasons for over-forecasted snowfall rates for Keweenaw and Luce counties…
  * Mid level dry air across Keweenaw county, as seen by the 00Z sounding, prevented maximum snow growth.
  * Dry slot moved in across Luce county, blocking moisture availability.
  * Frontogenesis band and isentropic ascent dissipated and increased in speed as it pushed off to the north, so not as much lift and moisture available for Keweenaw or Luce counties.

How did we do? Cont.

- Reasons for the underdone forecasted snow totals, especially near the WI border…
  - Despite the fact it was a system snow, many areas received 13 to 15:1 snow ratios!
    - Our snow ratios going into the forecast were slightly lower, giving lower totals overall. Enhanced lift in the DGZ worked to increase these ratios.
  - System stalled out (as a result of pivoting low pressure over Southern MN) placing the heaviest snow band over northern WI and southern half of Upper Michigan.
    - Although this was forecasted to happen, it would be nearly impossible to pinpoint exactly how long this would cause the band to stay in this same location. i.e., An extra 30 min to an hour, with snow rates at 2"/hr…
      (note increase in snowfall totals along WI border once snow started falling)
  - TROWAL contributed to heavier snowfall rates along the warm conveyer belt.

What DSS Did We Provide?

- Feb. 27, 2012
  - Ongoing snow near Lake Superior was main focus at this time.
  - Interview conducted with Iron Mountain newspaper about upcoming event.
- Feb. 28, 2012
  - Notified all airports in CWA that have commercial service (IWD, CMX, IMT, SAW, ESC) to give them a heads-up and more specific information about upcoming winter storm
  - Interview with ABC10 about what was to be expected with the upcoming winter storm.
  - Winter Storm Briefing link posted to the Top News
- Feb. 29, 2012
  - 2:16 AM - Midnight shift talked with the Marquette County Road Commission, giving them a weather update and expected timing for onset of snow to the county.
  - 4:11 AM – Talked with Gwinn schools to give them an update on the snow totals and timing.
  - 4:16 AM – Talked with Gladstone schools, also for an update on snow totals and timing (2 to 3 inches was reported on the ground by this time in that area)
  - 4:29 AM – Talked with Ishpeming schools, discussing if we plan on downgrading the warning to an advisory.
  - 5:20 AM – Interview with Eagle River Radio on expected snow storm in their area.
  - Top News Story posted linking to the Winter Weather Monitor during the evening shift, talking about how snow will begin winding down across Upper Michigan in the evening.
- March 1, 2012
  - Interview with Eagle River Radio concerning previous day's snow storm and total snow amounts.
  - Interview with Escanaba newspaper about previous day's storm and the forecast for the next event.
  - During evening shift, a Top News Story was posted recapping the event.

Conclusions

- Models were in good agreement allowing for good confidence in heavy snow
- Upper-level coupled jet support, F-Gen, TROWAL, Isentropic upglide and overall strong forcing in the DGZ supported increased snowfall
- Dry slot helped decrease snowfall totals over the far east…including Luce County
- Drier air and decreased forcing reduced totals over the north

Conclusions

- 24 hour lead time with Winter Storm Watches
- Warning were placed in the proper positions overall, but snowfall totals were higher than forecast over the Wisconsin border even though the general trend was there
- All warnings verified except Keweenaw and Luce Counties

References

http://solberg.snr.missouri.edu/ROCS/pub/Halcomb-thesis.pdf

http://clem.mscd.edu/~sng1/MTR3400/Trowal_SynopticI.pdf

http://www.crh.noaa.gov/mqt/?n=2012_02_29_winter_storm

http://www.eas.slu.edu/CIPS/slr.html

Questions