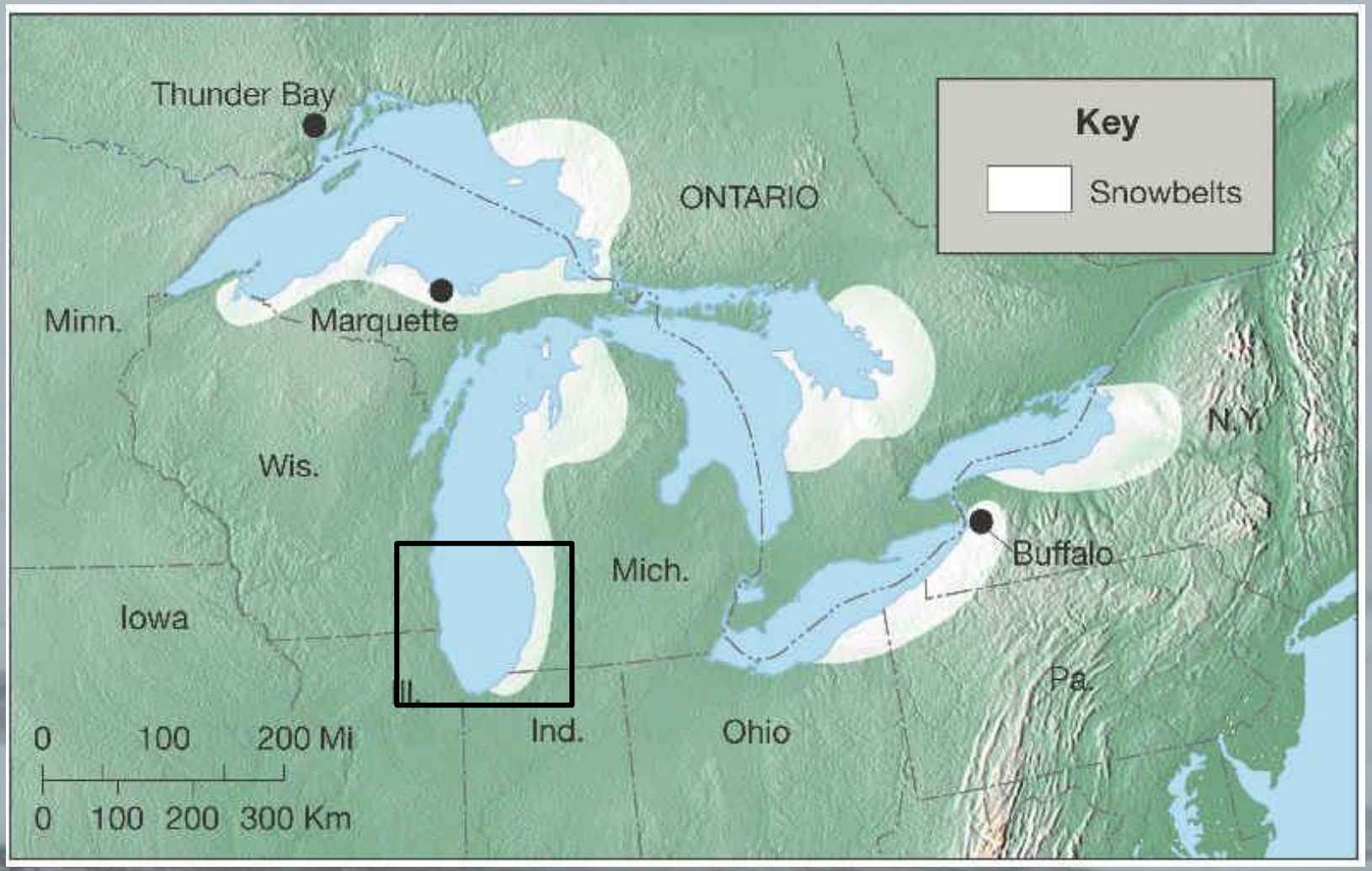
Examining North-South and West-East Oriented Lake Effect Snow Bands off Lake Michigan

Caleb Wood and Ed Shimon

Common GL Snowbelts



Fantastic LES Event!!

- https://youtu.be/KA9XNRHxKbg

Objective

- Develop a synoptic pattern overview of LES off Lake Michigan with respect to both N-S and W-E snow bands
- What specific meteorological conditions are needed to support LES bands in both geographic orientations?
- How does it affect ILX's CWA?

Key LES Ingredients

1. Instability
   - Temperature difference of 15-20ºC between the cold 850 mb layer and warm lake water
2. Wind Direction/Speed
   - Longer fetch = more moisture
   - Faster speed = LES pushed further inland
3. Wind Shear
   - Less than 60º change between sfc-700 mb preferred
4. Ice Coverage
   - Greatly inhibits LES development
   - Lake Superior connection

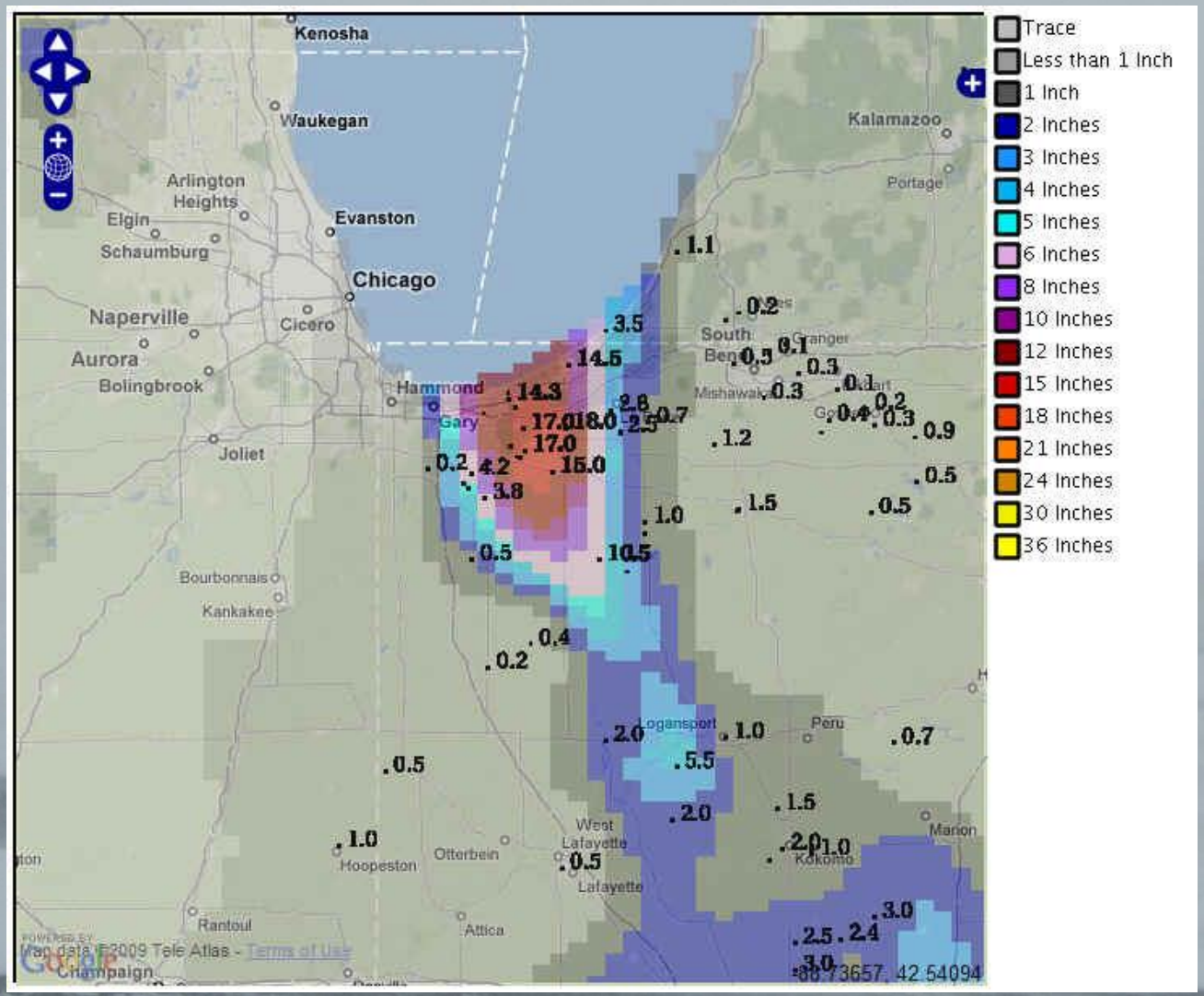
(Acciaioli, 2009)

Specific LES Events

- North - South
  - February 3-4, 2009 (Valpo Storm)
  - February 1-2, 2011 (Groundhog Blizzard)
  - February 10-11, 2012
- West – East
  - November 16-18, 2014
  - December 7-11, 2016

February 3-4, 2009

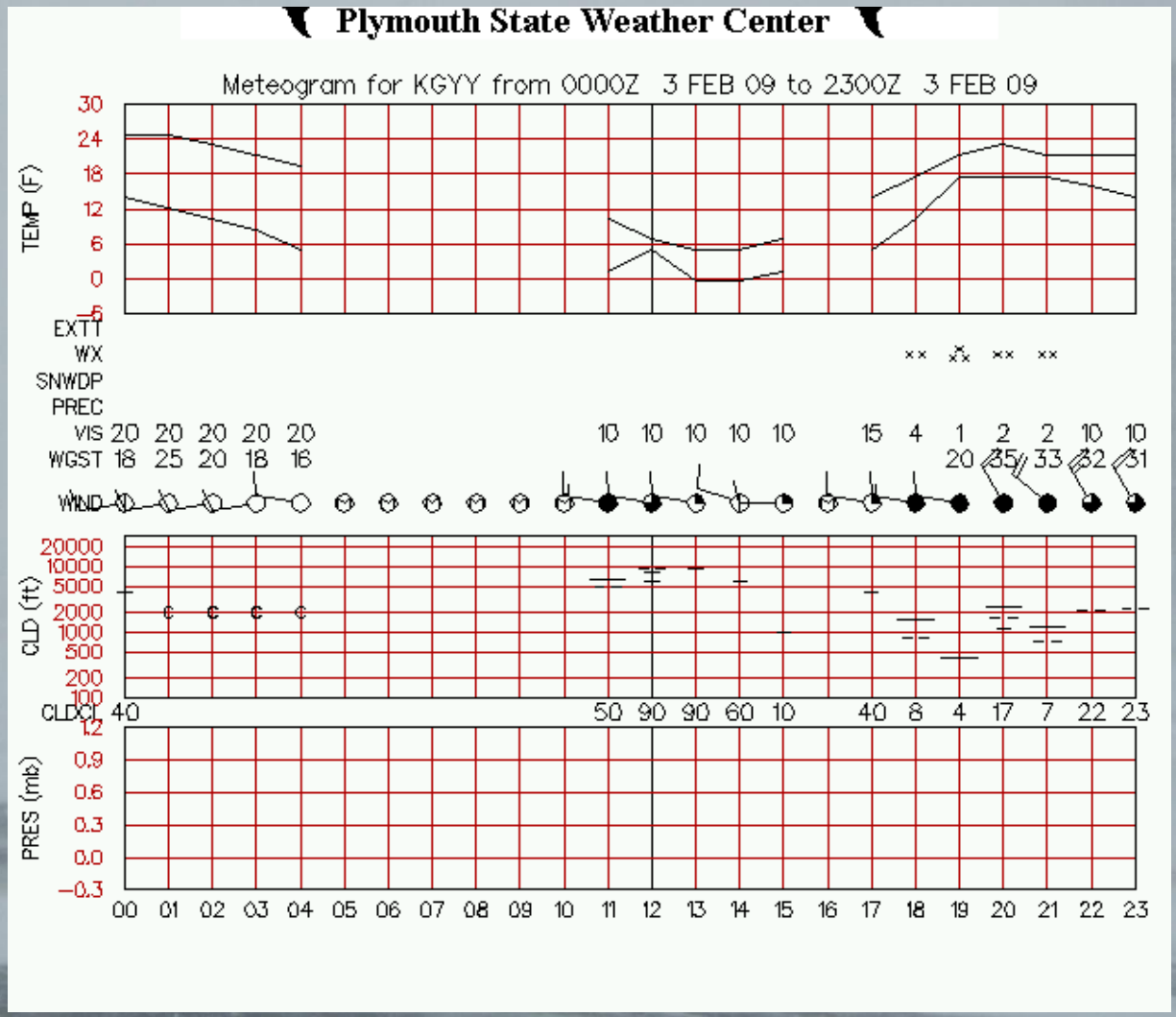
Snowfall Totals



Valparaiso, IN - 19.0 inches!

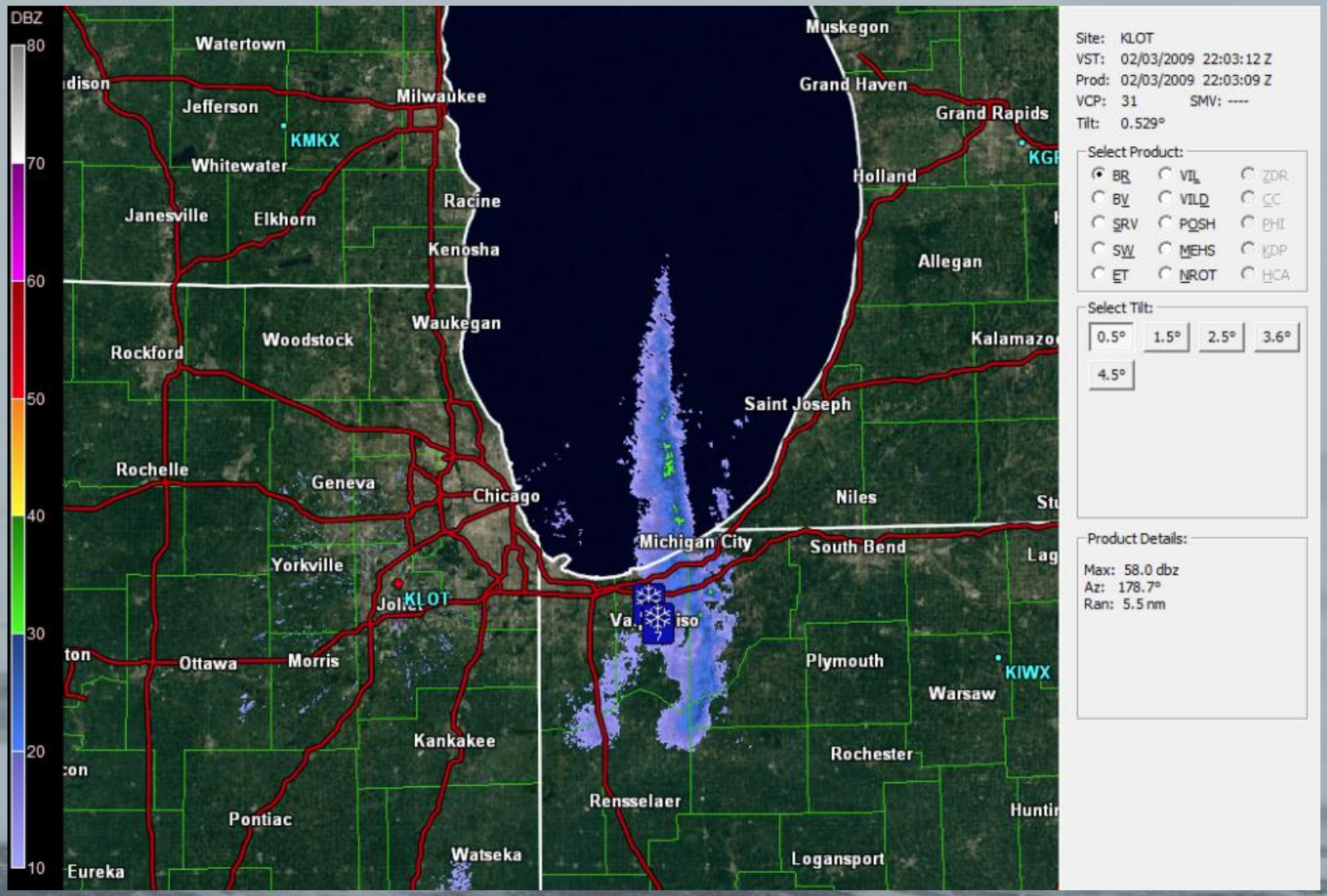
February 3-4, 2009

Meteogram - Gary, IN

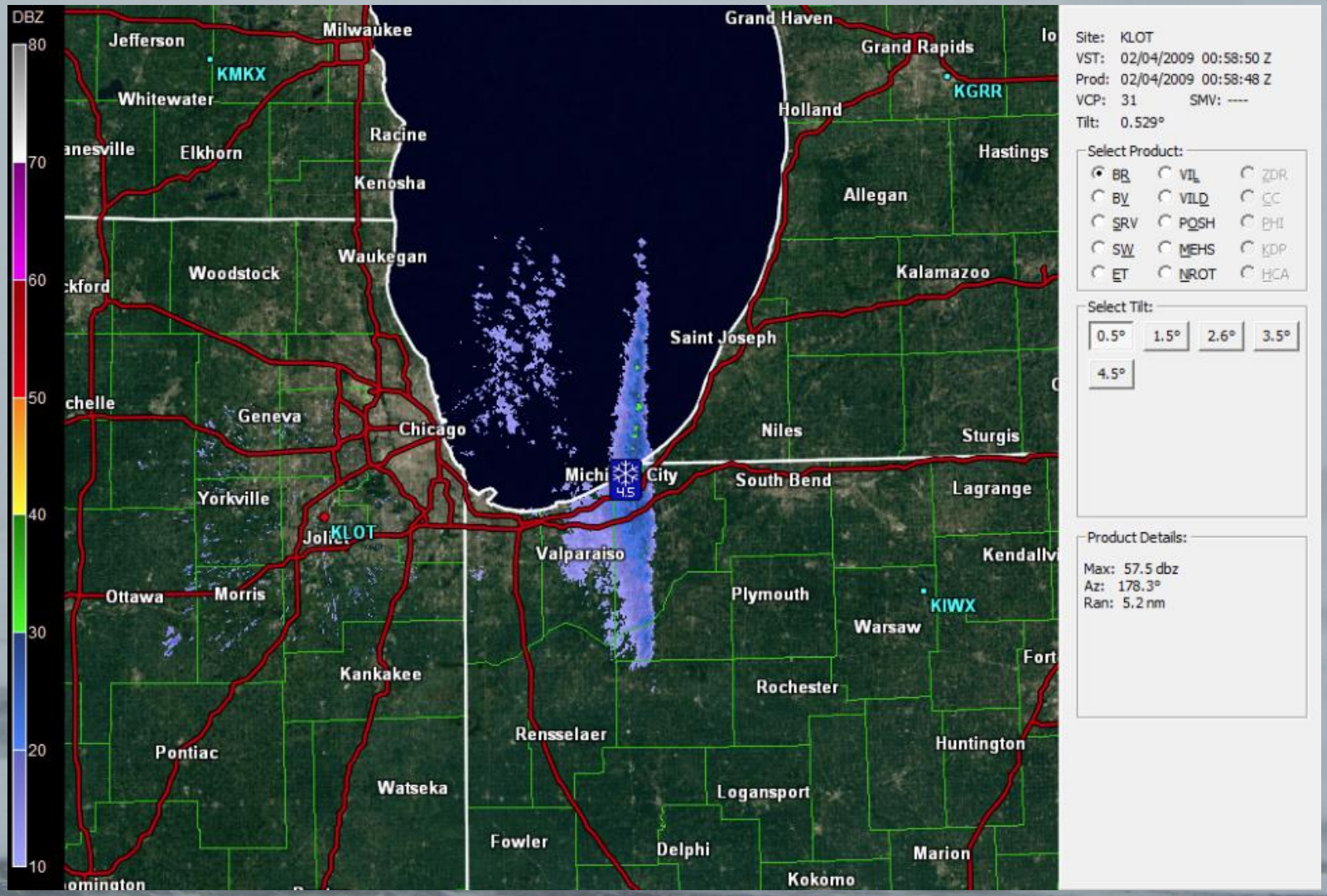


February 3-4, 2009

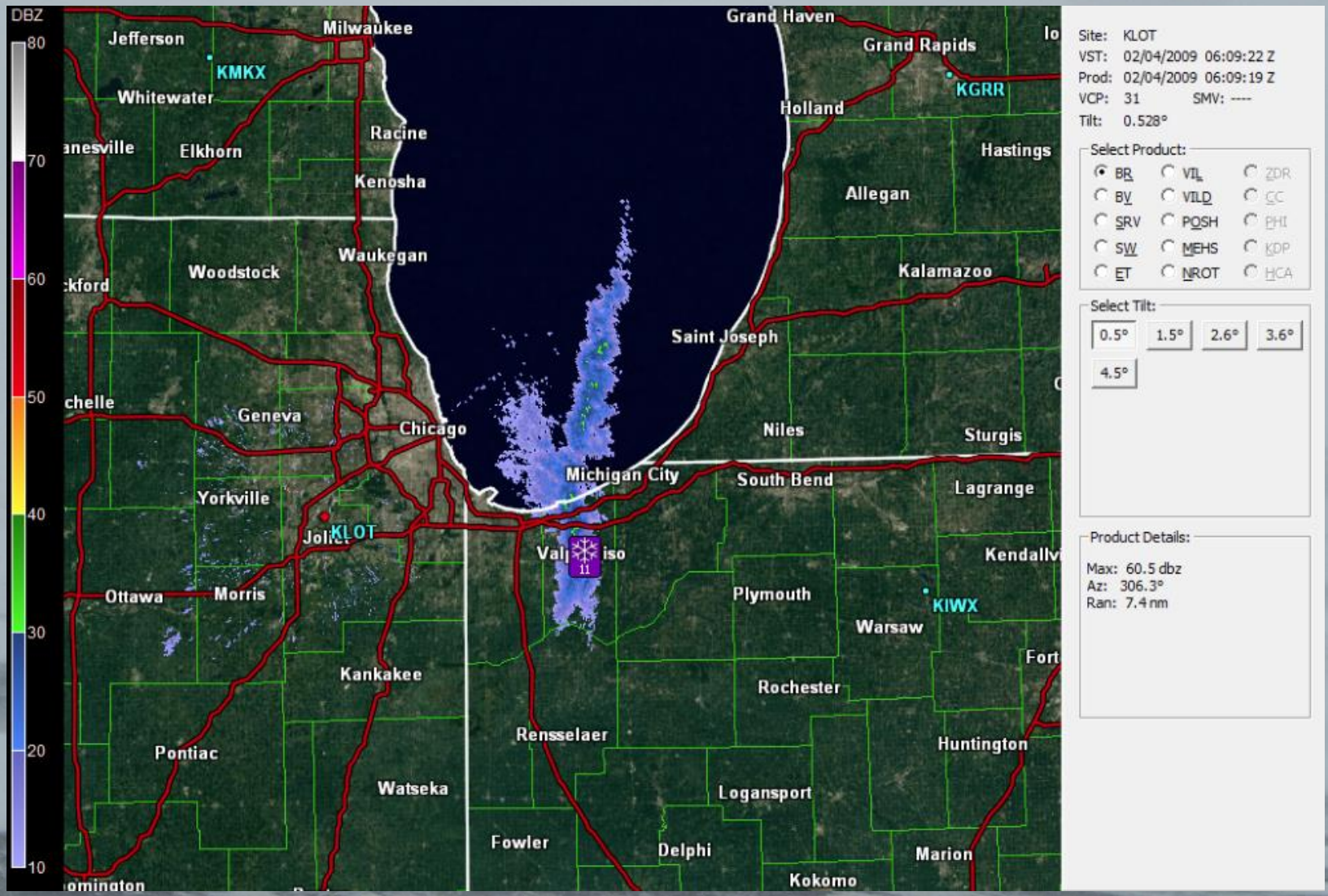
KLOT Reflectivity - Feb. 3 2203Z



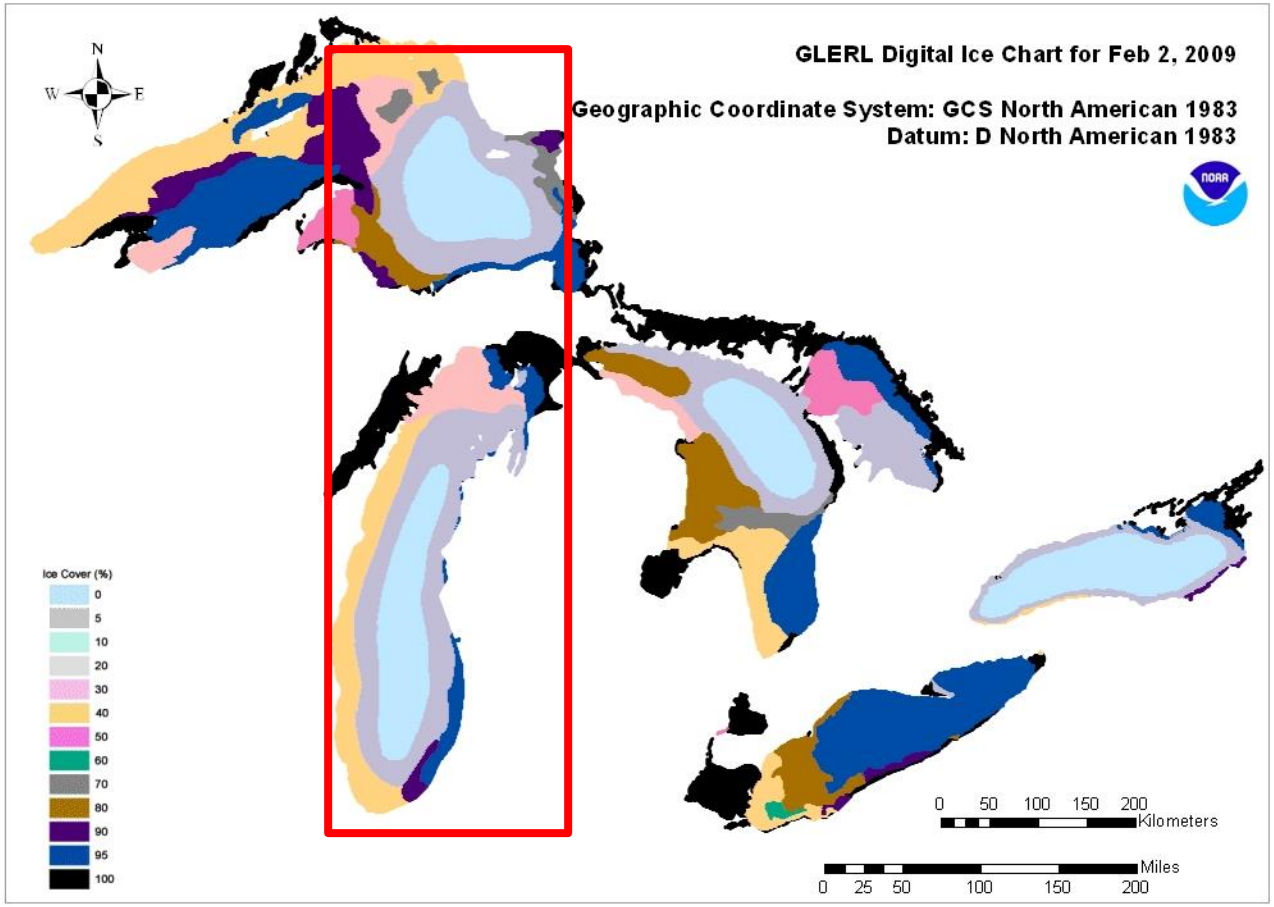
KLOT Reflectivity - Feb. 4 0058Z



KLOT Reflectivity - Feb. 4 0609Z

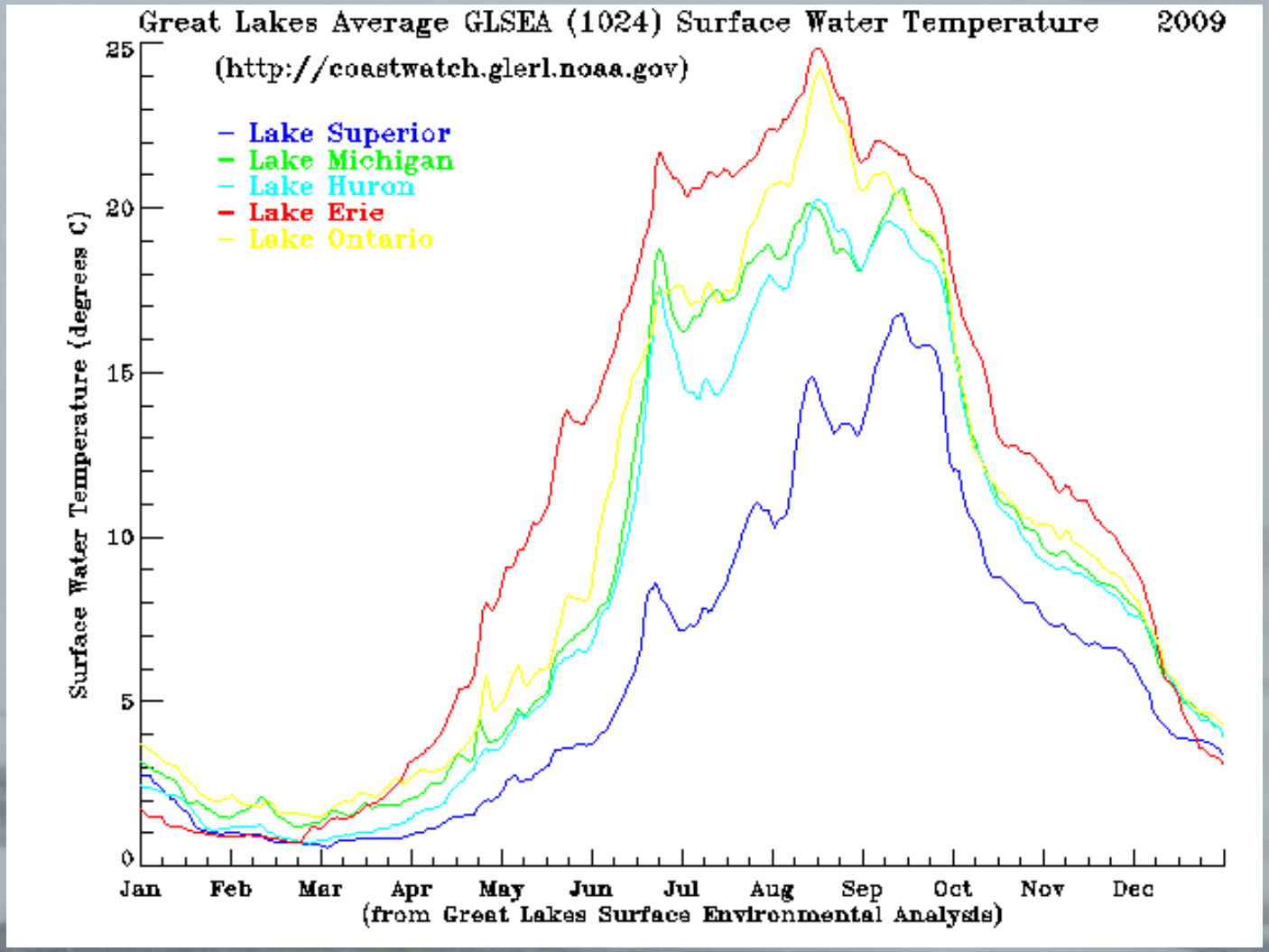


Lake Ice Coverage



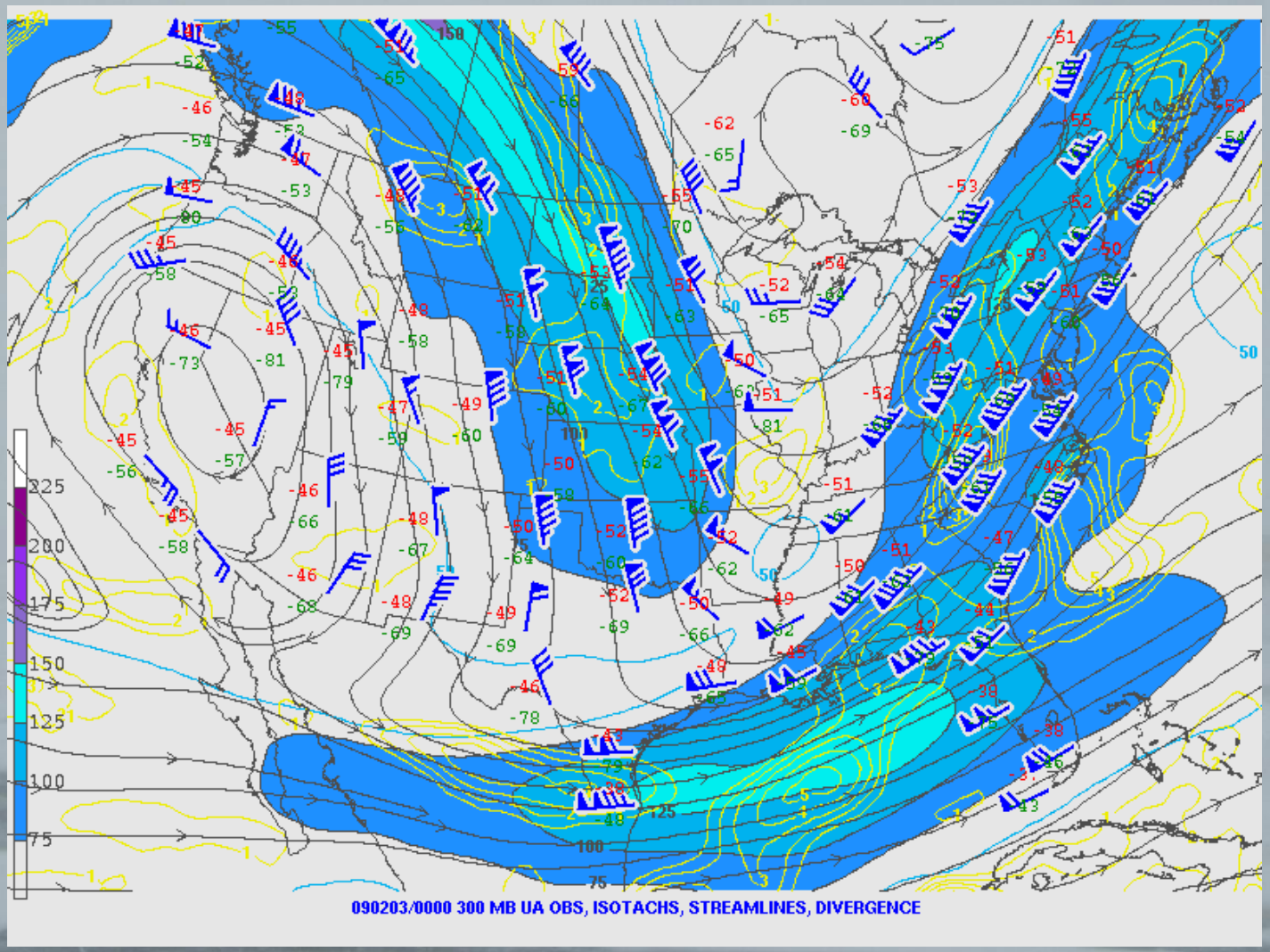
February 3-4, 2009

Surface Water Temps



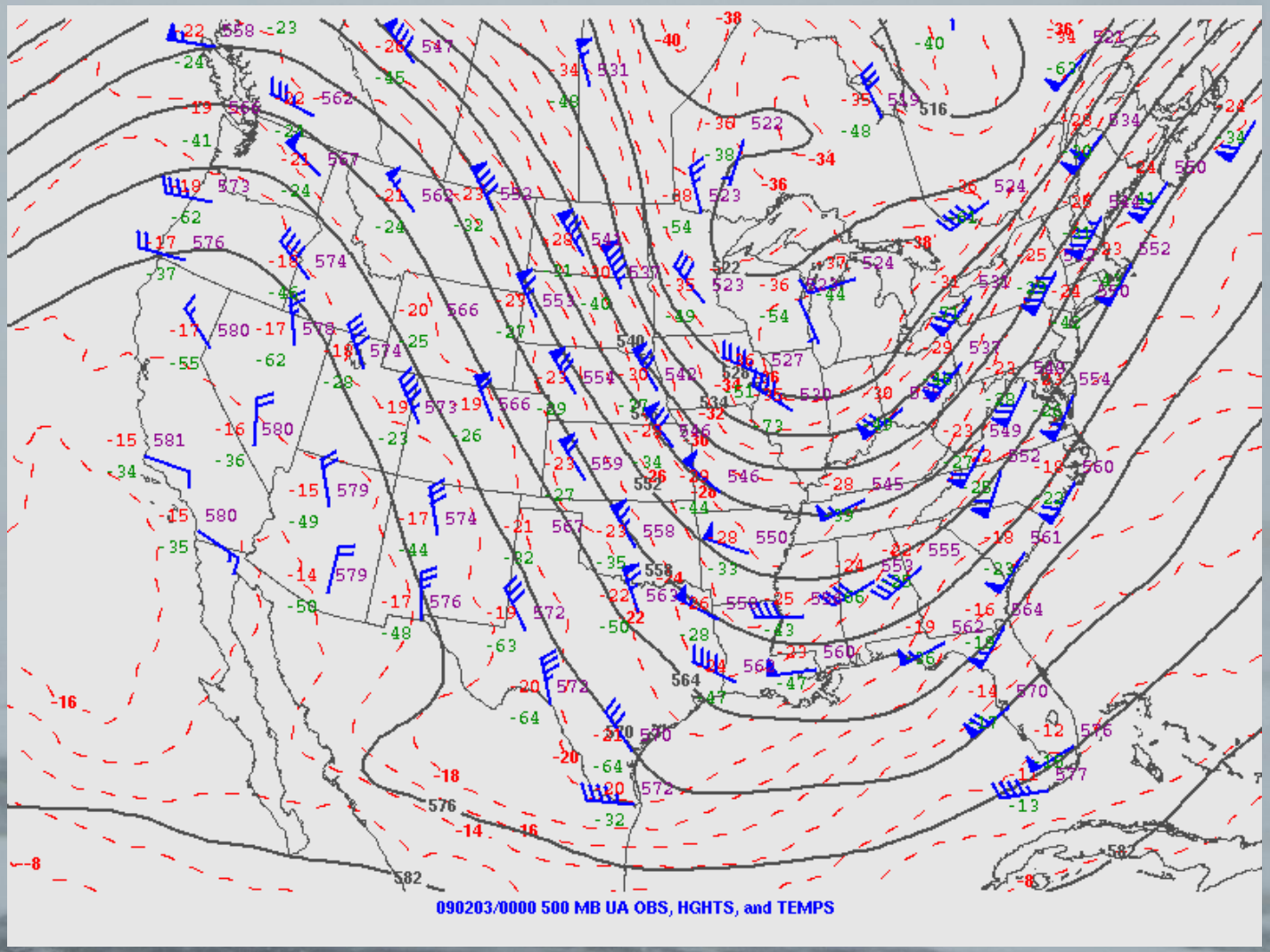
February 3-4, 2009

300 mb



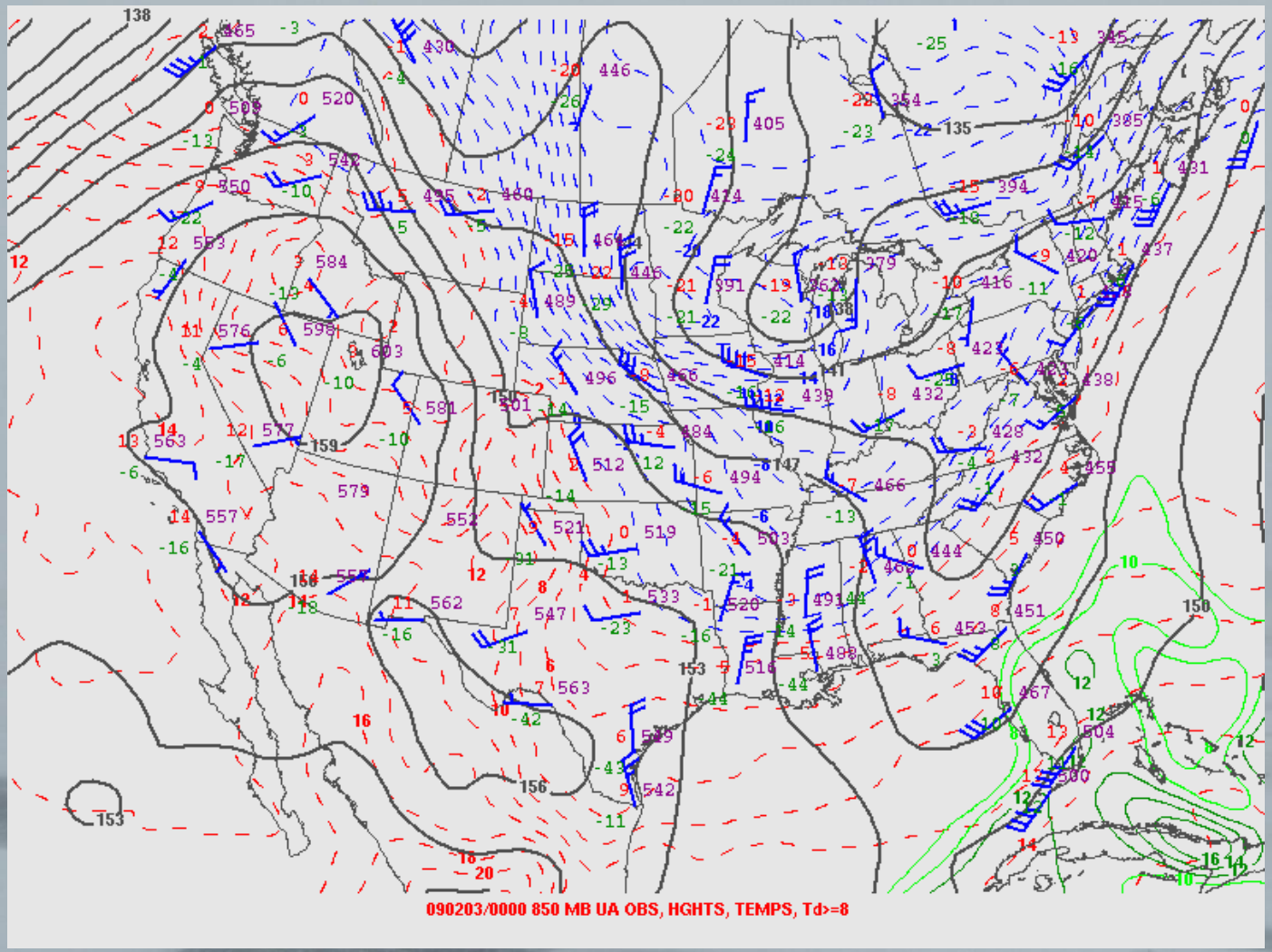
February 3-4, 2009

500 mb



February 3-4, 2009

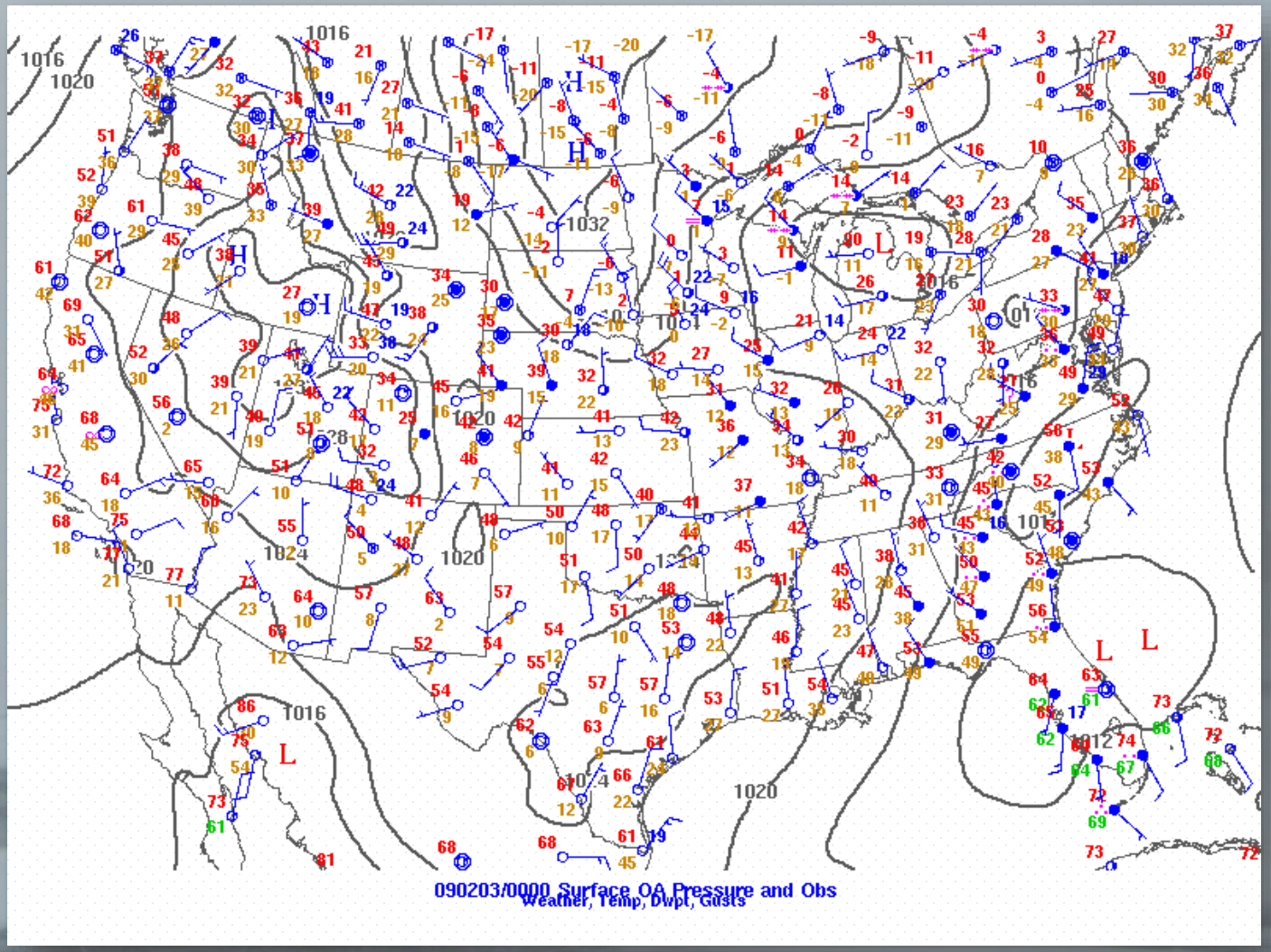
850 mb



Instability = 20-25°C

February 3-4, 2009

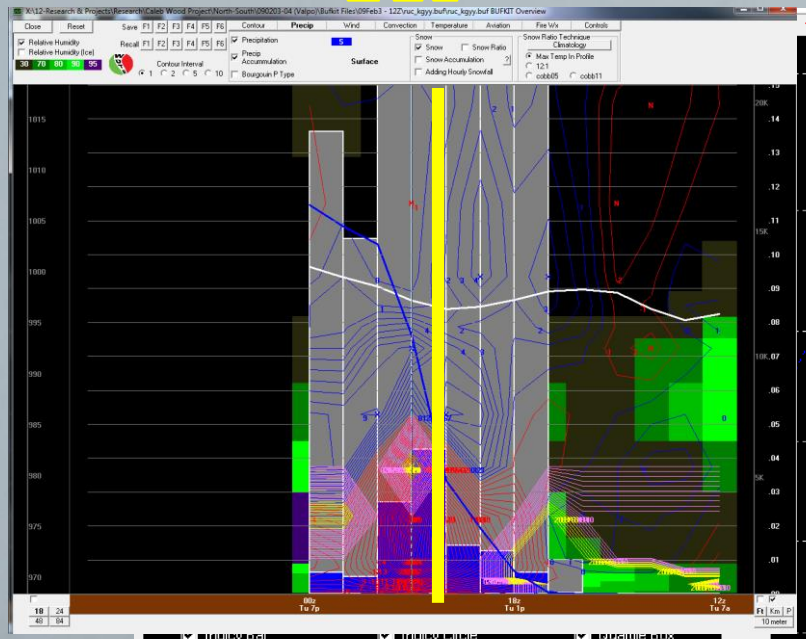
Surface Map

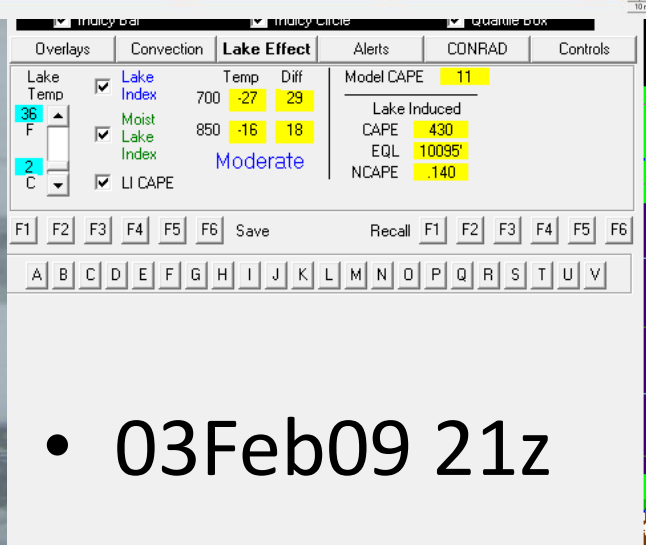


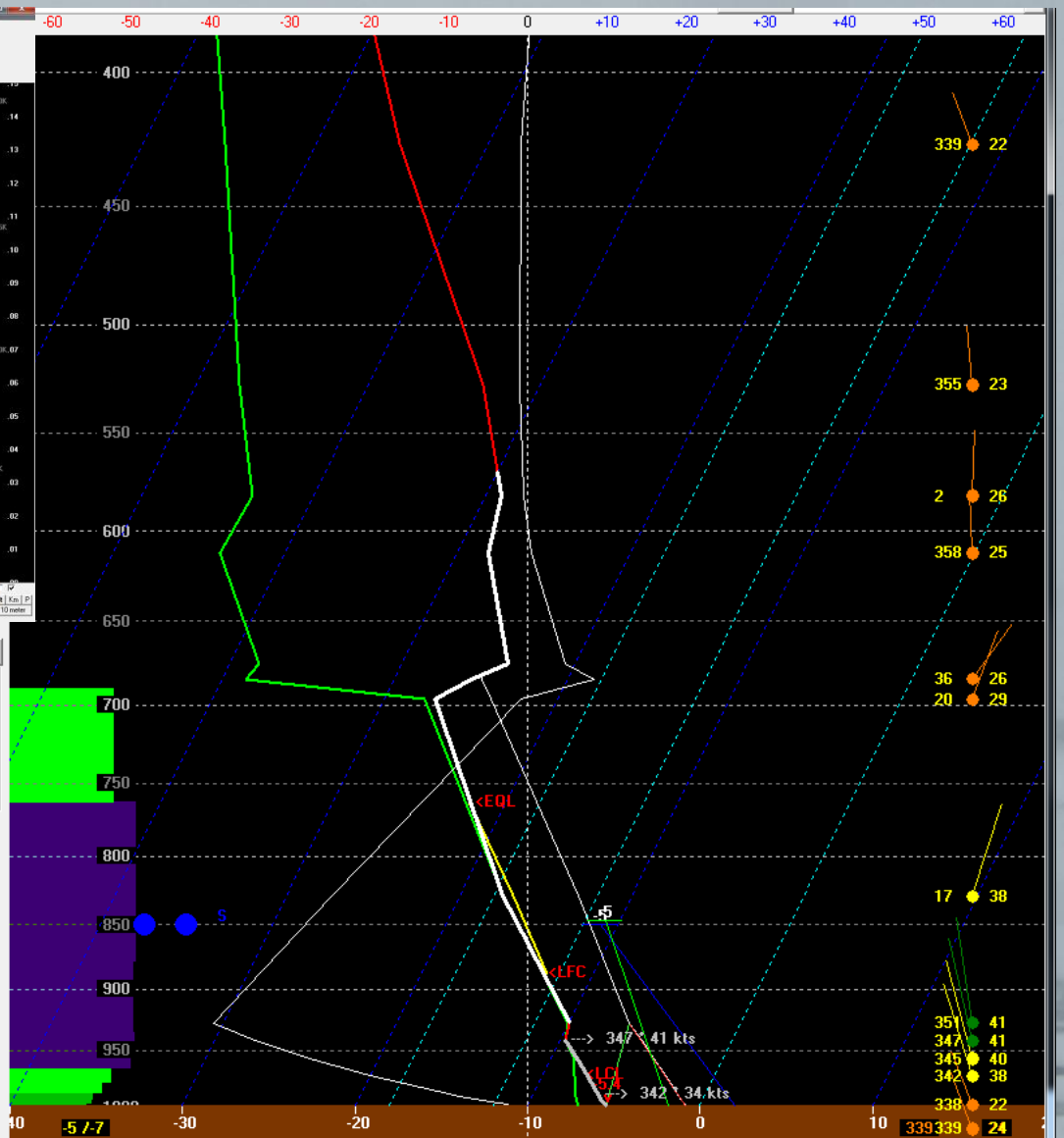
February 3-4, 2009

GYY BUFKIT Sounding - RAP

21z



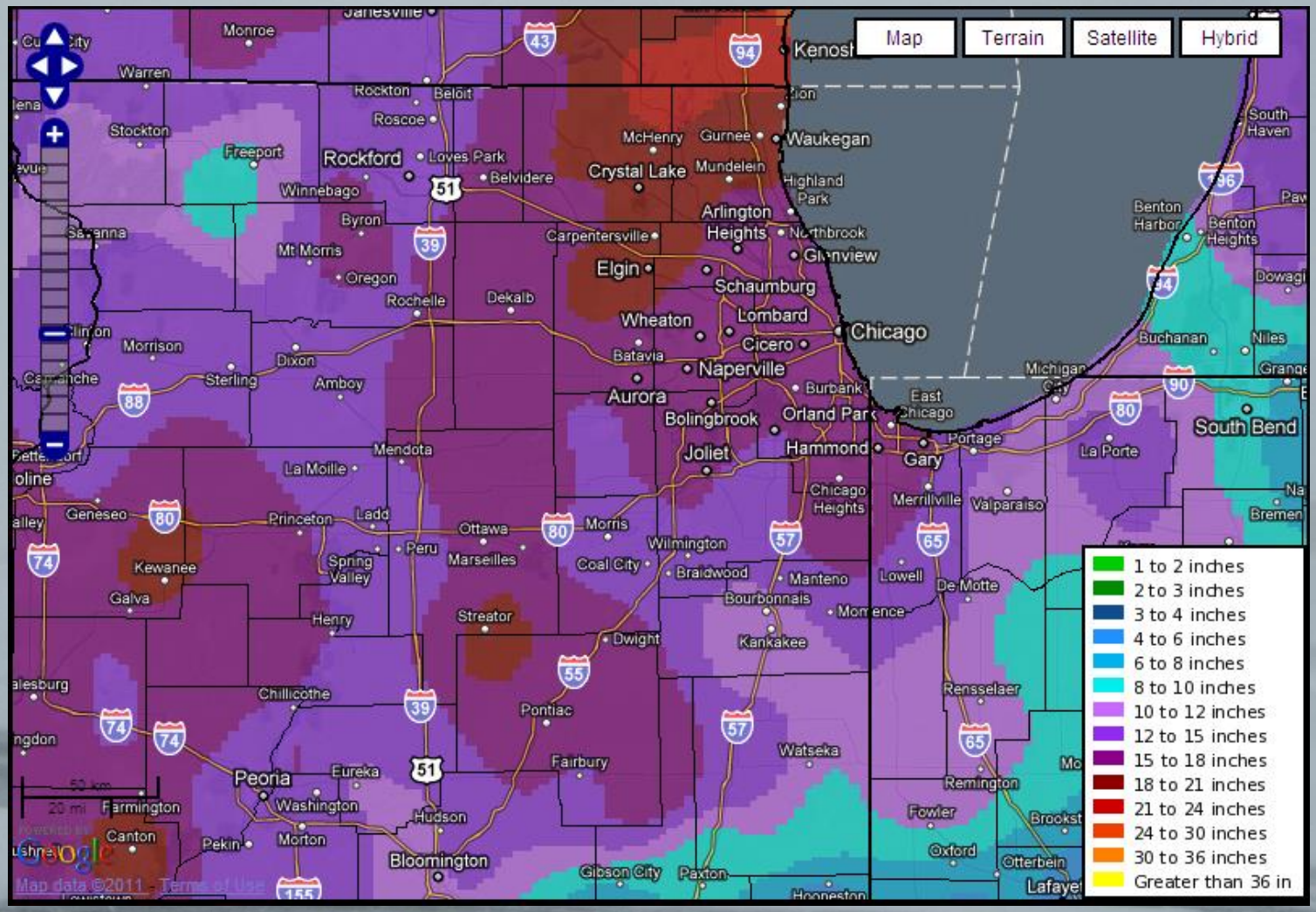




- 03Feb09 21z

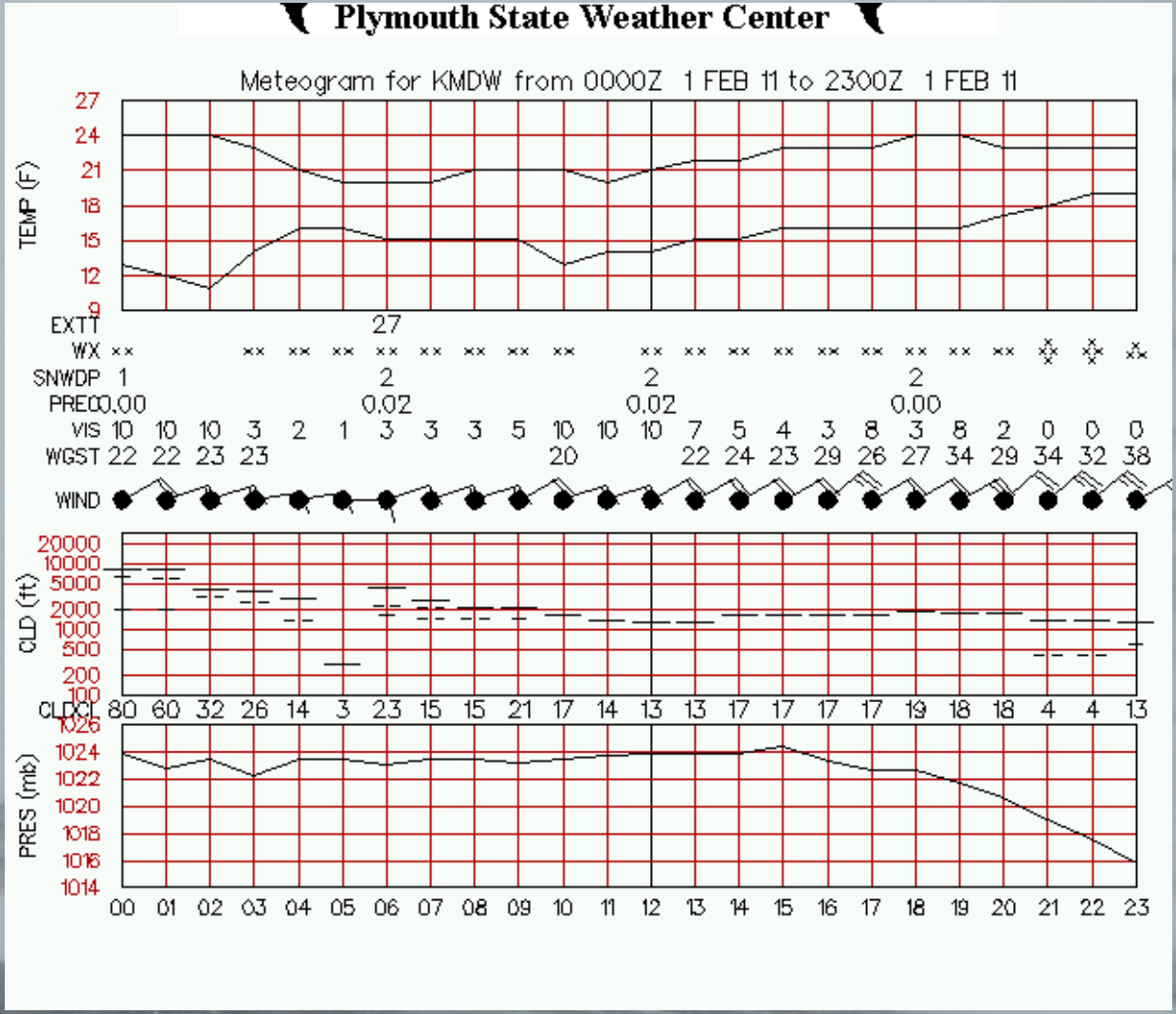
February 1-2, 2011

Snowfall Totals



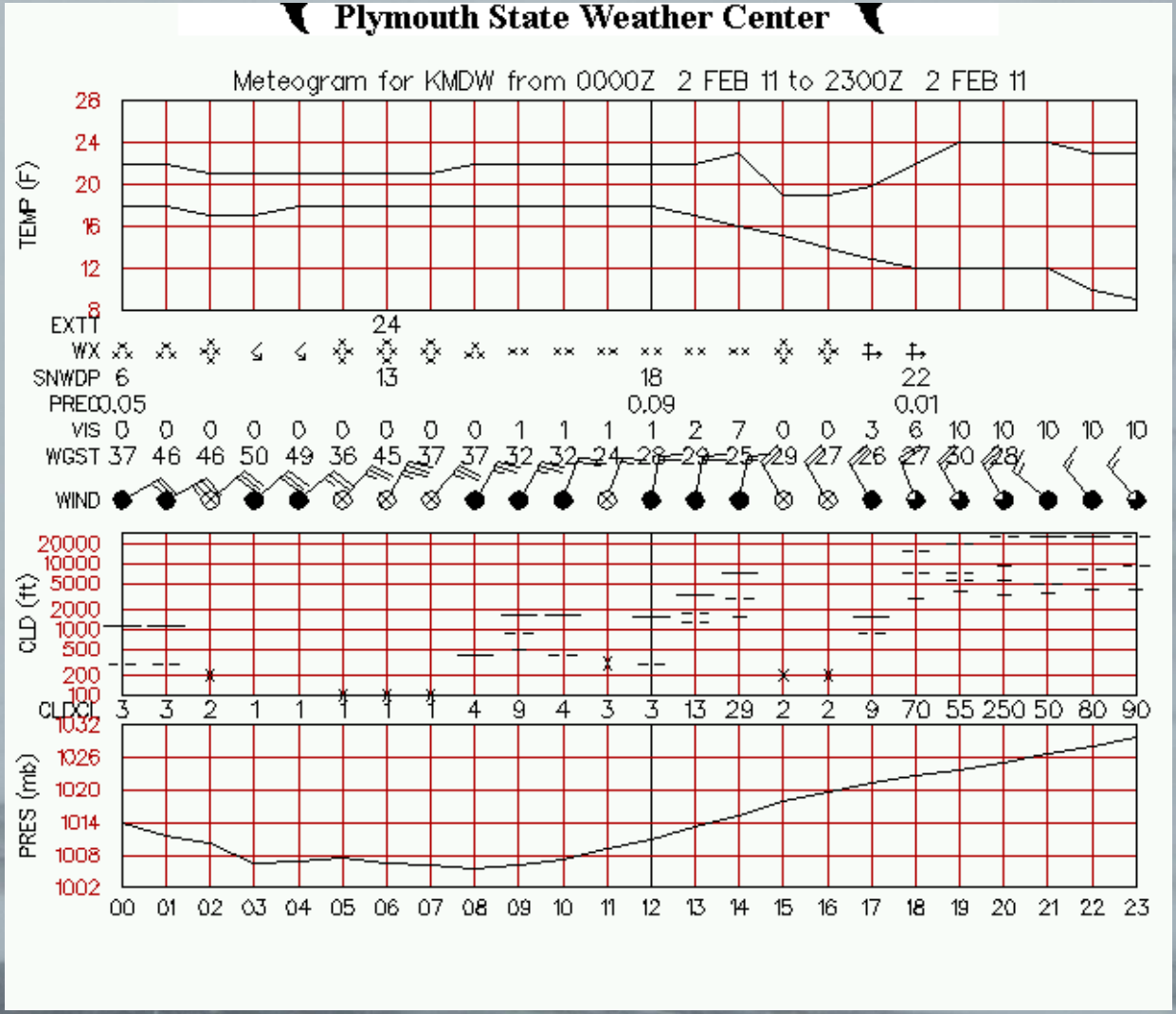
February 1-2, 2011

Meteogram - Chicago Midway



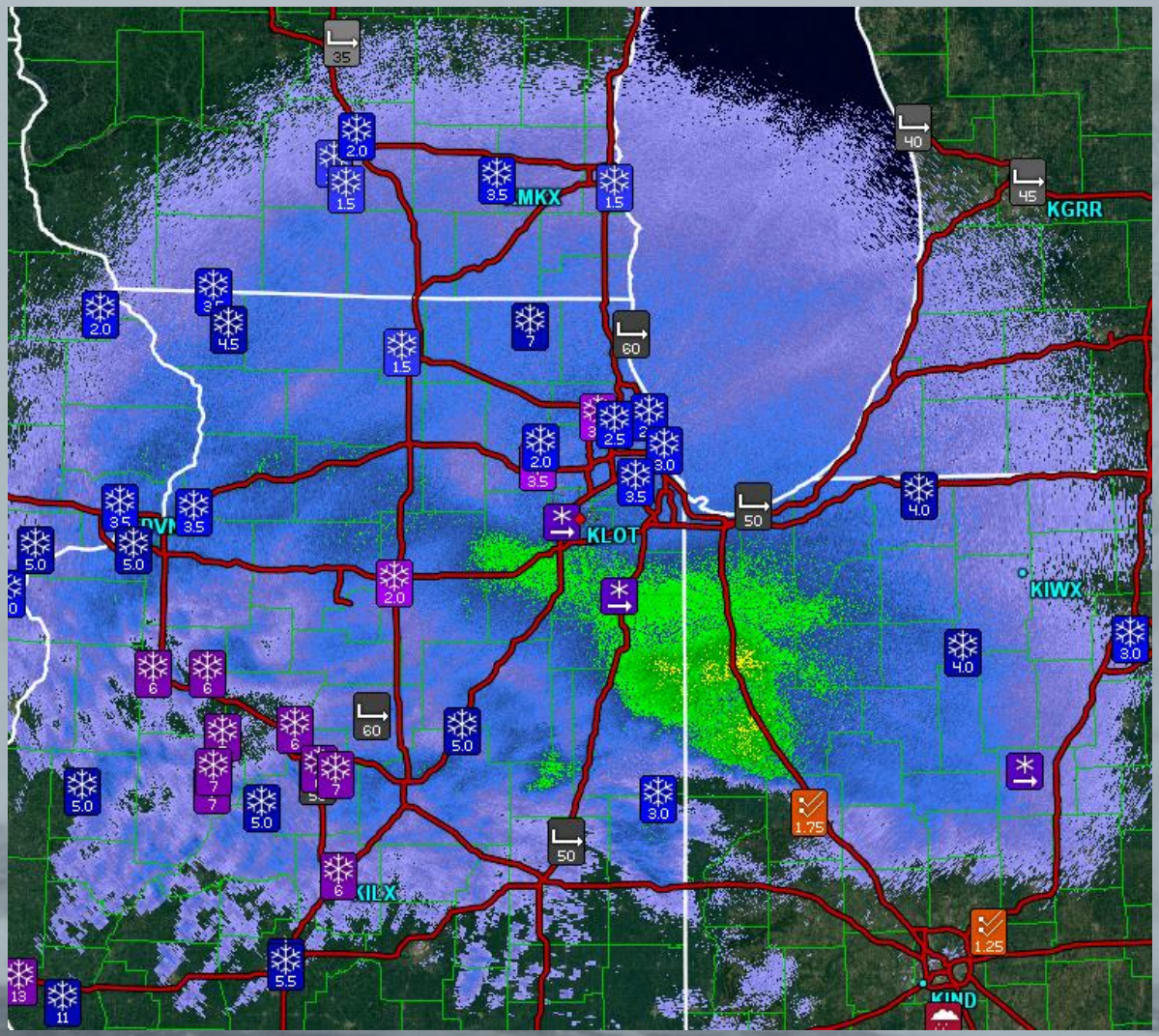
February 1-2, 2011

Meteogram - Chicago Midway



February 1-2, 2011

KLOT Reflectivity - Feb. 2 0006Z



February 1-2, 2011

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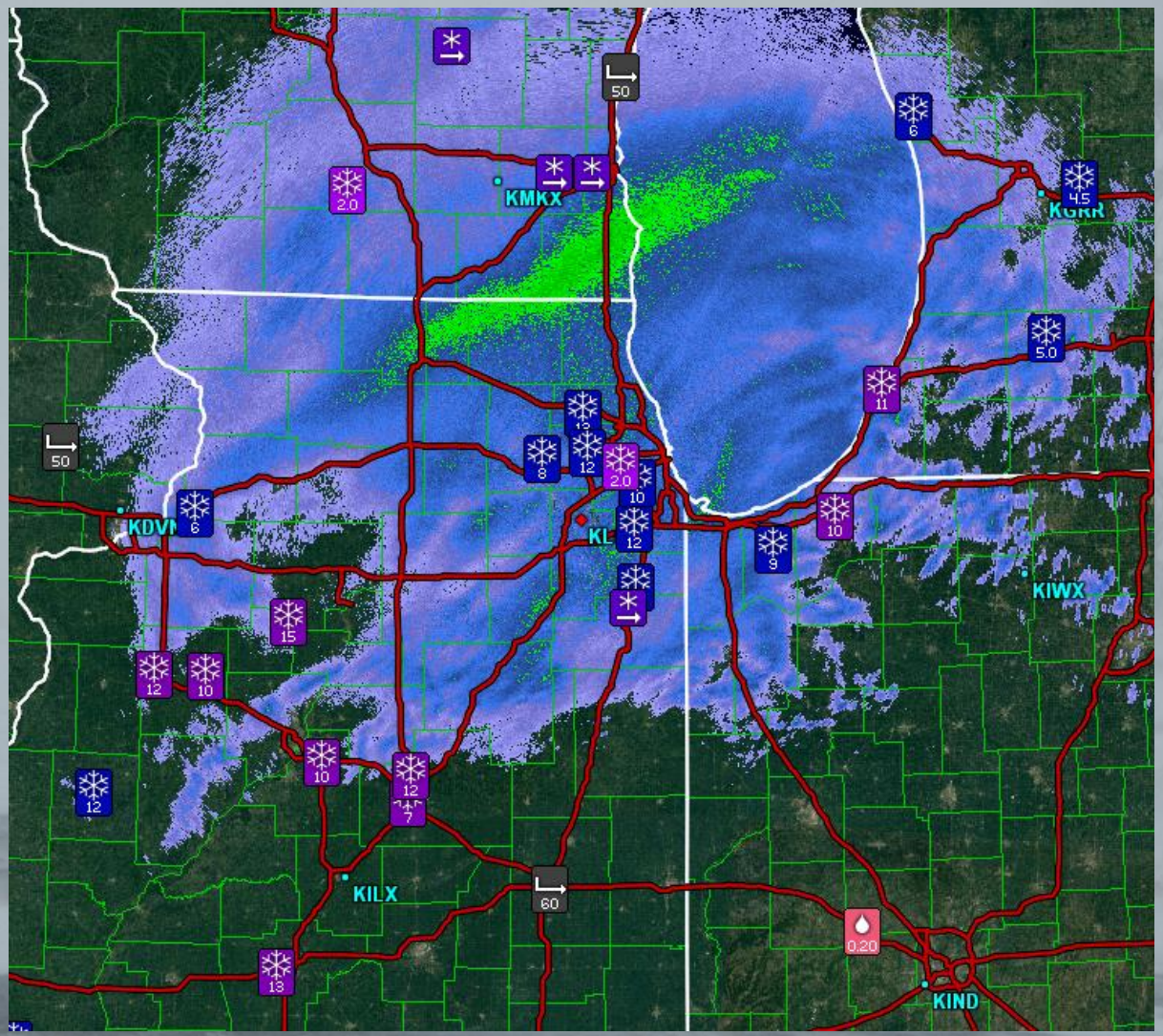
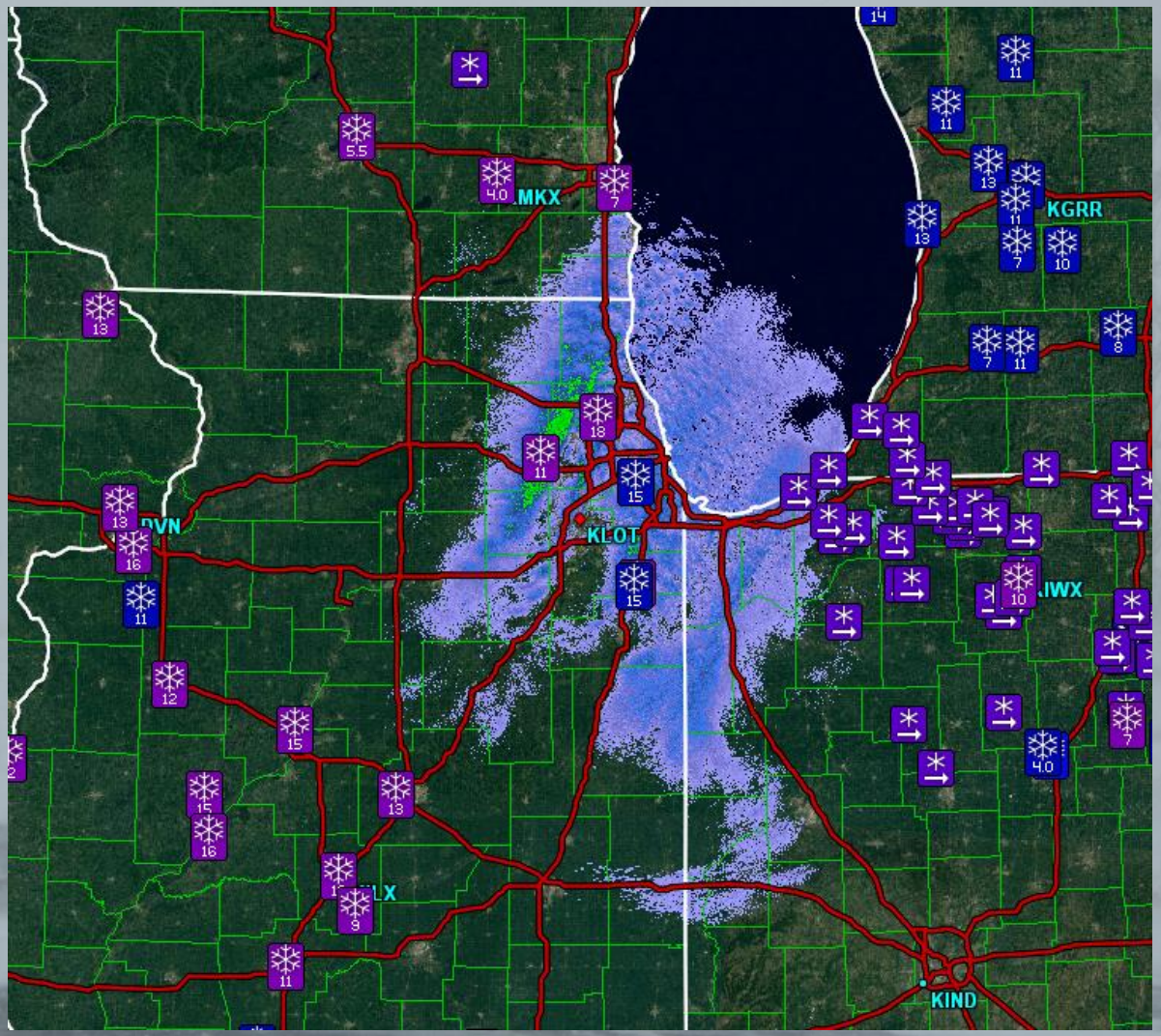


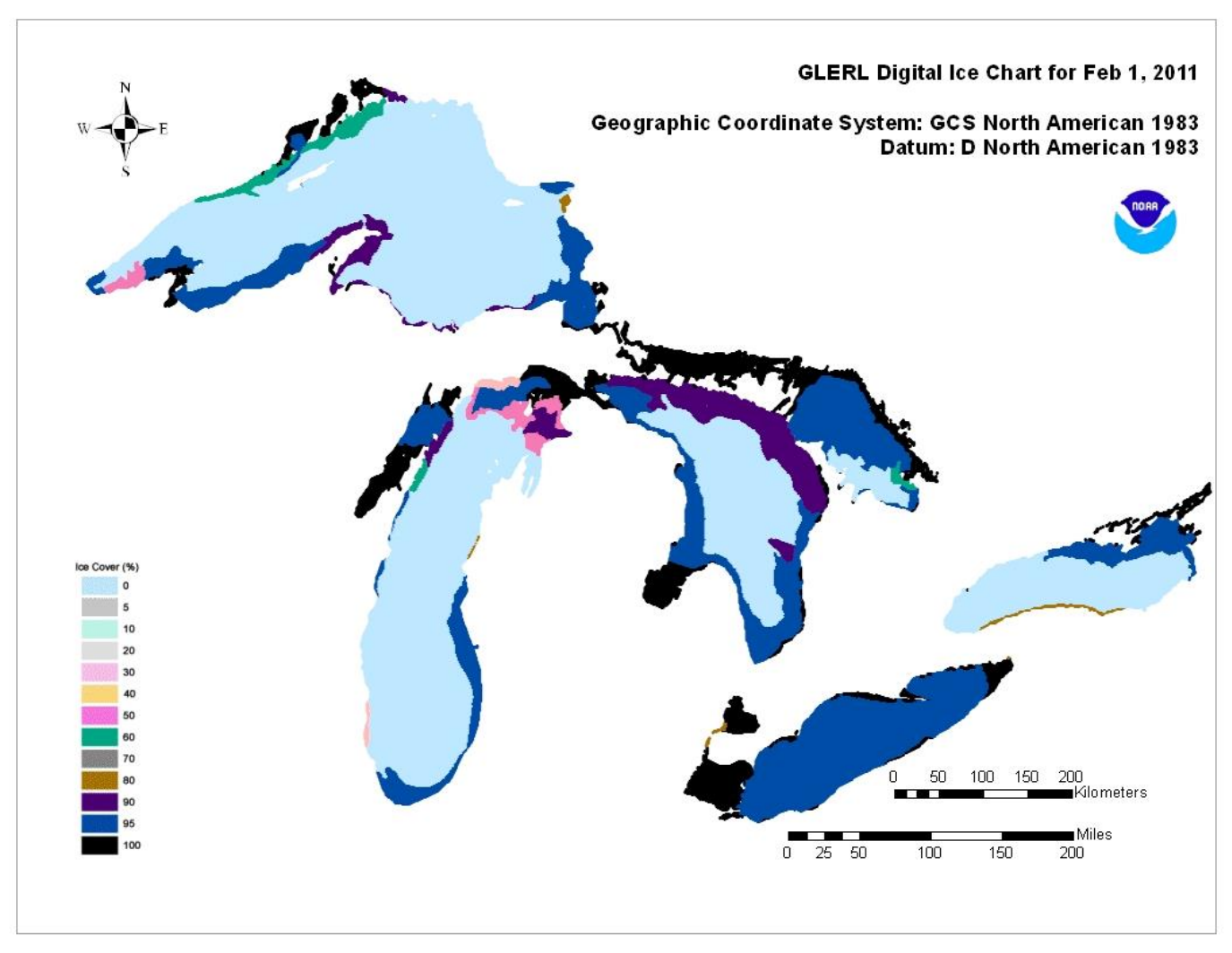
February 1-2, 2011

KLOT Reflectivity – Feb. 2 1226Z



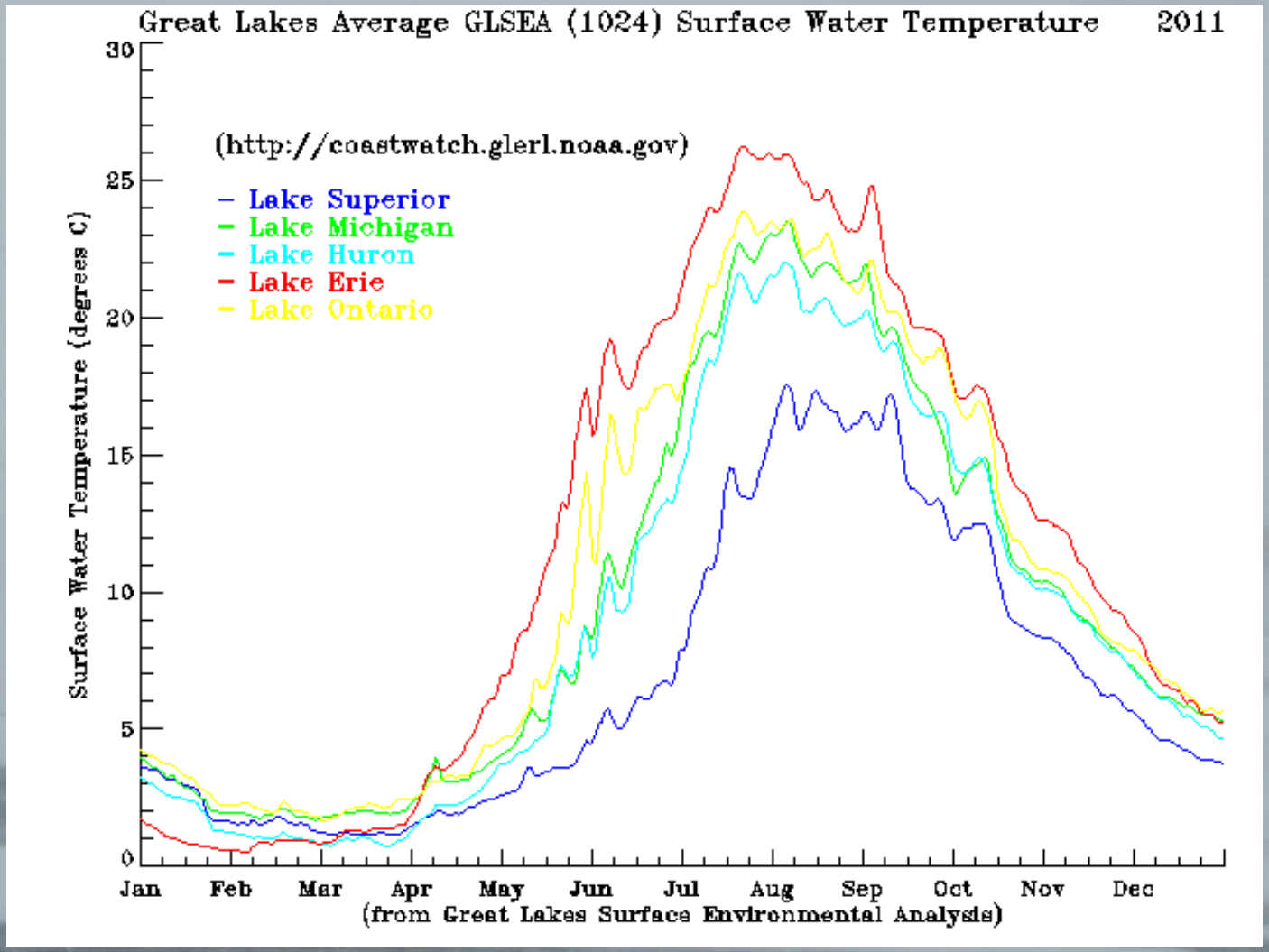
February 1-2, 2011

Lake Ice Coverage



February 1-2, 2011

Surface Water Temps



February 1-2, 2011

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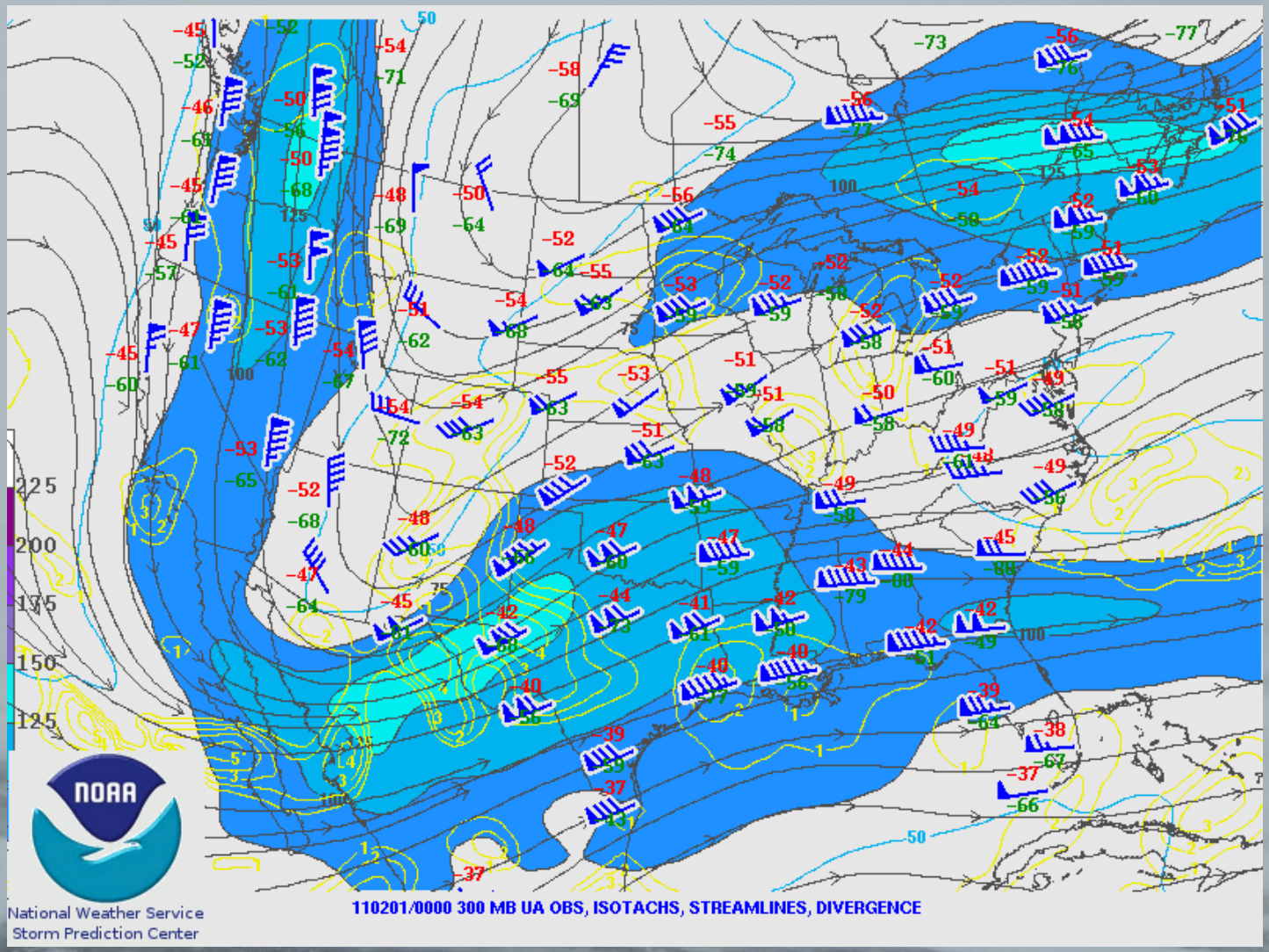

February 1-2, 2011

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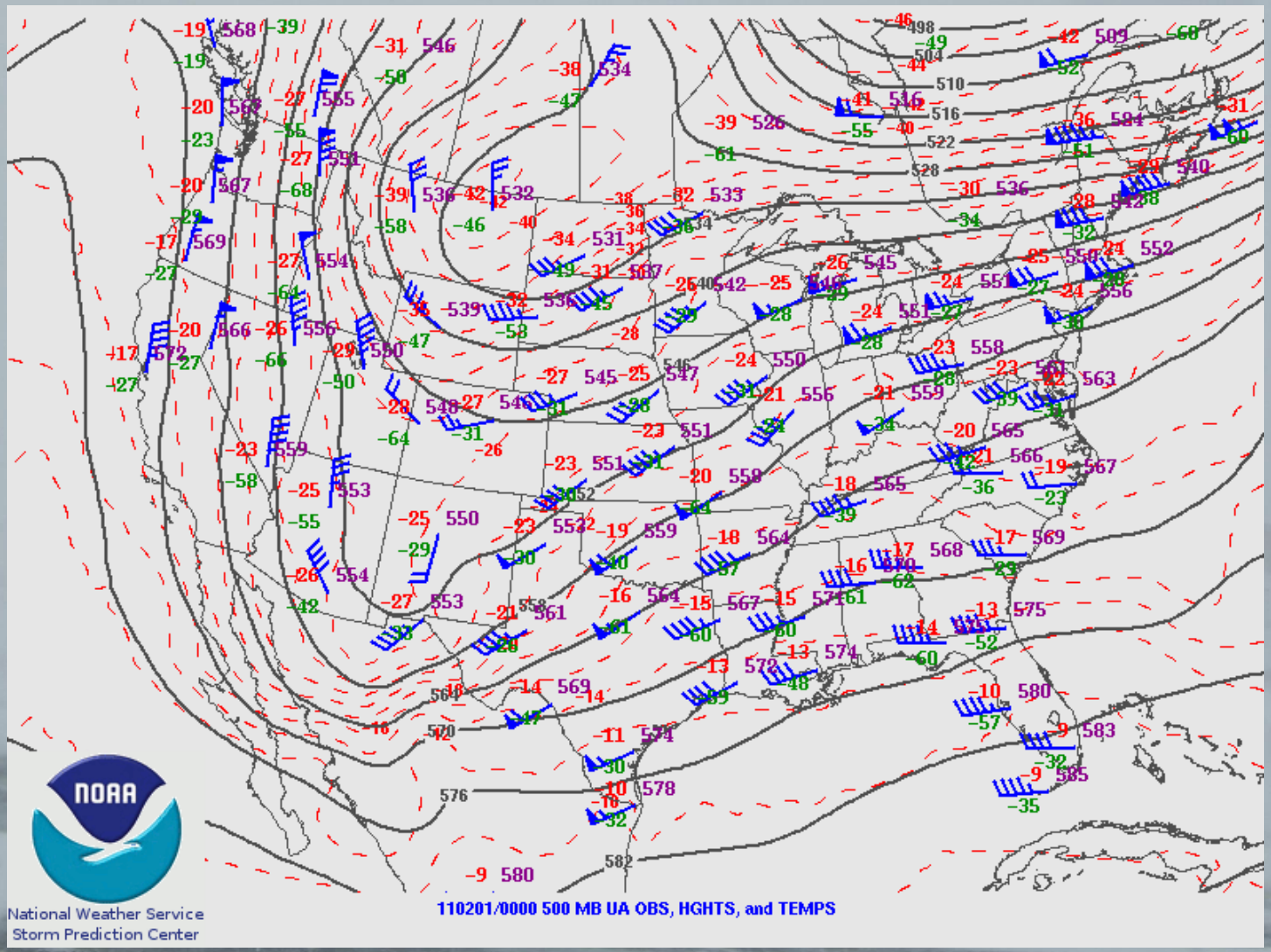
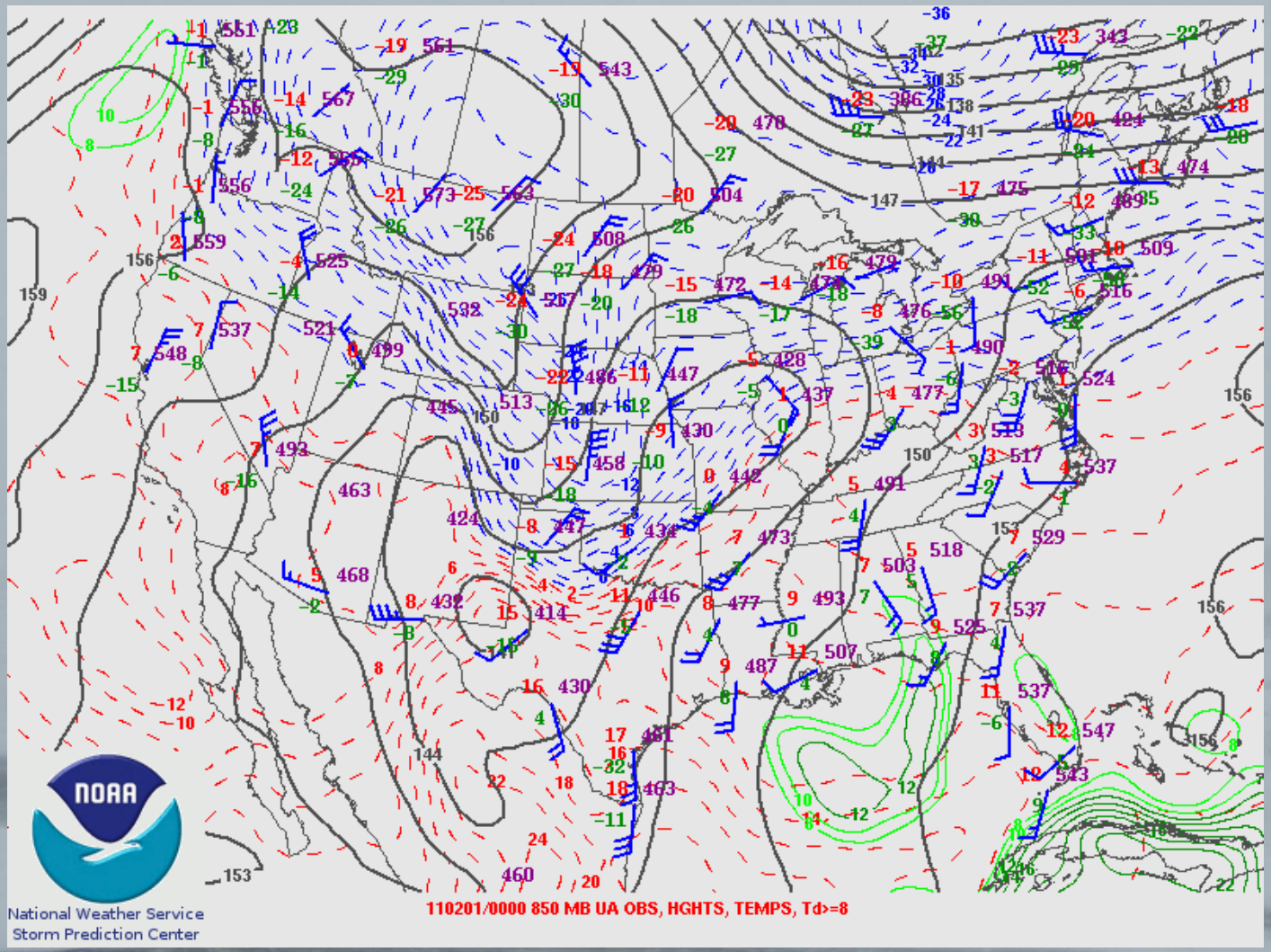


February 1-2, 2011

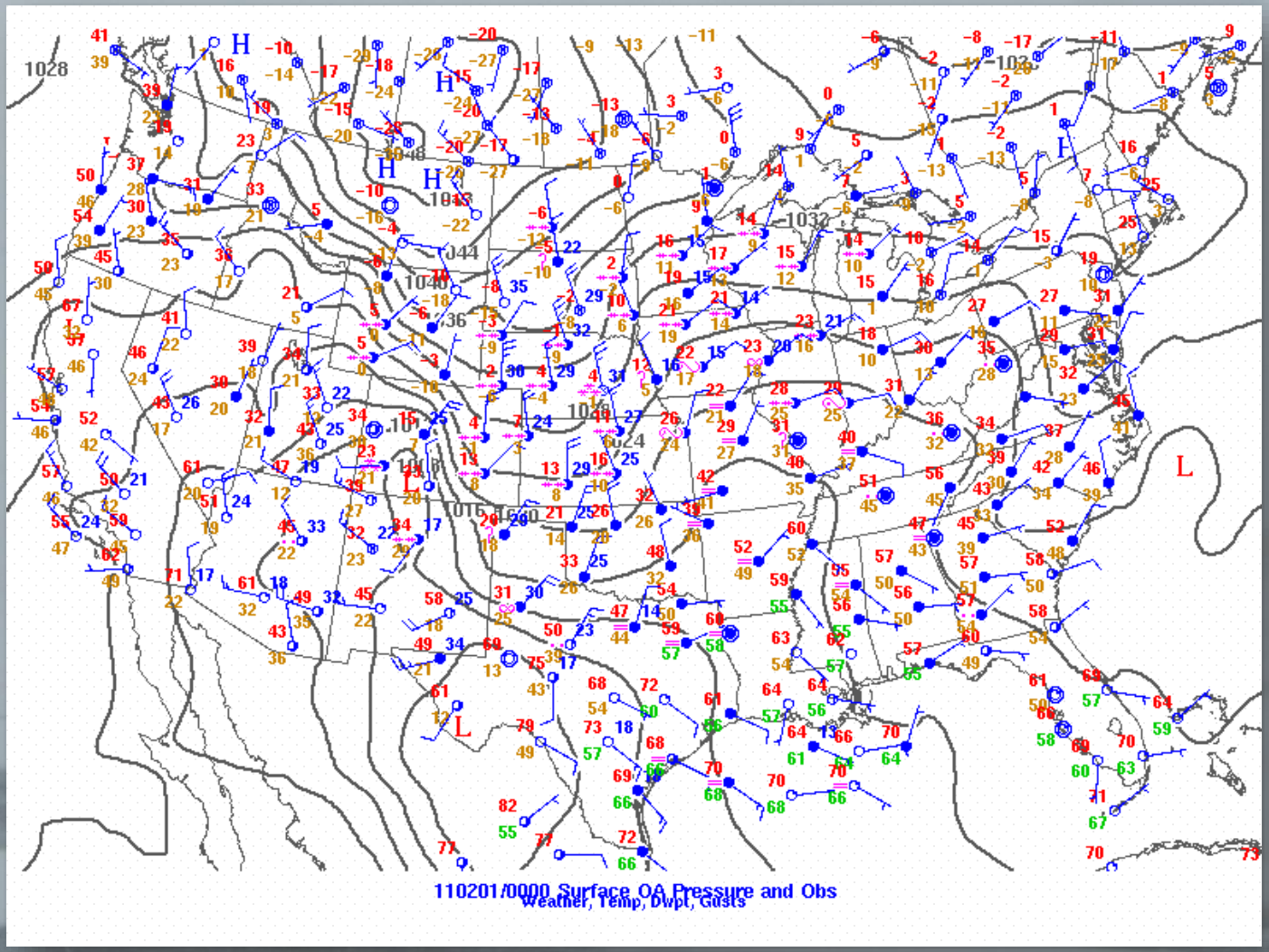
850 mb



Instability
= 20-25°C

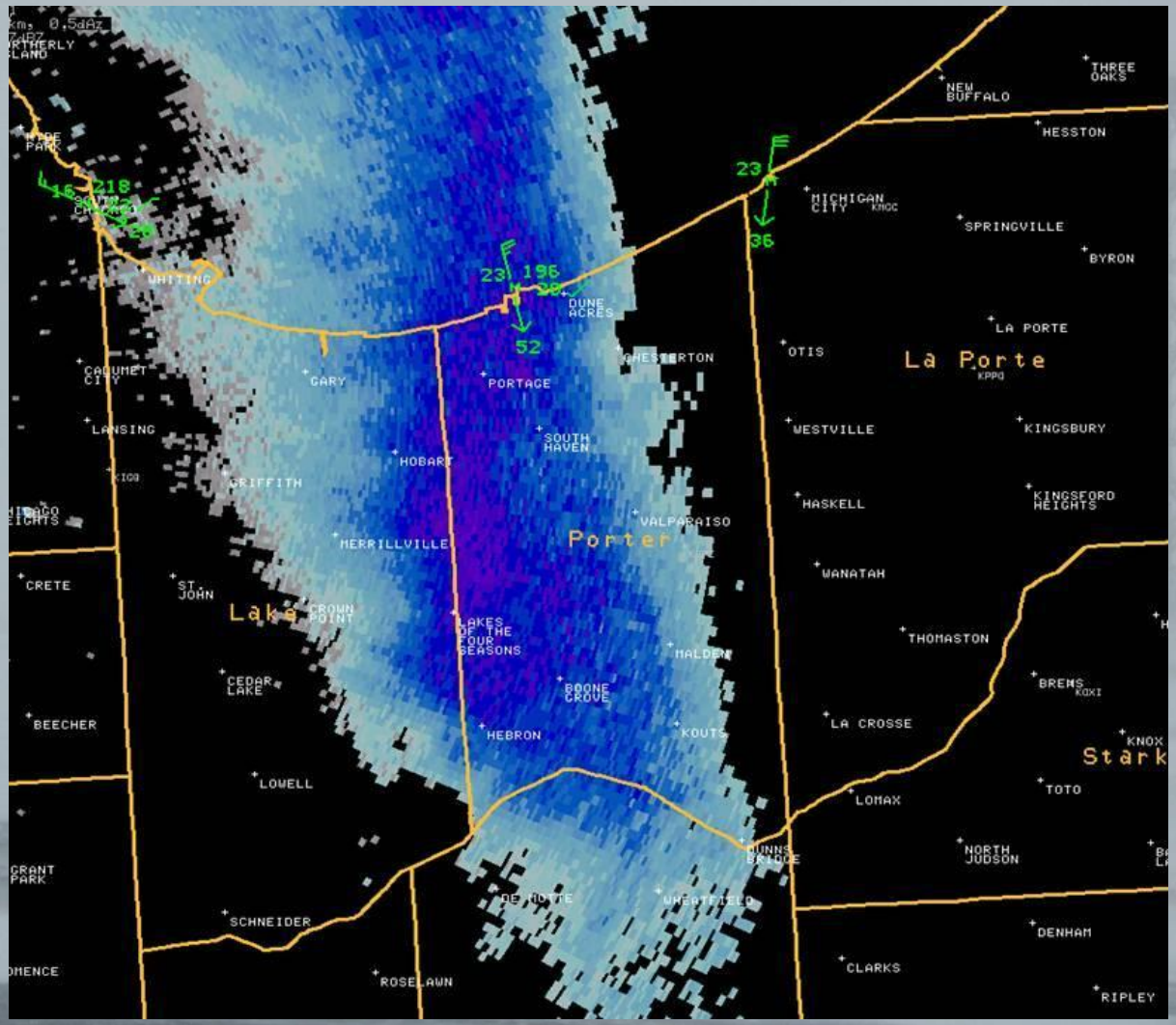
February 1-2, 2011

Surface Map

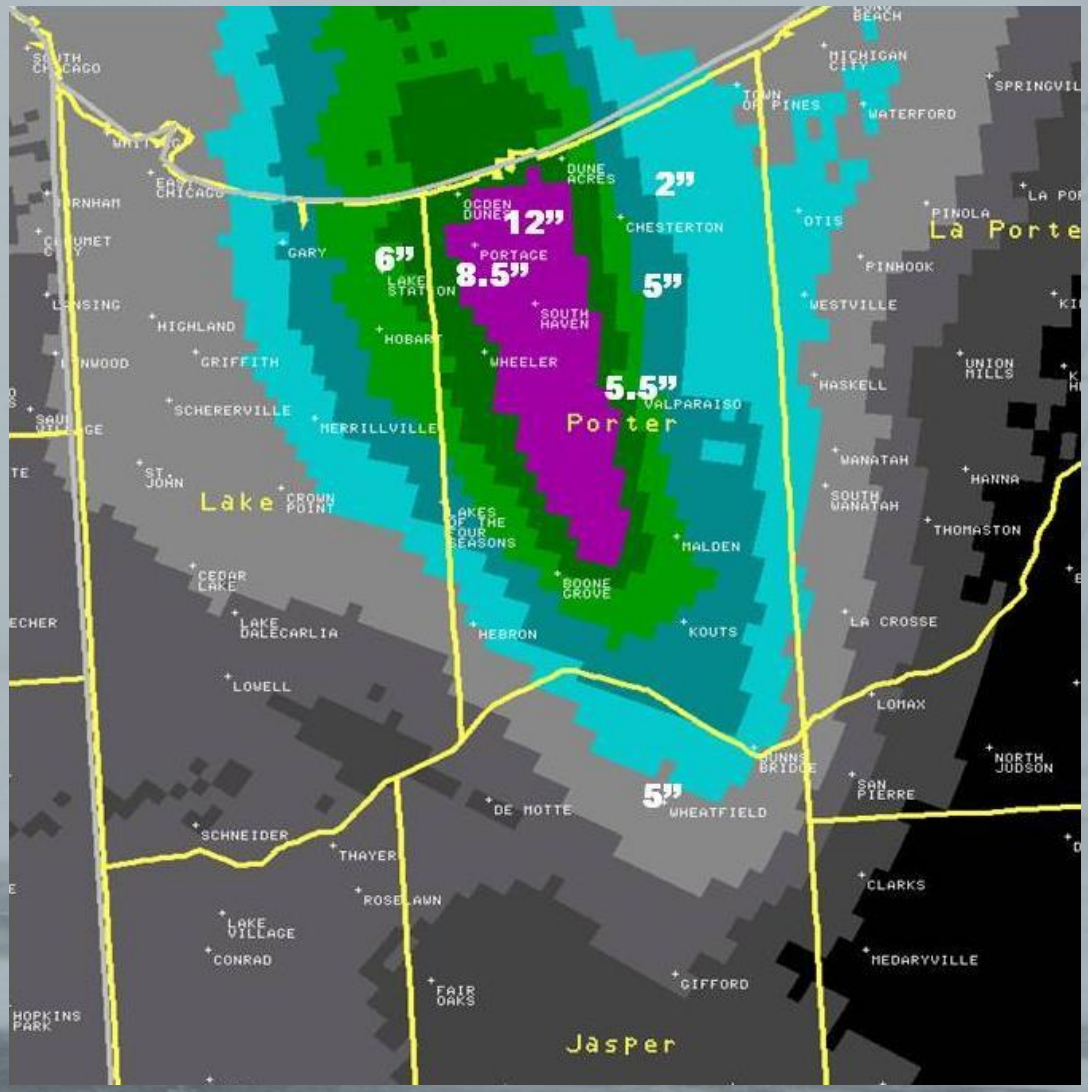


February 1-2, 2011

February 10-11, 2012

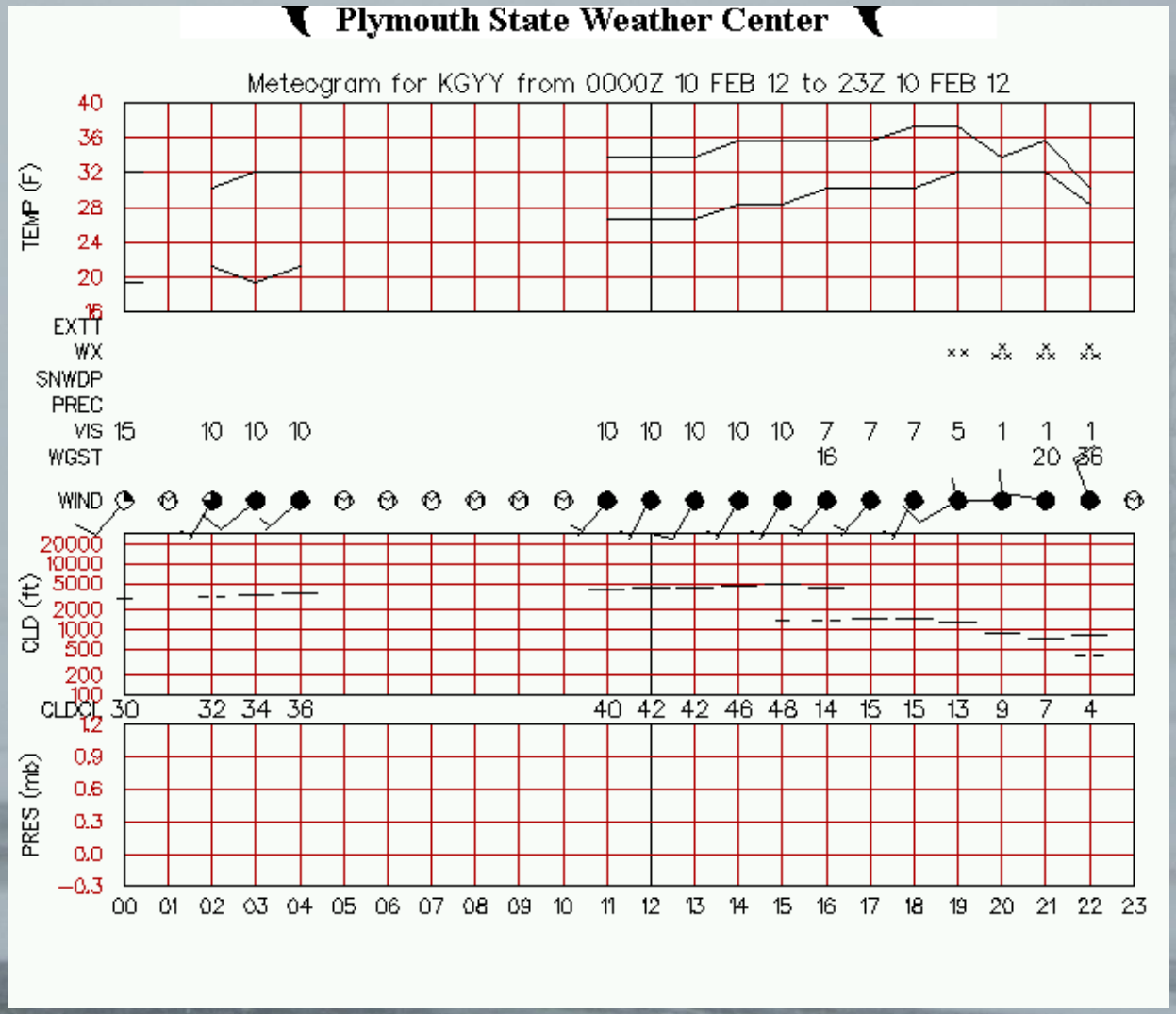


Snowfall Totals



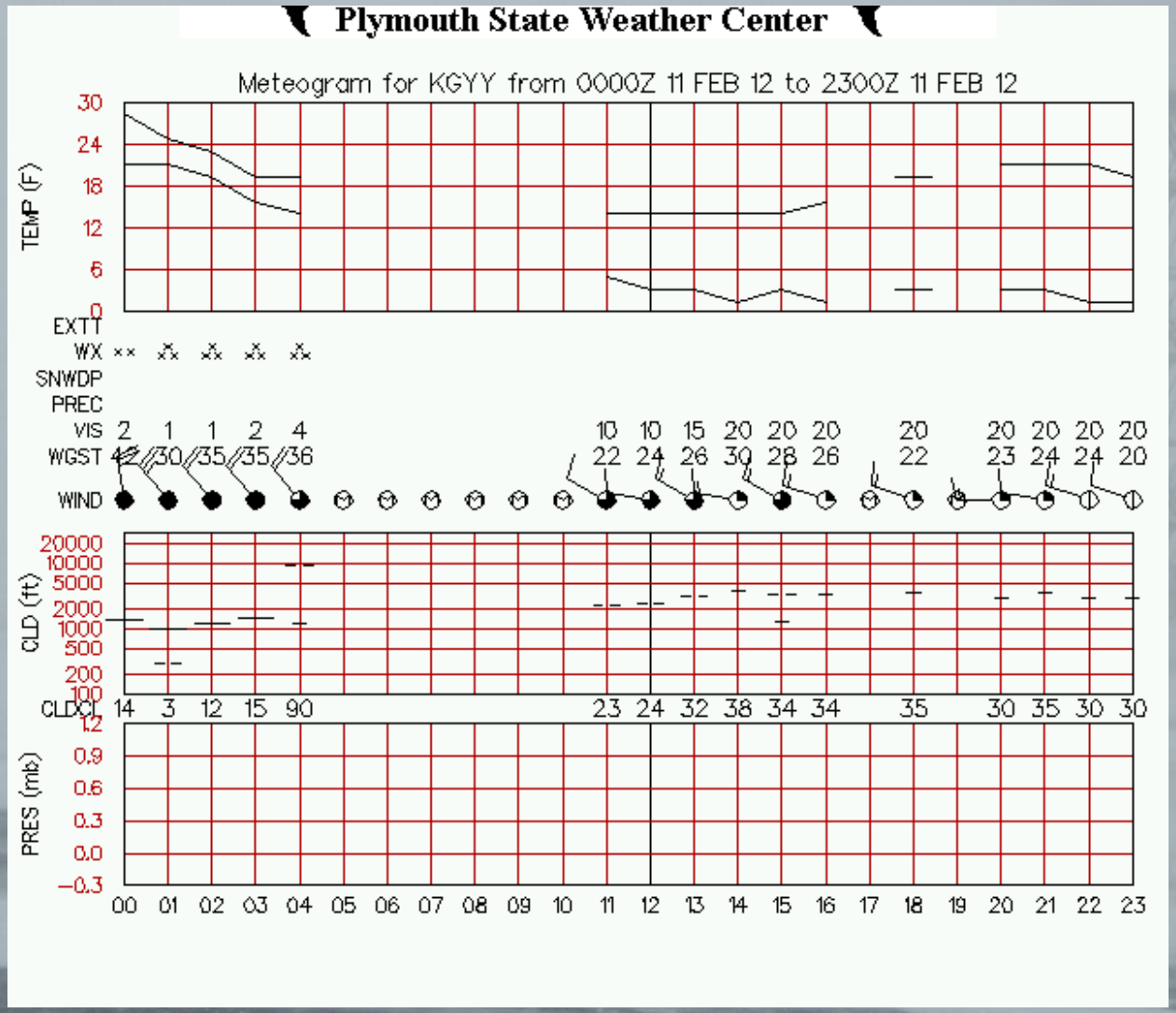
February 10-11, 2012

Meteogram - Gary, IN



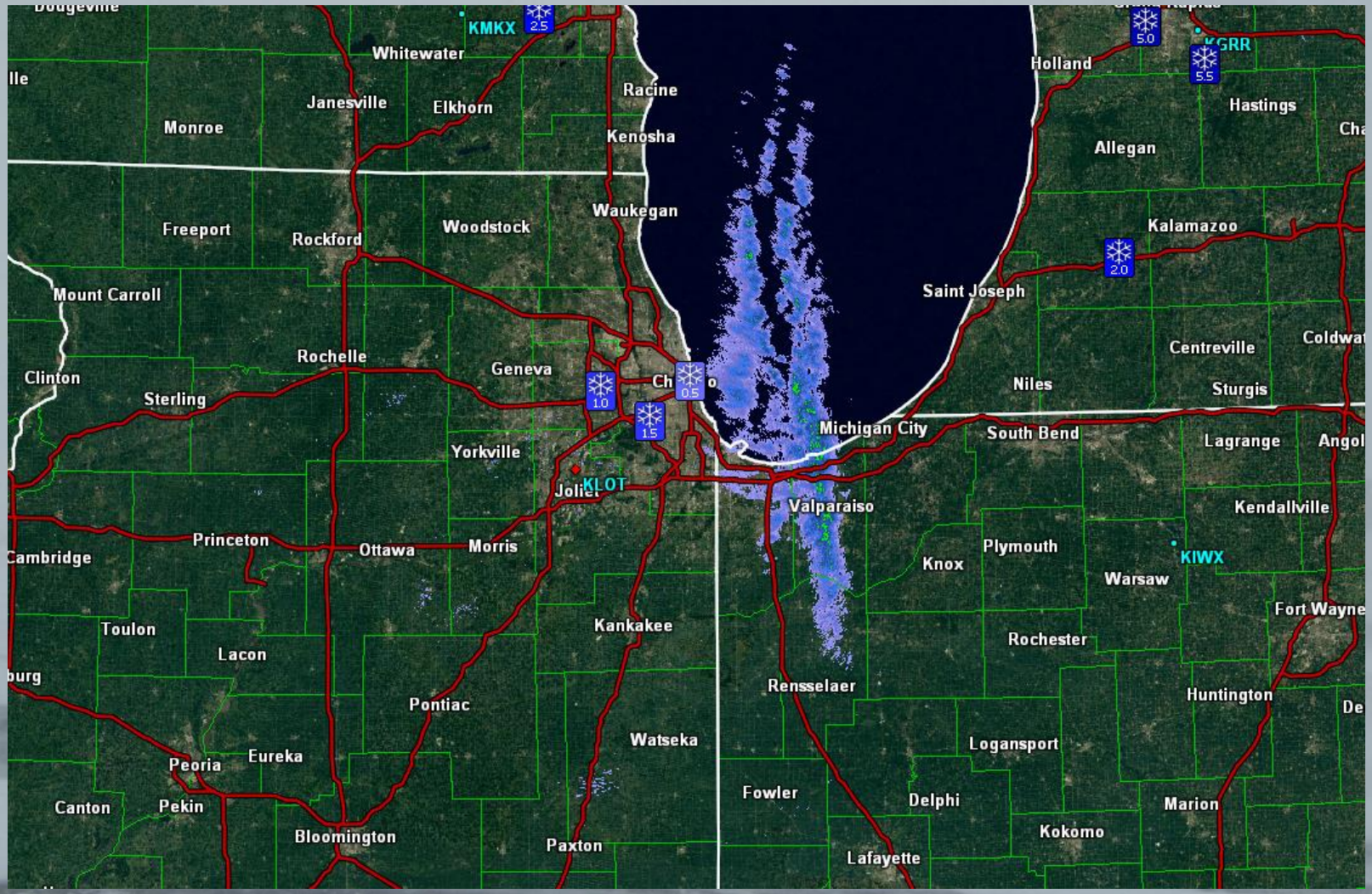
February 10-11, 2012

Meteogram - Gary, IN



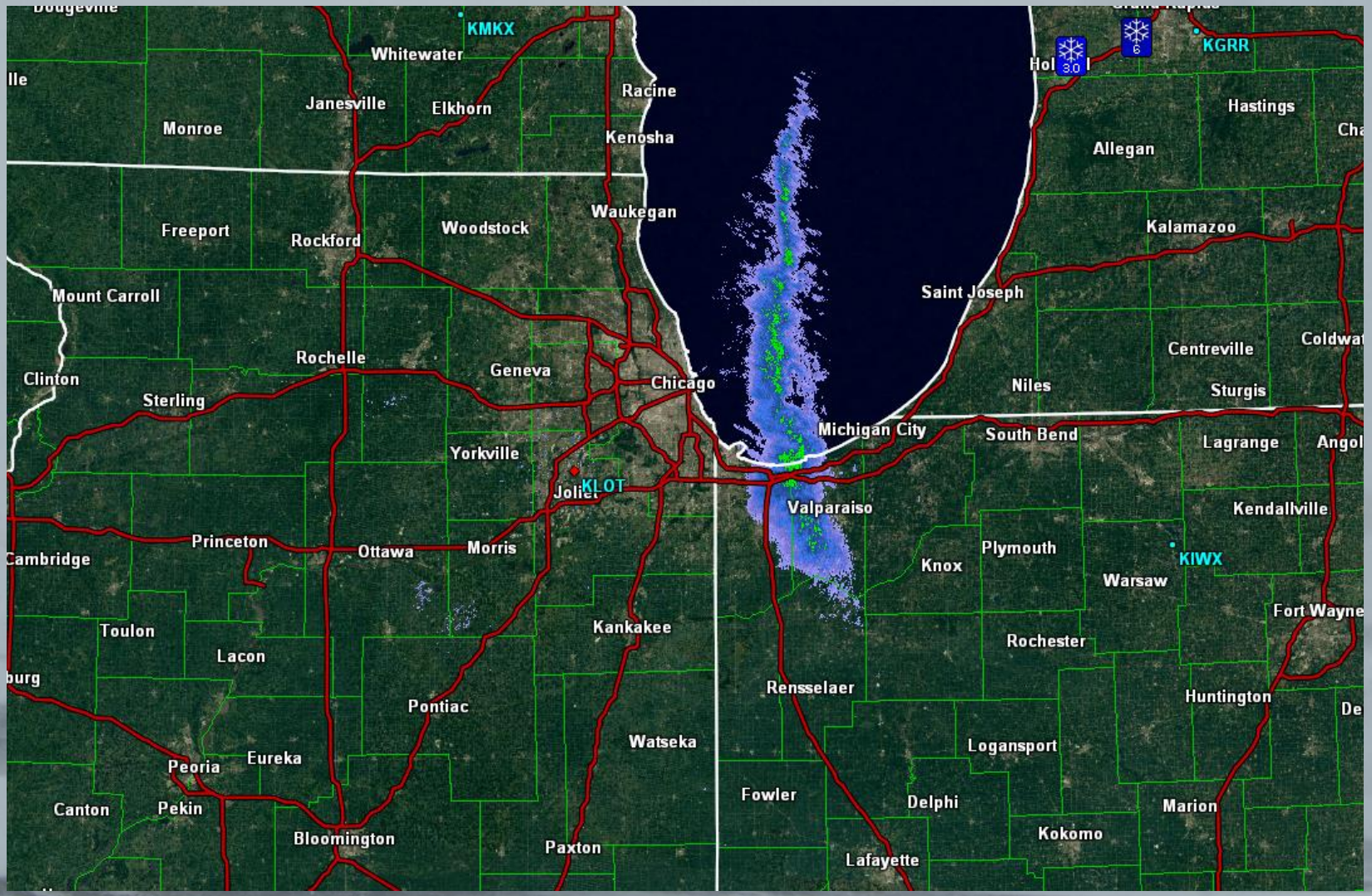
February 10-11, 2012

KLOT Reflectivity - Feb. 10 0249Z



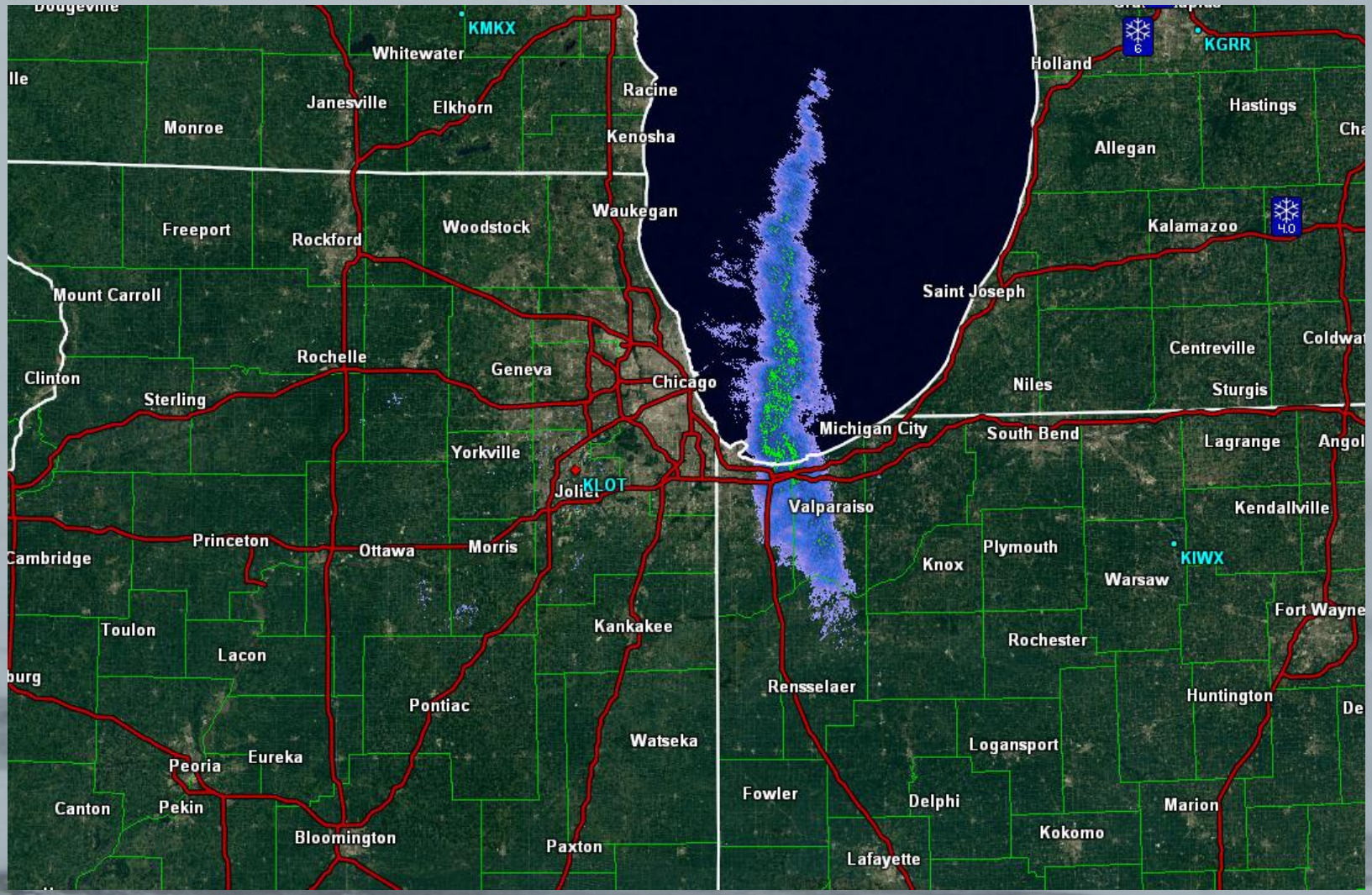
February 10-11, 2012

KLOT Reflectivity - Feb. 10 0358Z



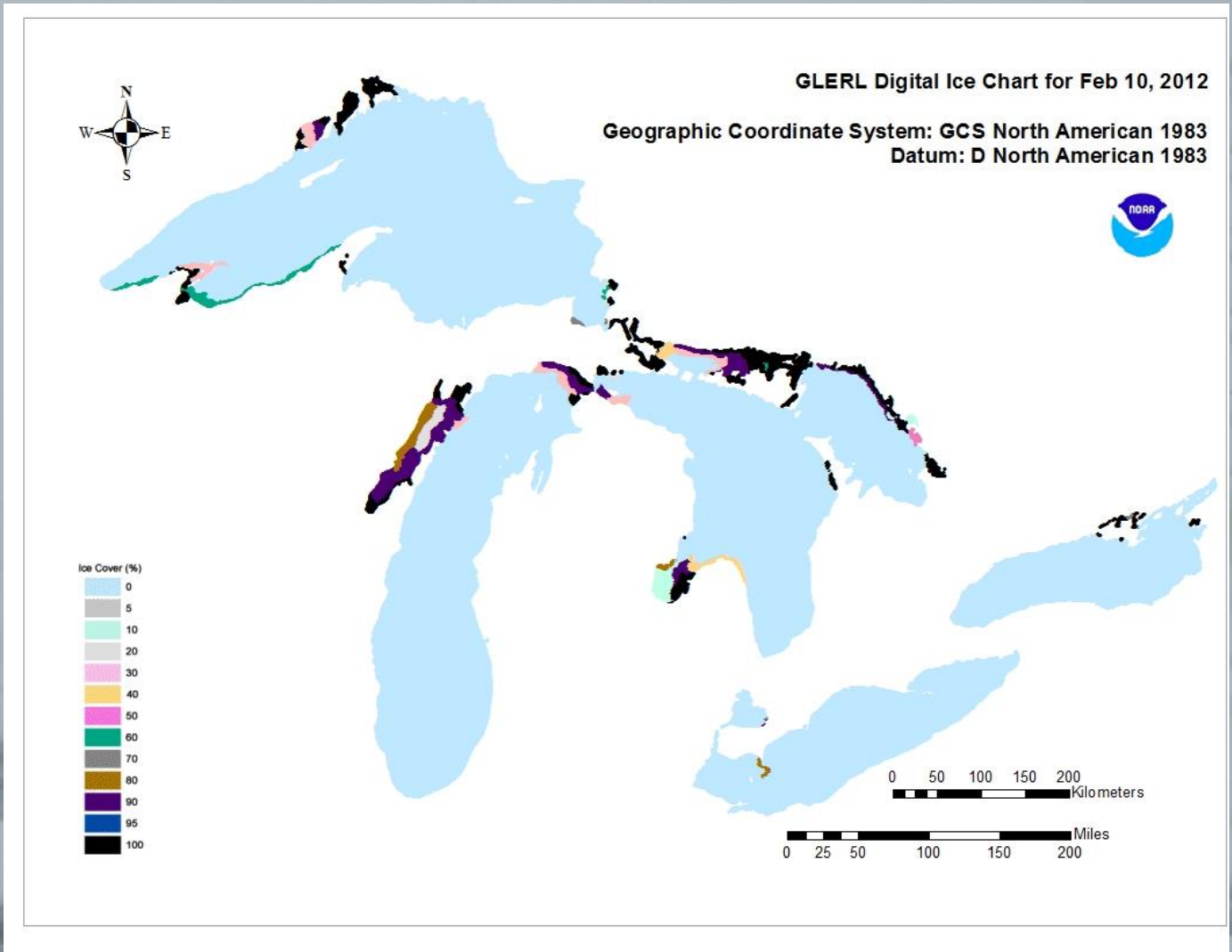
February 10-11, 2012

KLOT Reflectivity - Feb. 11 0427Z



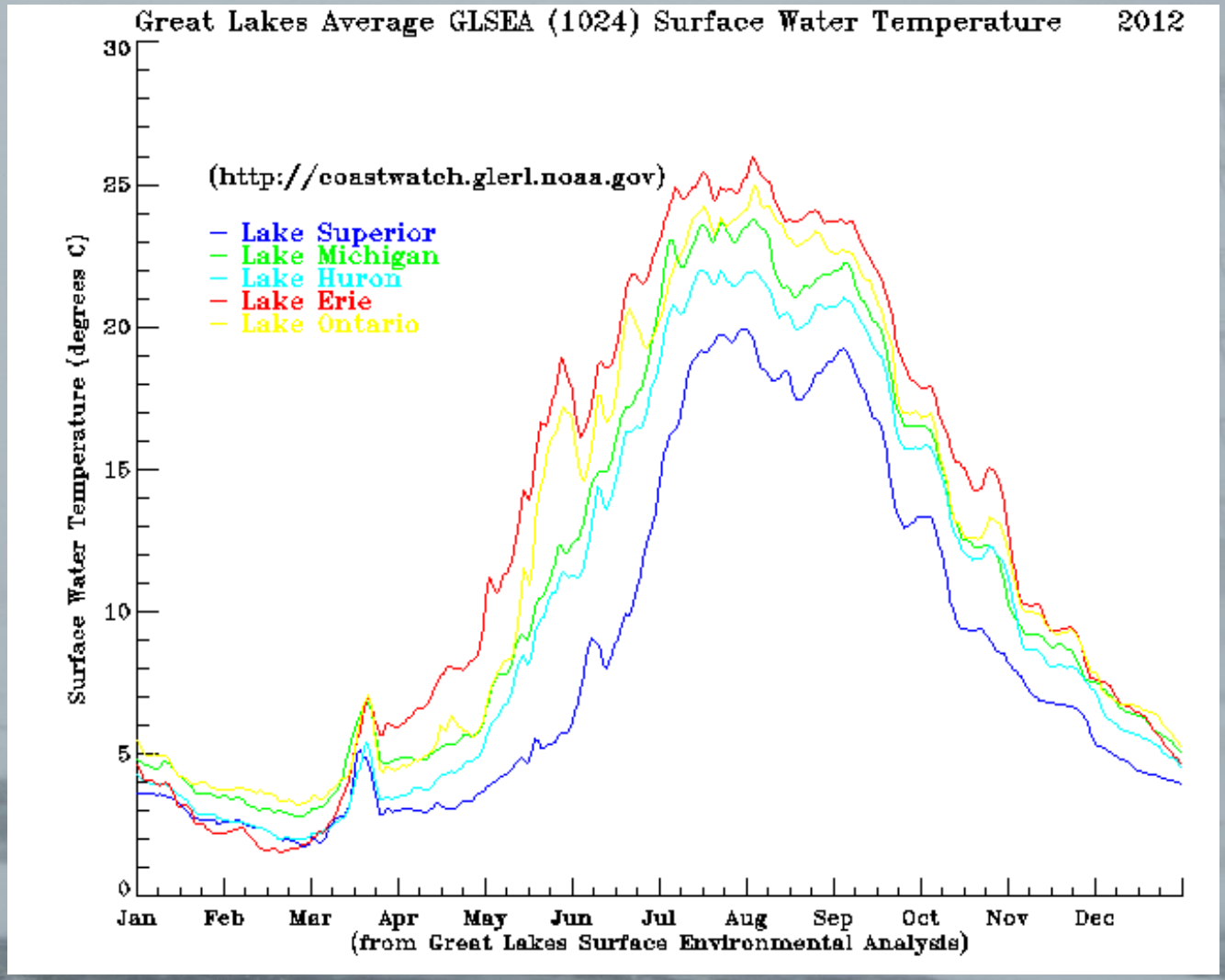
February 10-11, 2012

Lake Ice Coverage



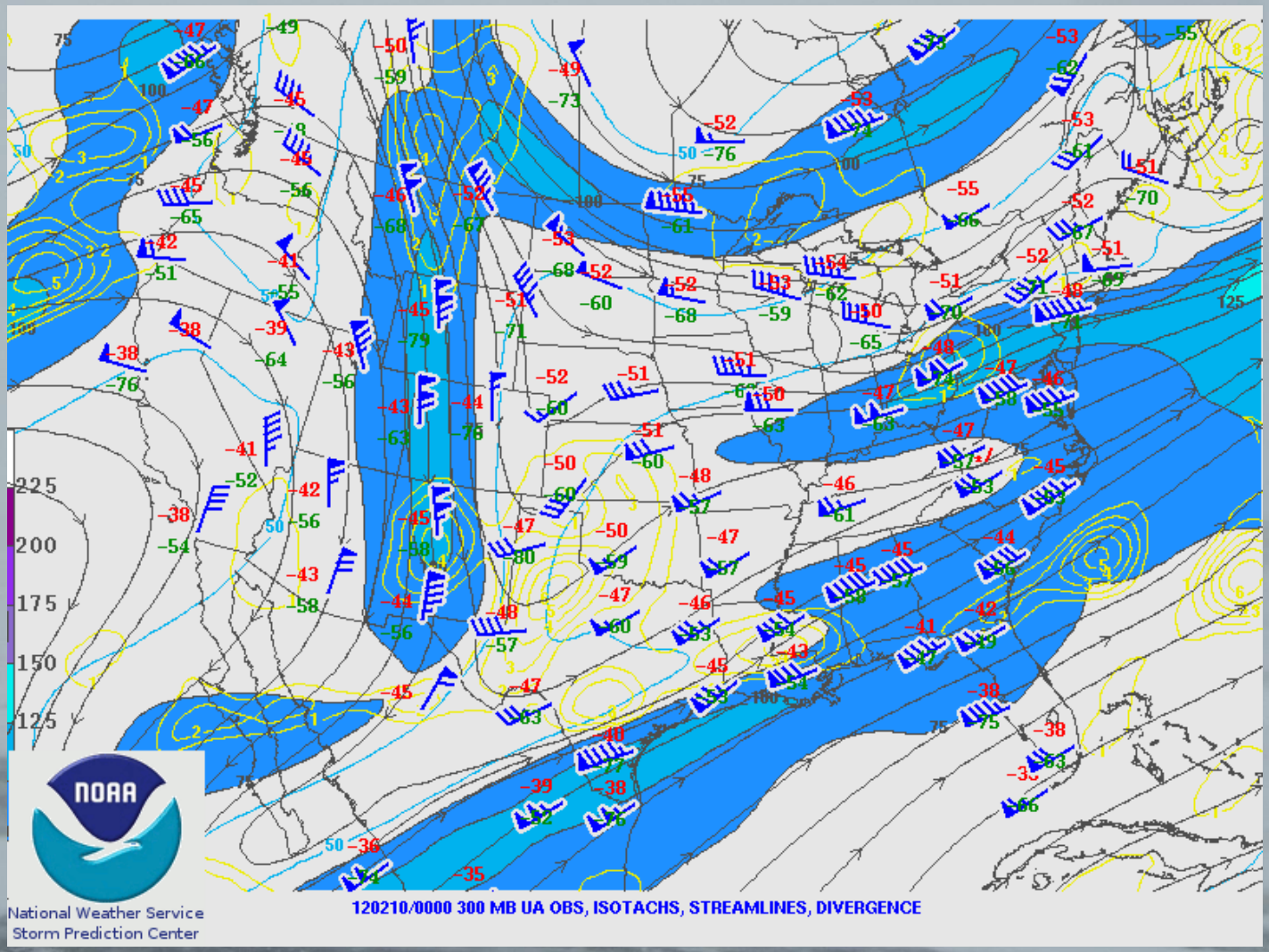
February 10-11, 2012

Surface Water Temps



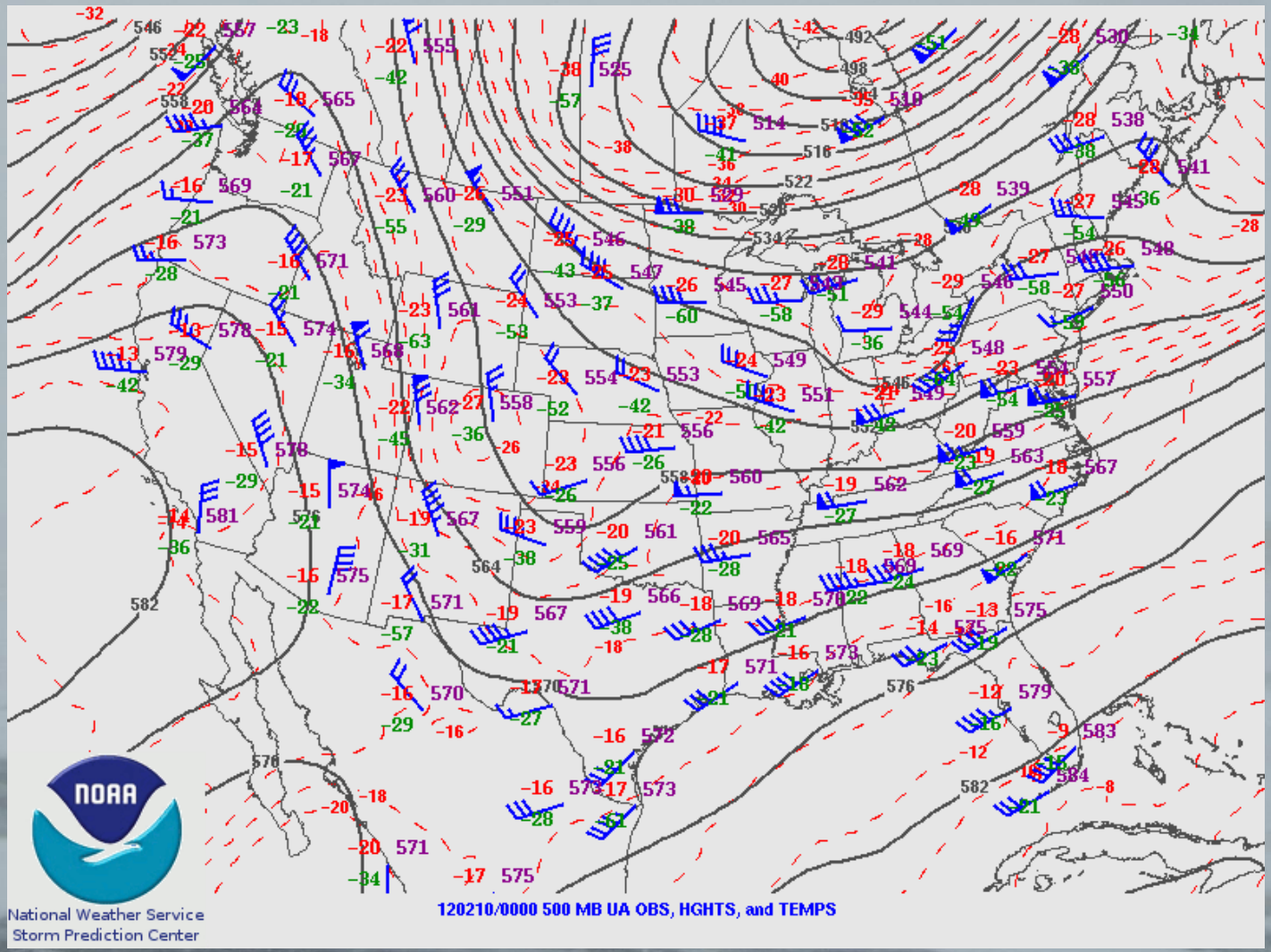
February 10-11, 2012

300 mb



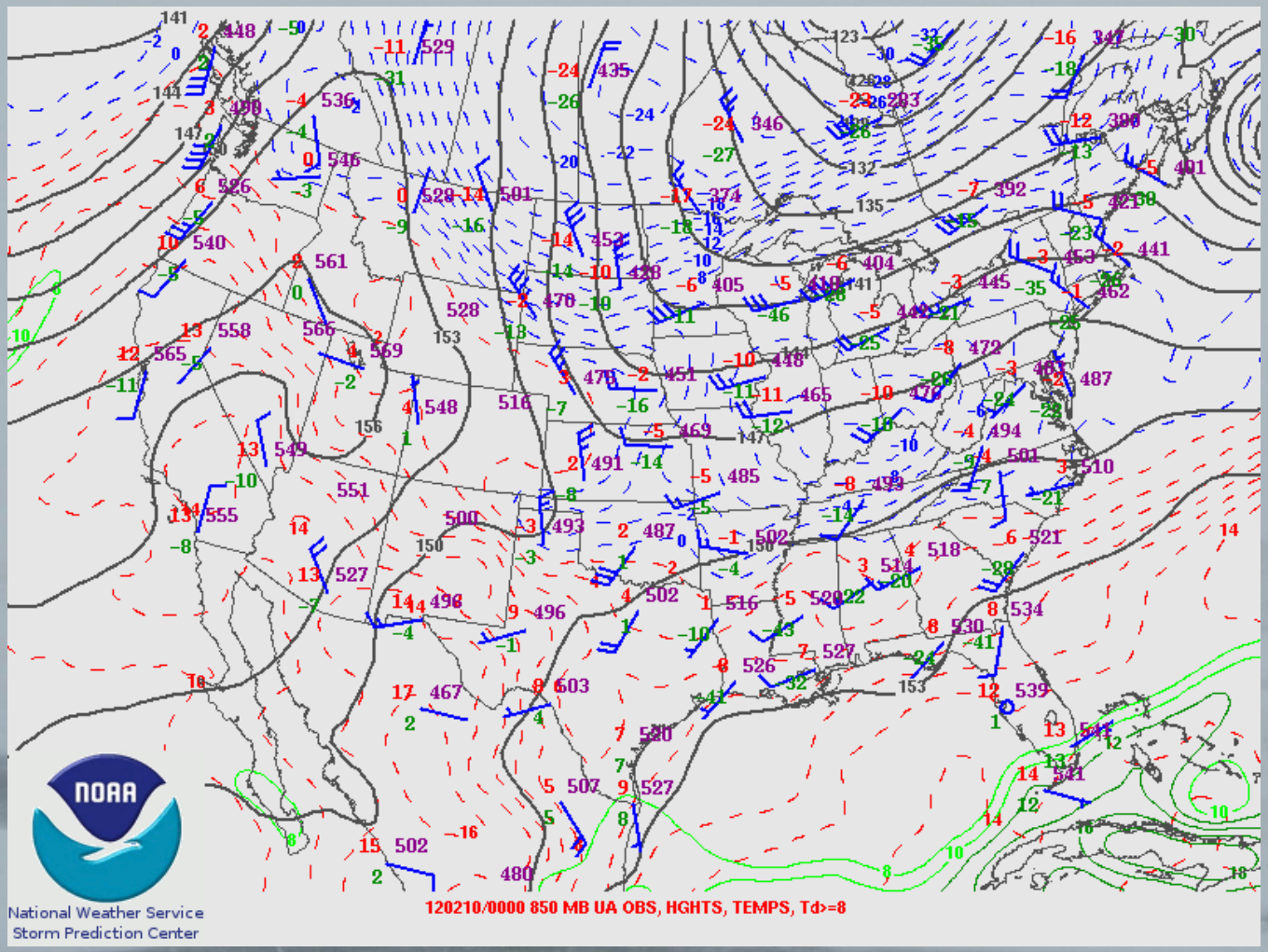
February 10-11, 2012

500 mb



February 10-11, 2012

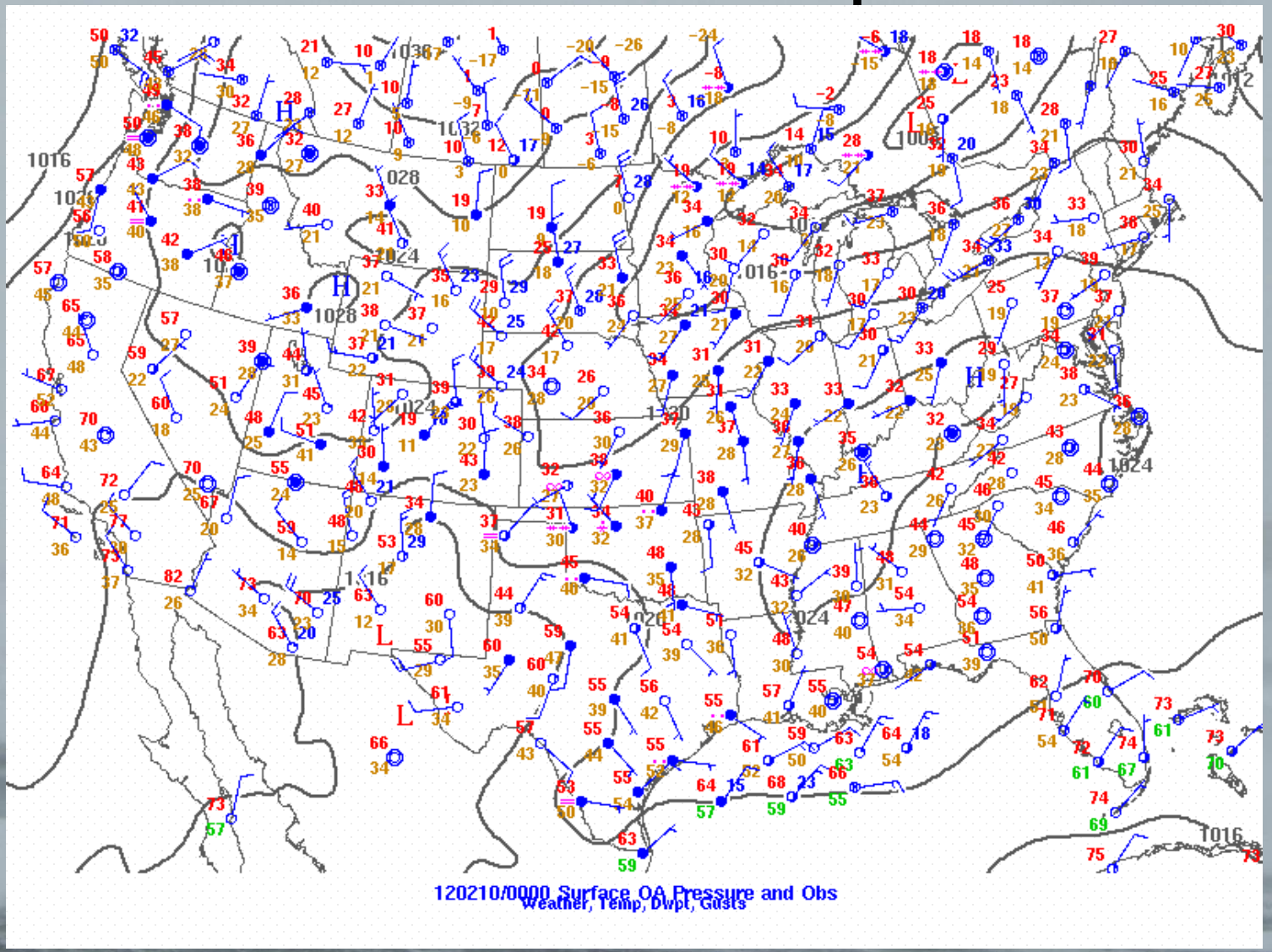
850 mb



Instability = 21-24°C

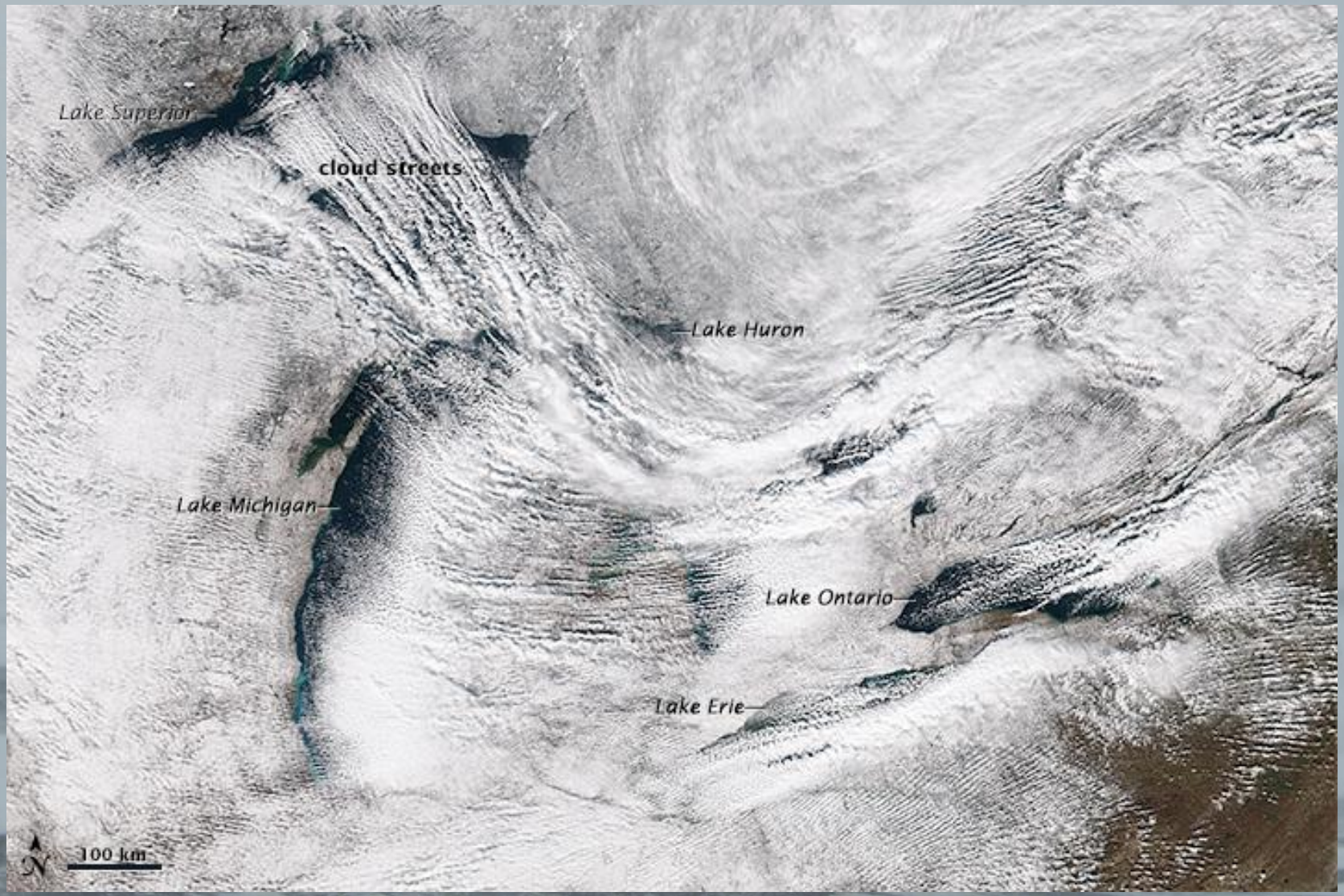
February 10-11, 2012

Surface Map

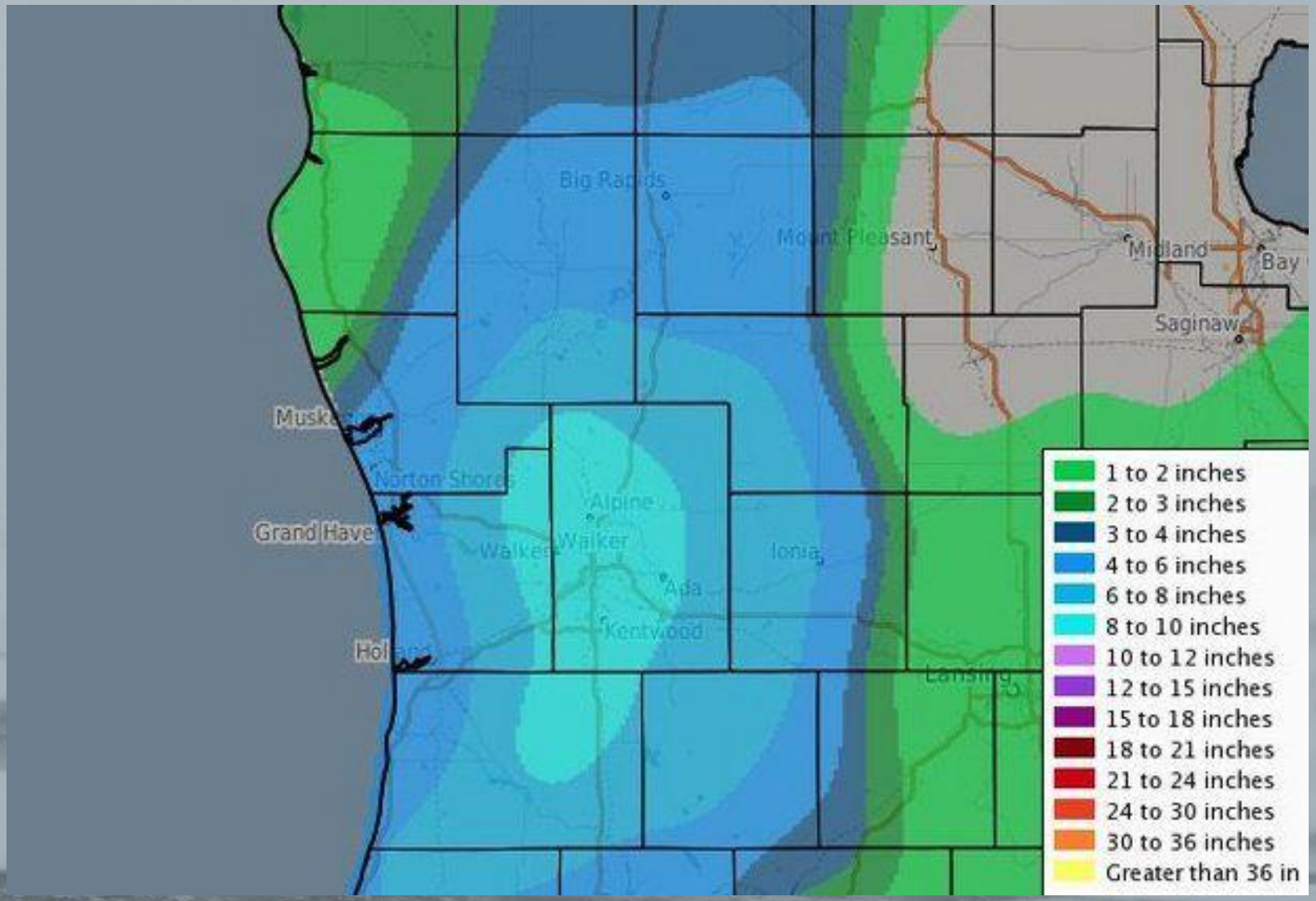


February 10-11, 2012

November 16-18, 2014

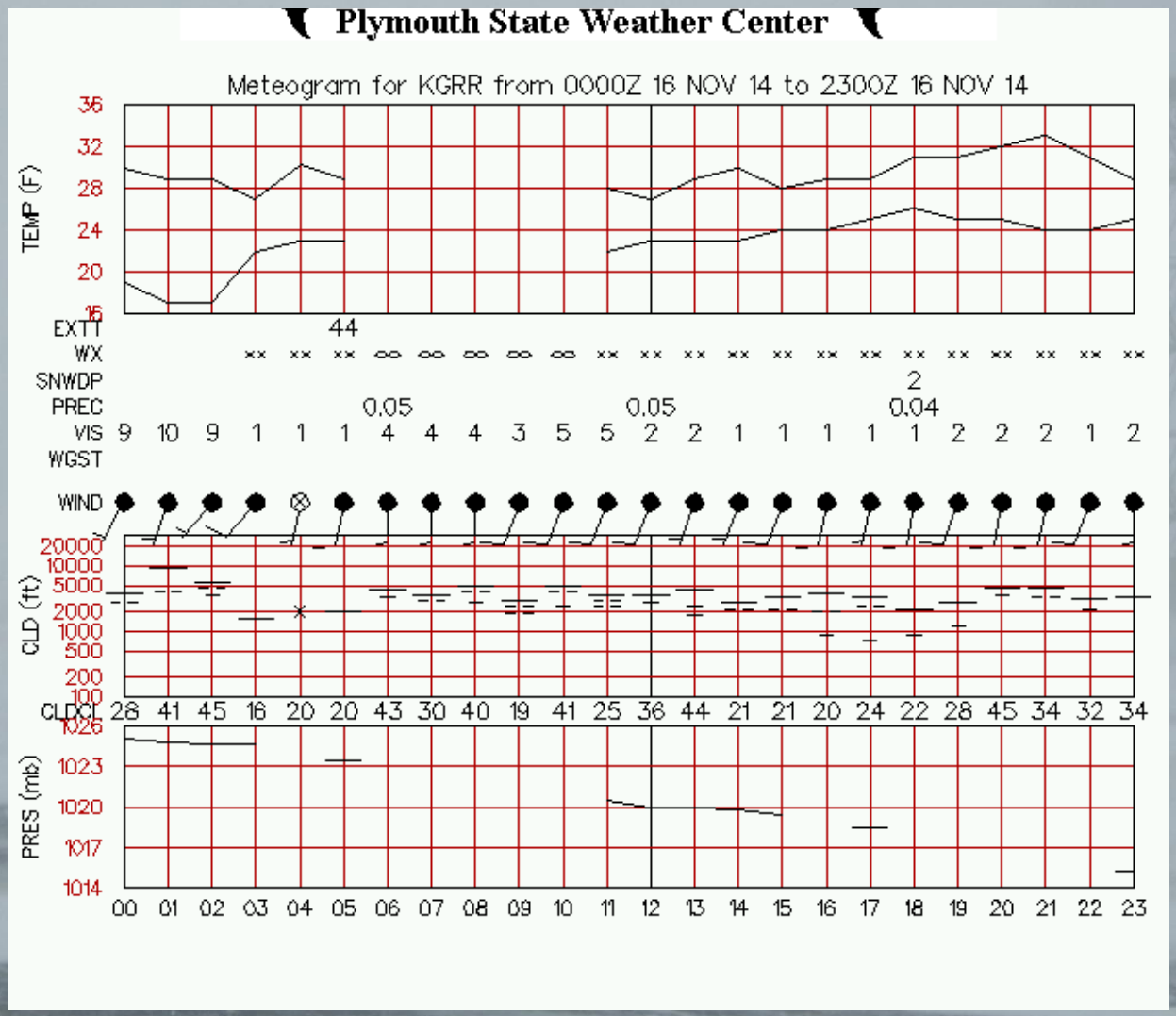


Snowfall Totals



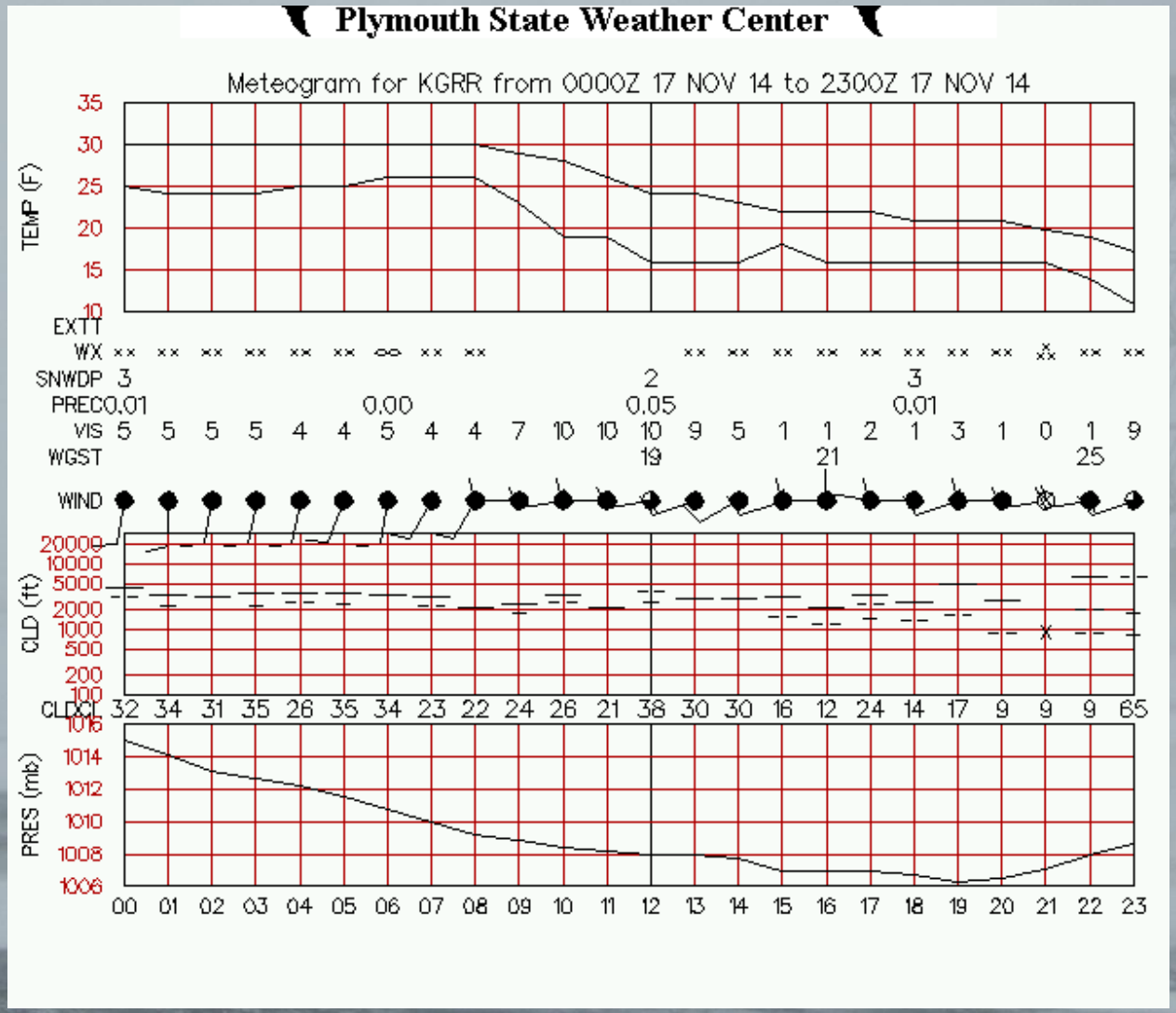
November 16-18, 2014

Meteogram - Grand Rapids, MI



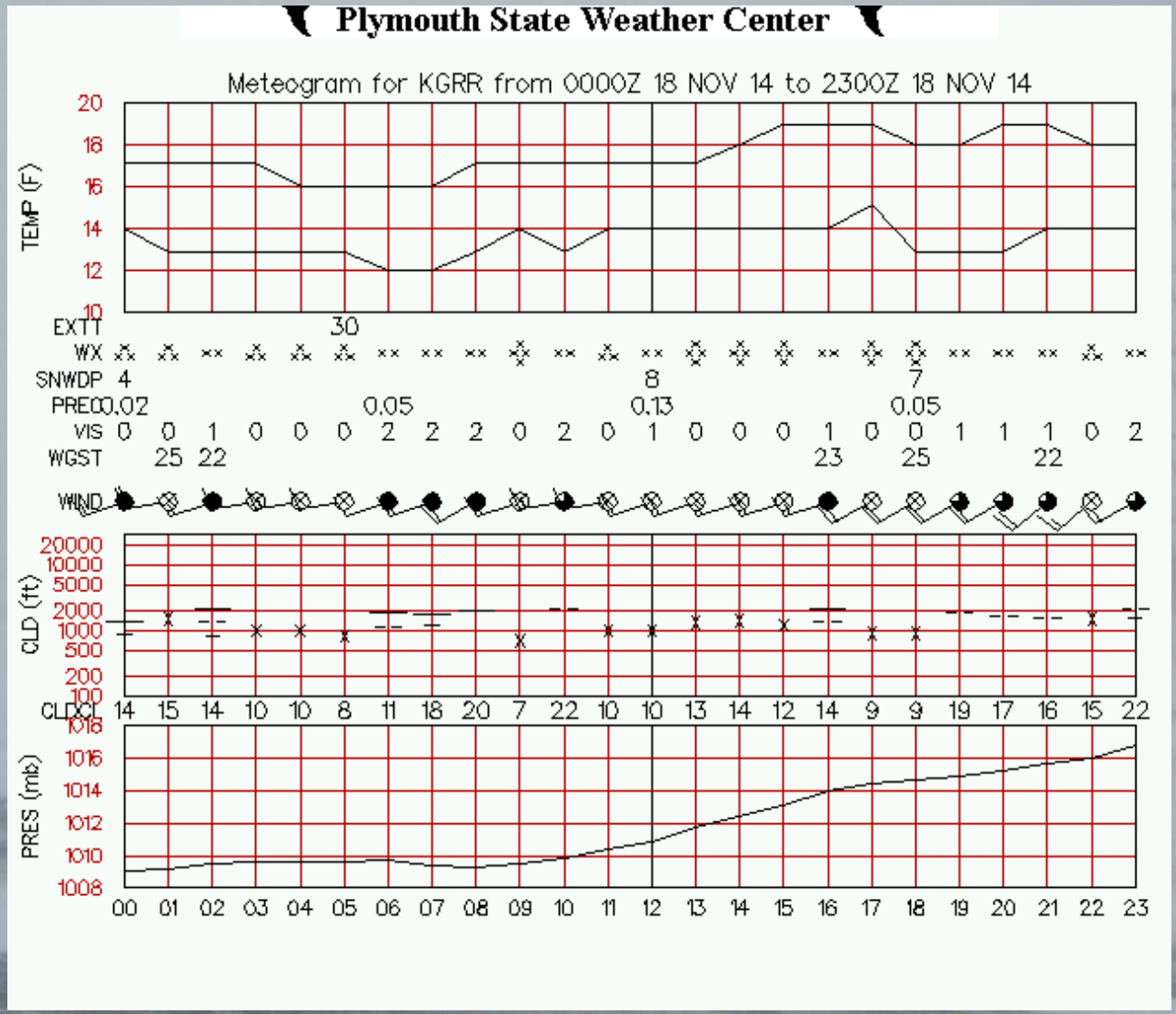
November 16-18, 2014

Meteogram - Grand Rapids, MI



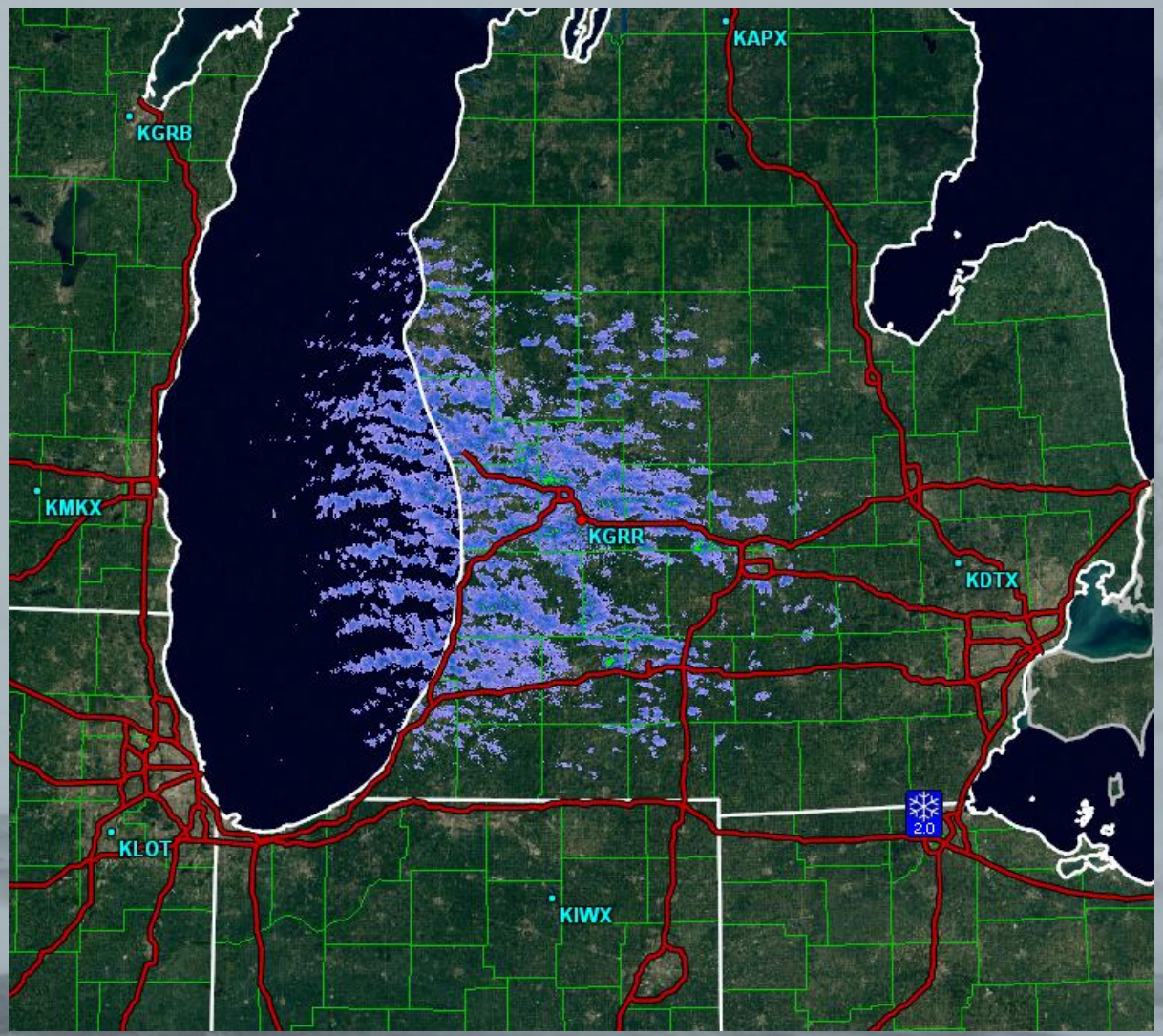
November 16-18, 2014

Meteogram - Grand Rapids, MI



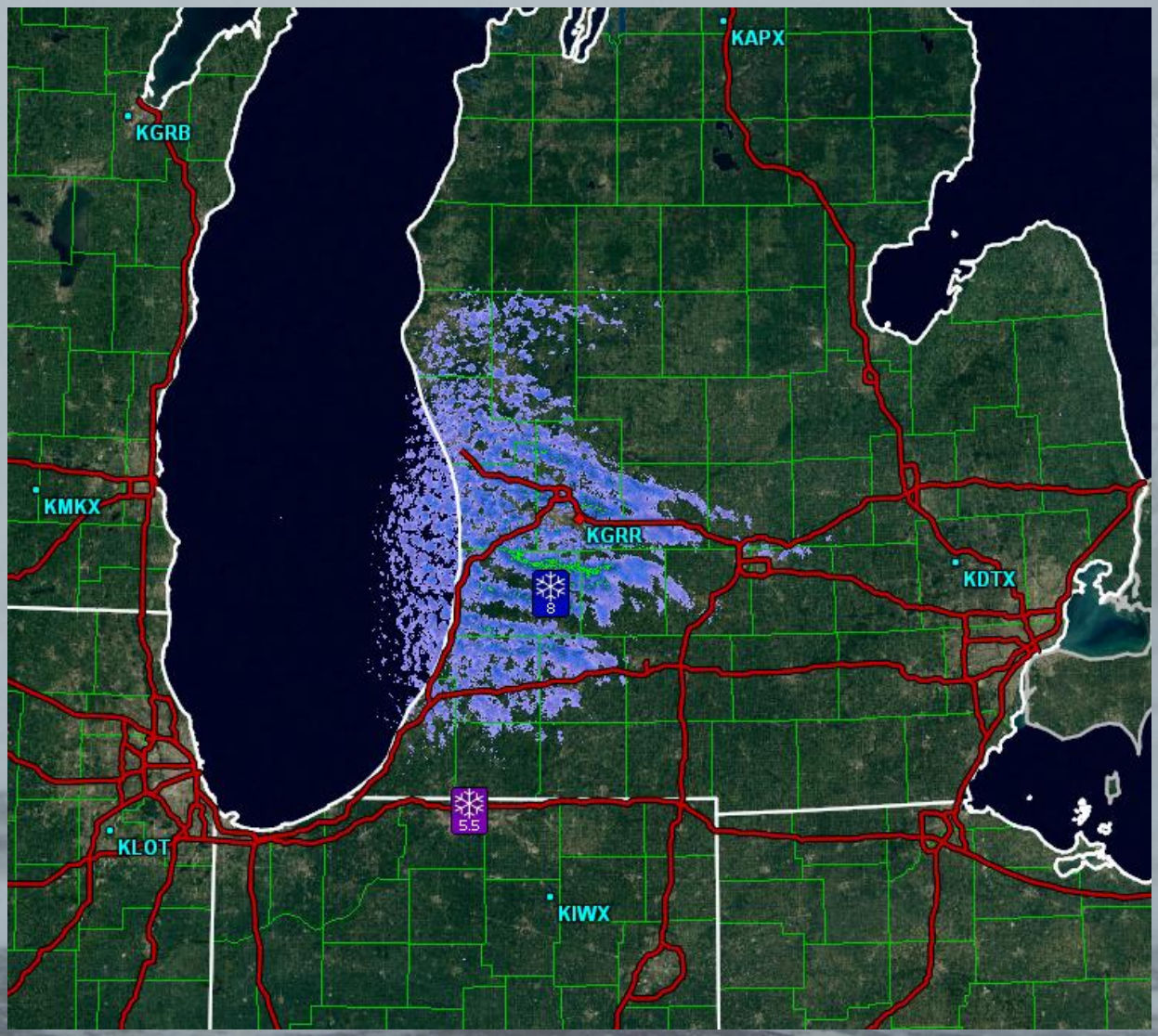
November 16-18, 2014

KGRR Reflectivity - Nov. 17 2003Z



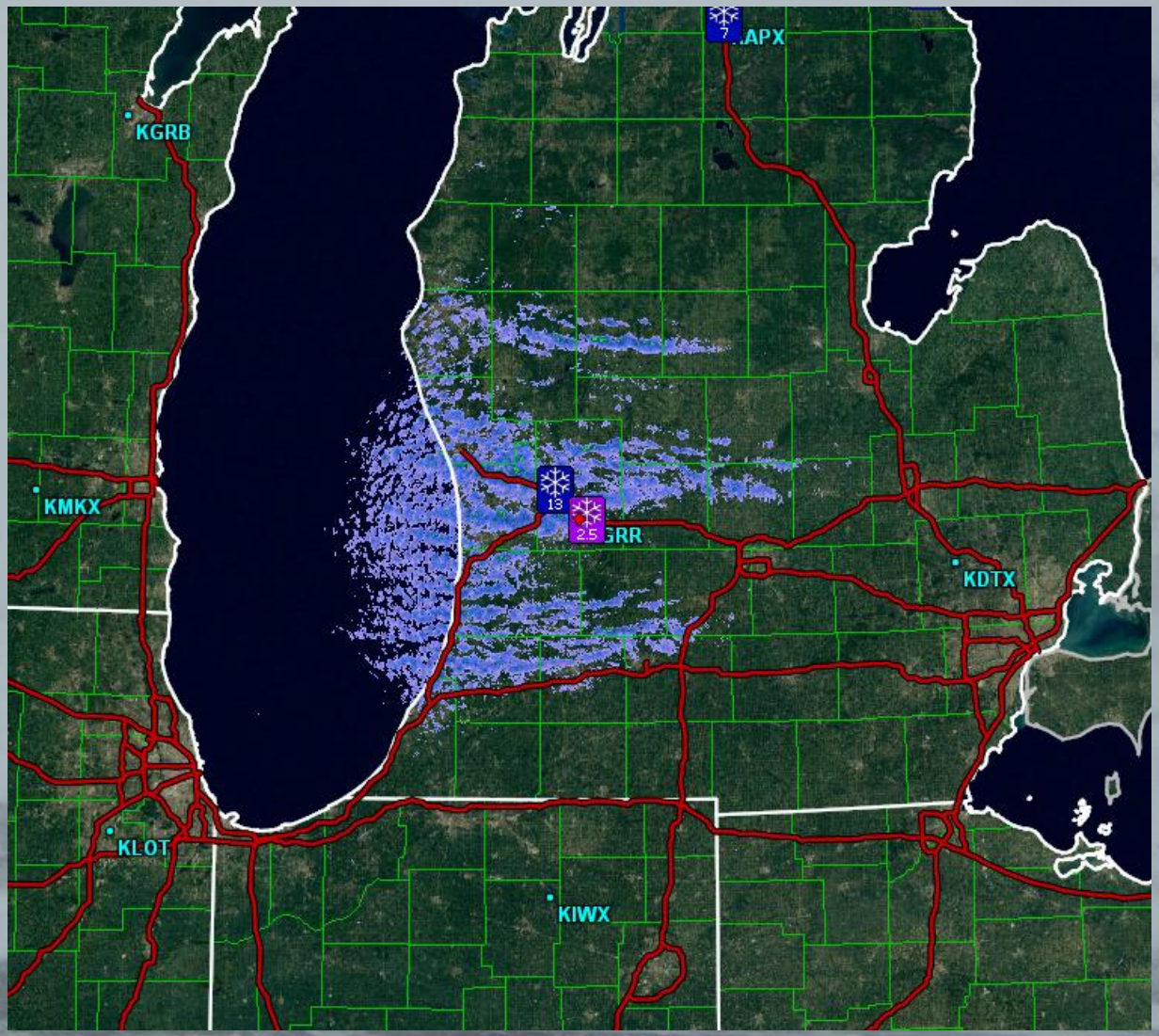
November 16-18, 2014

KGRR Reflectivity - Nov. 18 0919Z



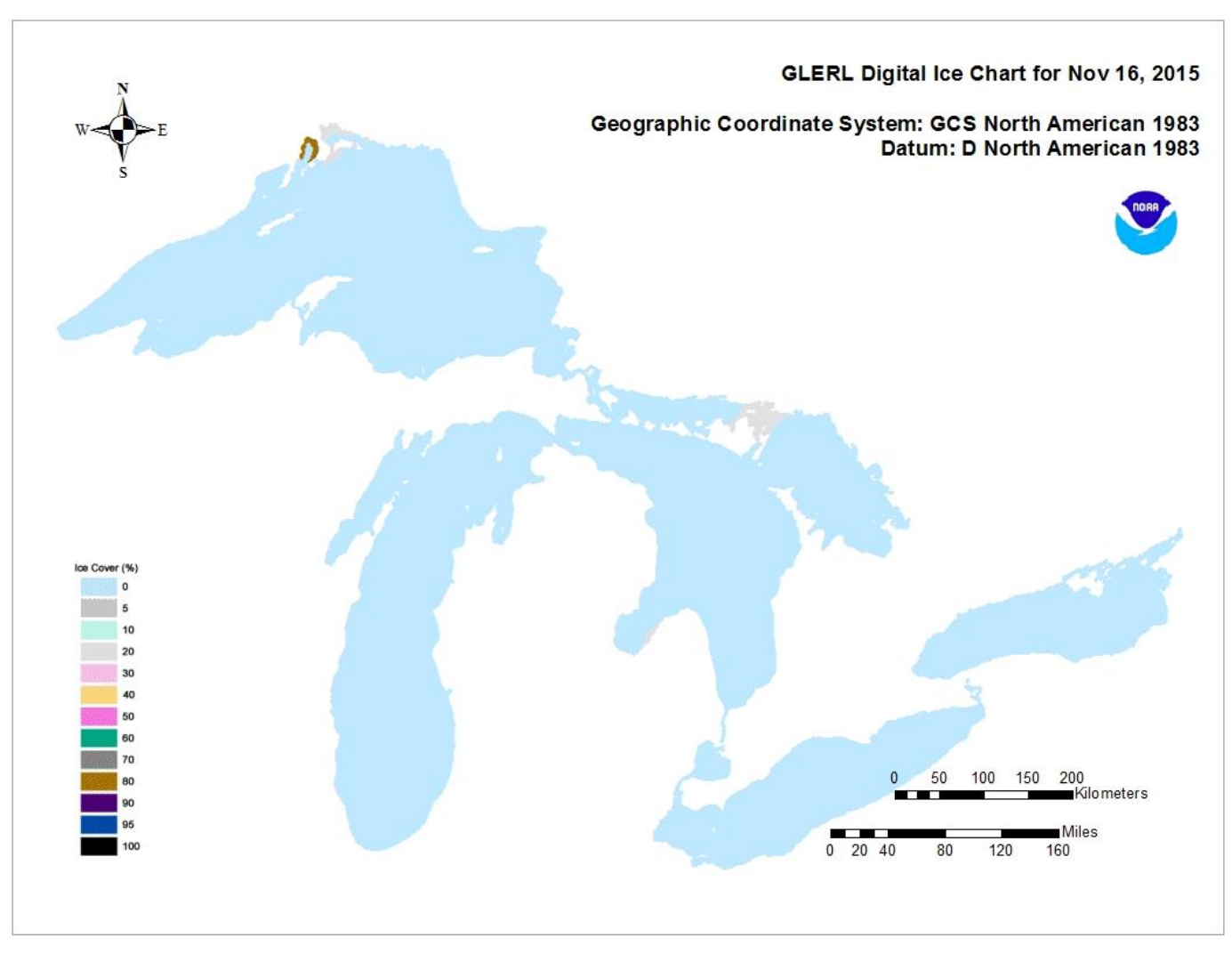
November 16-18, 2014

KGRR Reflectivity – Nov. 18 1821Z



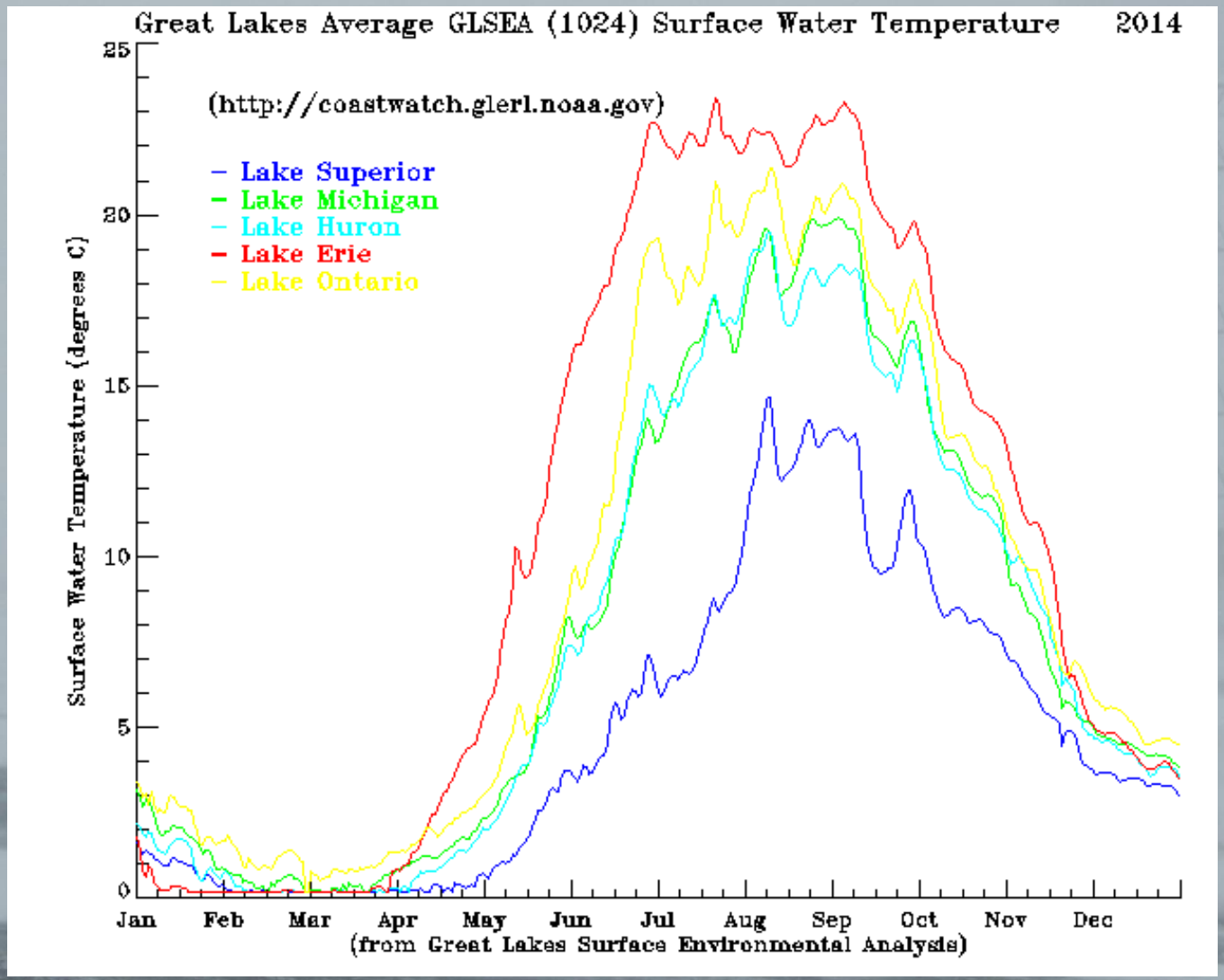
November 16-18, 2014

Lake Ice Coverage



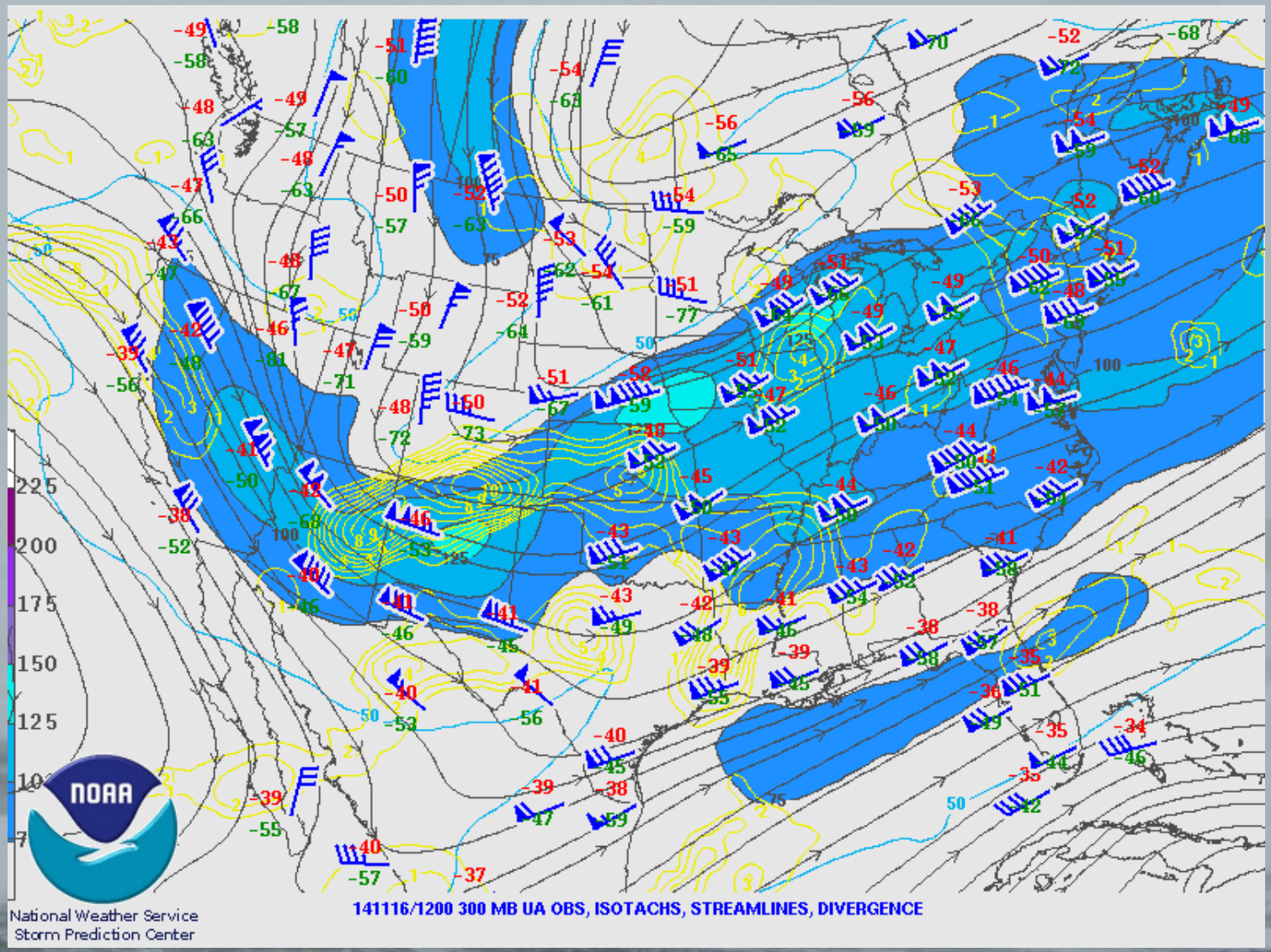
November 16-18, 2014

Surface Water Temps



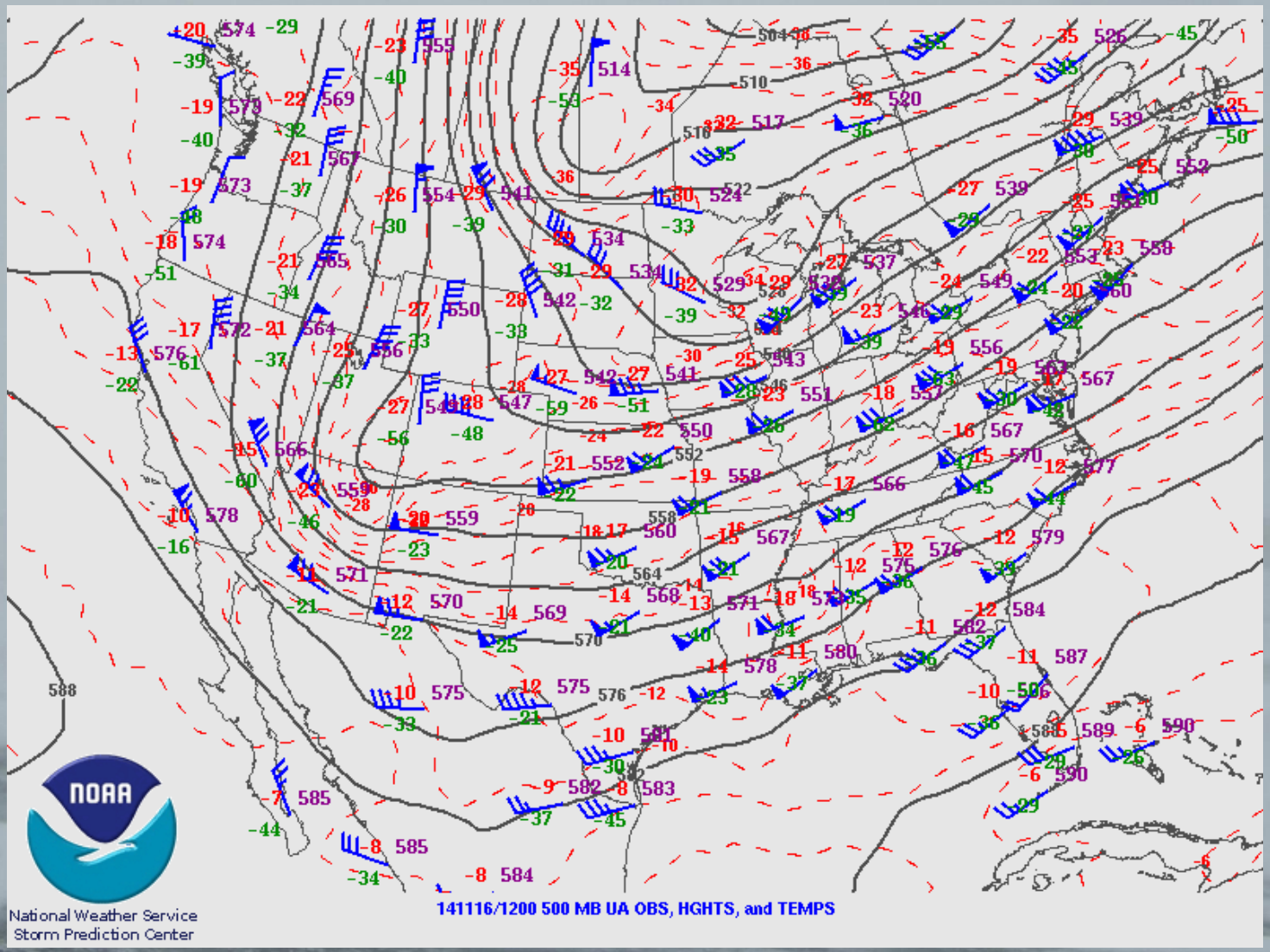
November 16-18, 2014

300 mb



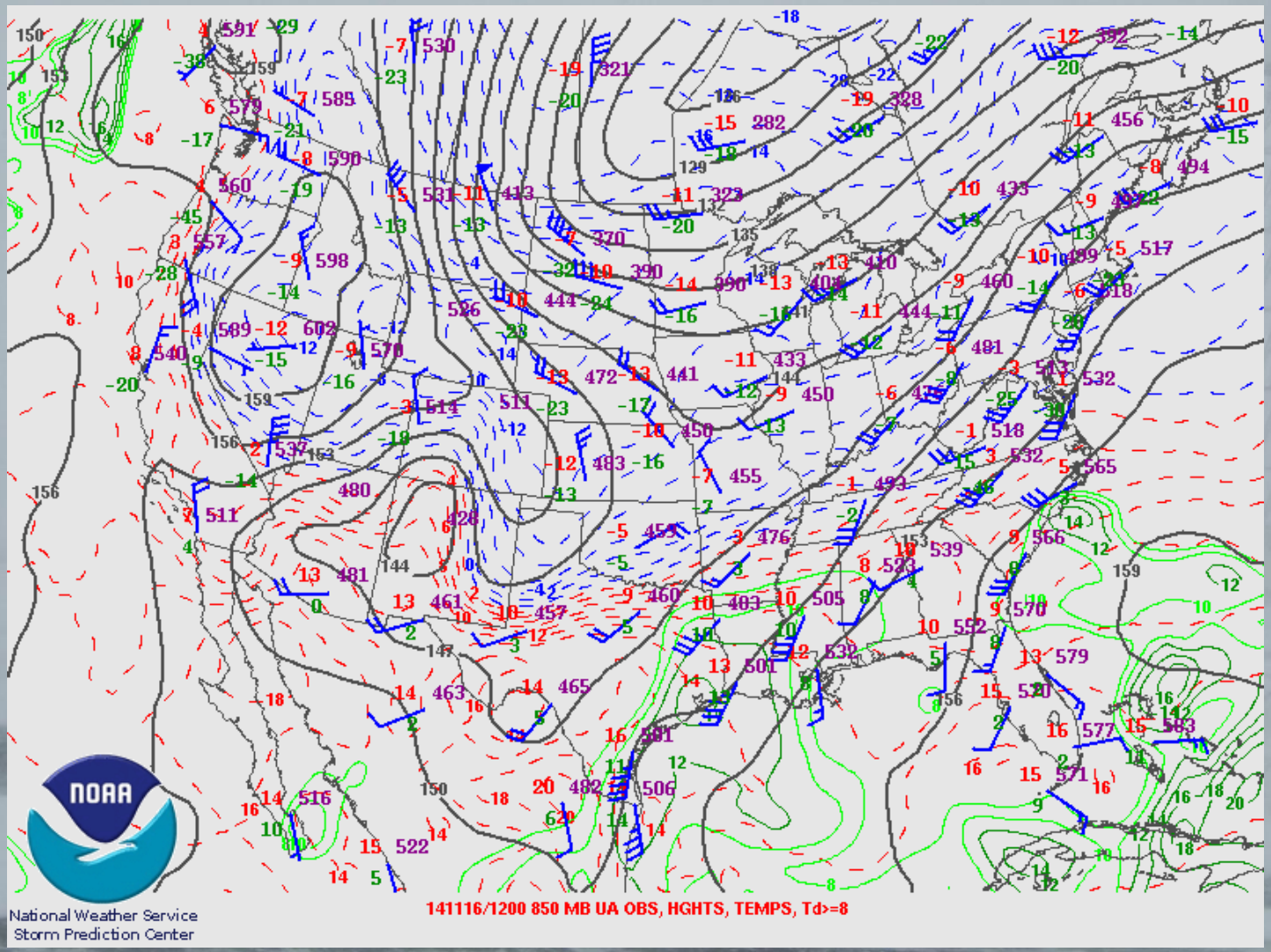
November 16-18, 2014

500 mb



November 16-18, 2014

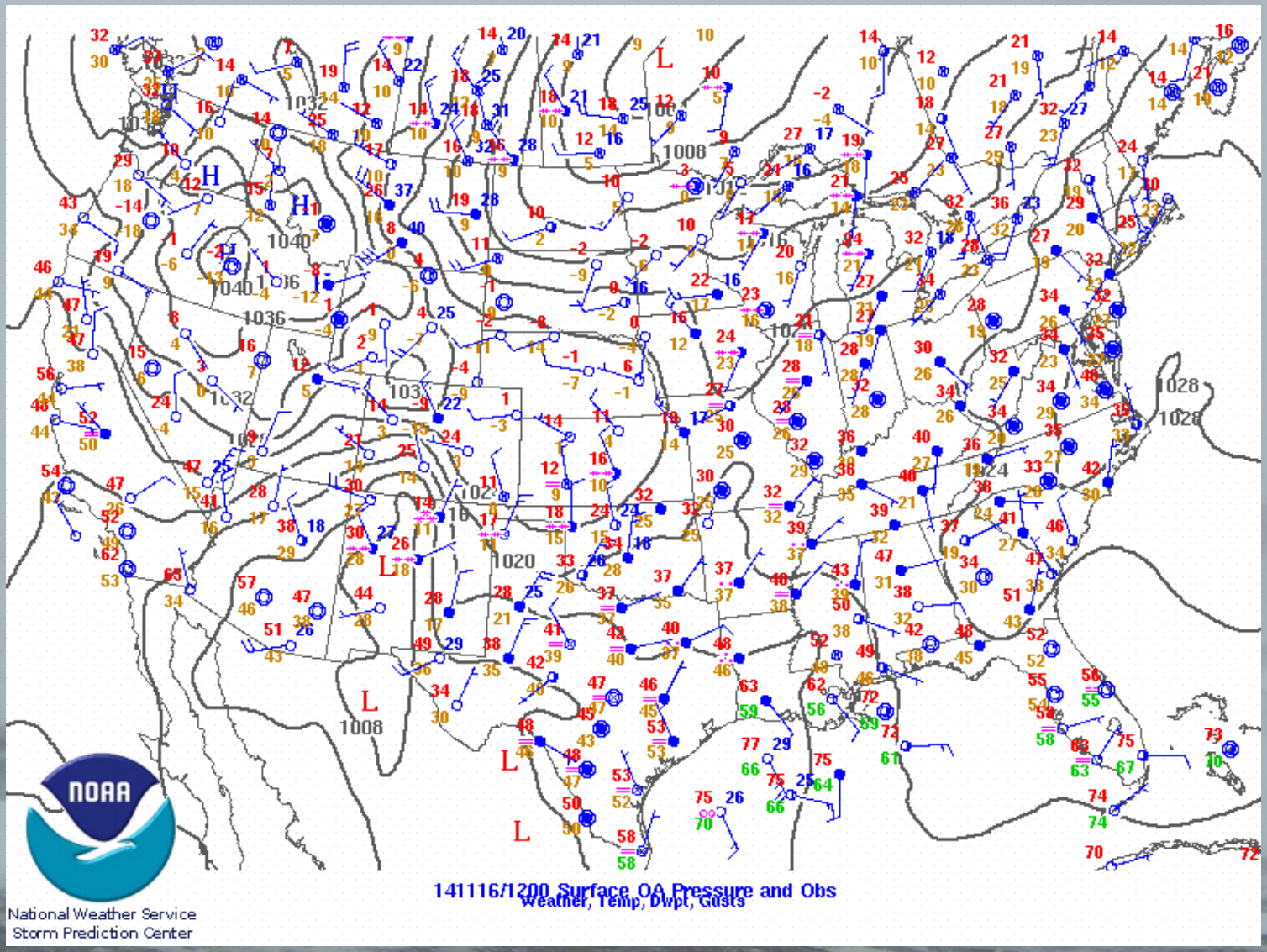
850 mb



Instability
= 22-27°C

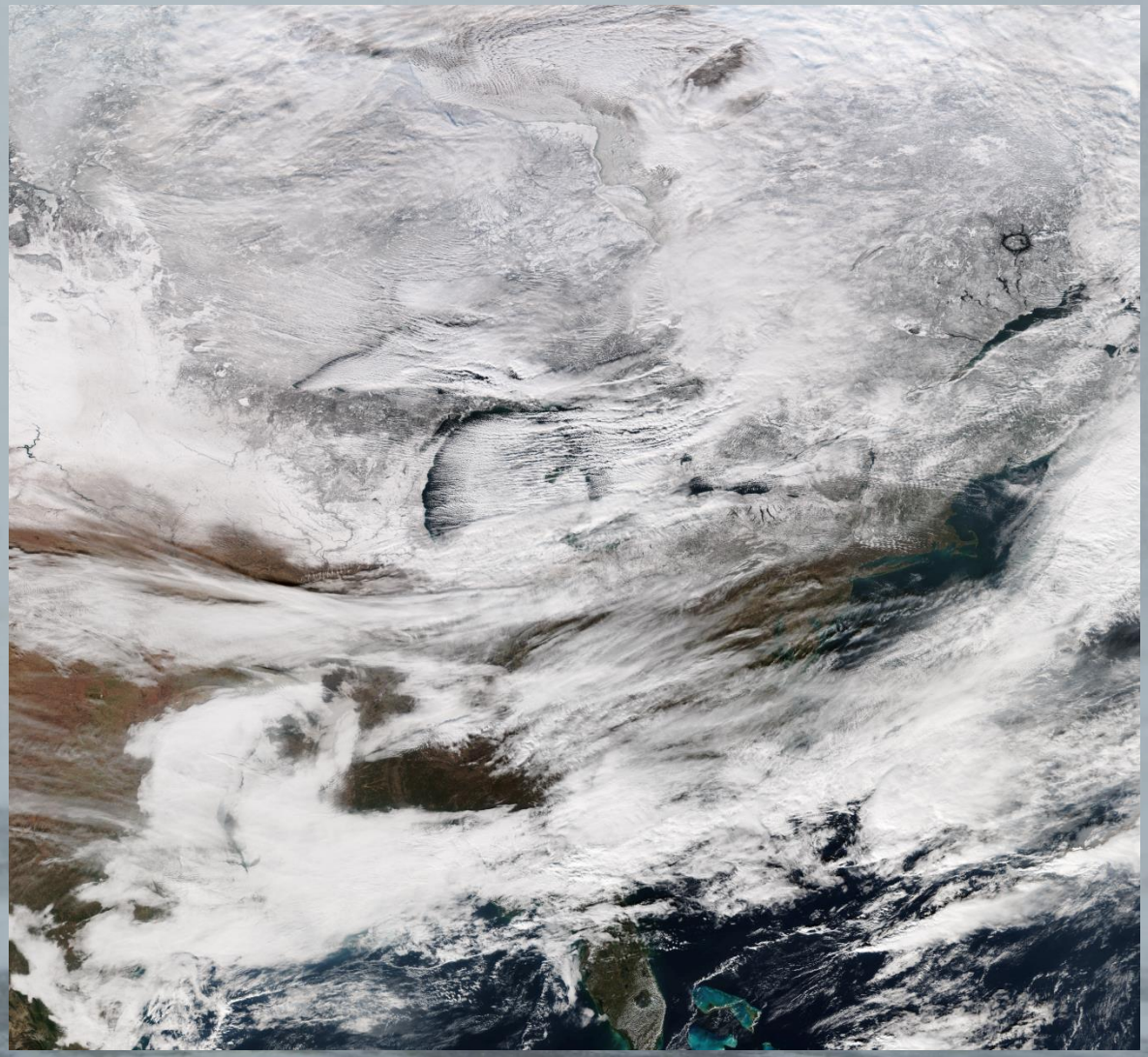
November 16-18, 2014

Surface Map

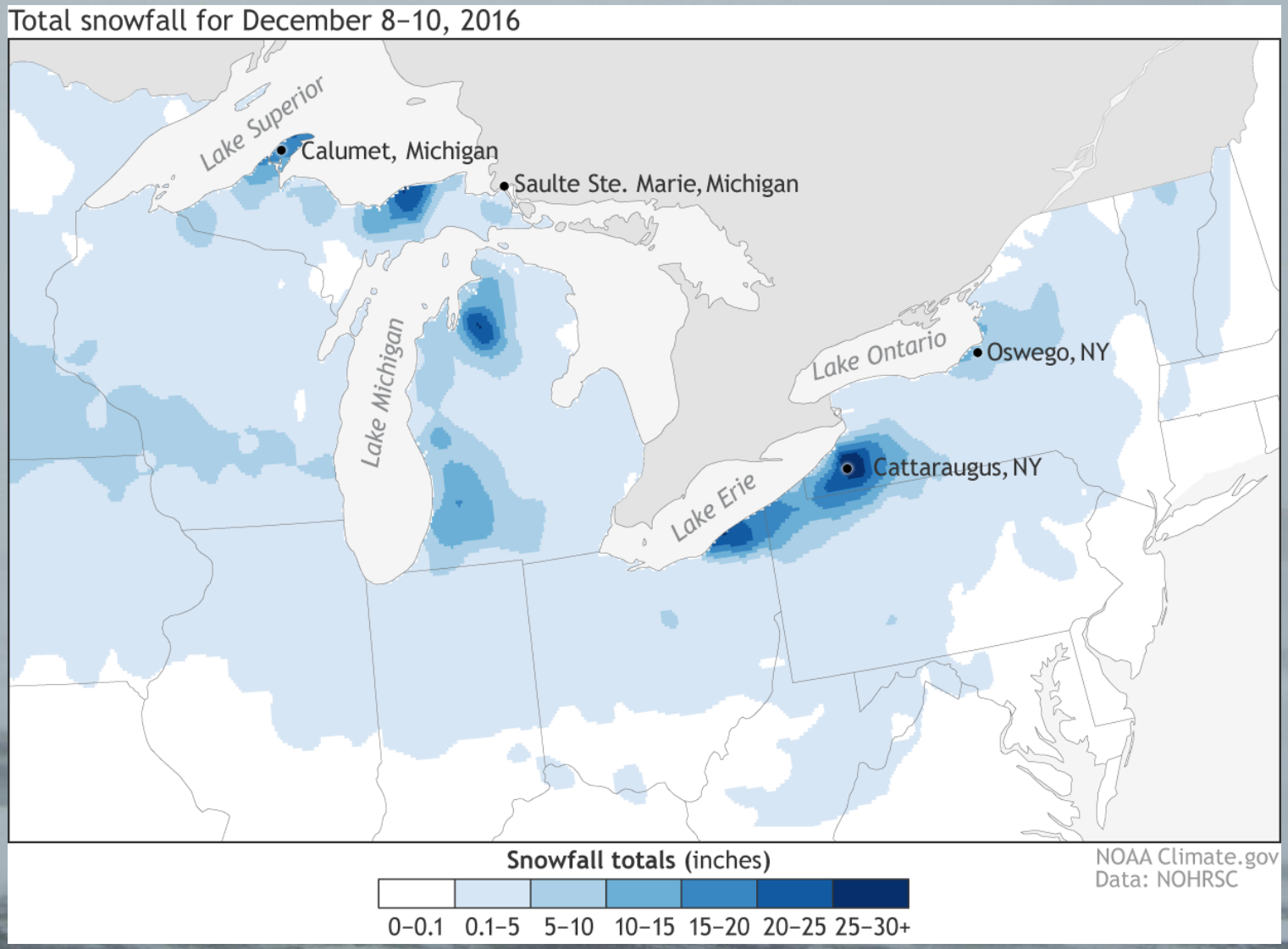


November 16-18, 2014

December 8-11, 2016

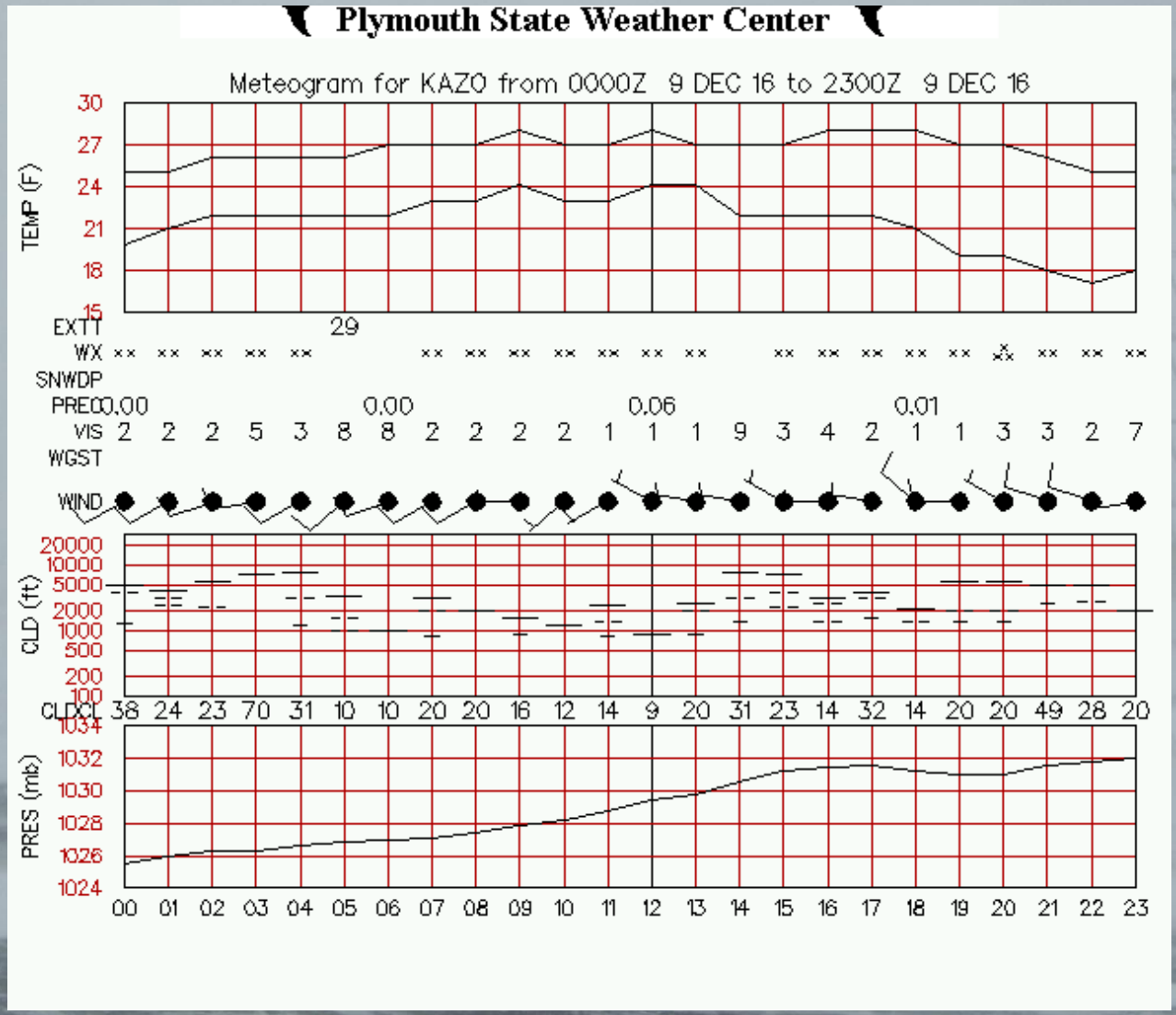


Snowfall Totals



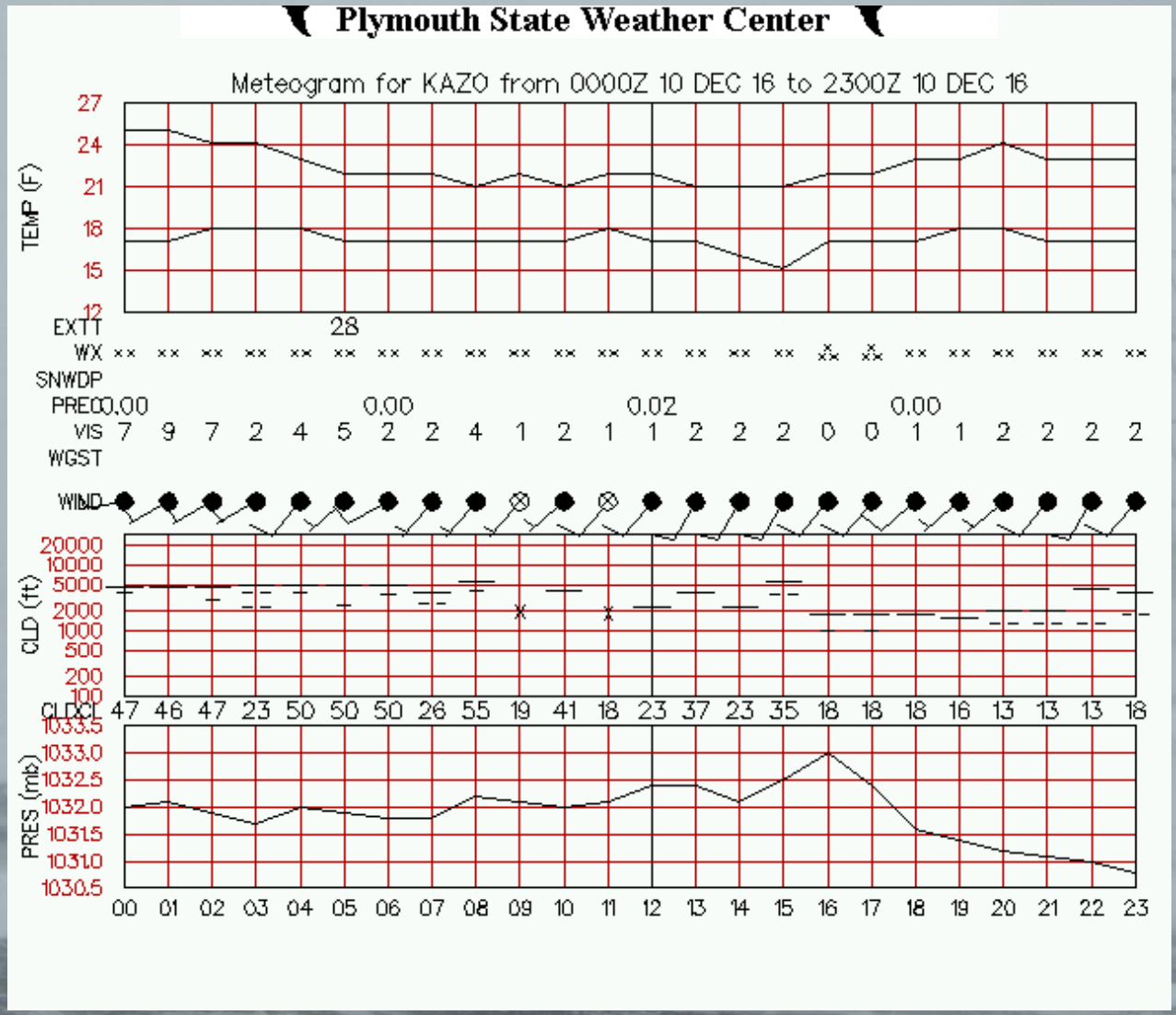
December 8-11, 2016

Meteogram - Kalamazoo, MI



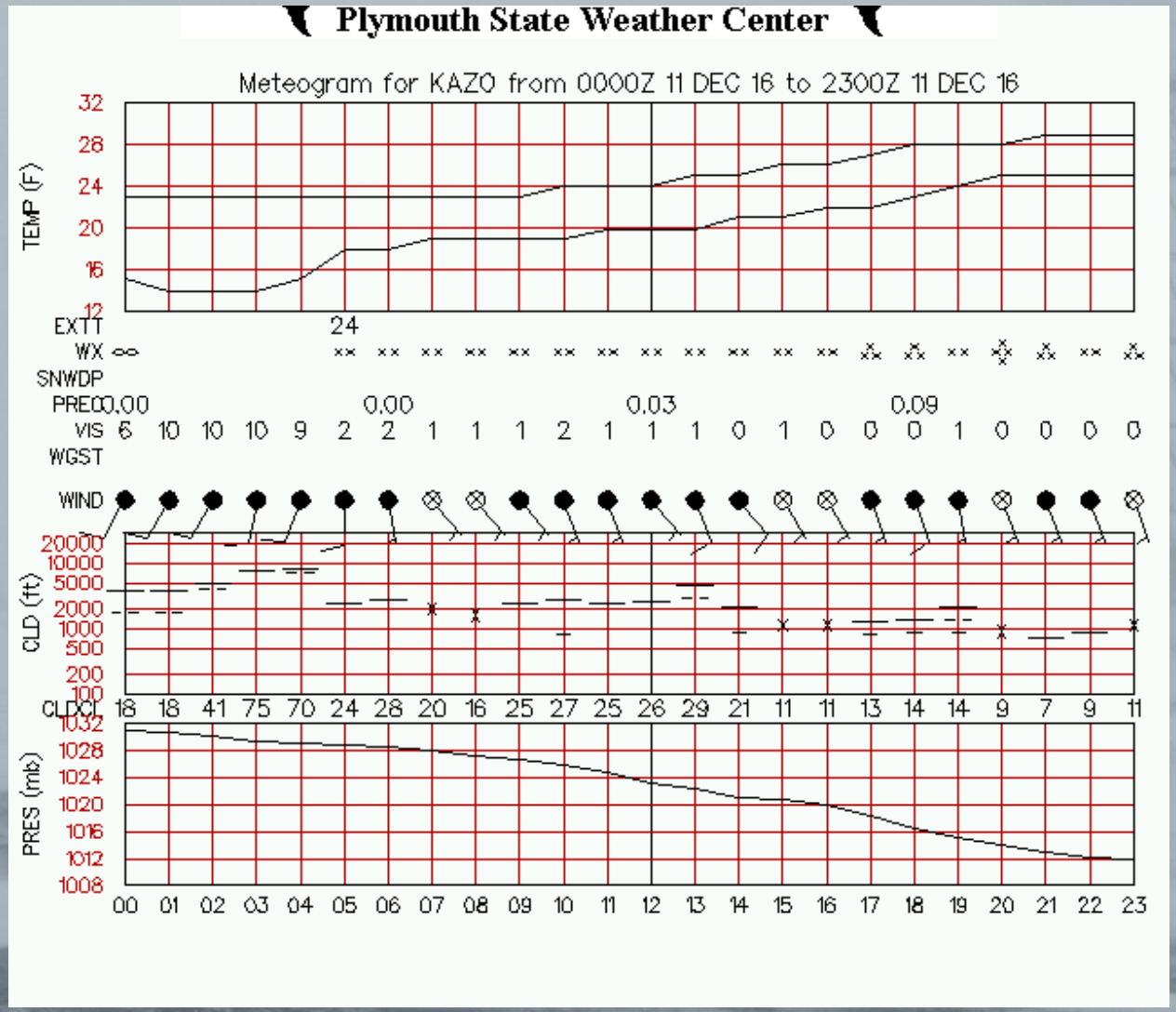
December 8-11, 2016

Meteogram - Kalamazoo, MI



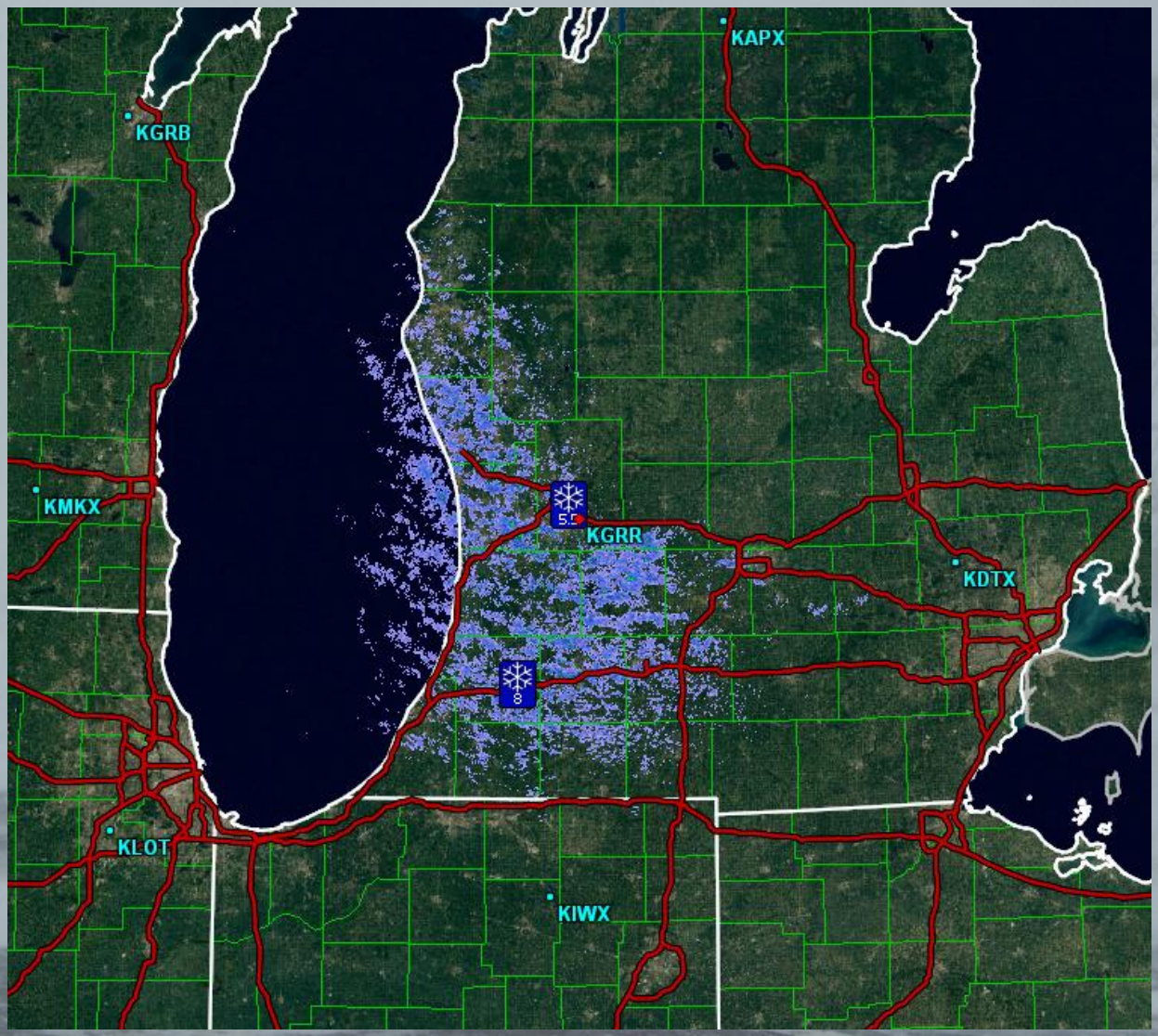
December 8-11, 2016

Meteogram - Kalamazoo, MI

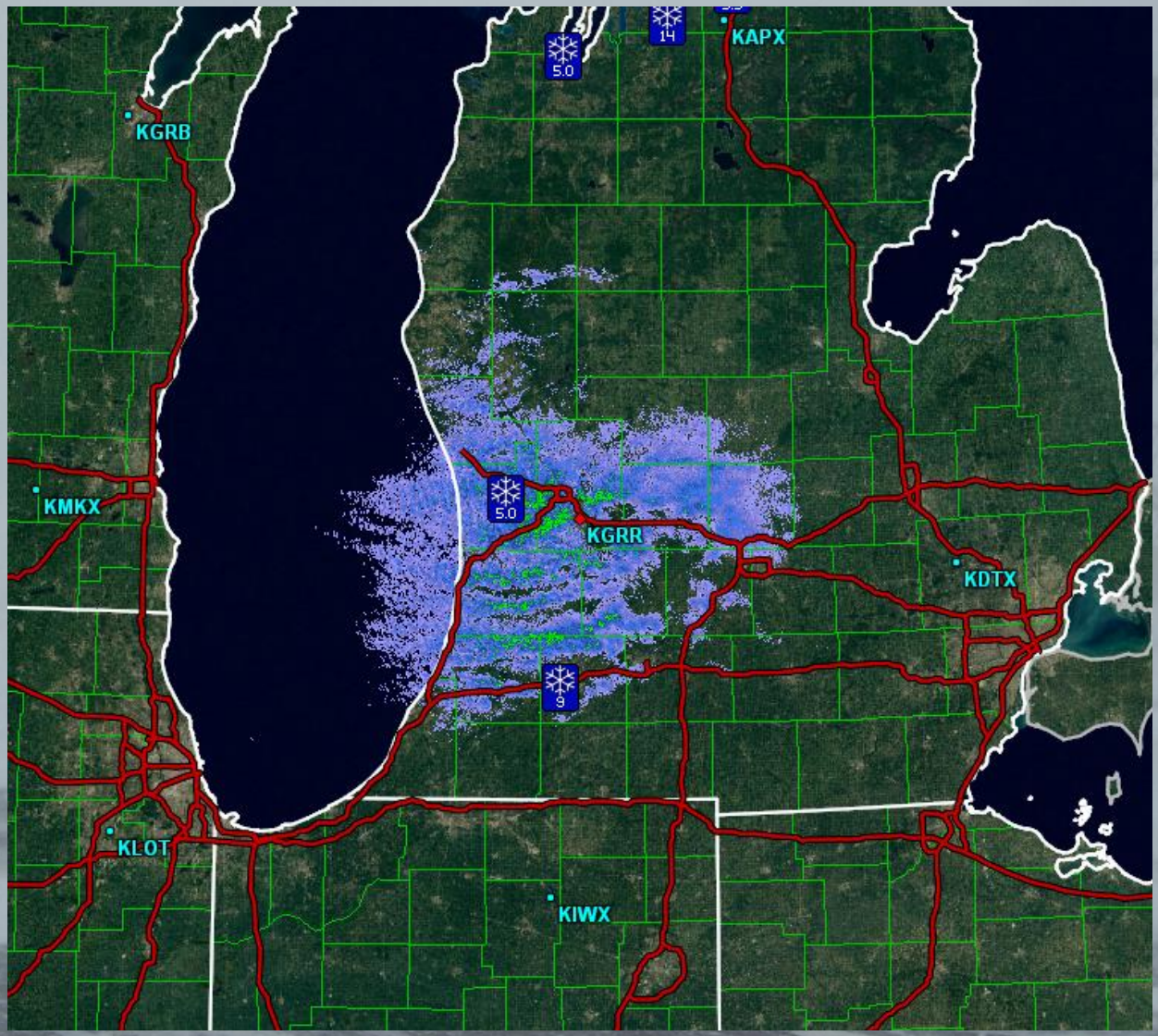


December 8-11, 2016

KGRR Reflectivity – Dec. 10 0058Z

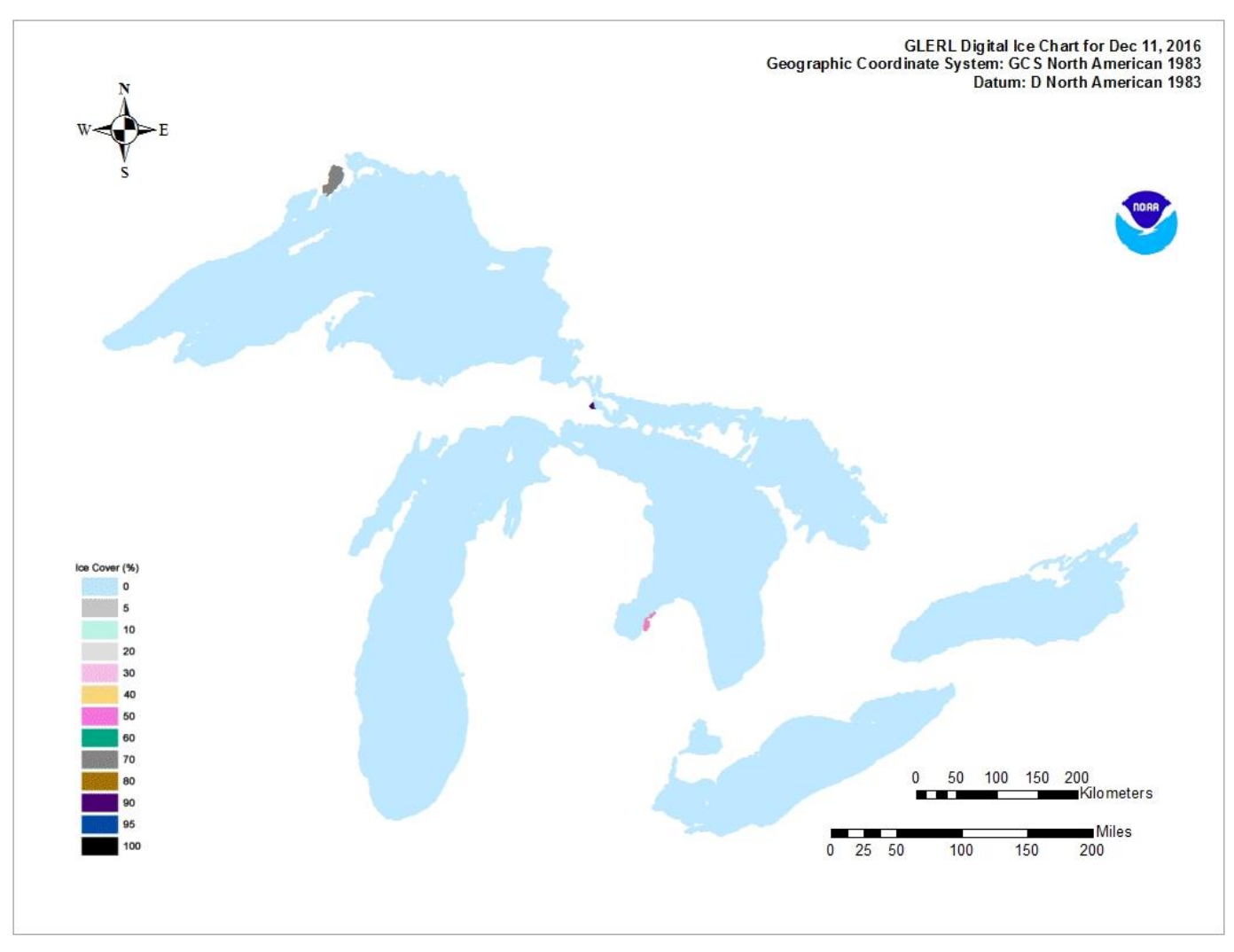


KGRR Reflectivity – Dec. 10 1328Z



December 8-11, 2016

Lake Ice Coverage



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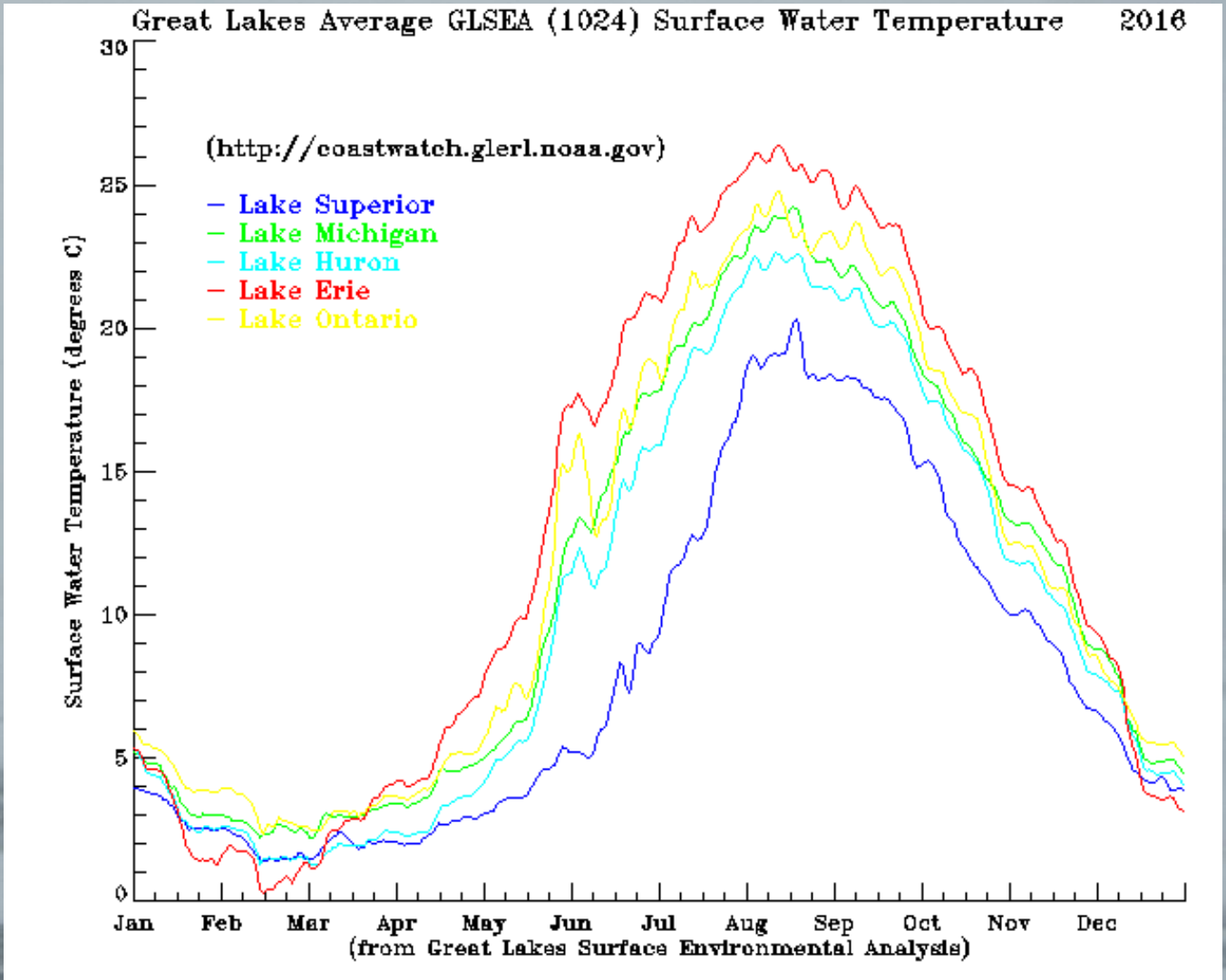
Surface Water Temps



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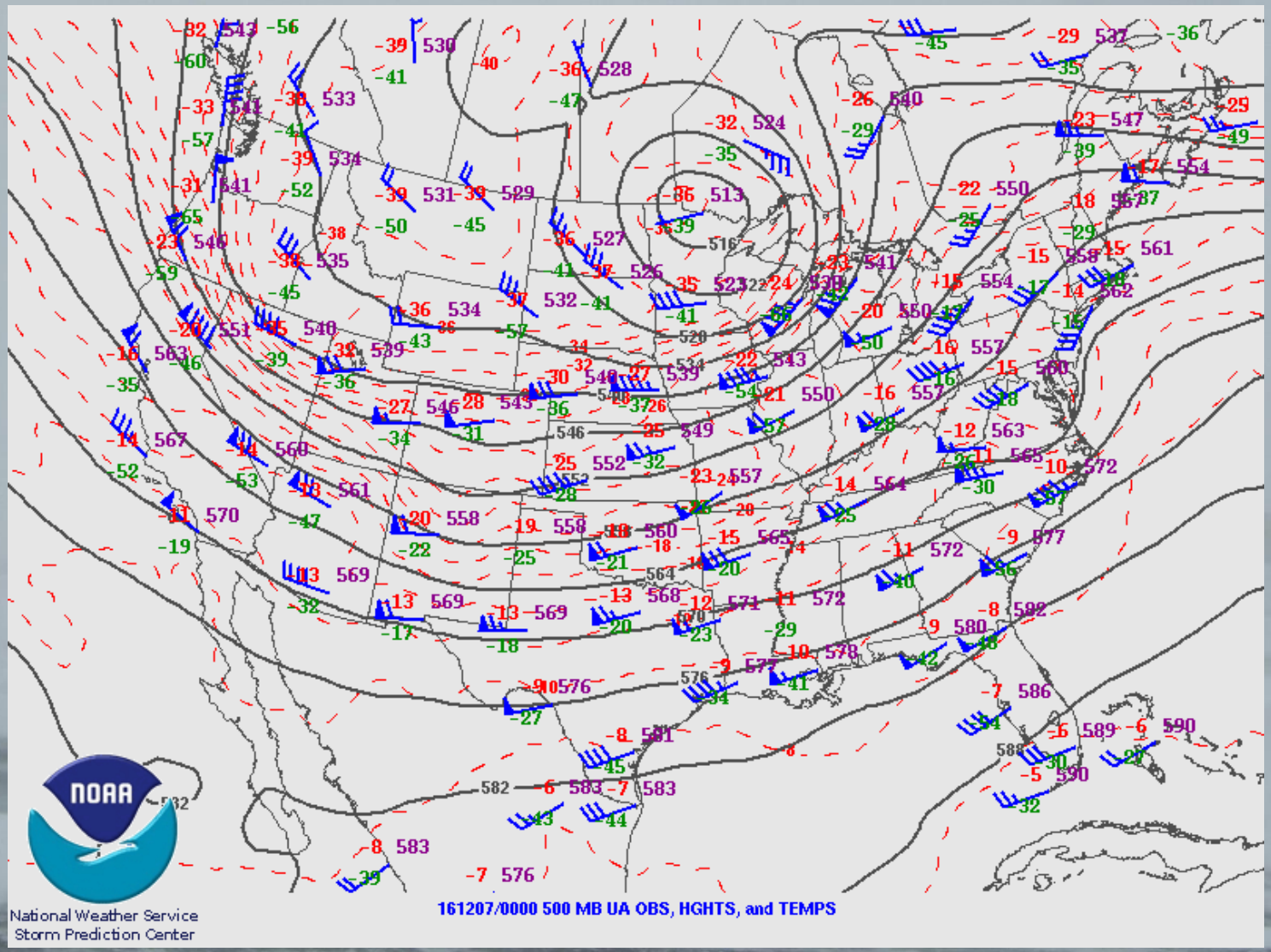
500 mb



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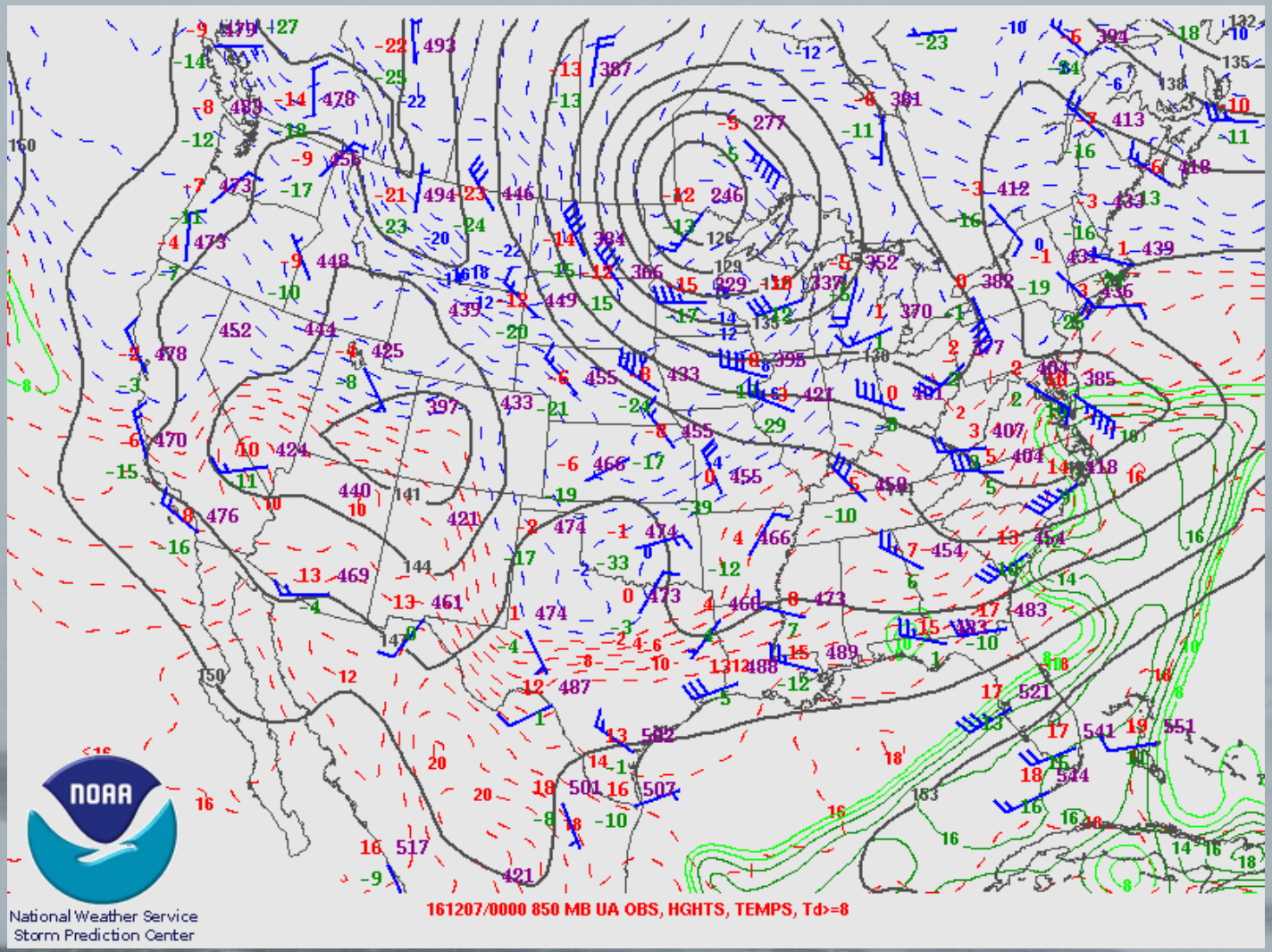
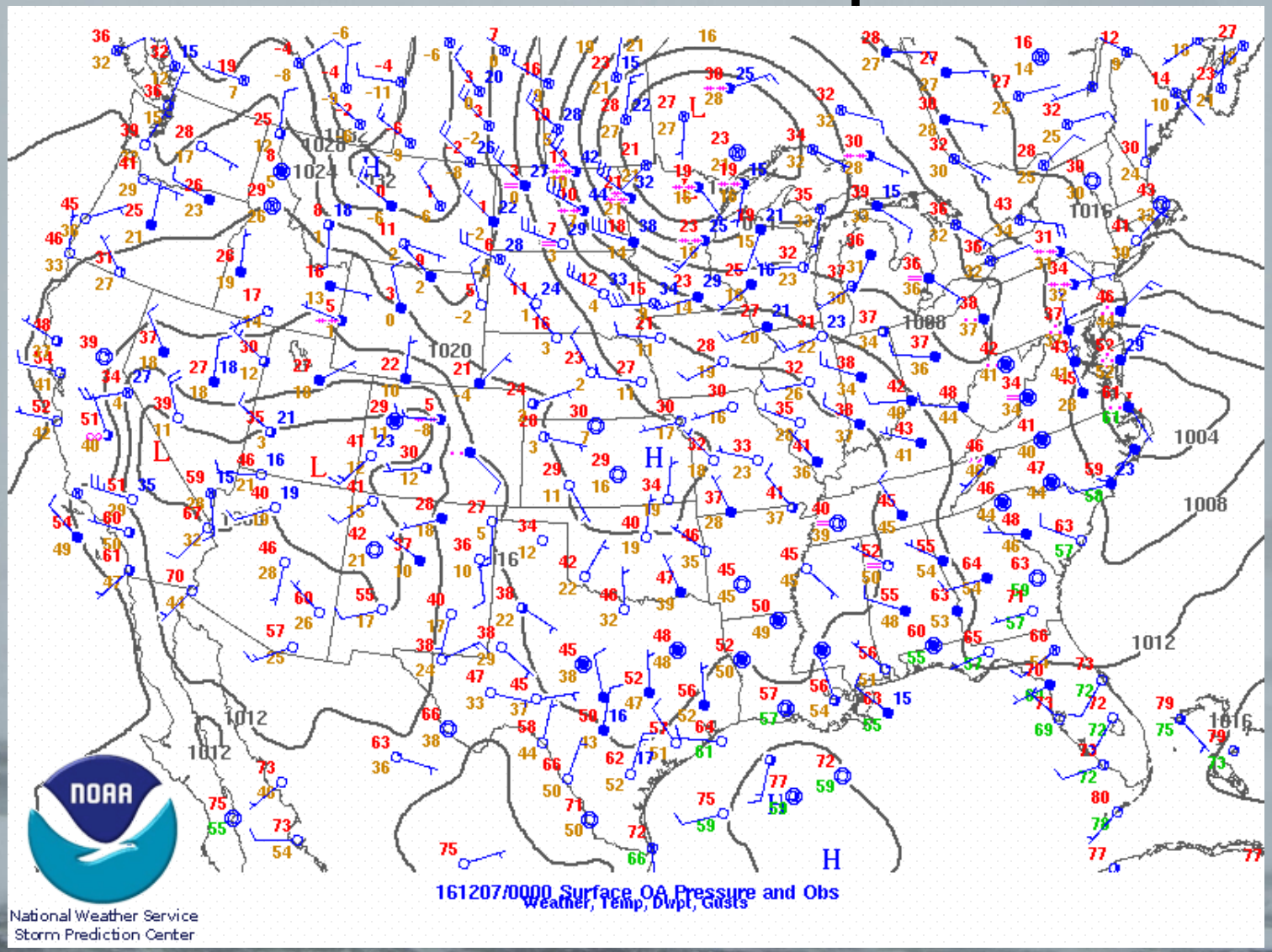
850 mb



Instability
= 21-23°C

December 8-11, 2016

Surface Map



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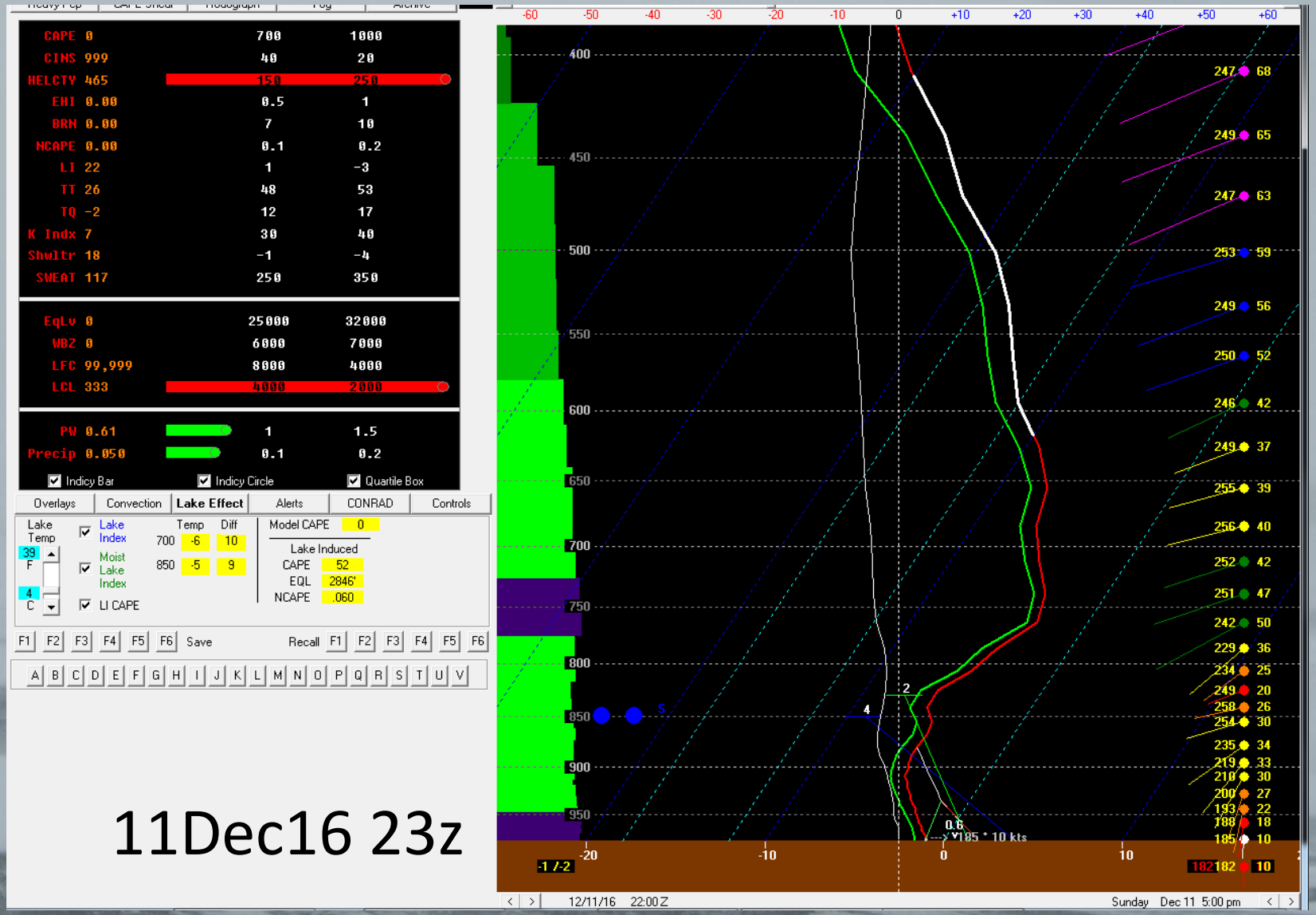
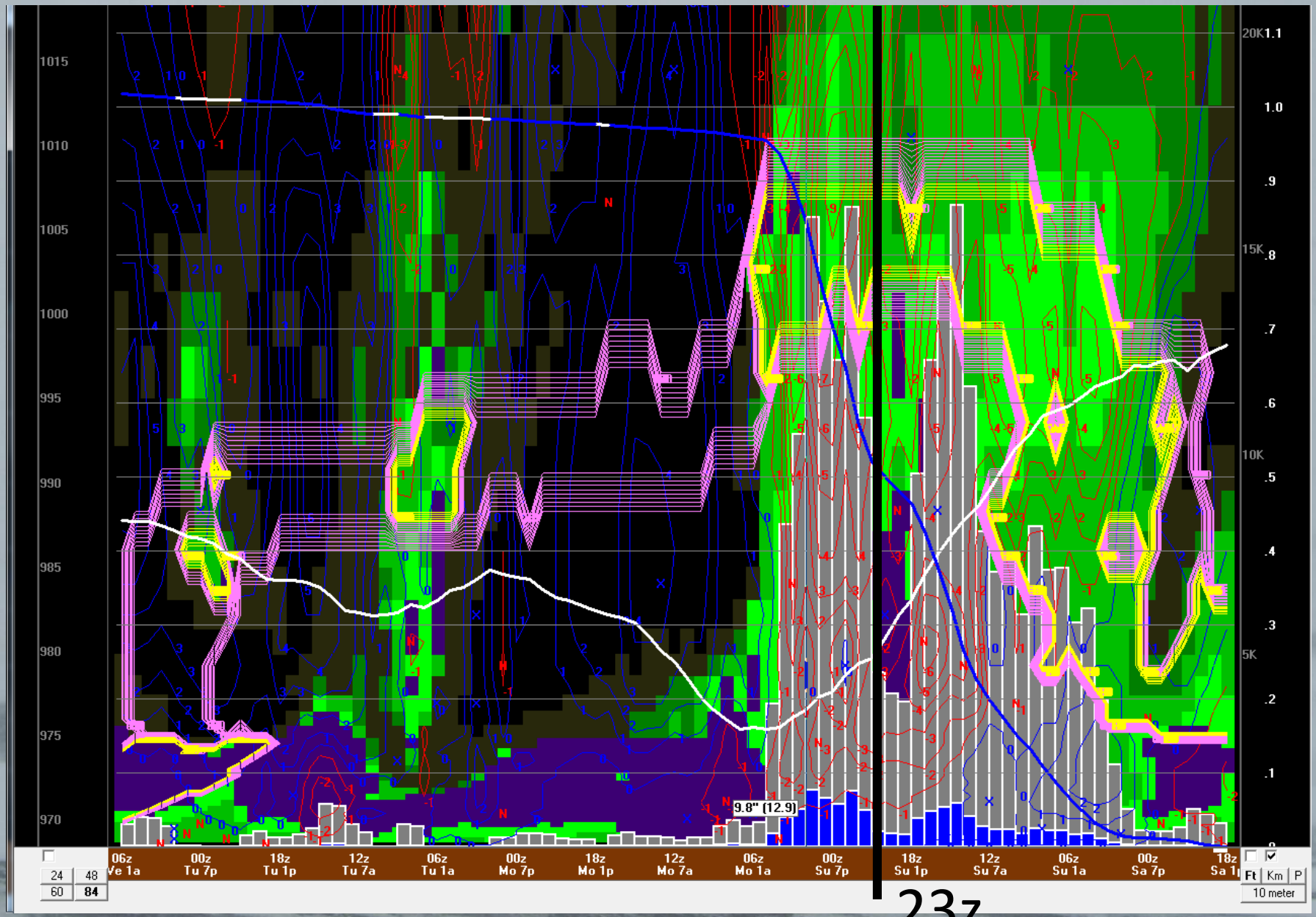
KAZO BUFKIT Sounding – NAM12



11Dec16 23z

KAZO BUFKIT Sounding – NAM12



23z

Conclusions

- North-South LES Bands
  - Jet stream dips well into SE, allowing for CAA from Canada
  - Upper-level trough in eastern third, ridge building in west
    - Trajectory inflection point (NW flow)
  - 850 mb - sfc water instability values between 20-25°C
  - Sub 1000 mb sfc low in NE, 1030+ mb high in high plains
    - Promote NNW winds at surface across Lake Michigan
  - Limited ice coverage on both interior Superior and Michigan

Conclusions

- West-East LES Bands
  - Jet stream max well into SE, improving CAA into region
  - Upper level trough axis east of Midwest
  - 850 mb – sfc water instability values of 20-25°C
  - Sub 1000 mb low in Ontario region, strong sfc high developing in Plains
  - Almost no ice coverage on Lake Michigan (early season)

ILX Impacts

1. Strong sfc high located in Northern Plains
2. Strong sfc low located in eastern GL/NE
3. 700 - 850 mb winds need to be upwards of 30 kts and northeasterly --- Long duration!
4. Unfrozen Lake Michigan a must!

References

- Acciaioli, Anthony. (2009). Forecasting Lake Effect Snow off of Southern Lake Michigan: A Primer. *NWS Chicago Studies*.
- Great Lakes Environmental Research Laboratory
- Great Lakes Surface Environmental Analysis
- National Centers for Environmental Information
- NWS Chicago WFO
- PSU Bufkit Database
- Plymouth State Weather Center
- Storm Prediction Center

Questions?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