DREAMING OF A WHITE CHRISTMAS: A REVIEW OF THE 25-26 DECEMBER 2017 LAKE EFFECT SNOW EVENT IN ERIE, PA

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METEOROLOGIST AND CLIMATE SERVICES FOCAL POINT

NATIONAL WEATHER SERVICE - CLEVELAND, OHIO

26TH ANNUAL GREAT LAKES OPERATIONAL METEOROLOGY WORKSHOP

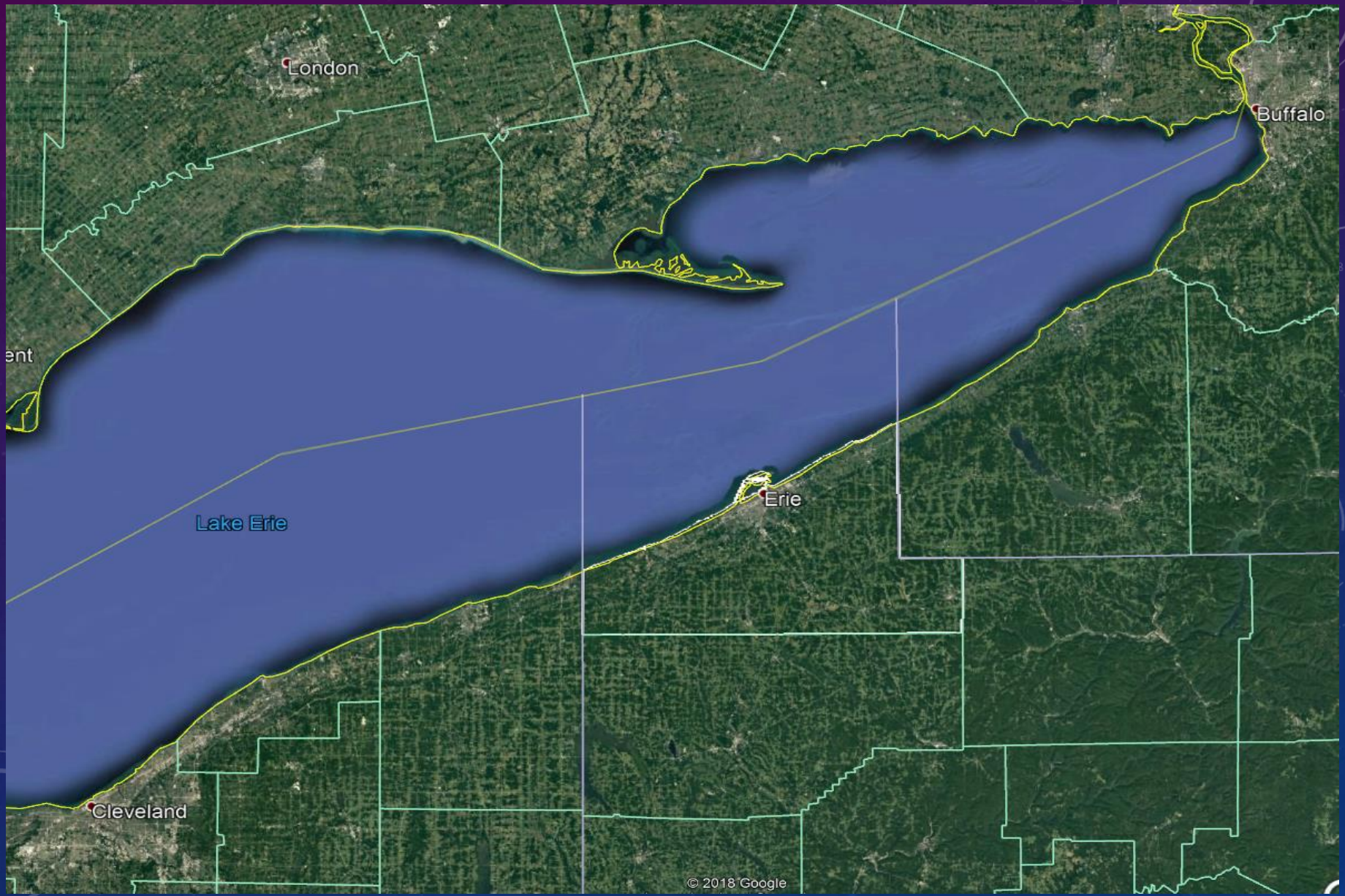
GREAT LAKES BALLROOM AT THE DRURY PLAZA HOTEL, CLEVELAND, OHIO

PRESENTED: MAY 2, 2018

PRESENTATION DISCLAIMER

Snow amounts and records presented in this talk are presently deemed PRELIMINARY and NON-OFFICIAL and should be not be considered final until certified by the National Centers for Environmental Information (NCEI).

LOCATION OF ERIE, PA



HISTORY OF THE ERIE CLIMATE SITE

- Observations began in downtown Erie, PA on 25 May 1873
  - Taken by several federal groups: Signal Service and Weather Bureau
- Weather Bureau moved to Airport in 1948 but climate site remained in downtown Erie through August 1953, when federal building closed
- WSO Erie at Airport was climate source through 2005
- ASOS now source of all observations- Snow was now paid observer
- Snow was measured at a private residence about a mile northeast of the airport from 2005-2017, when the private citizen retired
- Snow is now measured at the airport again by private business with site within 800 feet of the original airport and WSO Erie

WINTER CLIMATOLOGY OF ERIE, PA

- Lake effect snow reigns during winter months
- Average Annual Snowfall: 100.9”
- Average Number of Winter Warning Events: 5
  - (6” of snow in 12 hours or 8” of snow in 24 hours)

- December and January Top 10s: 45-65”
- Annual Top 10s: 125-165” annual snow

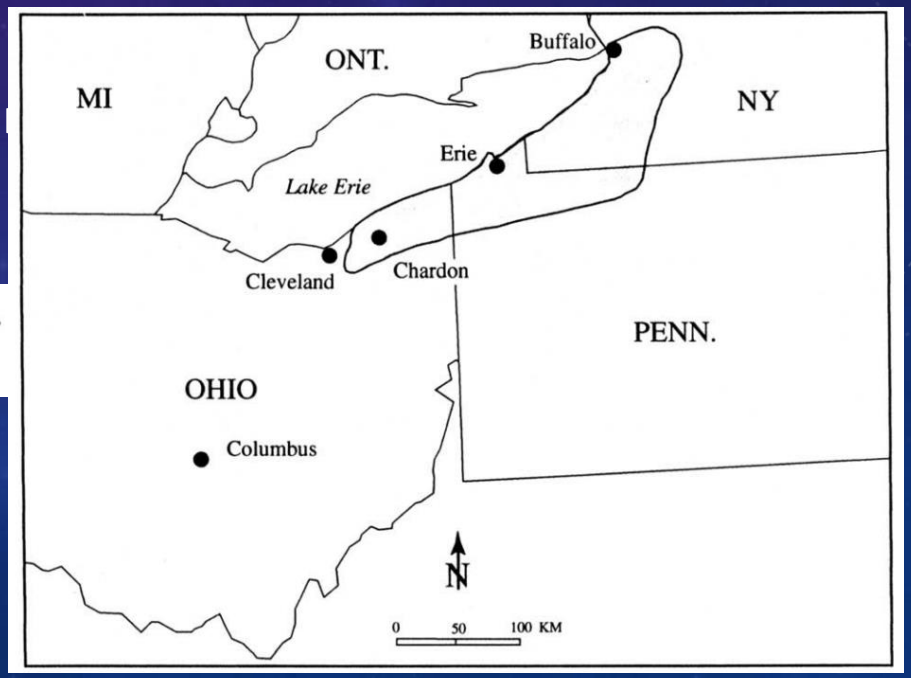
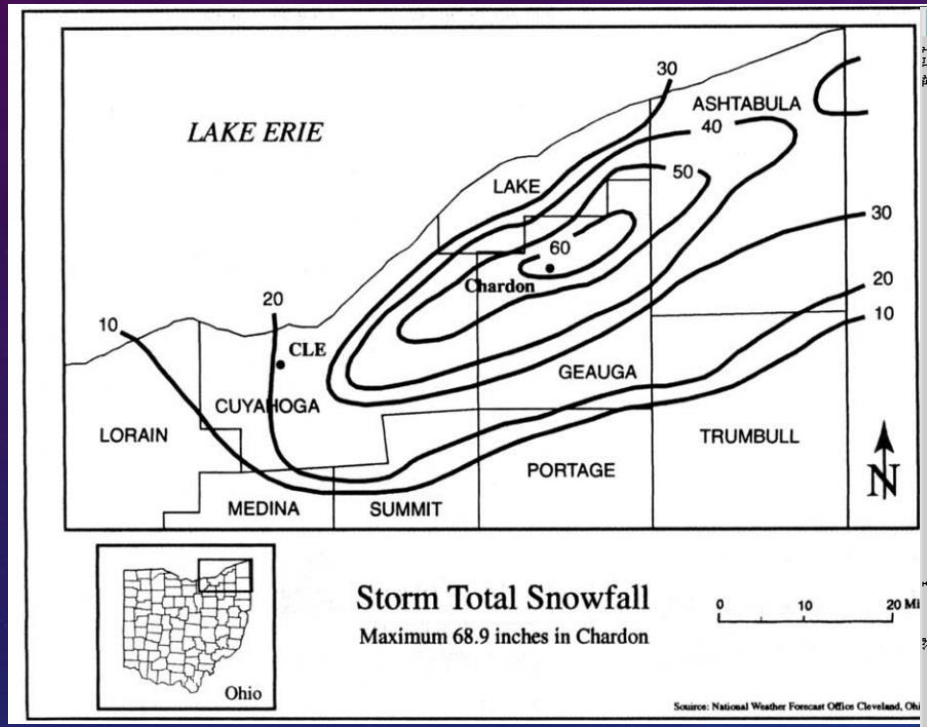


FIG. 1. The Lake Erie snowbelt where average annual snowfall is 200–450 cm (80–180 in.).

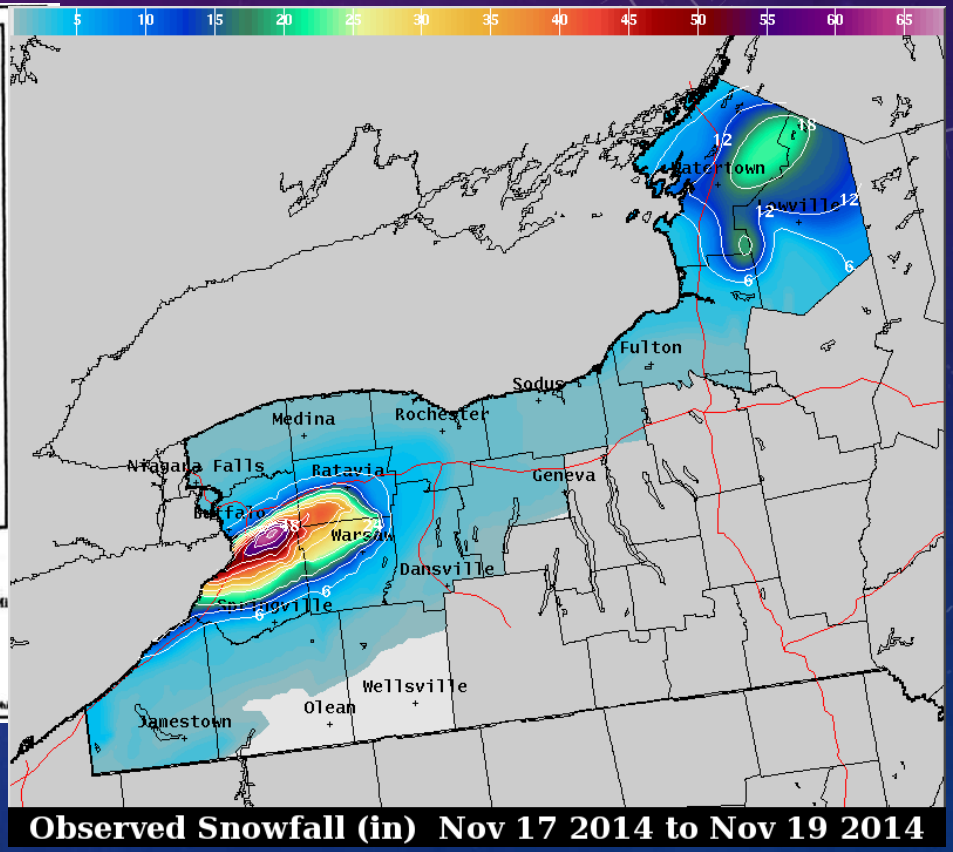
LAKE ERIE SNOW BELT…
NO STRANGER TO EXTREME SNOW EVENTS

Northeast Ohio- November 1996



Maximum: 68.9” snow in Chardon, Ohio

Western New York- November 2014



Maximum: 65.0” snow, south of Cheektowaga, NY

Totals through 21 November 2014: Over 7 feet of snow

SNOWFALL AT ERIE THROUGH DECEMBER 6TH

- November 2017 Monthly Snowfall: 0.5”
  - Average November Snowfall: 8.5”
- December 2017 Monthly Snowfall: Trace
  - Average Snowfall through December 6th: 3.9”
  - Average December Snowfall: 27.5”
- Winter 2017-2018 Seasonal Snowfall: 0.5”
  - Average Winter Season Snowfall through December 6th: 12.4”
  - Average Winter Season Snowfall: 100.9”

SNOWFALL AT ERIE THROUGH DECEMBER 22ND

- December 2017 Monthly Snowfall: 34.6”
  - Average Snowfall through December 22nd: 18.1”
  - Average December Snowfall: 27.5”
- Winter 2017-2018 Seasonal Snowfall: 35.1”
  - Average Winter Season Snowfall through December 22nd: 26.6”
  - Average Winter Season Snowfall: 100.9”

Snow depth at Erie Airport was 0” at 7 AM on December 23rd.

SO… YOU'RE DREAMING OF A WHITE CHRISTMAS?

NWS CLEVELAND FORECAST FOR 24-28 DECEMBER 2017

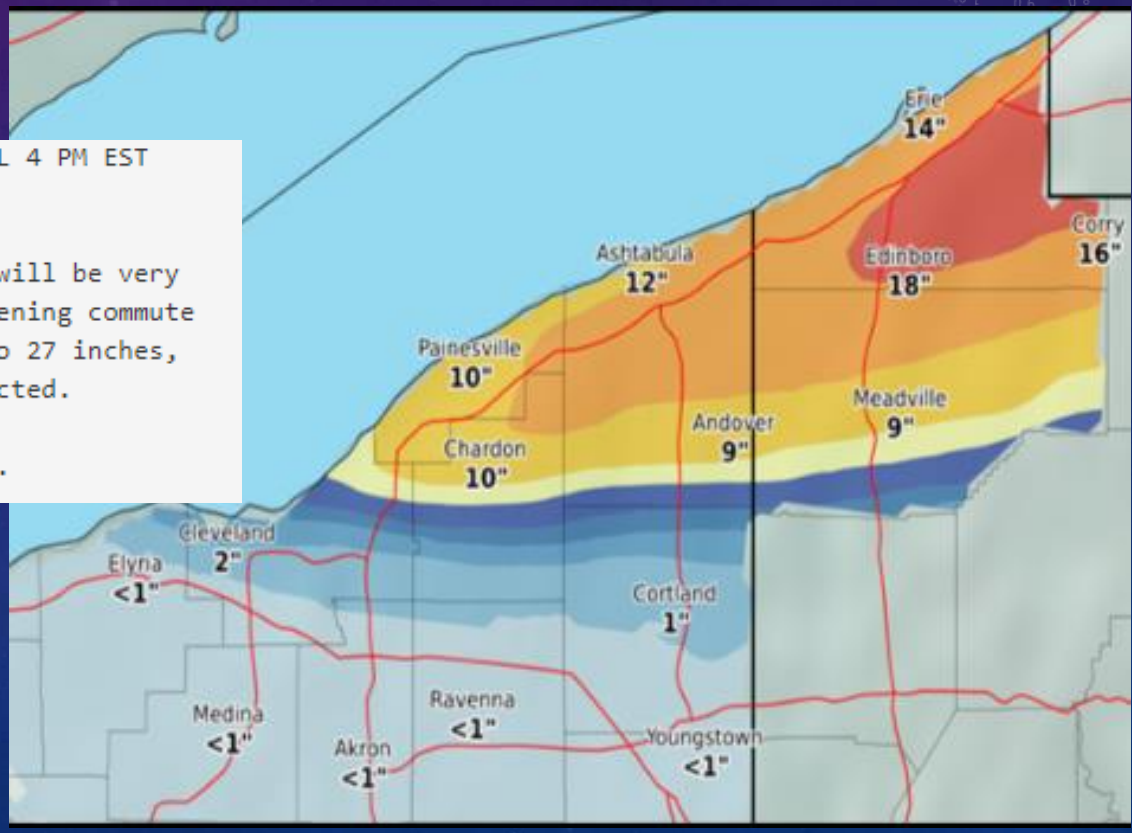
Snowfall forecast valid
21z 12/24 to 21z 12/27

...LAKE EFFECT SNOW WARNING REMAINS IN EFFECT UNTIL 4 PM EST WEDNESDAY...

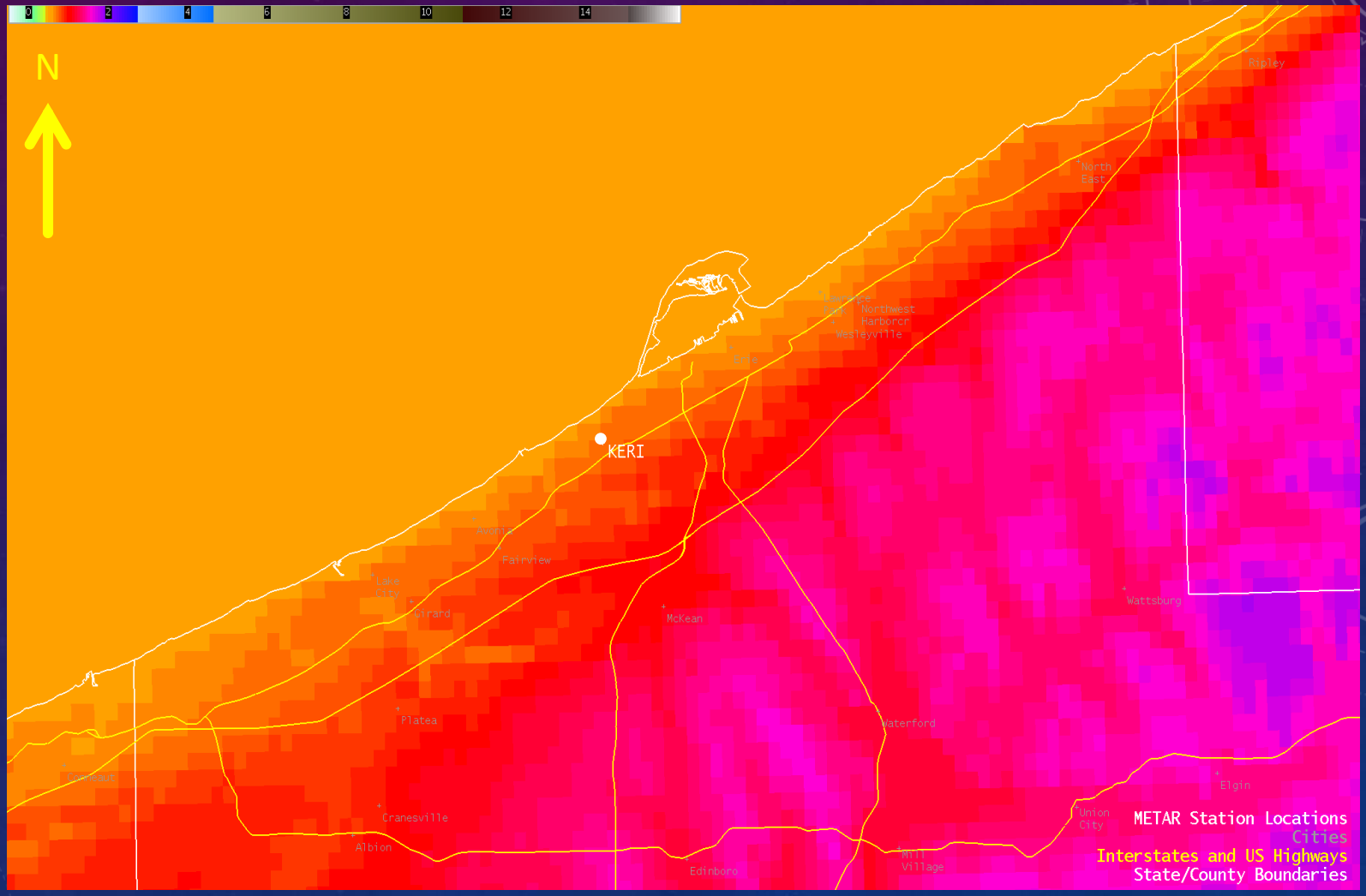
* WHAT...Heavy lake effect snow occurring. Travel will be very difficult to impossible, including during the evening commute on Monday. Additional snow accumulations of 23 to 27 inches, with localized amounts up to 32 inches, are expected.

* WHERE...Northern Erie and Southern Erie counties.

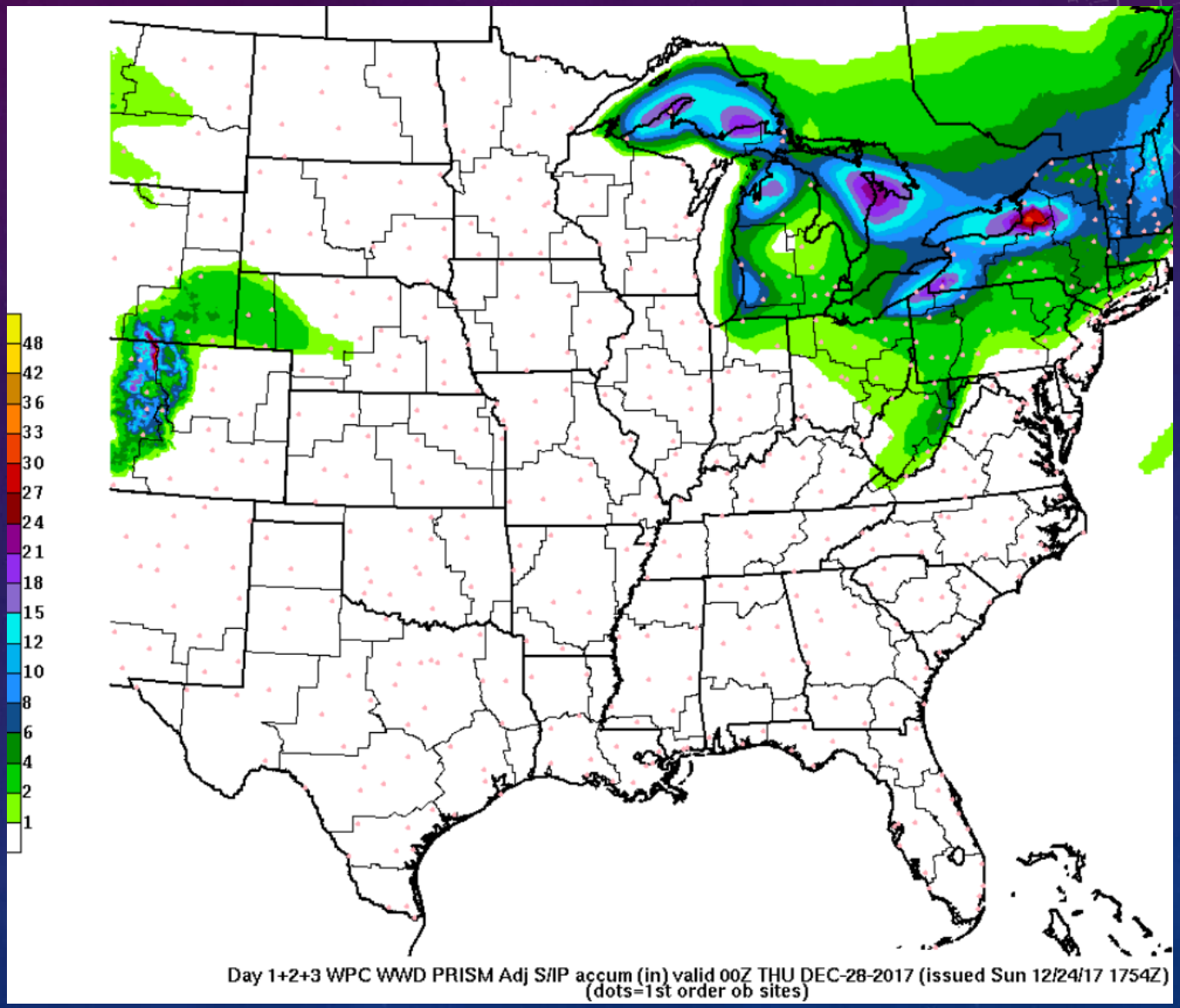
Snowfall forecast valid
12z 12/25 to 12z 12/27



ERIE AREA TOPOGRAPHY MAP



WPC FORECAST FOR 24-28 DECEMBER 2017

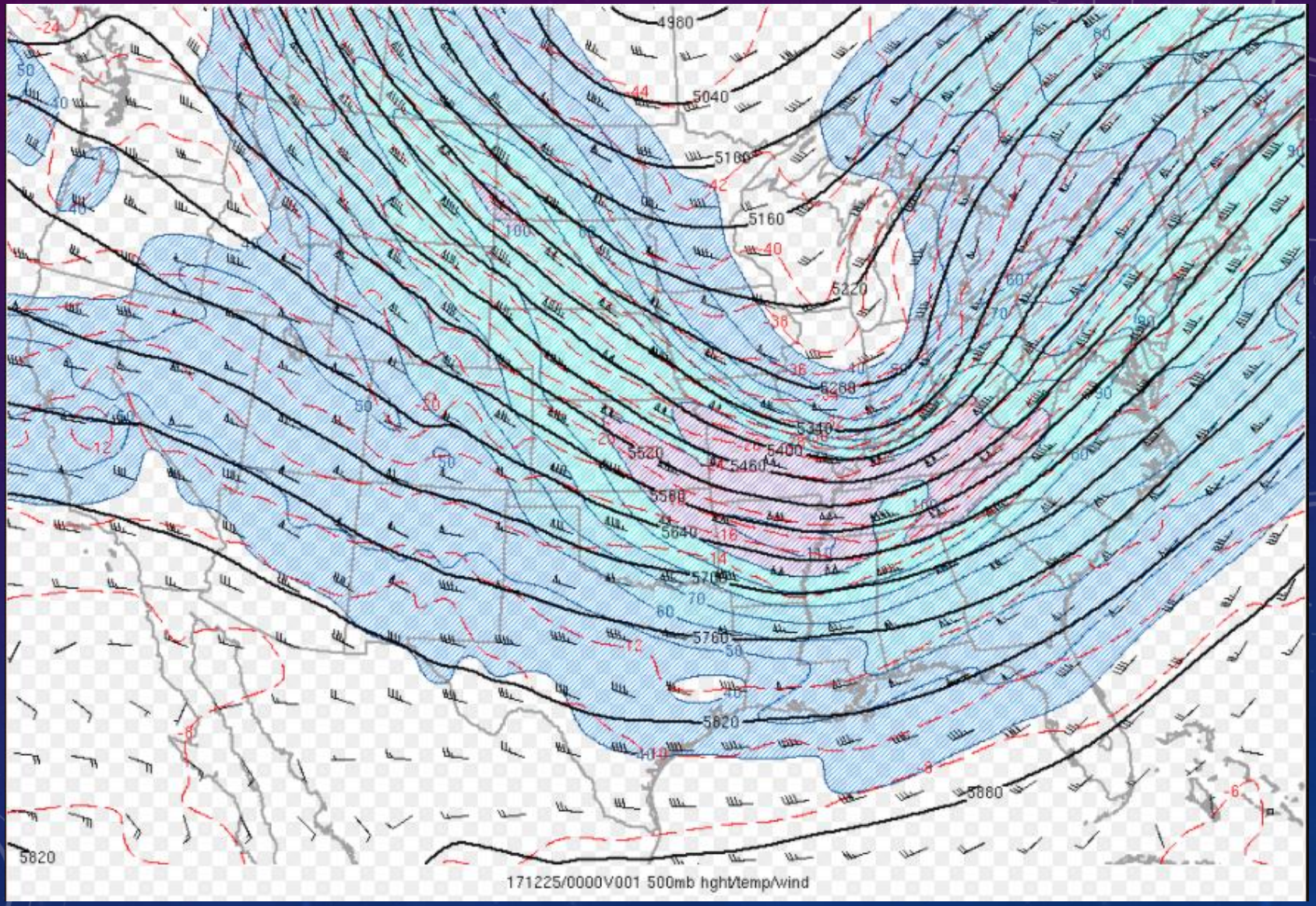


METEOROLOGY OF THE 25-26 DECEMBER 2017 EVENT

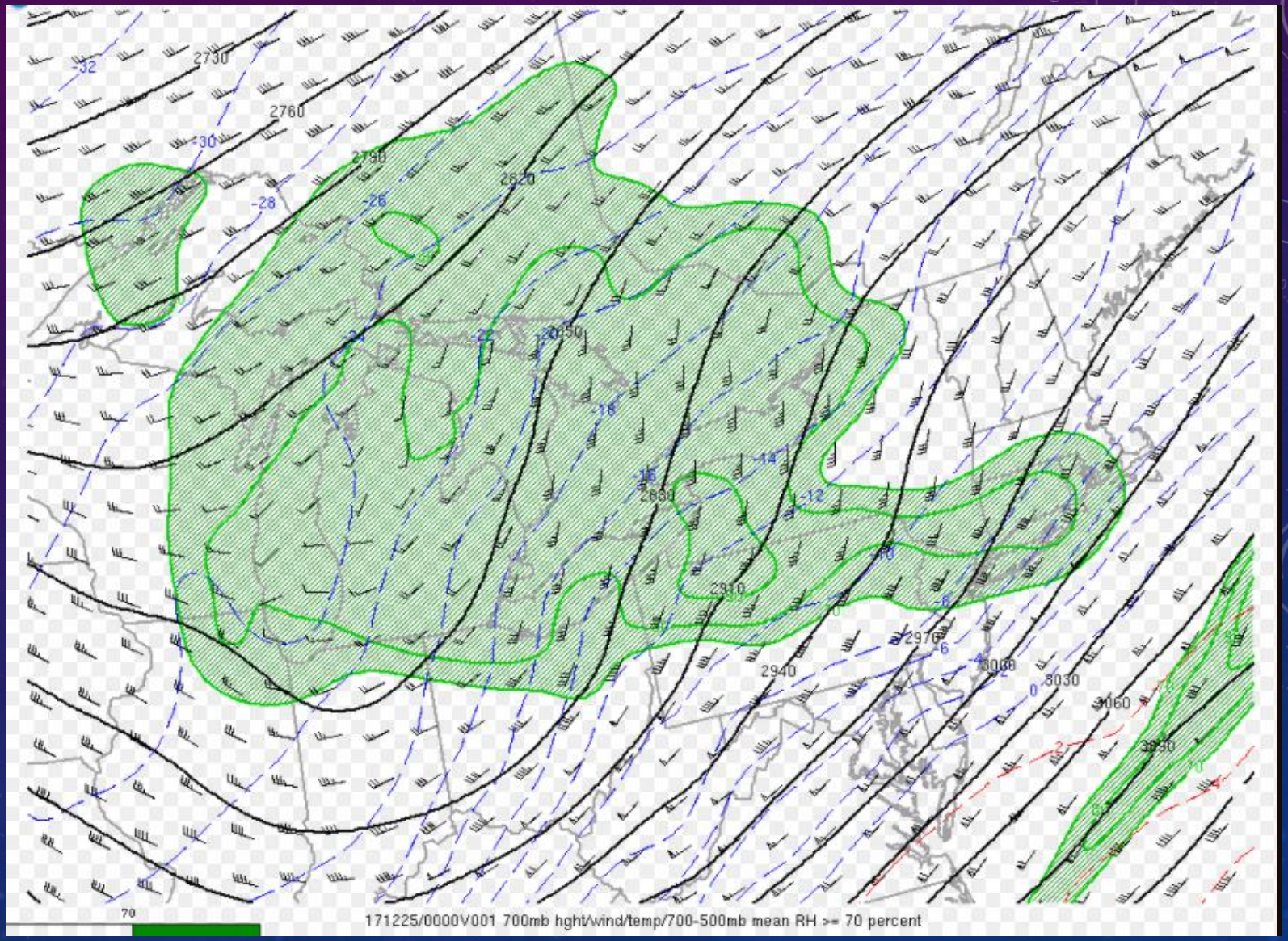
HOW DOES ERIE, PA GET AN EXTREME LAKE EFFECT EVENT?

- First half of winter event
  - Better chance of above normal water temperatures
  - Less chance of ice coverage on Lake Erie
- Single Band Development most effective:
  - Favorable fetch- 250° or 260° wind allows for a 200+ mile fetch over Lake Erie that will impact Northwest Pennsylvania
  - Convergence over Lake Erie (SW flow on US side, NW flow on Canadian Side)
  - Minimal directional shear
  - Good boundary layer depth and thermodynamics
  - Sufficient moisture

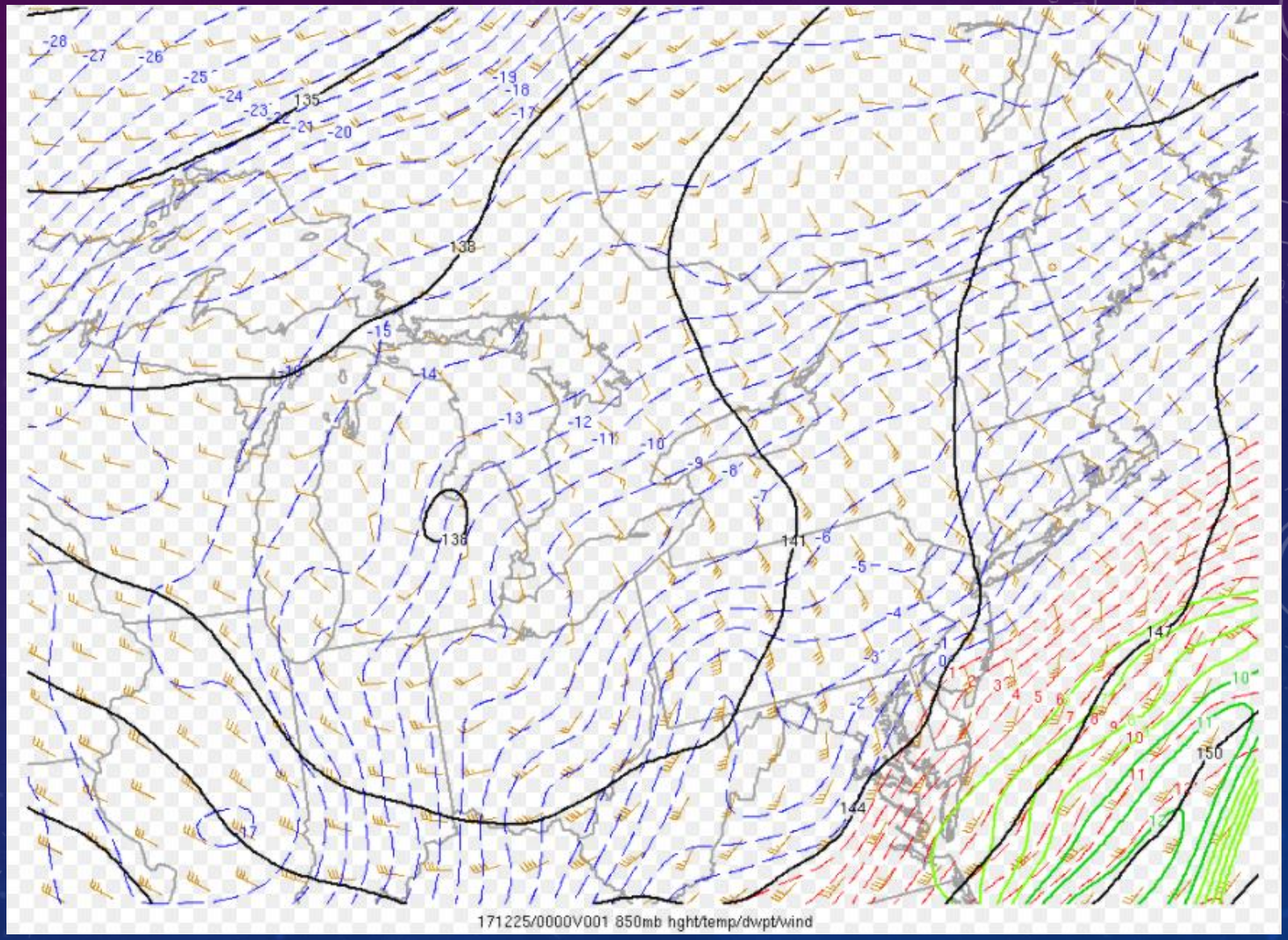
500 MB- 00Z 25 DECEMBER 2017



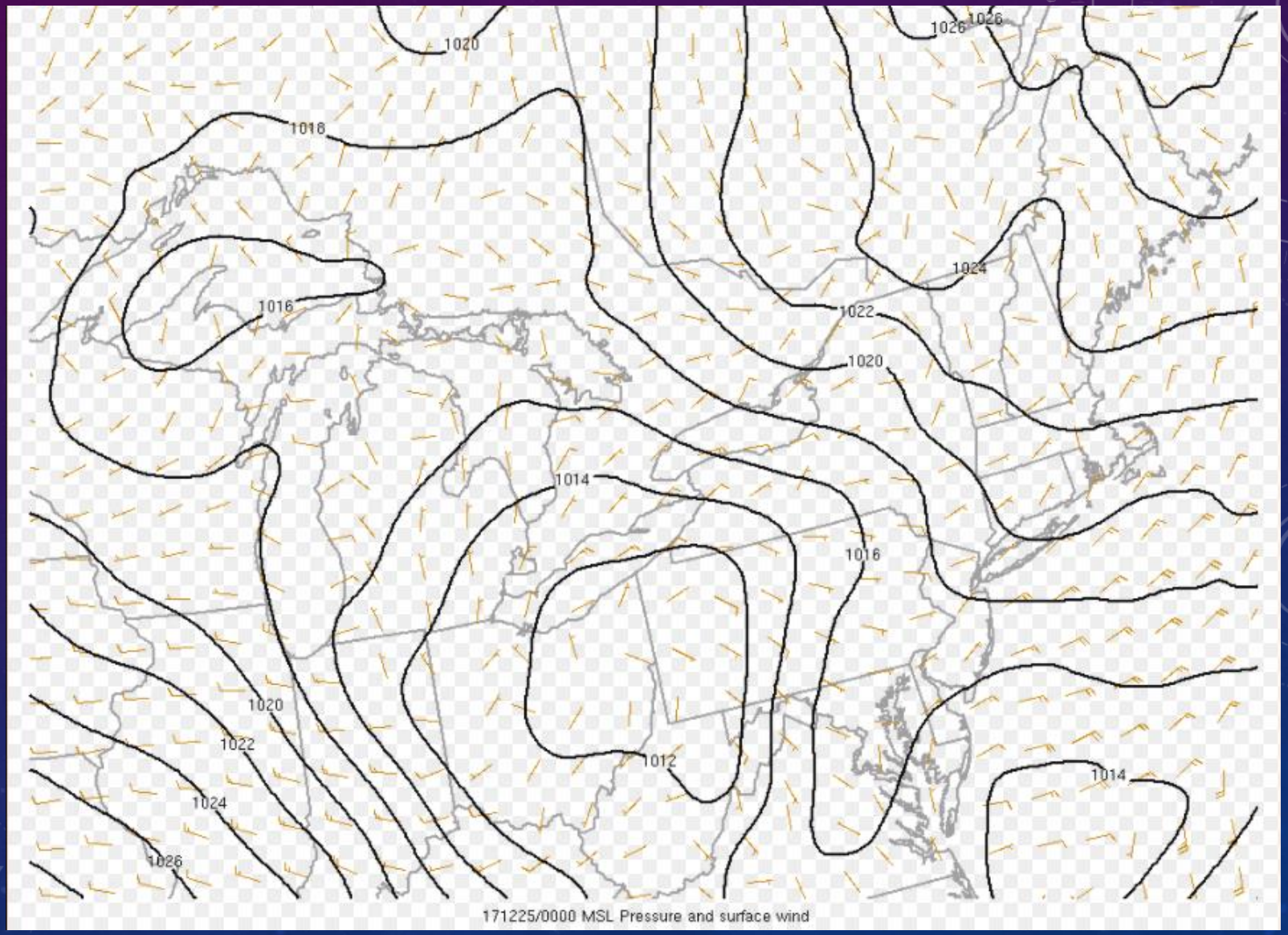
700 MB- 00Z 25 DECEMBER 2017



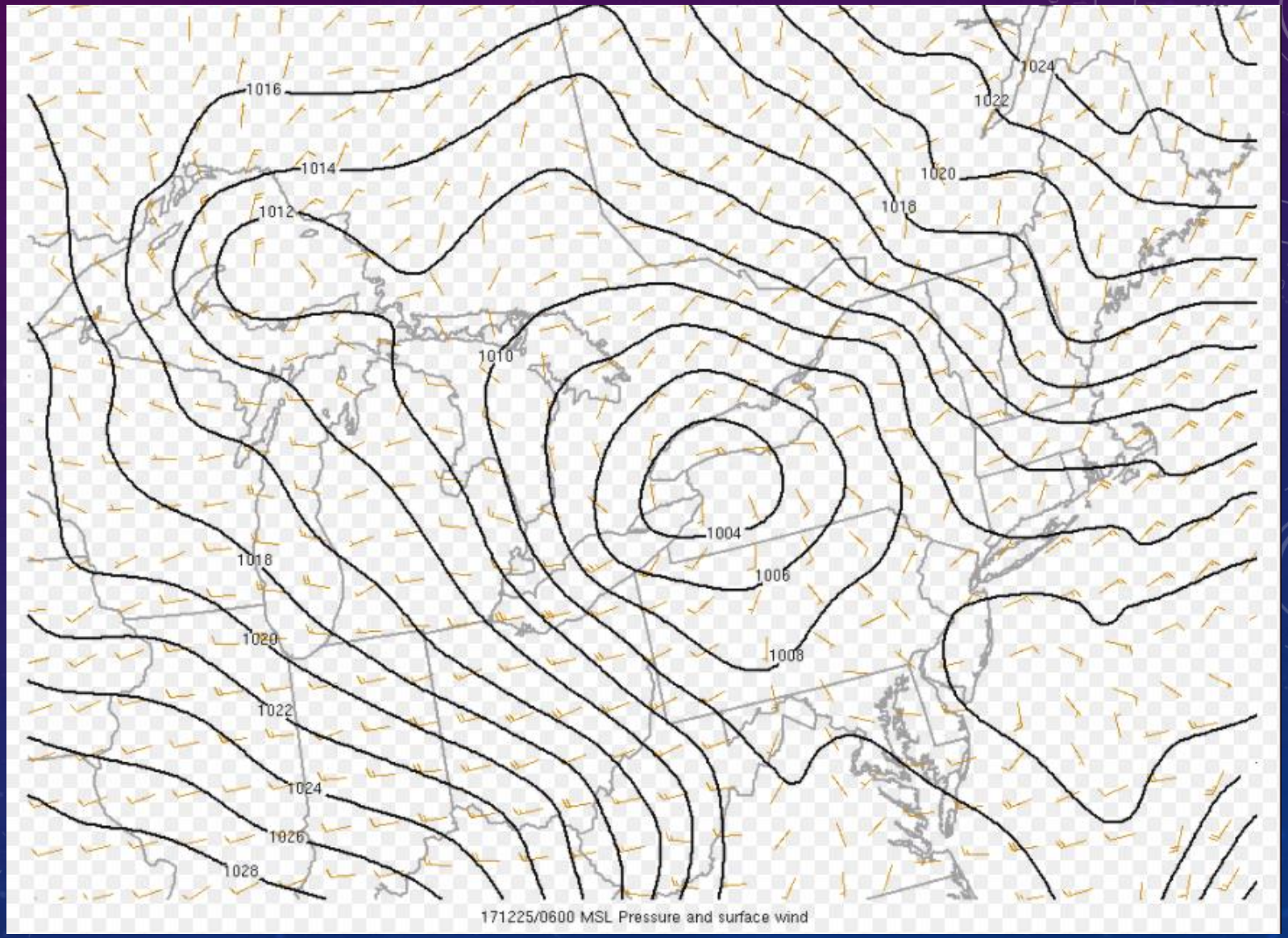
850 MB- 00Z 25 DECEMBER 2017



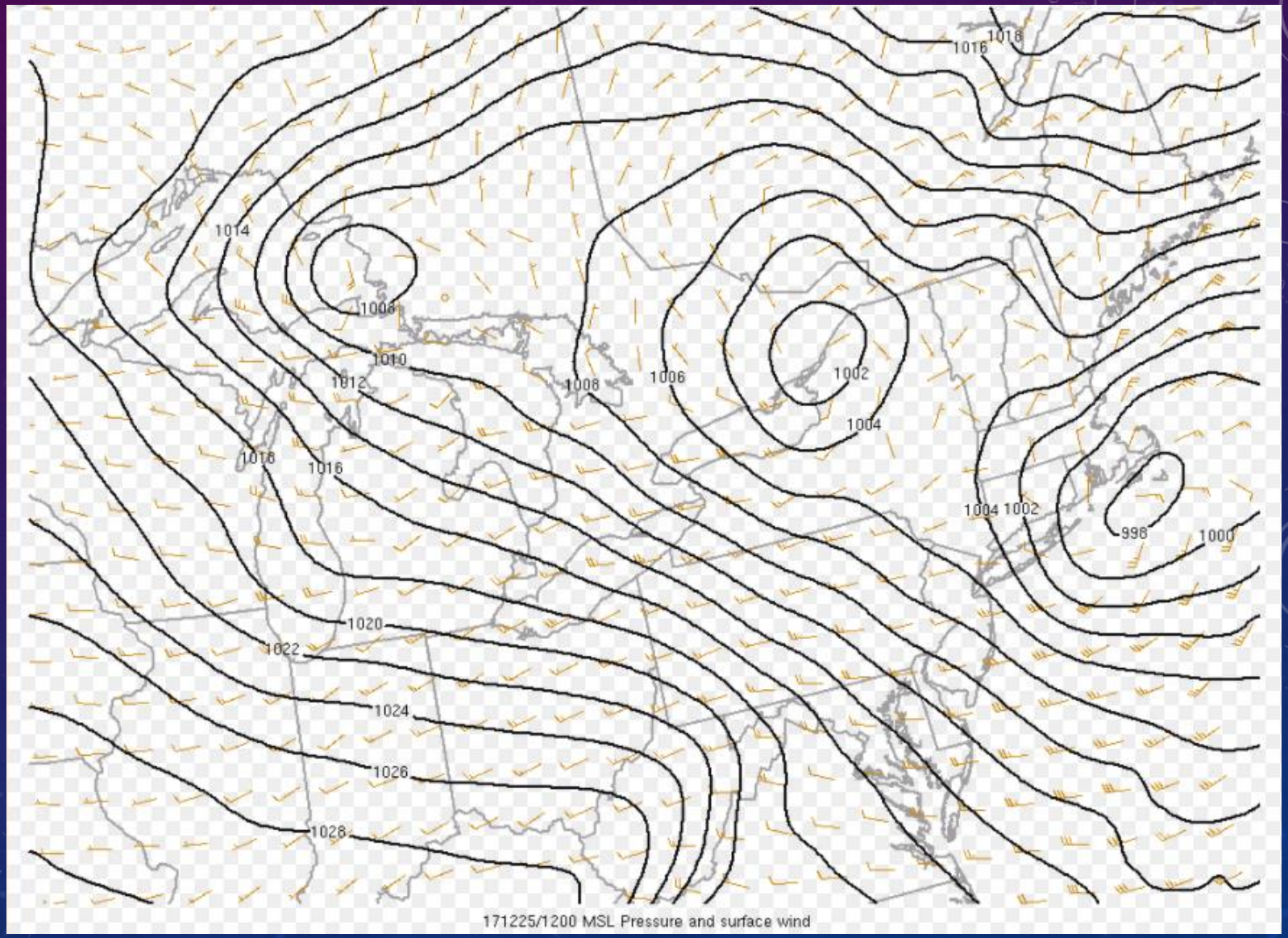
SURFACE- 00Z 25 DECEMBER 2017



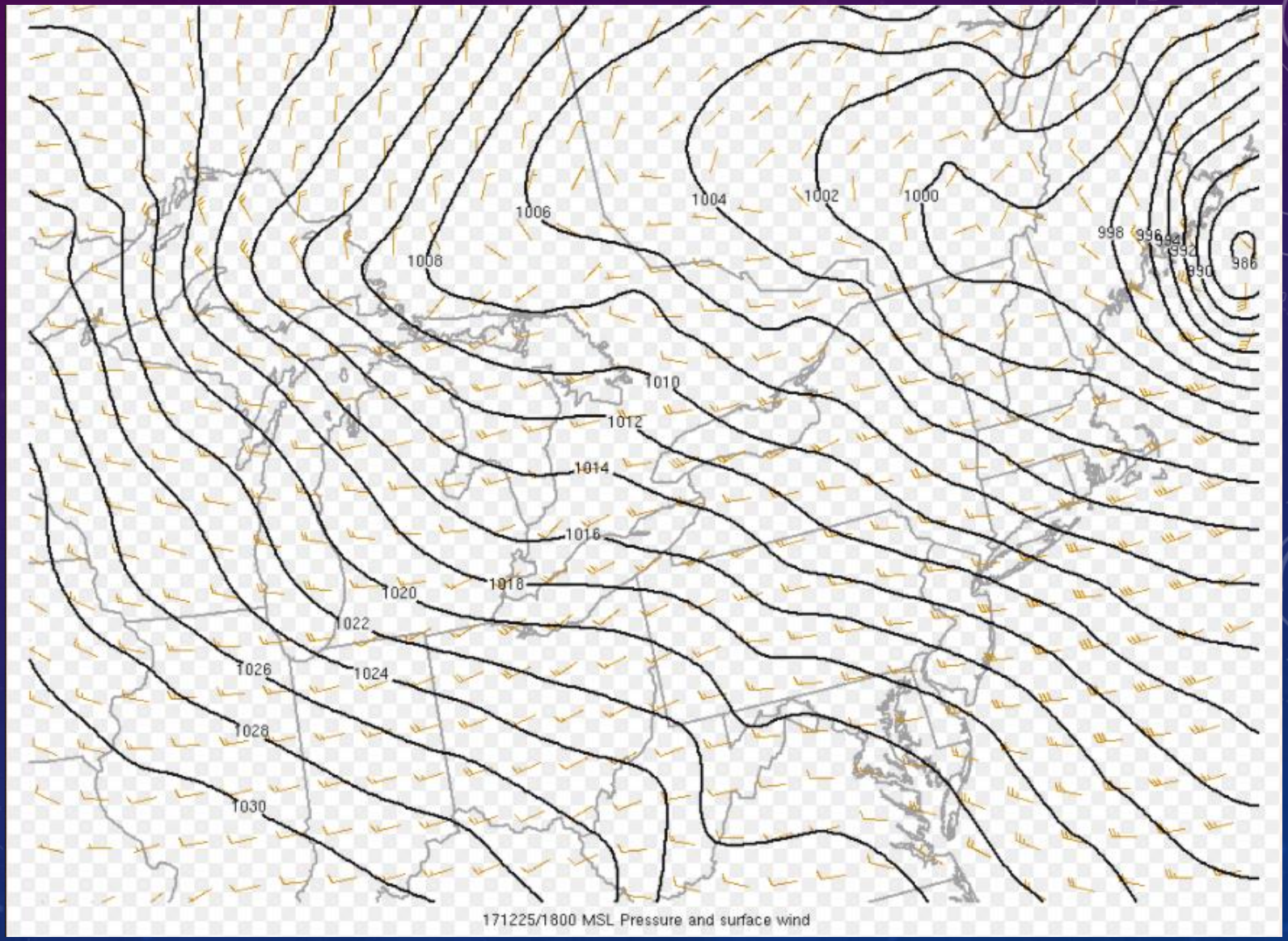
SURFACE- 06Z 25 DECEMBER 2017



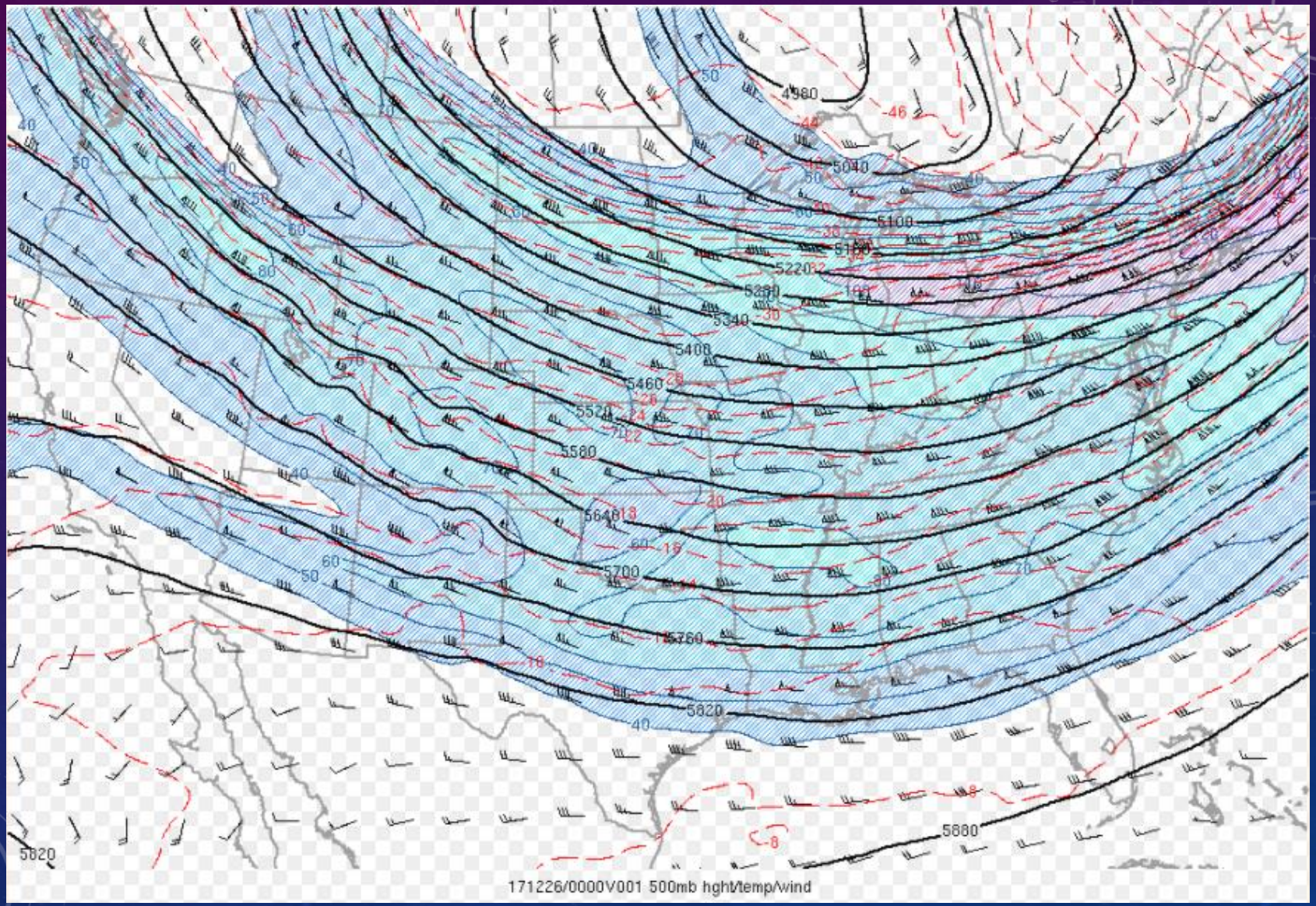
SURFACE- 12Z 25 DECEMBER 2017



SURFACE- 18Z 25 DECEMBER 2017



500 MB- 00Z 26 DECEMBER 2017



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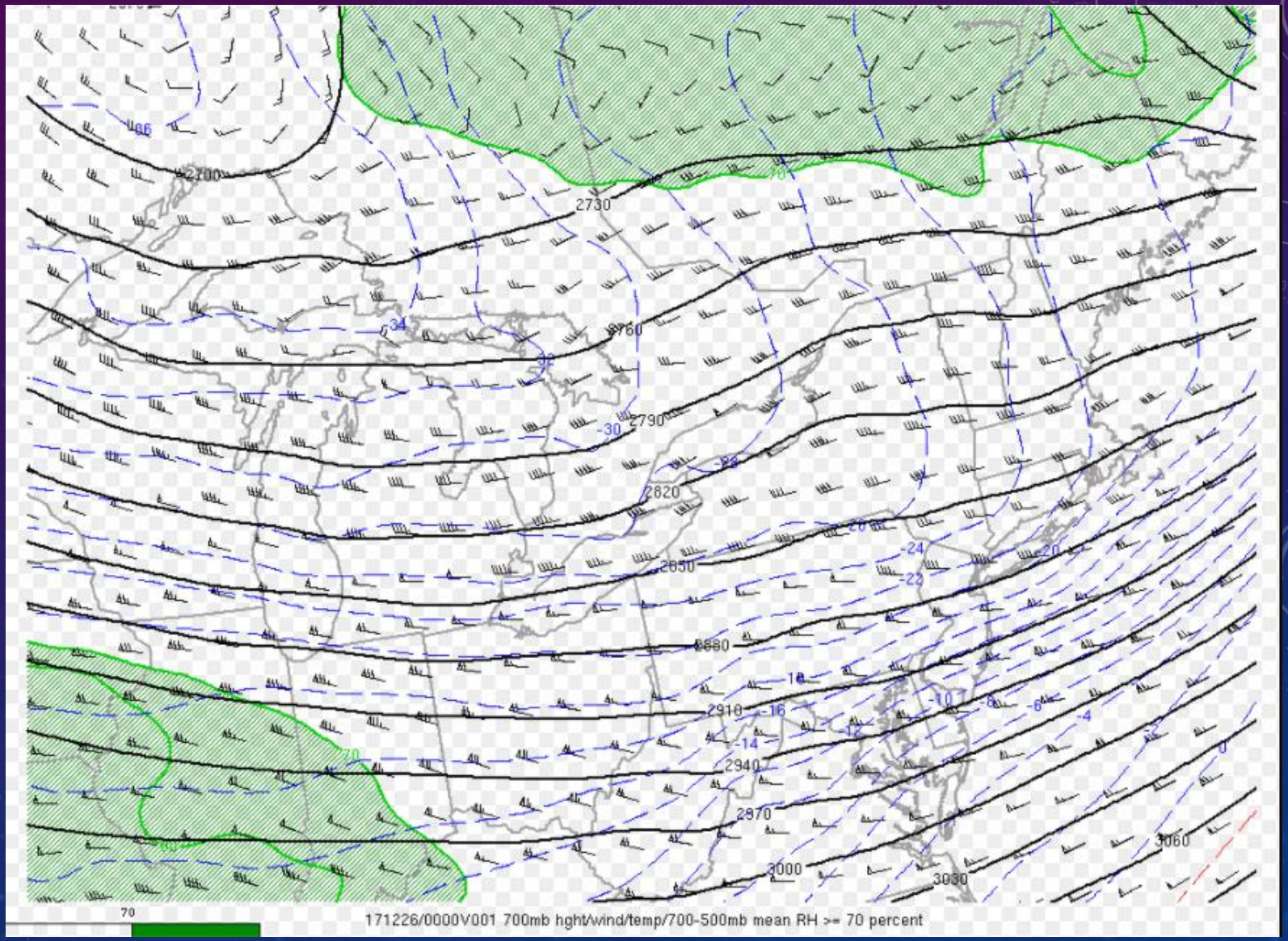

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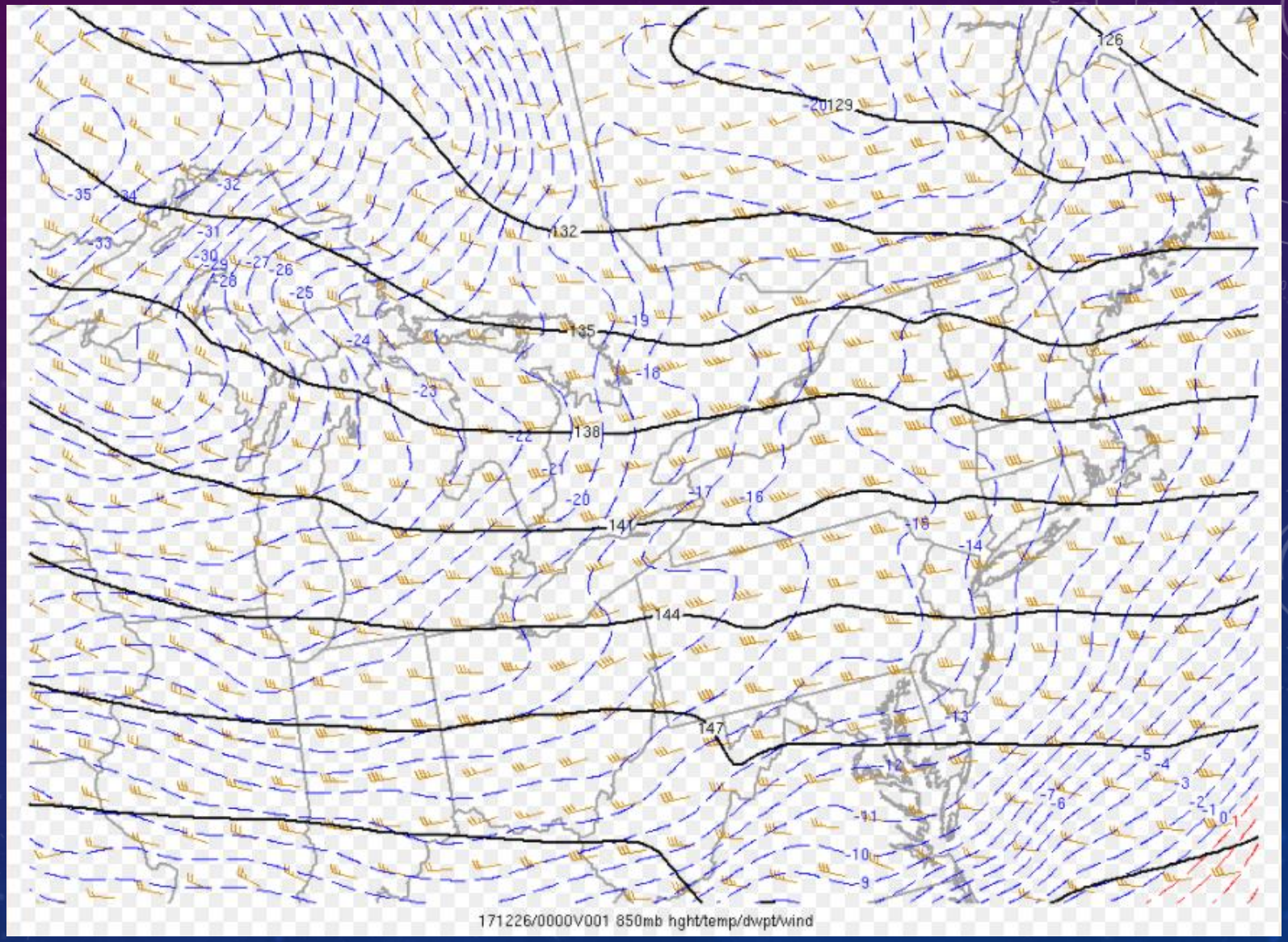

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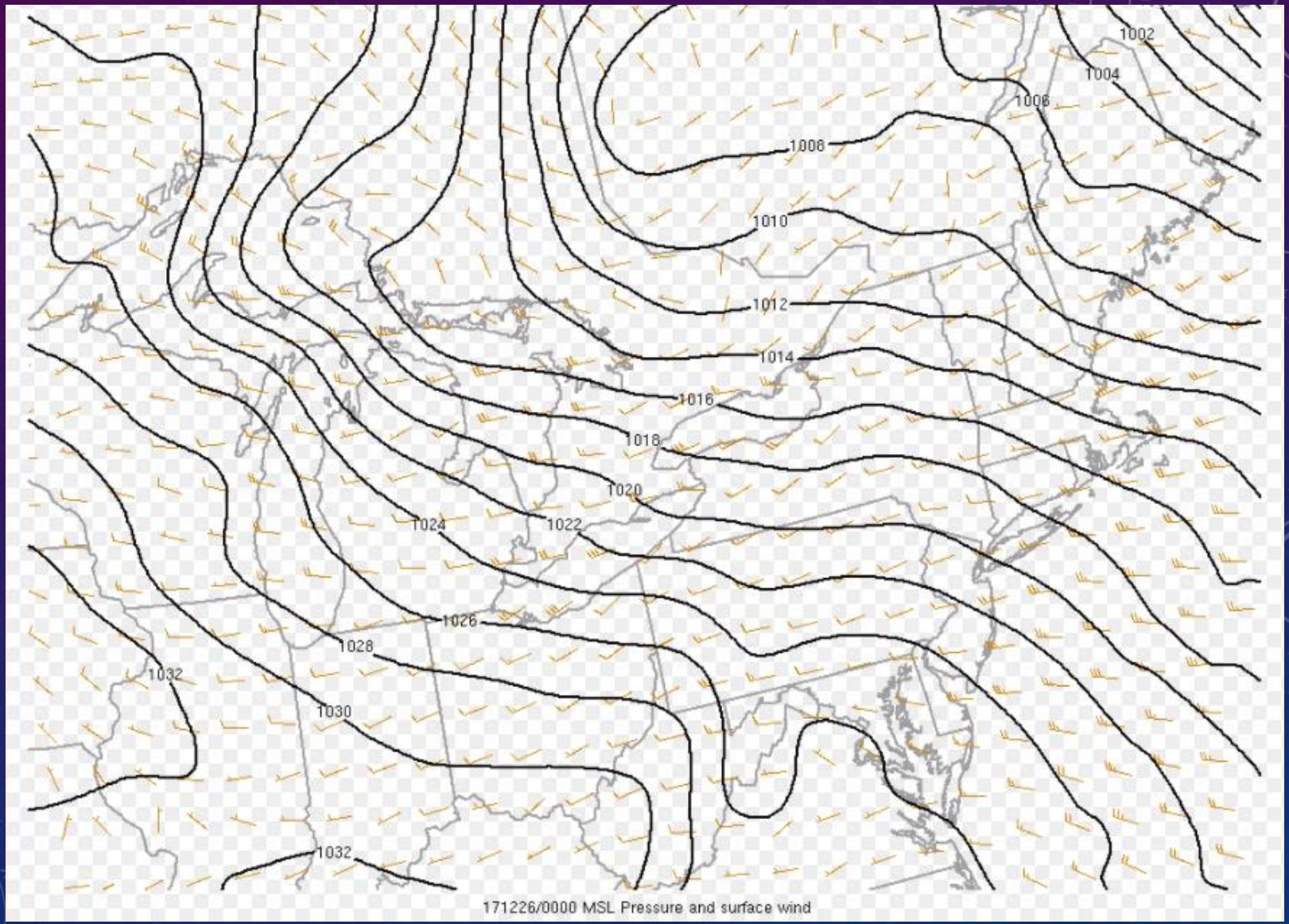

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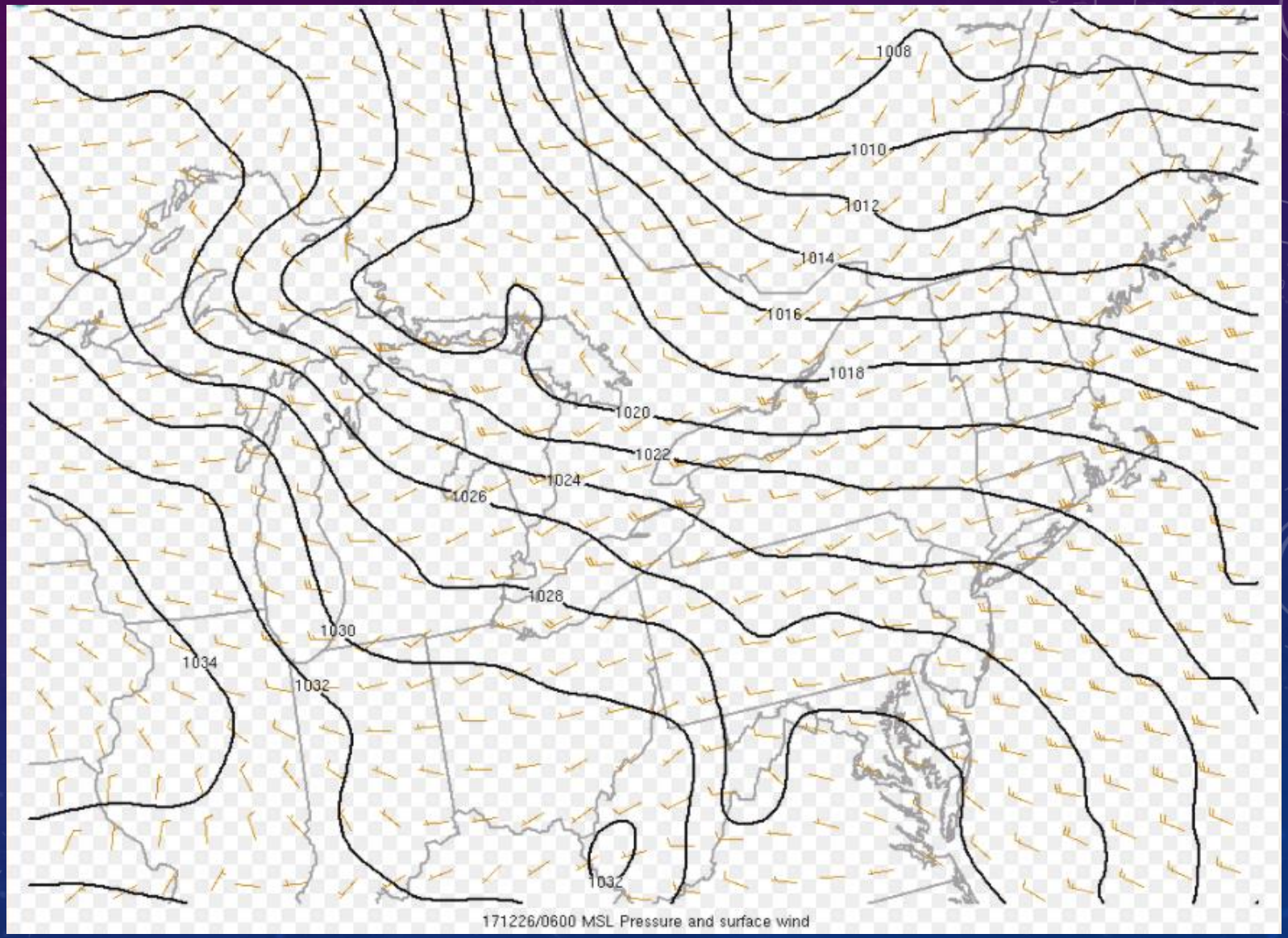
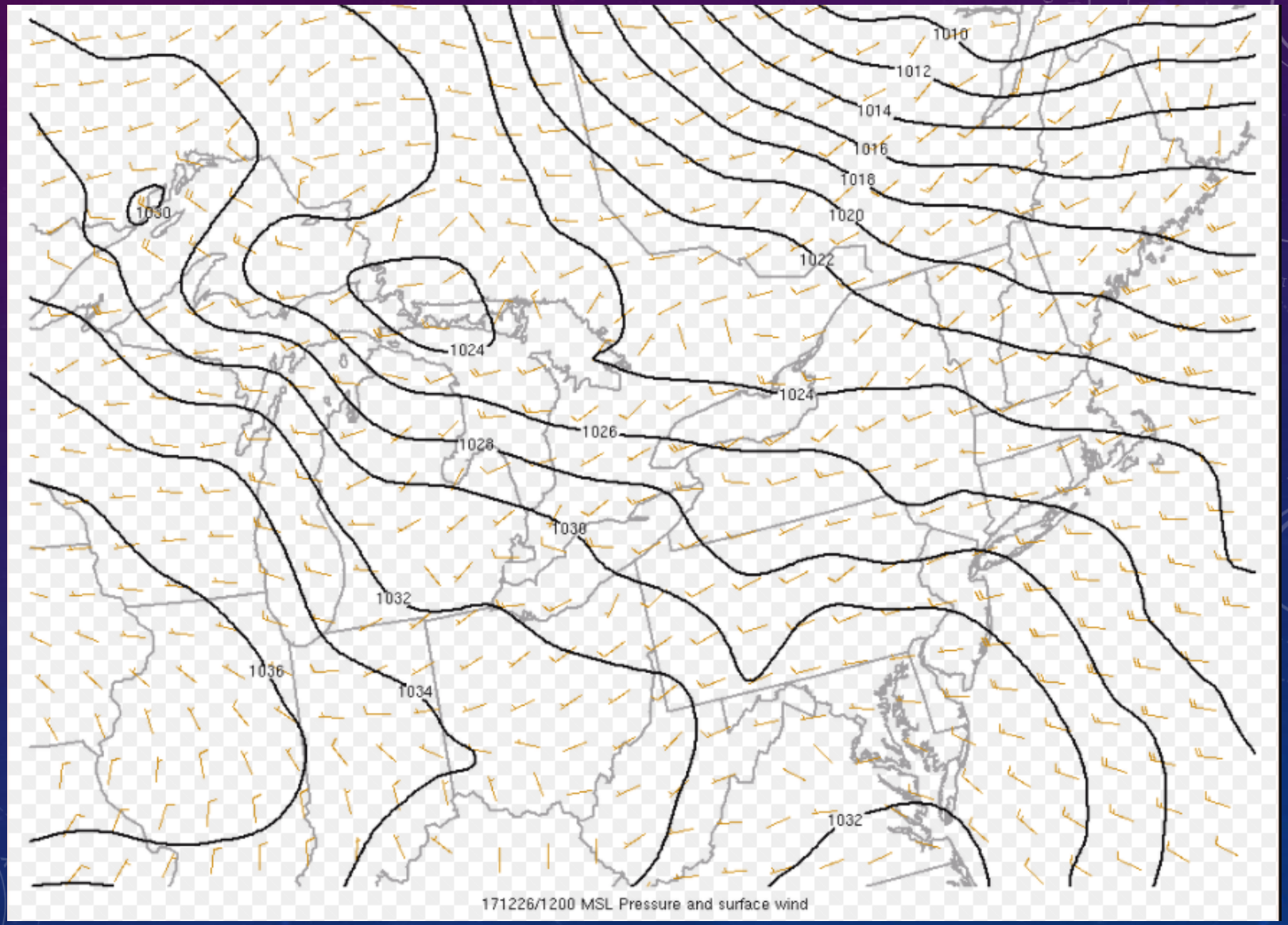


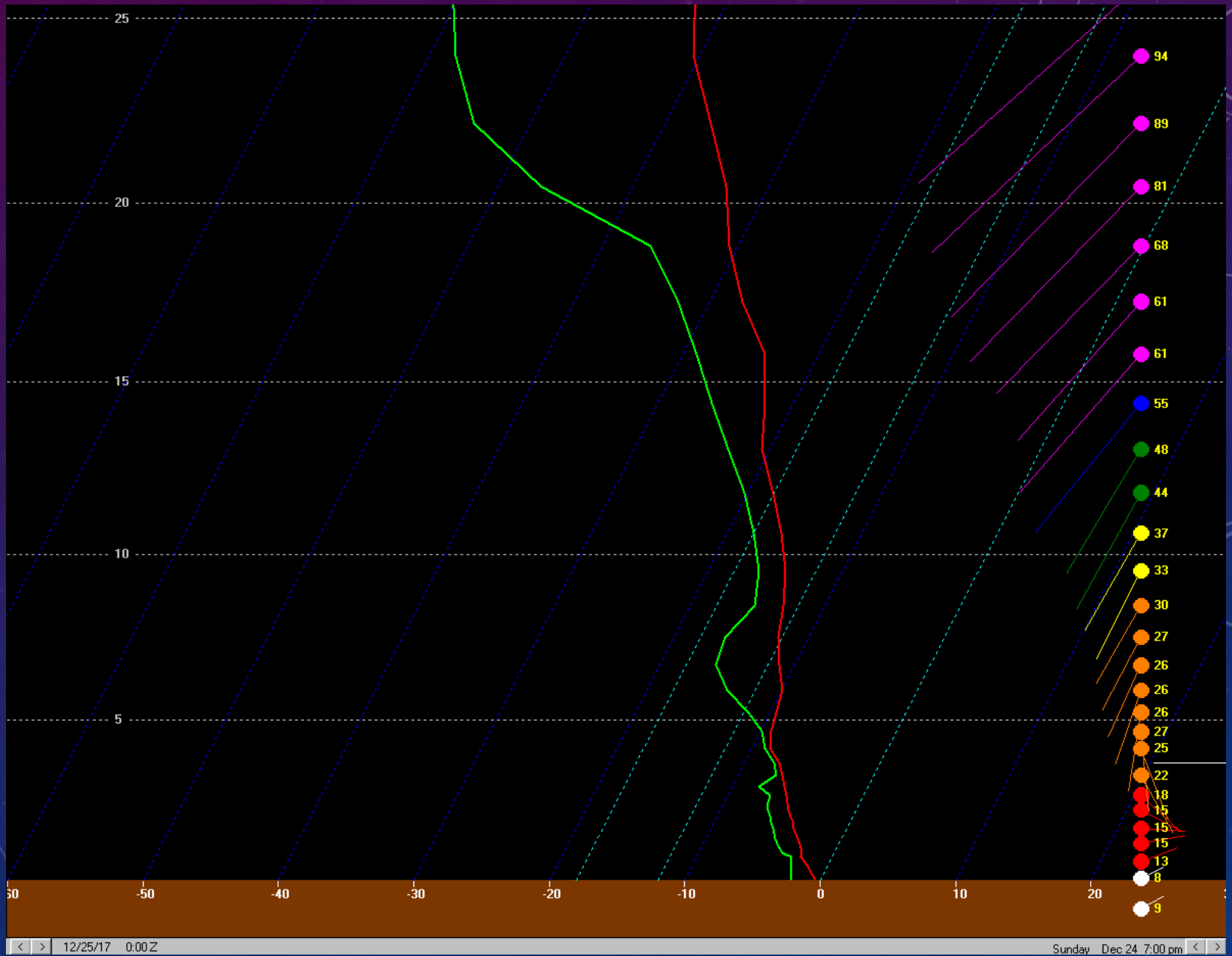
SURFACE- 12Z 26 DECEMBER 2017



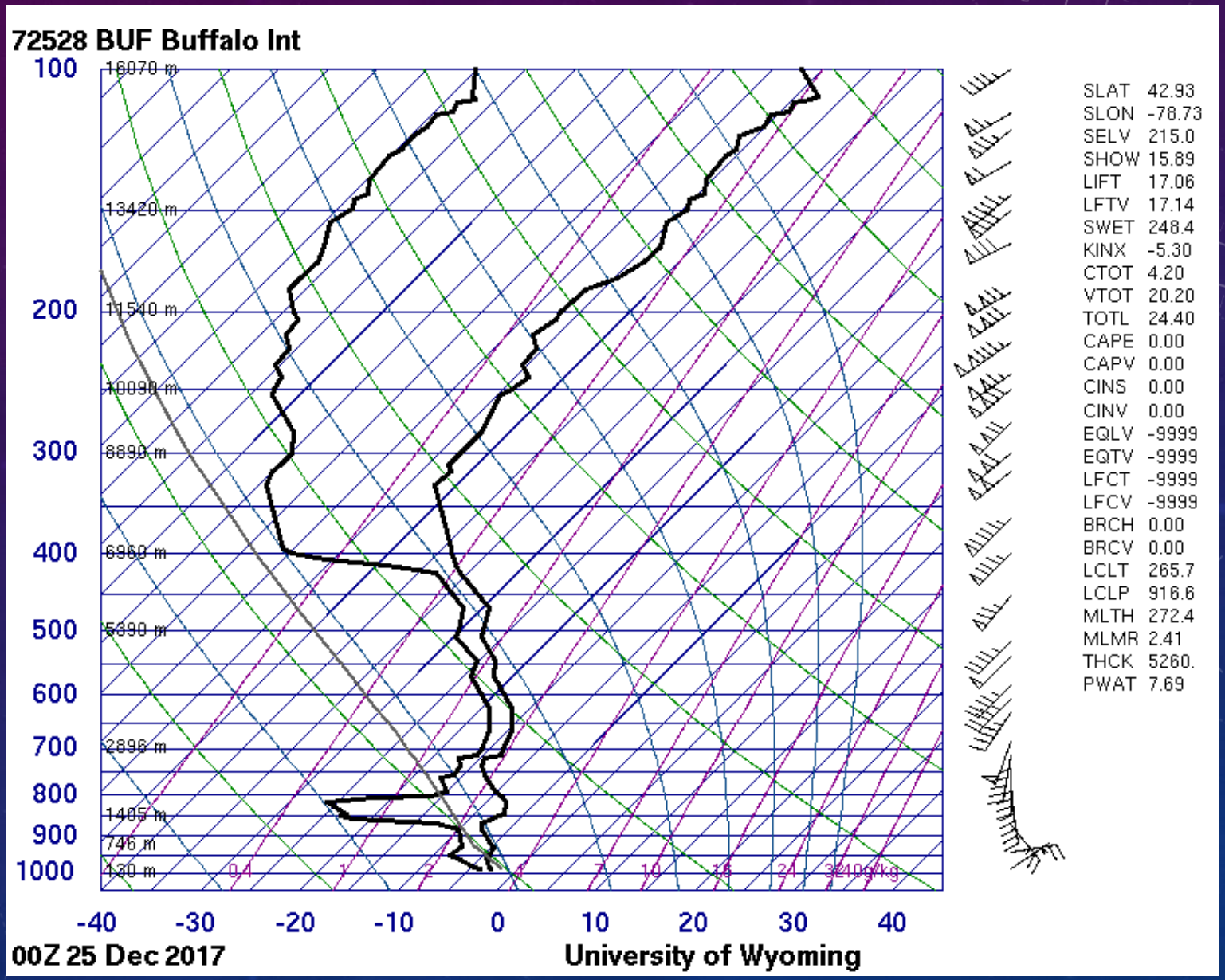
LAKE ERIE WATER TEMPERATURES

- No ice was found on Lake Erie during this event as water temperatures were 5-10°F above normal
- Water temperatures of 3-5°C allowed for enhanced thermodynamic profiles and more instability to promote lake effect growth and higher snowfall rates
- Let’s take a look at some soundings…

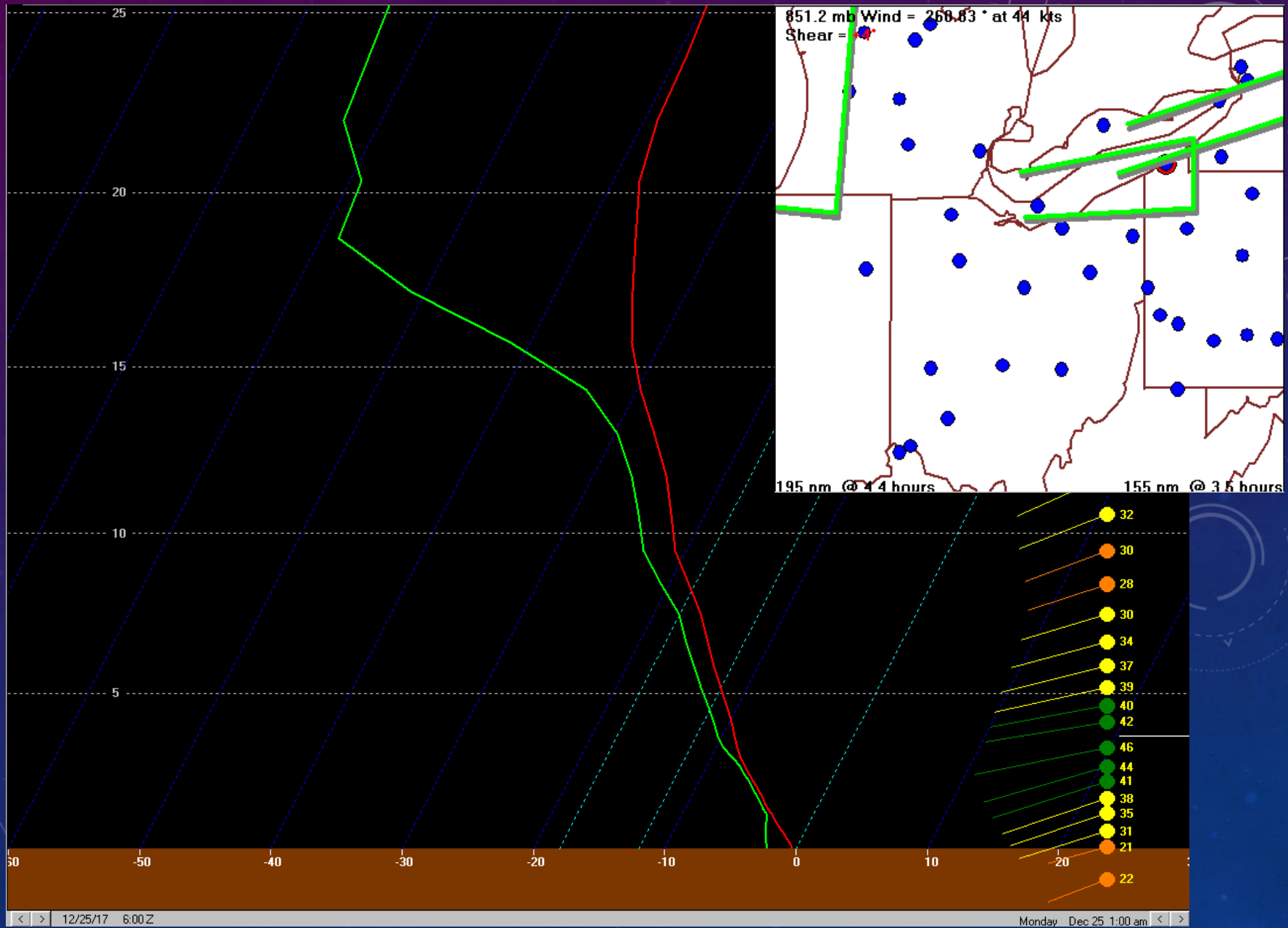
BUFKIT SOUNDINGS/TRAJECTORIES- 00Z 25 DEC 2017- ERIE, PA



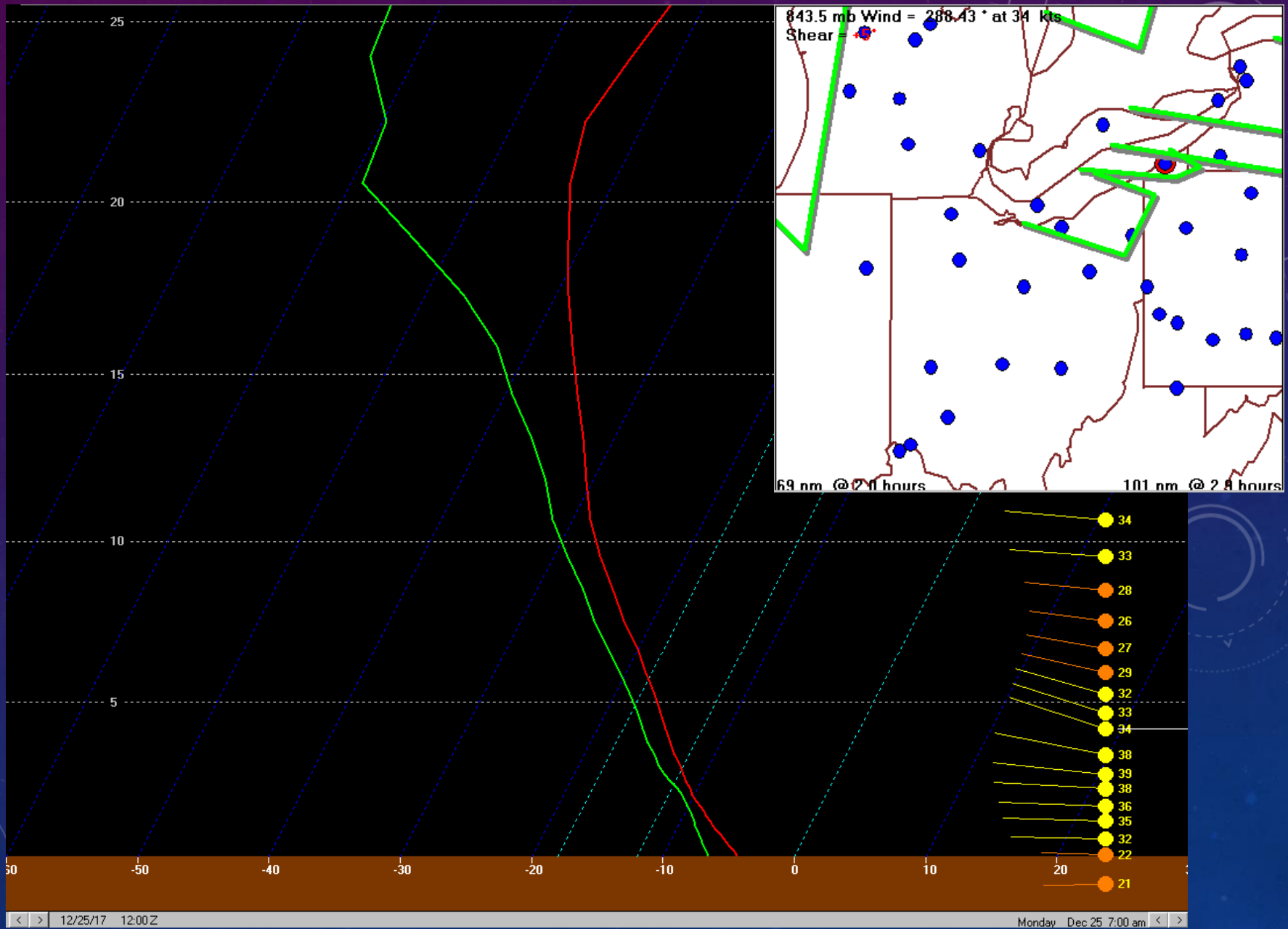
BUF SOUNDING- 00Z 25 DEC 2017



06Z 25 DEC 2017- ERIE, PA



12Z 25 DEC 2017- ERIE, PA



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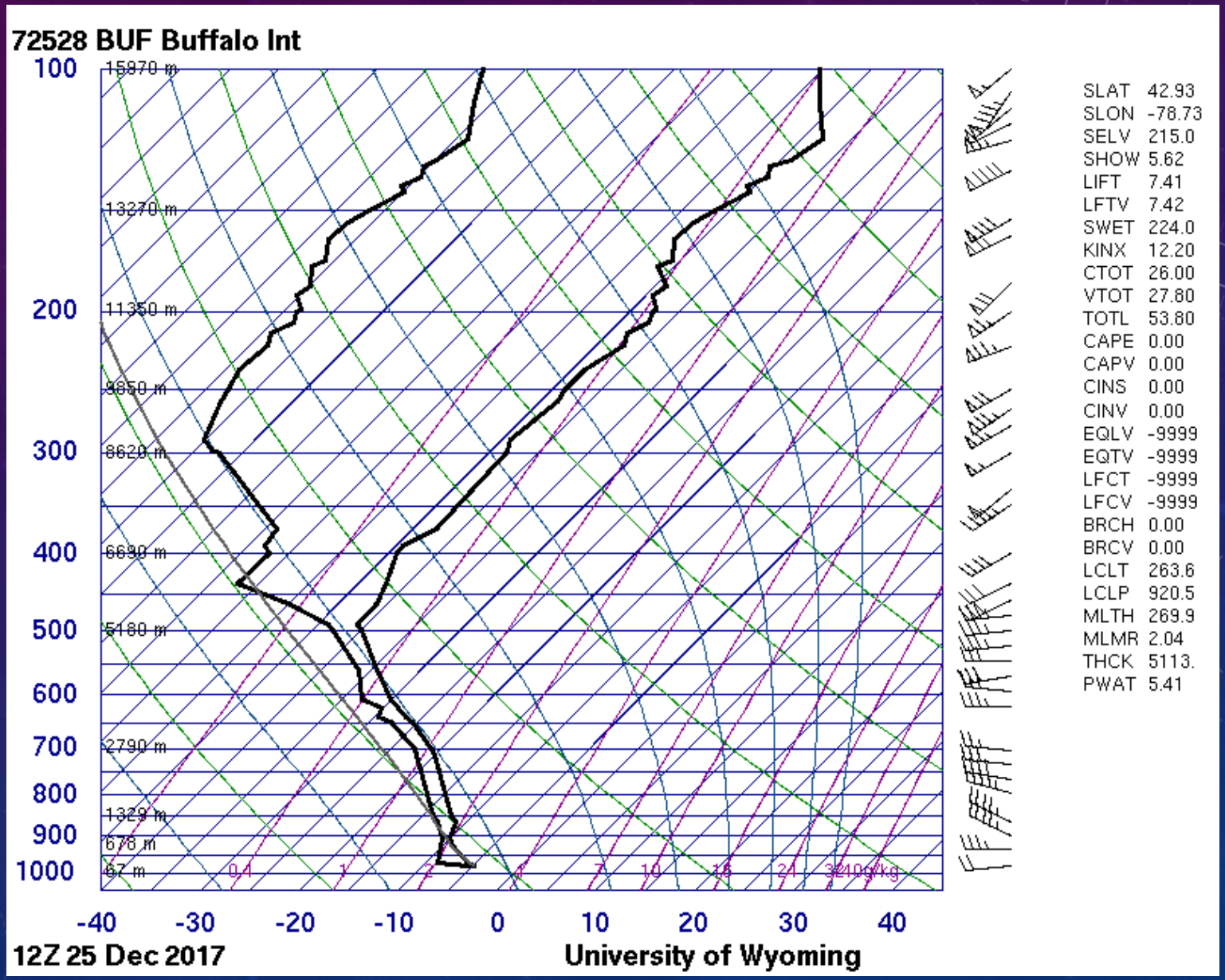
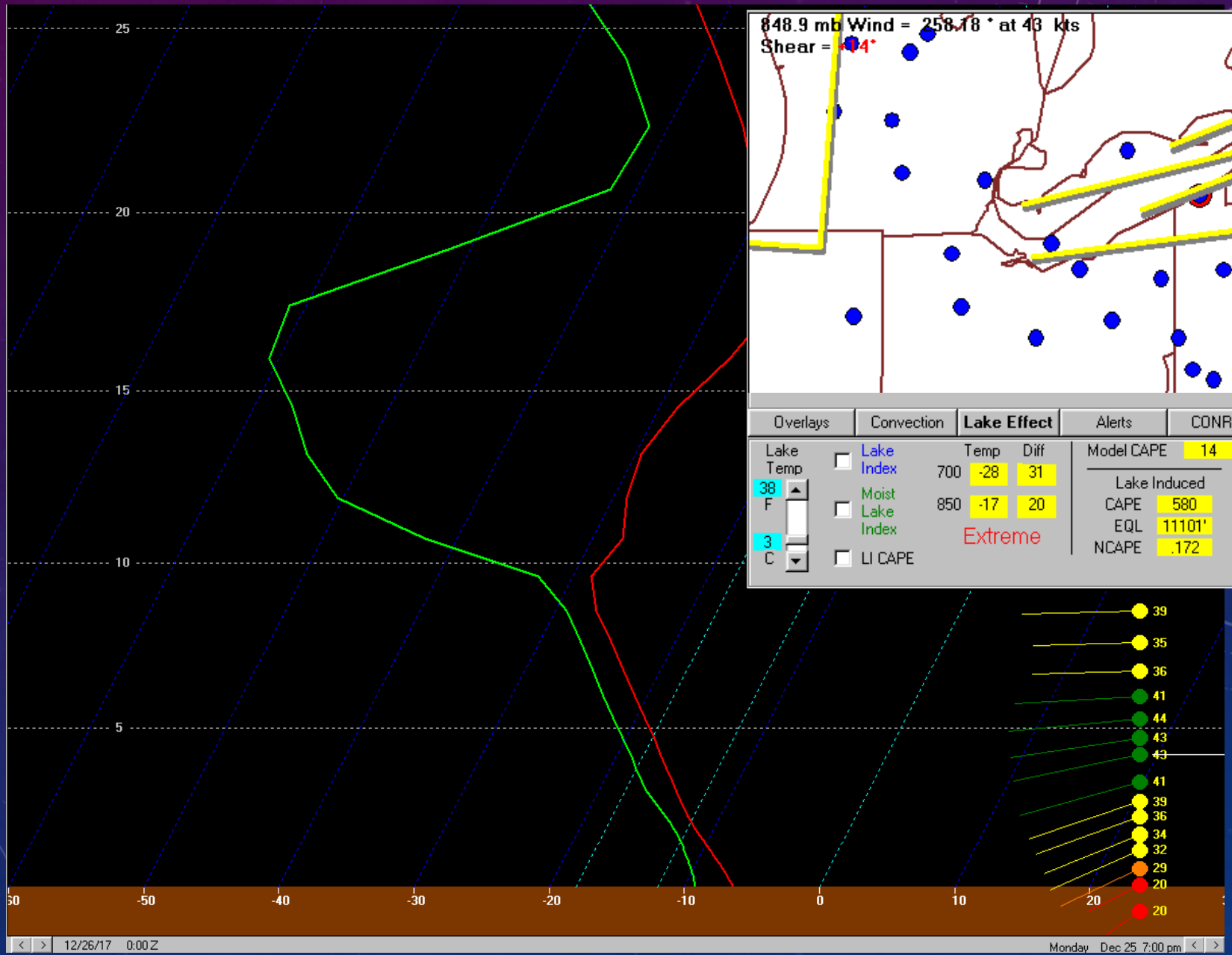


00Z 26 DEC 2017- ERIE, PA



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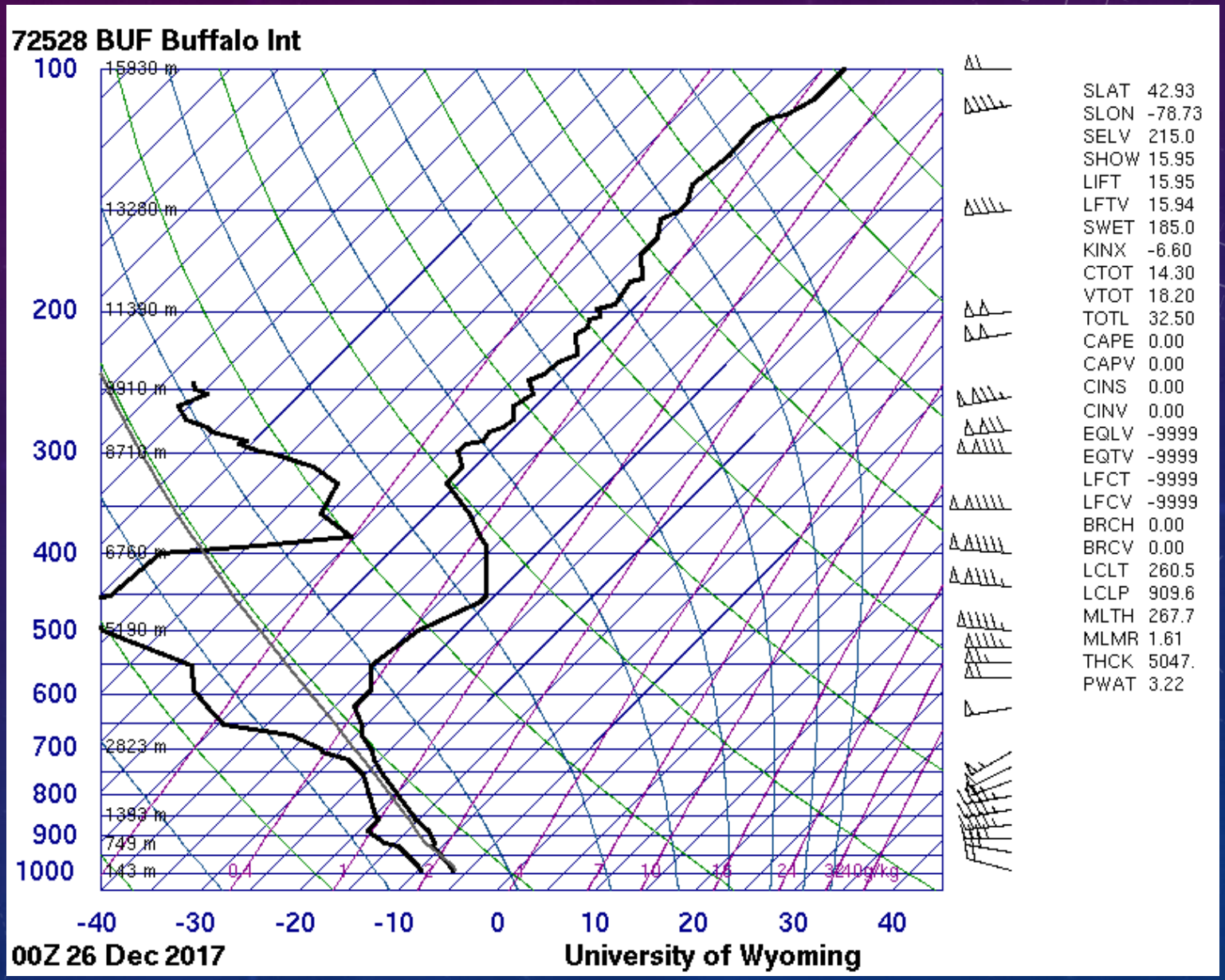
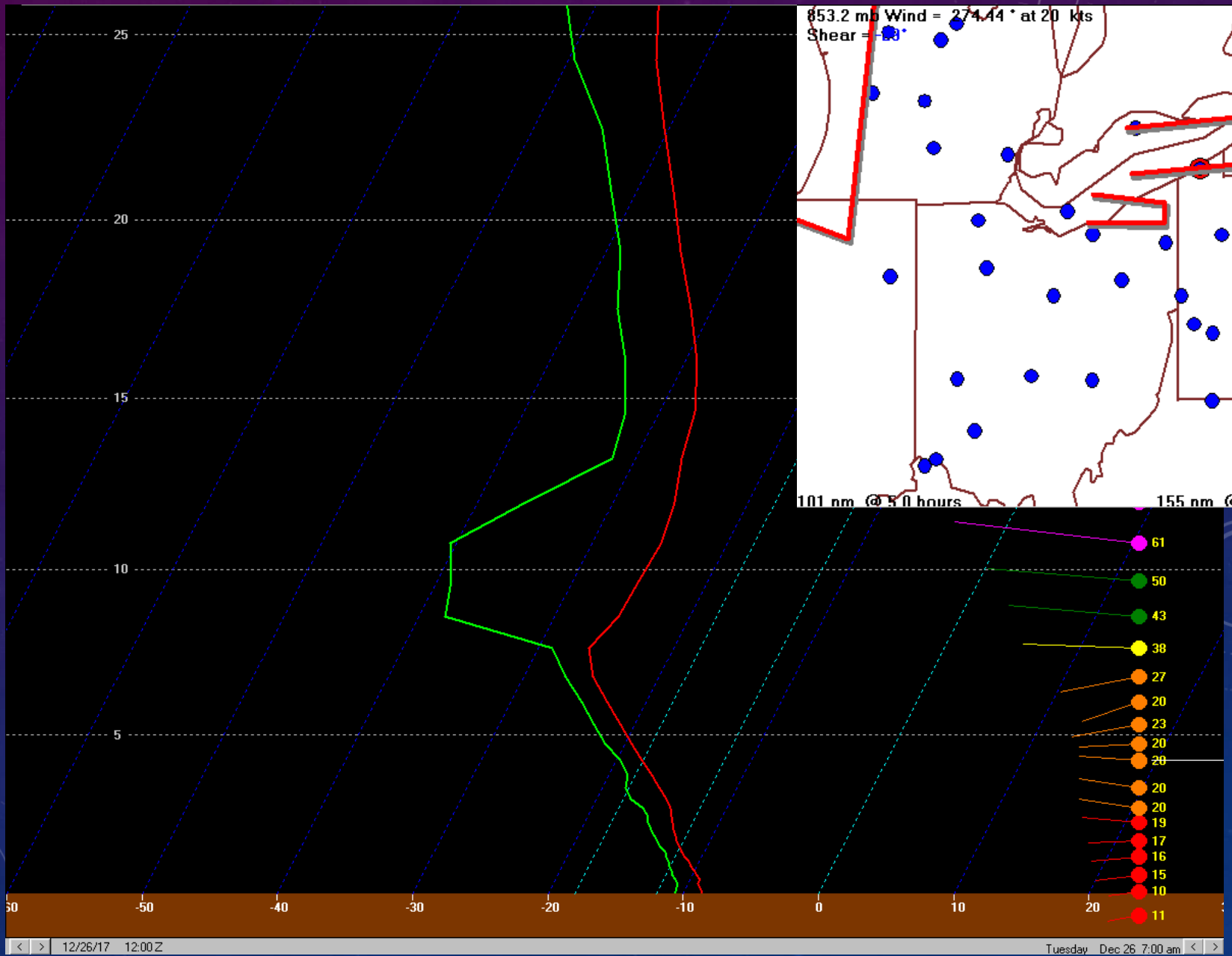
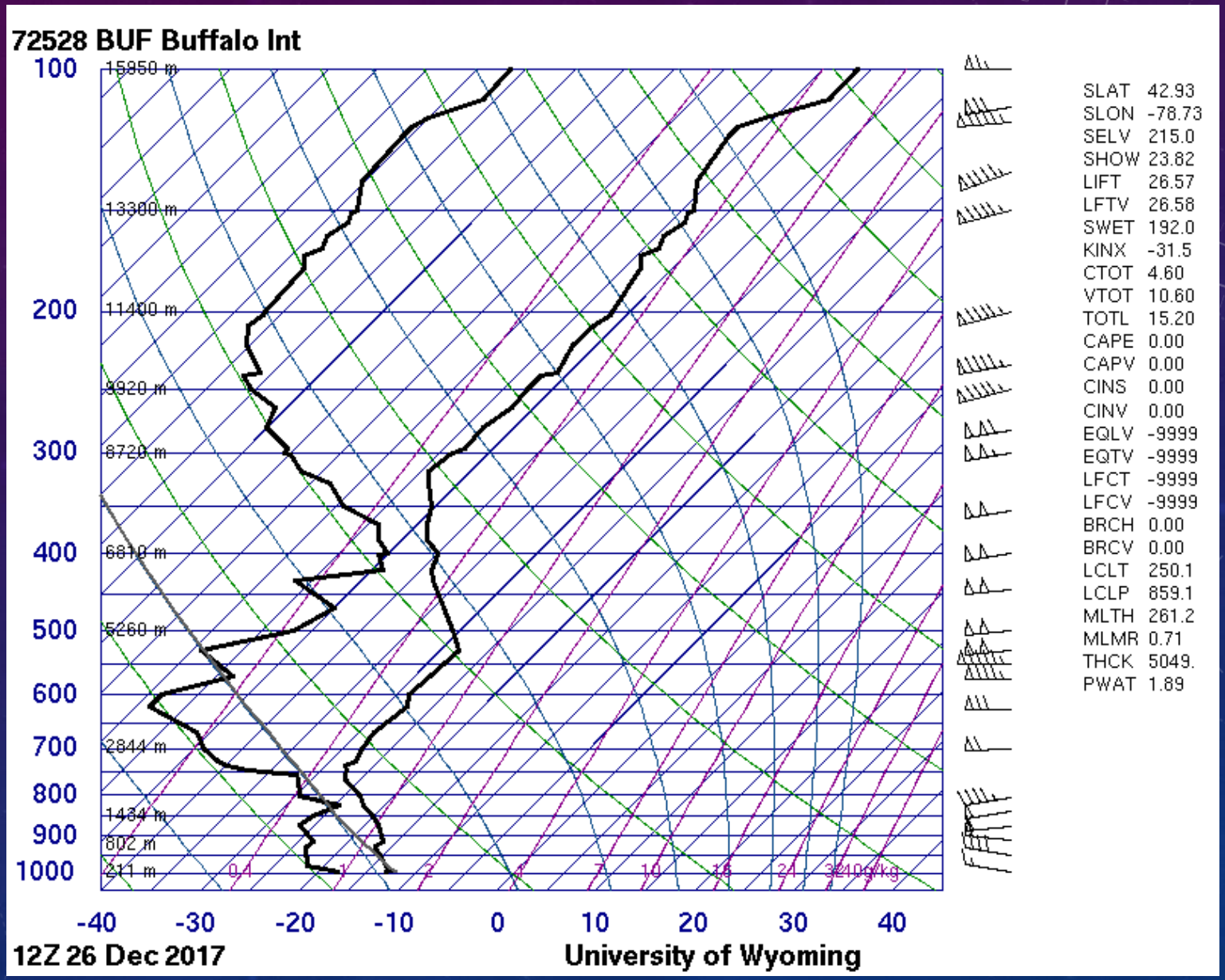


12Z 26 DEC 2017- ERIE, PA

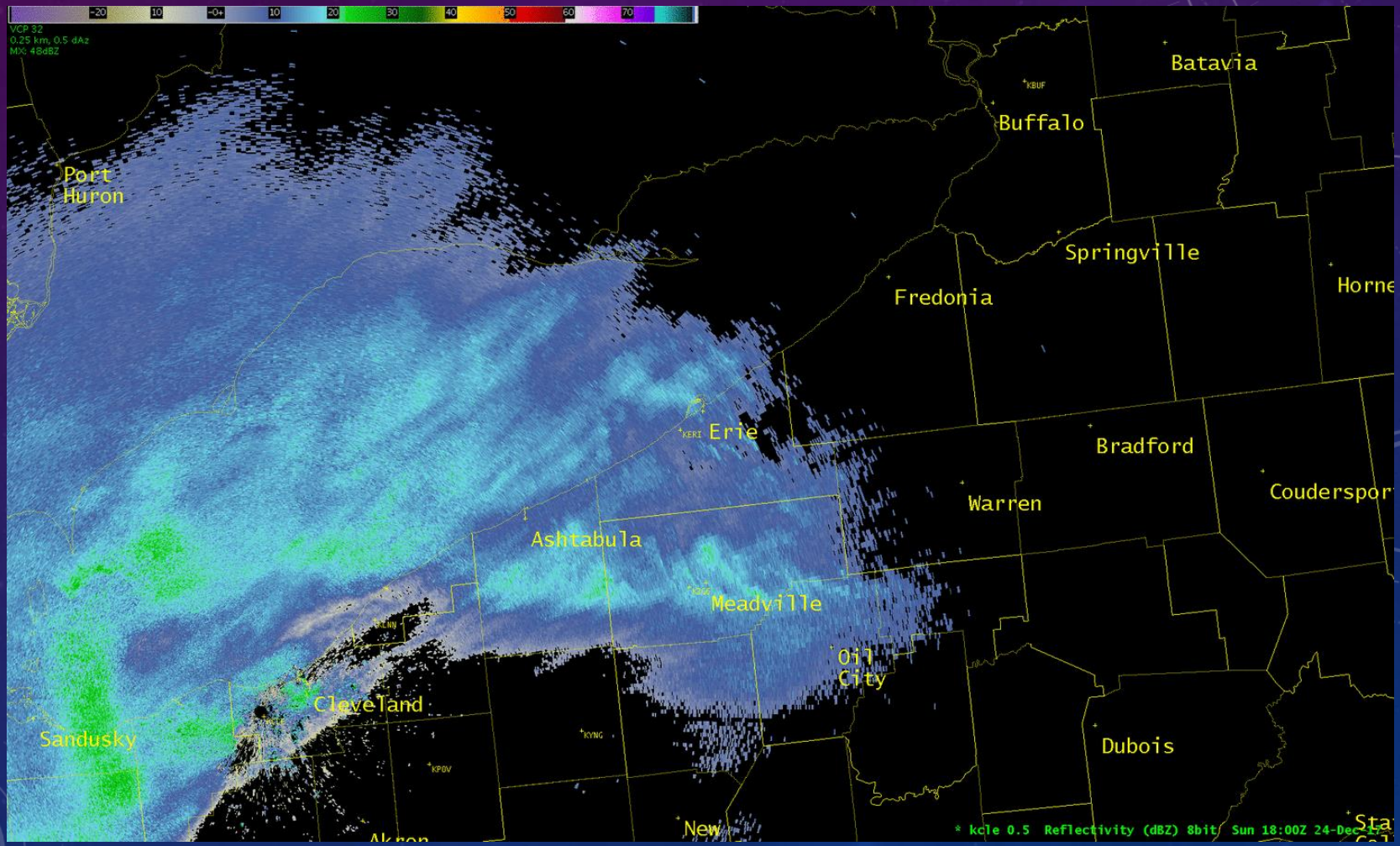


BUF SOUNDING- 12Z 26 DEC 2017

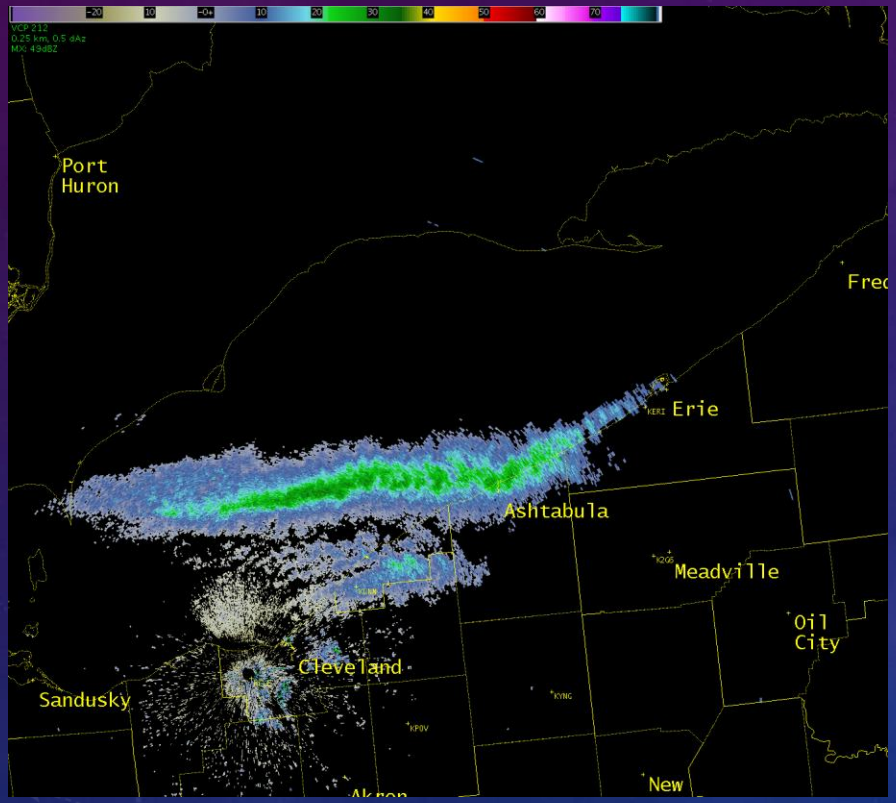


RADAR AND SATELLITE DATA FROM THE 25-26 DECEMBER 2017 EVENT

RADAR DATA

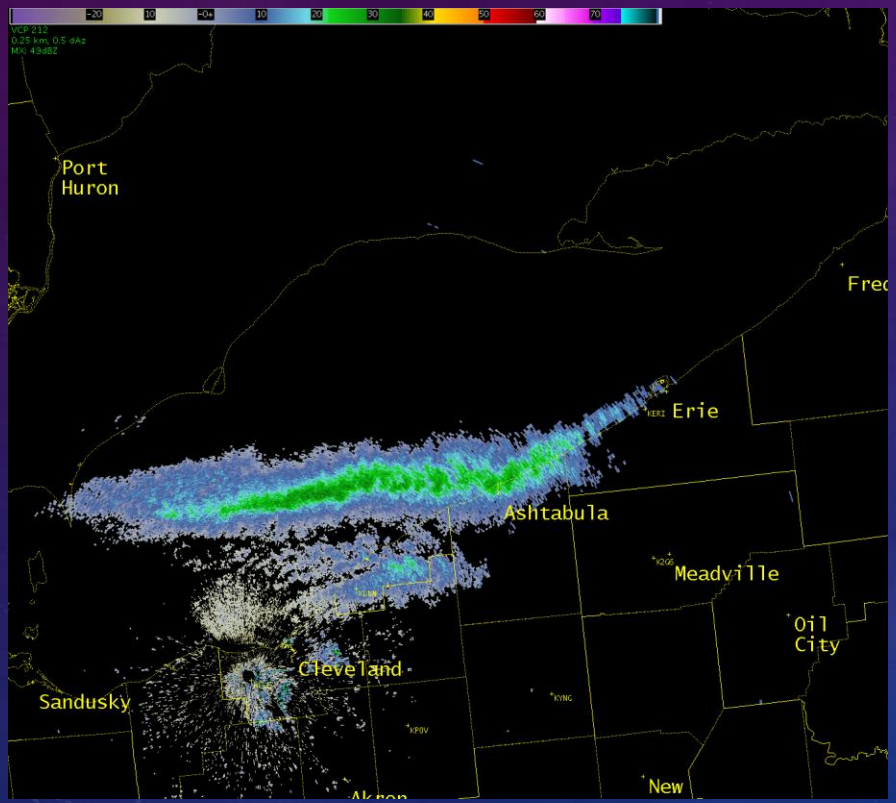

VCP 32
0.25 km, 0.5 dAz
MX: 48dBZ
Batavia
KBUF
Buffalo
Port Huron
Springville
Fredonia
Horne
KERI
Erie
Bradford
Warren
Couderspor
Ashtabula
Meadville
Oil City
Cleveland
Sandusky
KYNG
KFDY
Dubois
New
* kcle 0.5 Reflectivity (dBZ) 8bit Sun 18:00Z 24-Dec

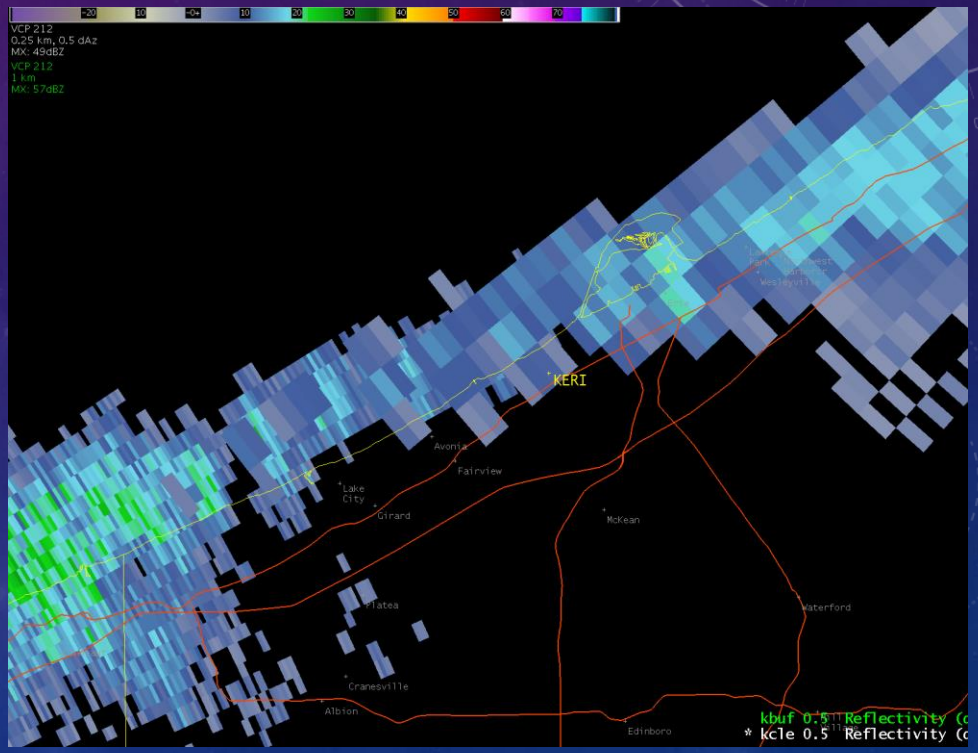
ERIE RADAR PROBLEM



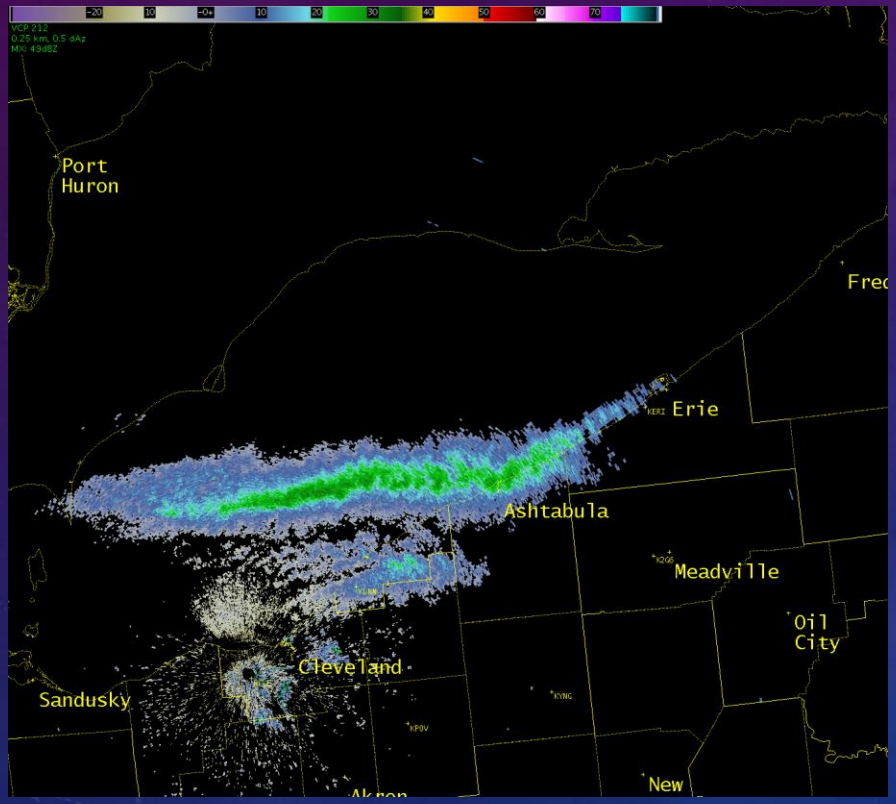
- Erie is about 100 miles ENE of the KCLE radar and 100 miles SW of the KBUF radar
- Both radars 0.5° slice is about 10,000 feet above the city of Erie
- Therefore, the radars overshoot the lake effect snow in NW PA and we cannot see it although it is occurring
- Solutions:
  - Composite reflectivity and interpolate
  - GOES-16!!

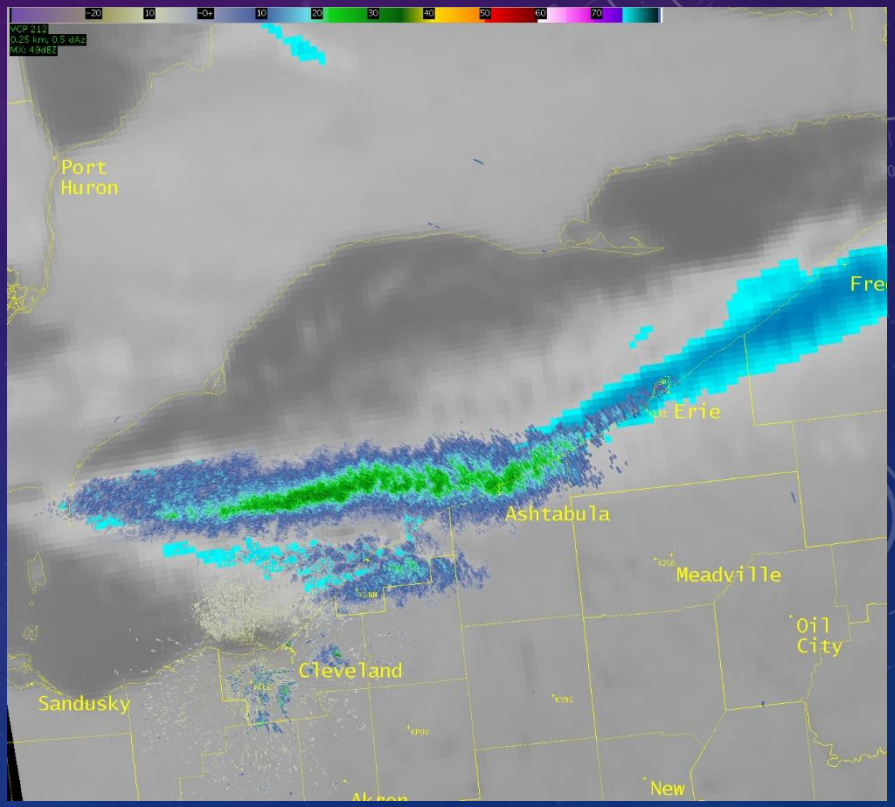
ERIE RADAR SOLUTION- COMPOSITE REFLECTIVITY



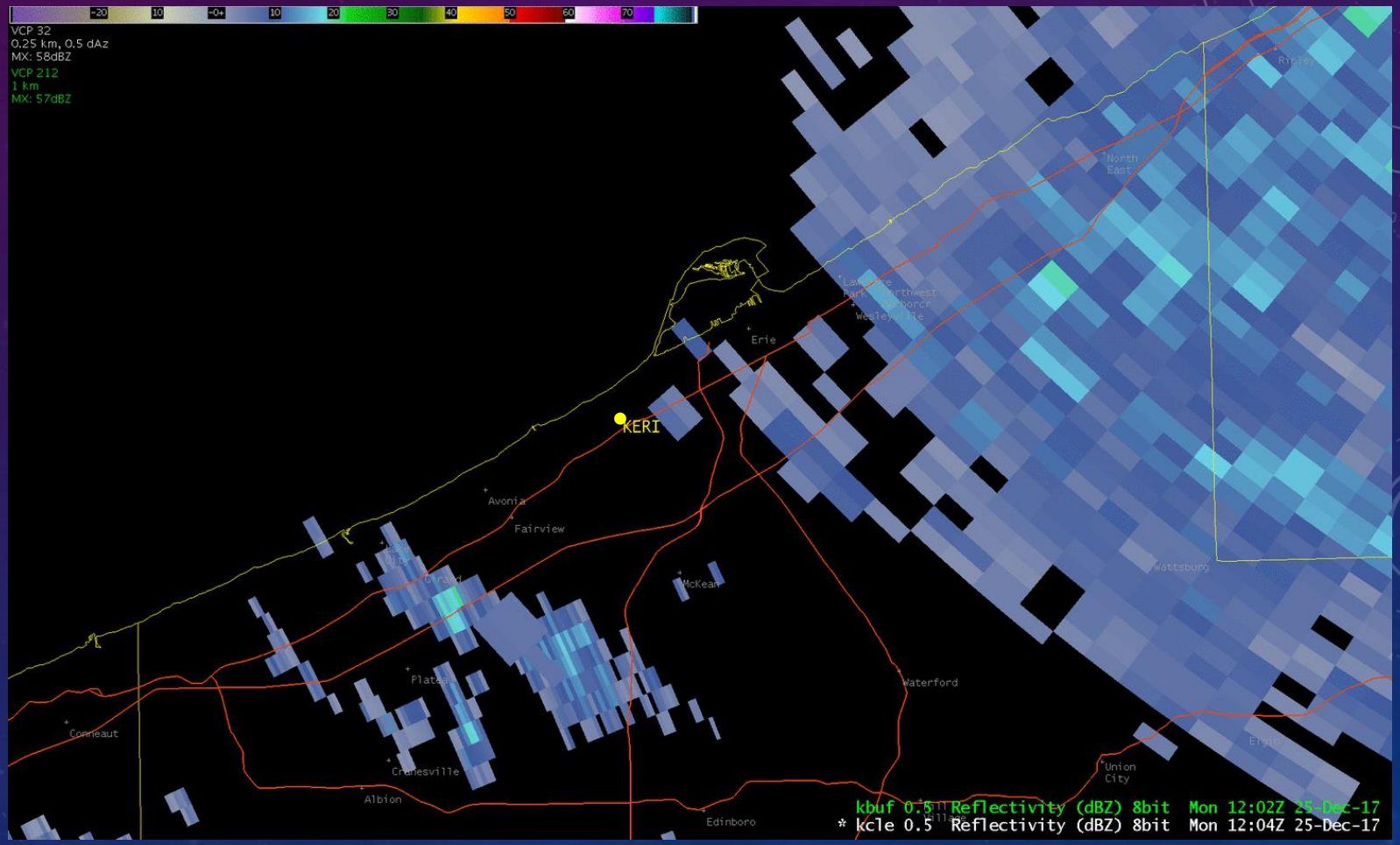


ERIE RADAR SOLUTION- GOES 16 OVERLAY

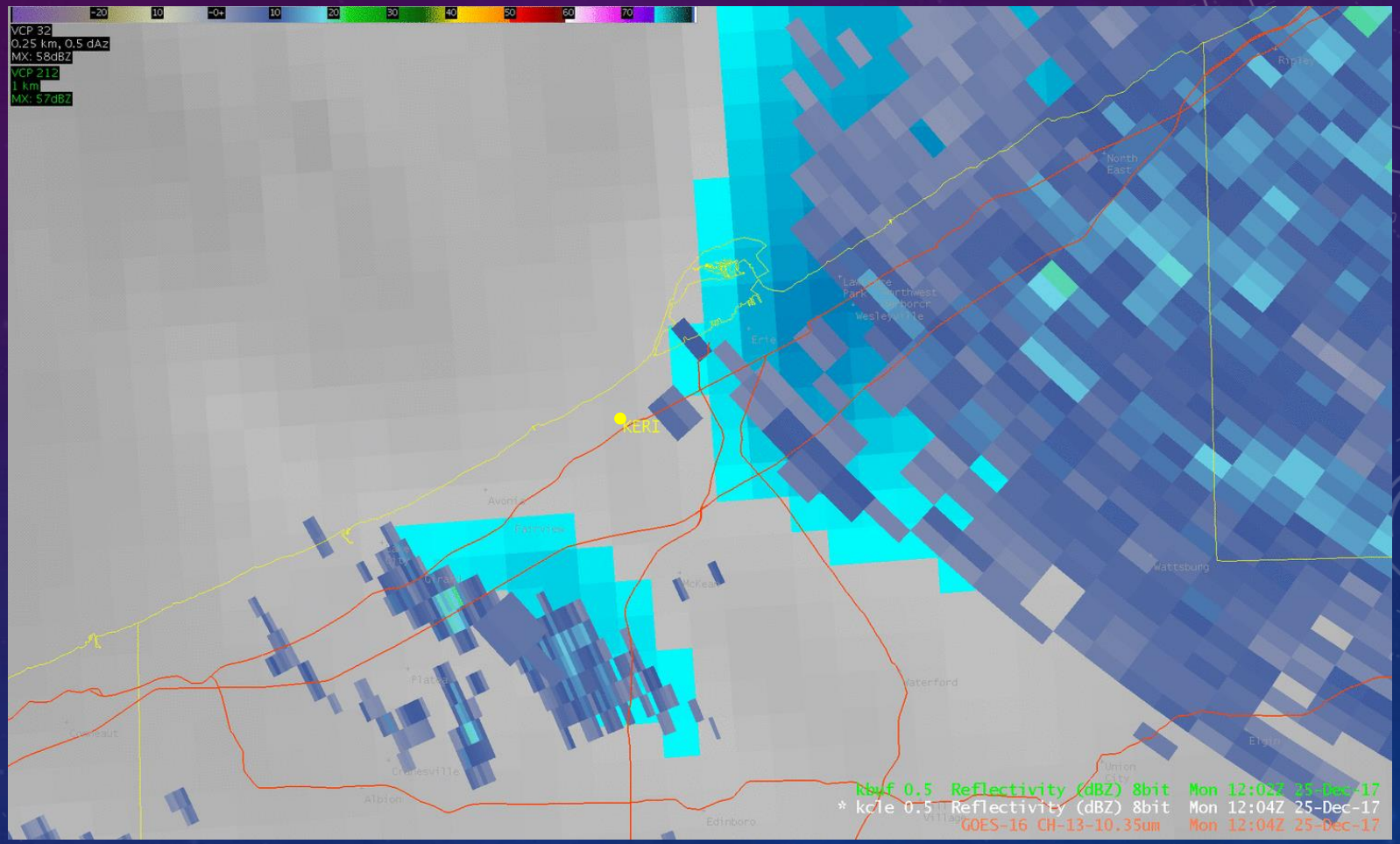




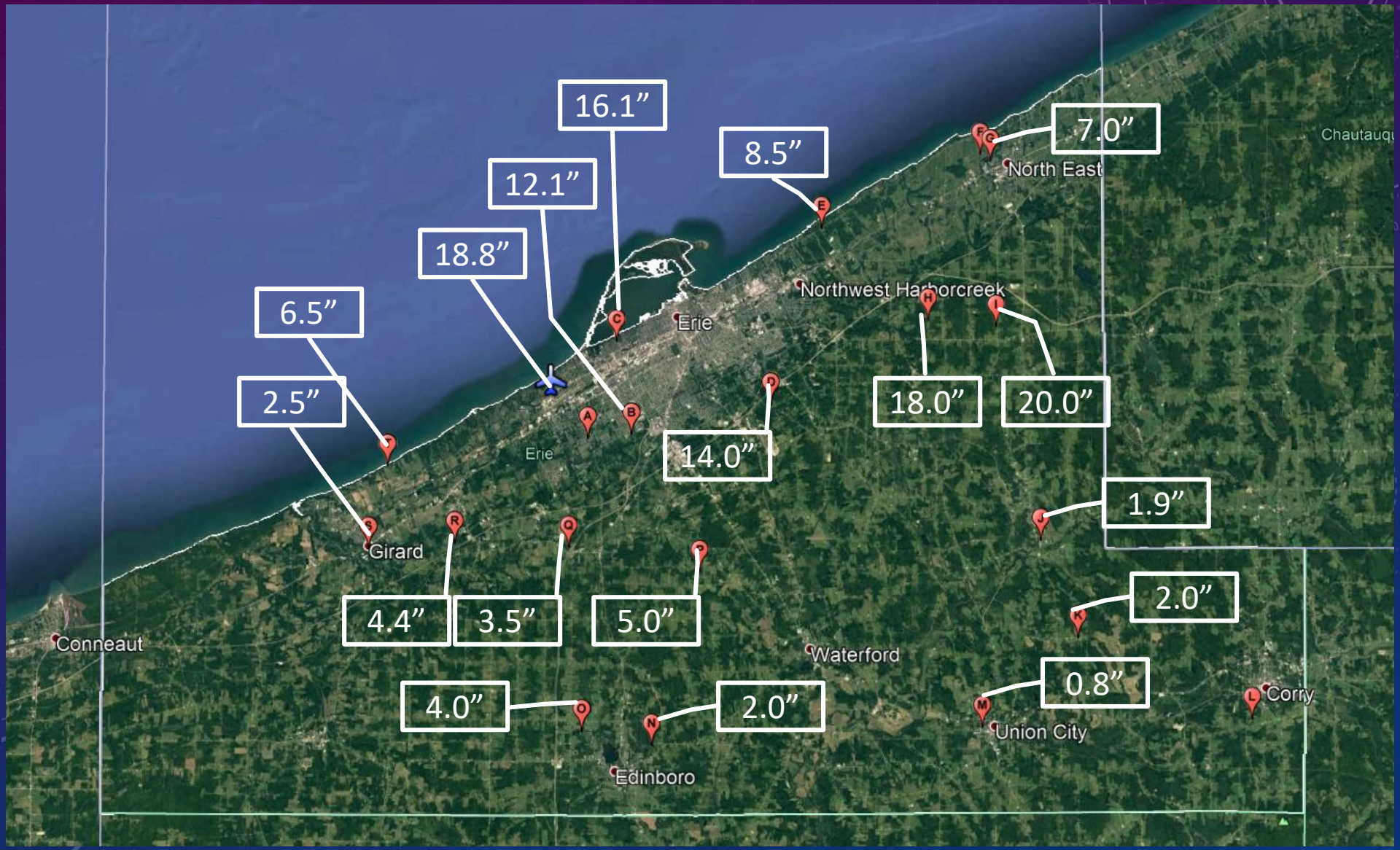
ZOOMED-IN COMPOSITE REFLECTIVITY



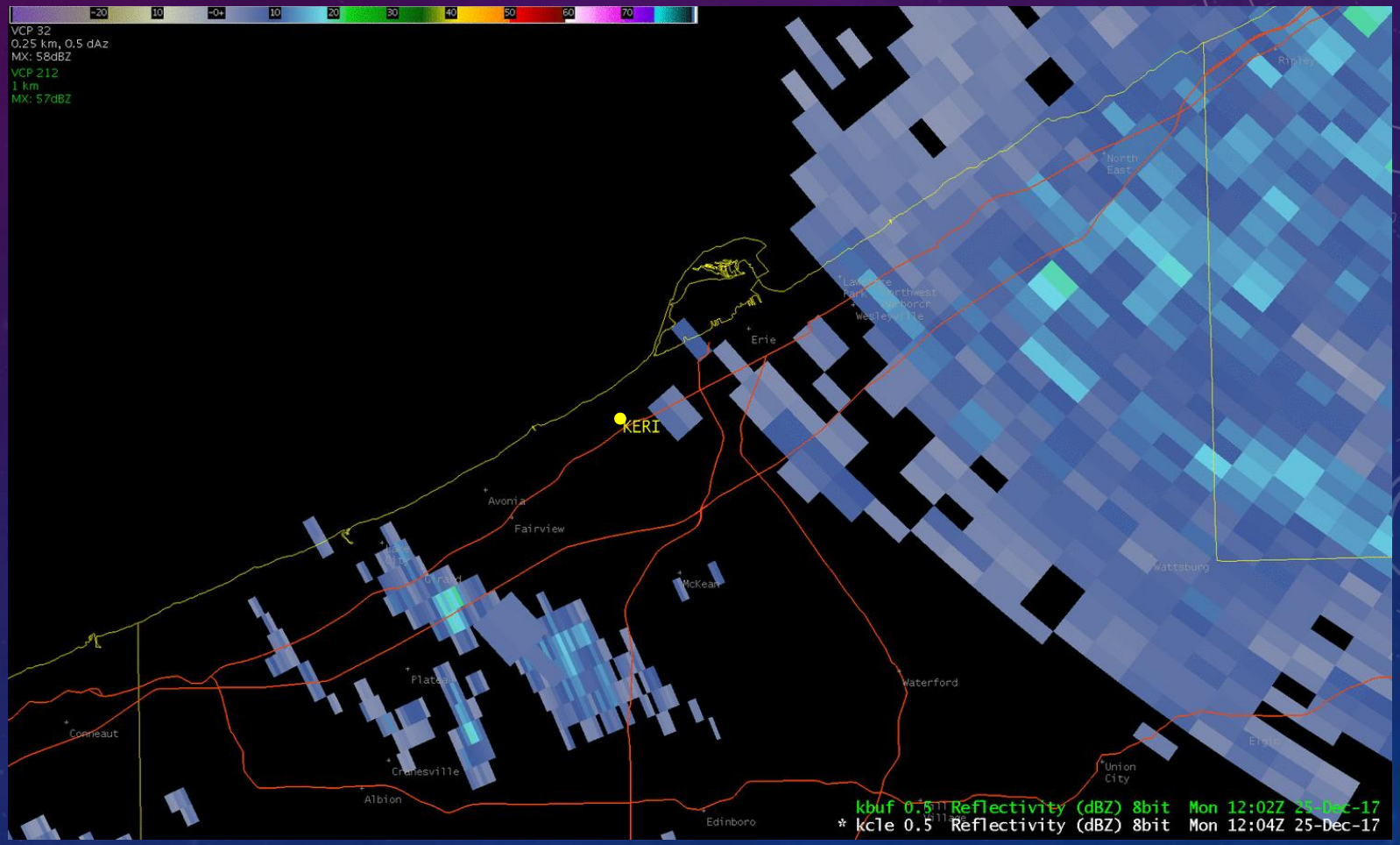
ZOOMED-IN COMPOSITE REFLECTIVTY + GOES 16



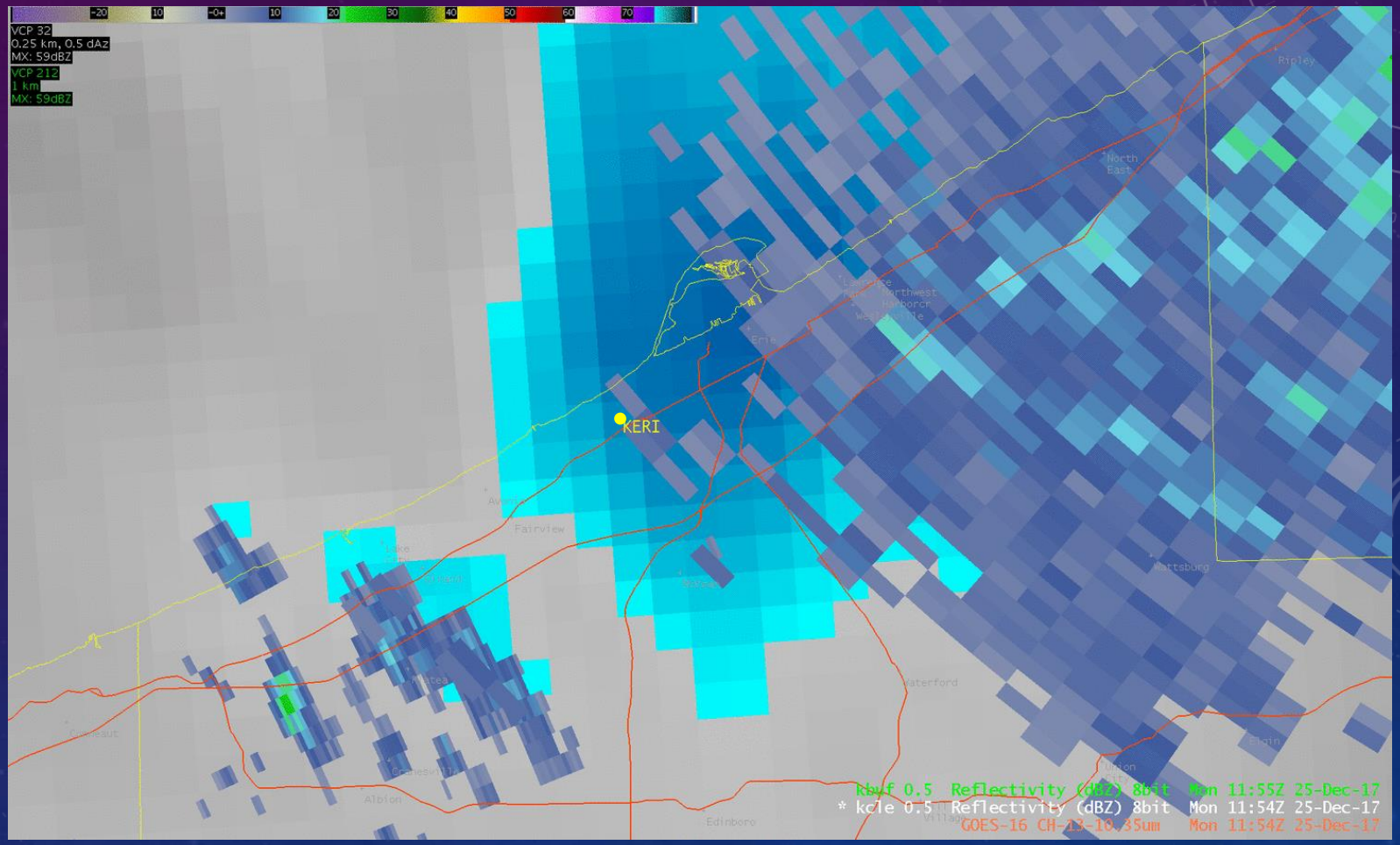
MAP OF 12 HOUR TOTALS (7AM 12/25 TO 7PM 12/25)



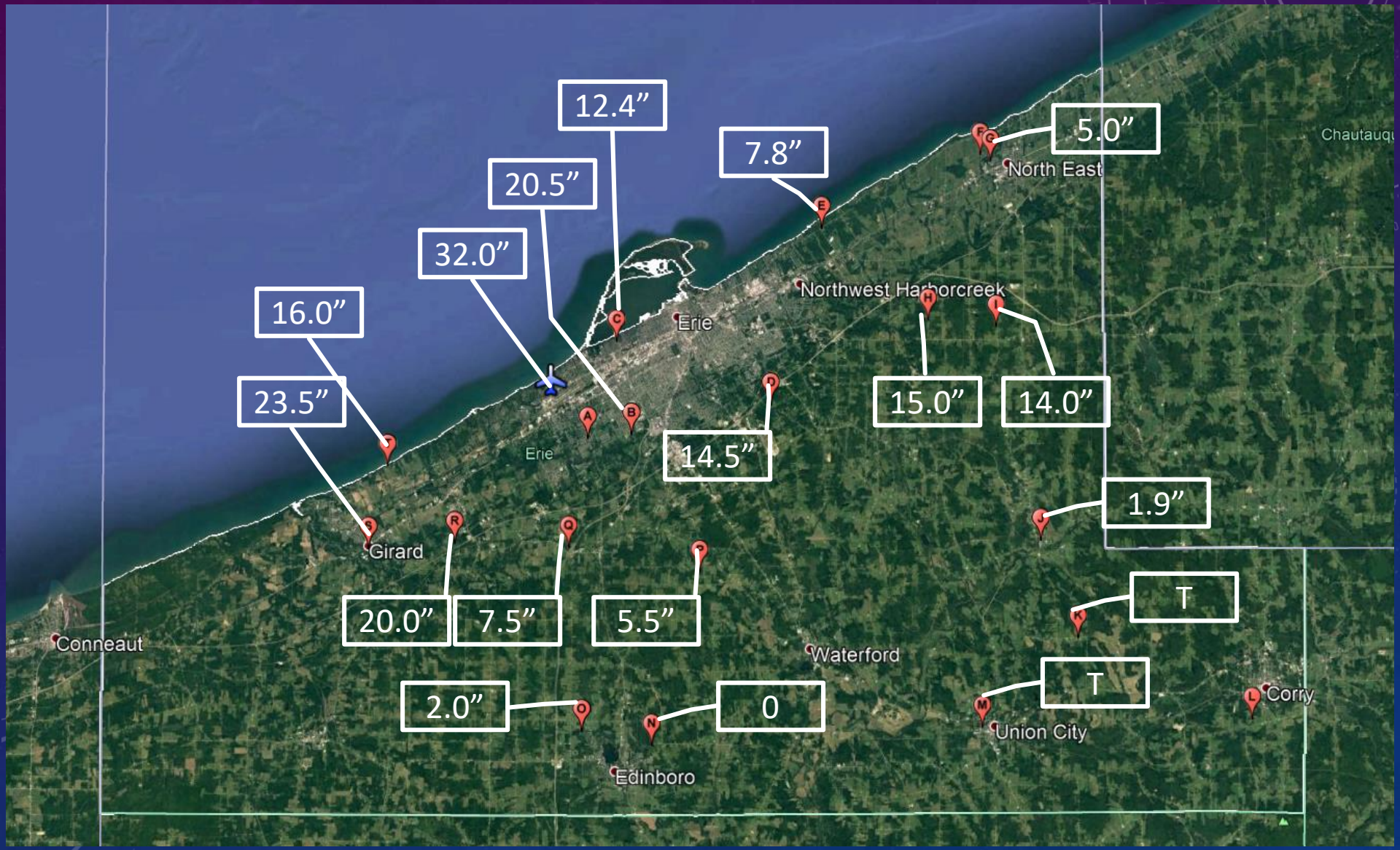
ZOOMED-IN COMPOSITE REFLECTIVITY
(7 AM 12/25 TO 7 PM 12/25)



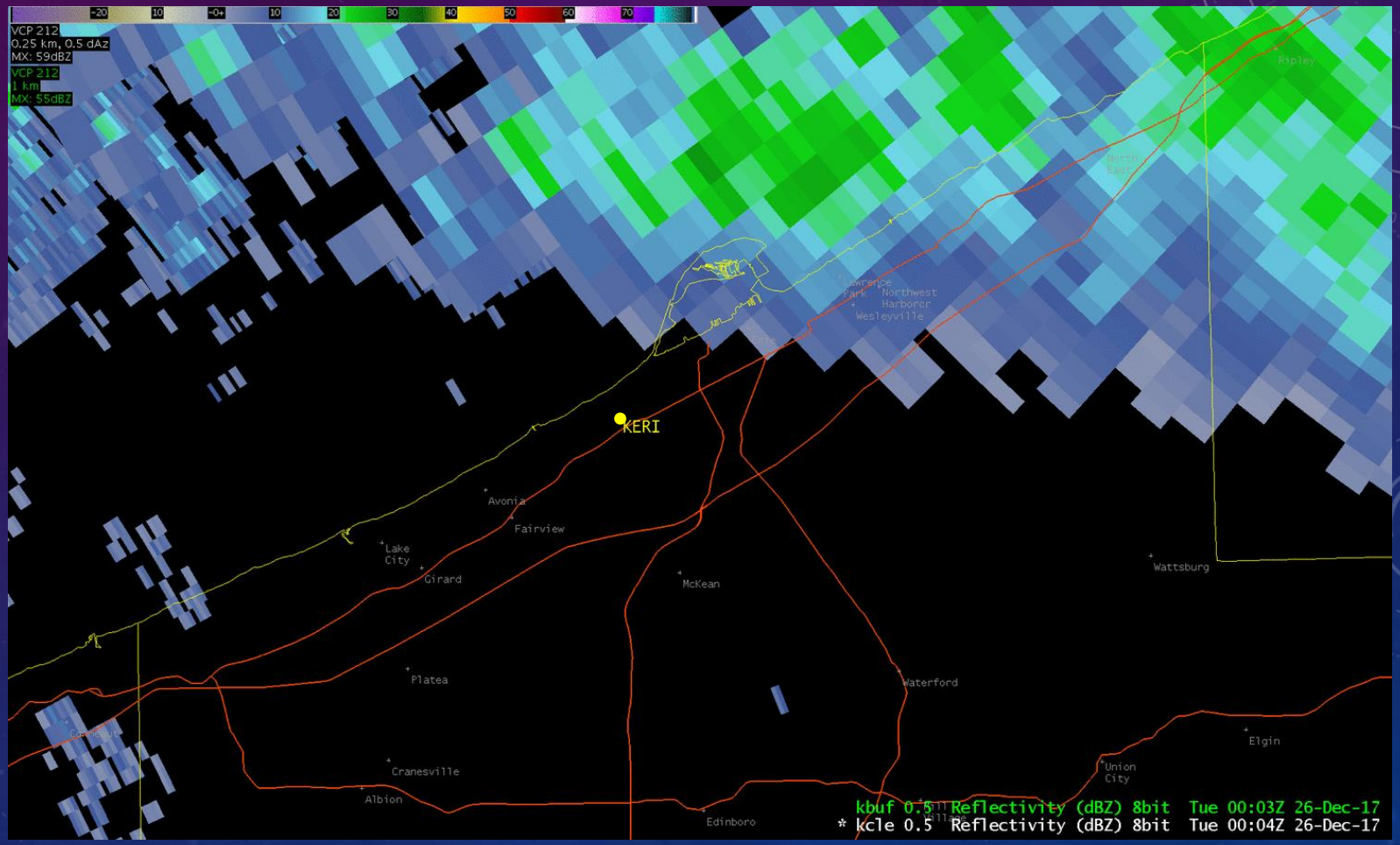
ZOOMED-IN COMPOSITE REFLECTIVITY + GOES 16
(7 AM 12/25 TO 7 PM 12/25)



MAP OF 12 HOUR TOTALS (7PM 12/25 TO 7AM 12/26)

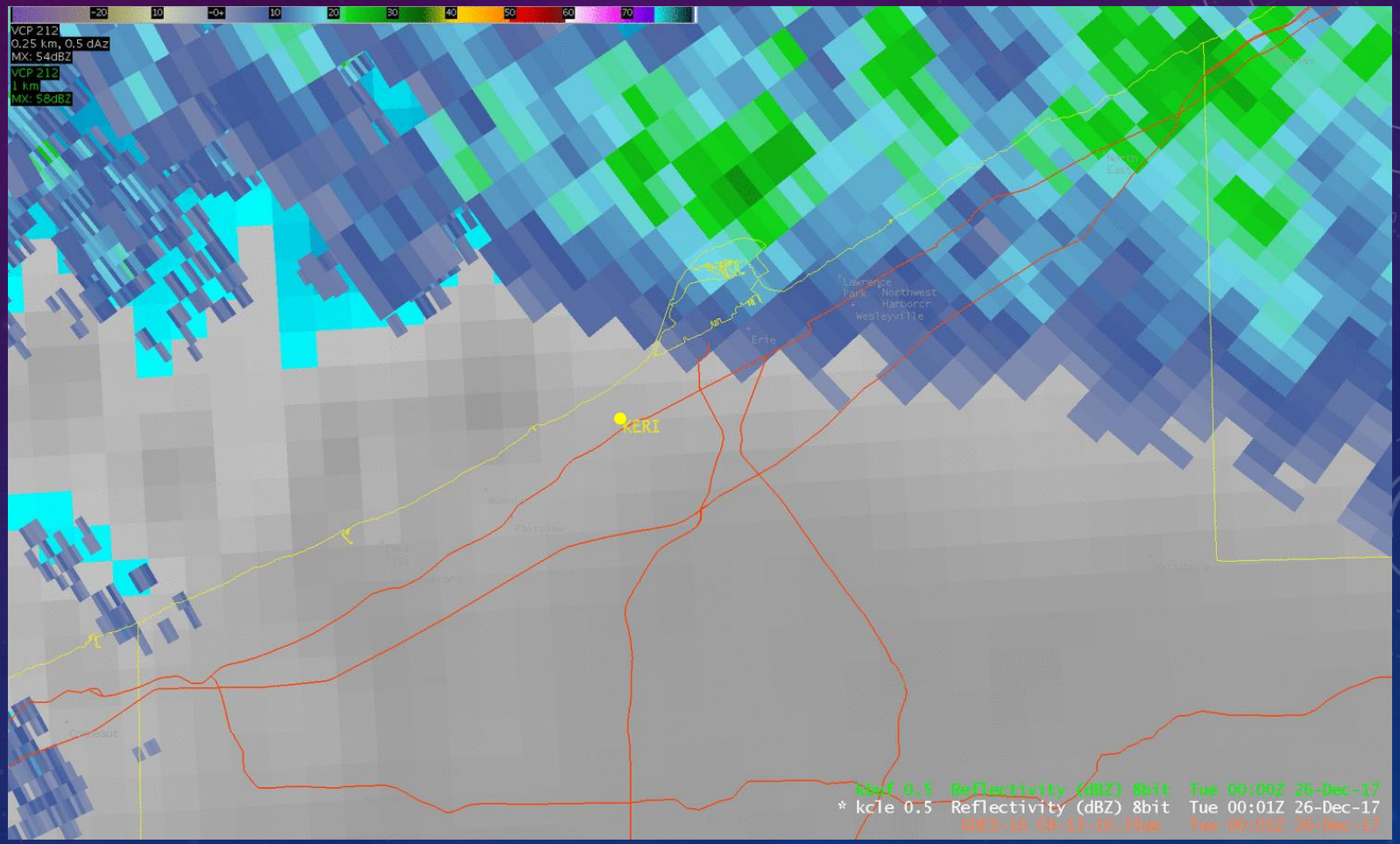


ZOOMED-IN COMPOSITE REFLECTIVITY
(7 PM 12/25 TO 7 AM 12/26)

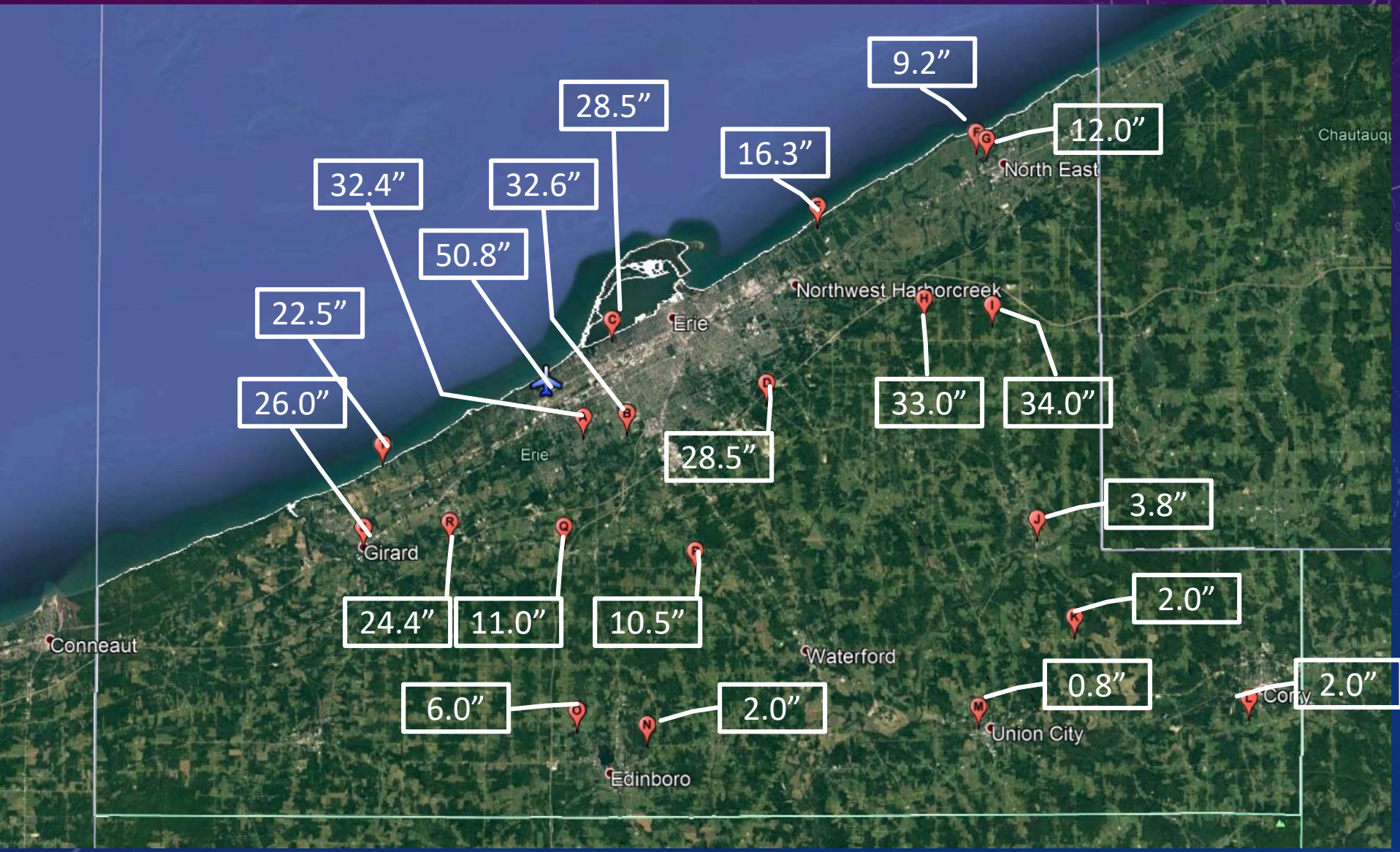


ZOOMED-IN COMPOSITE REFLECTIVITY + GOES 16

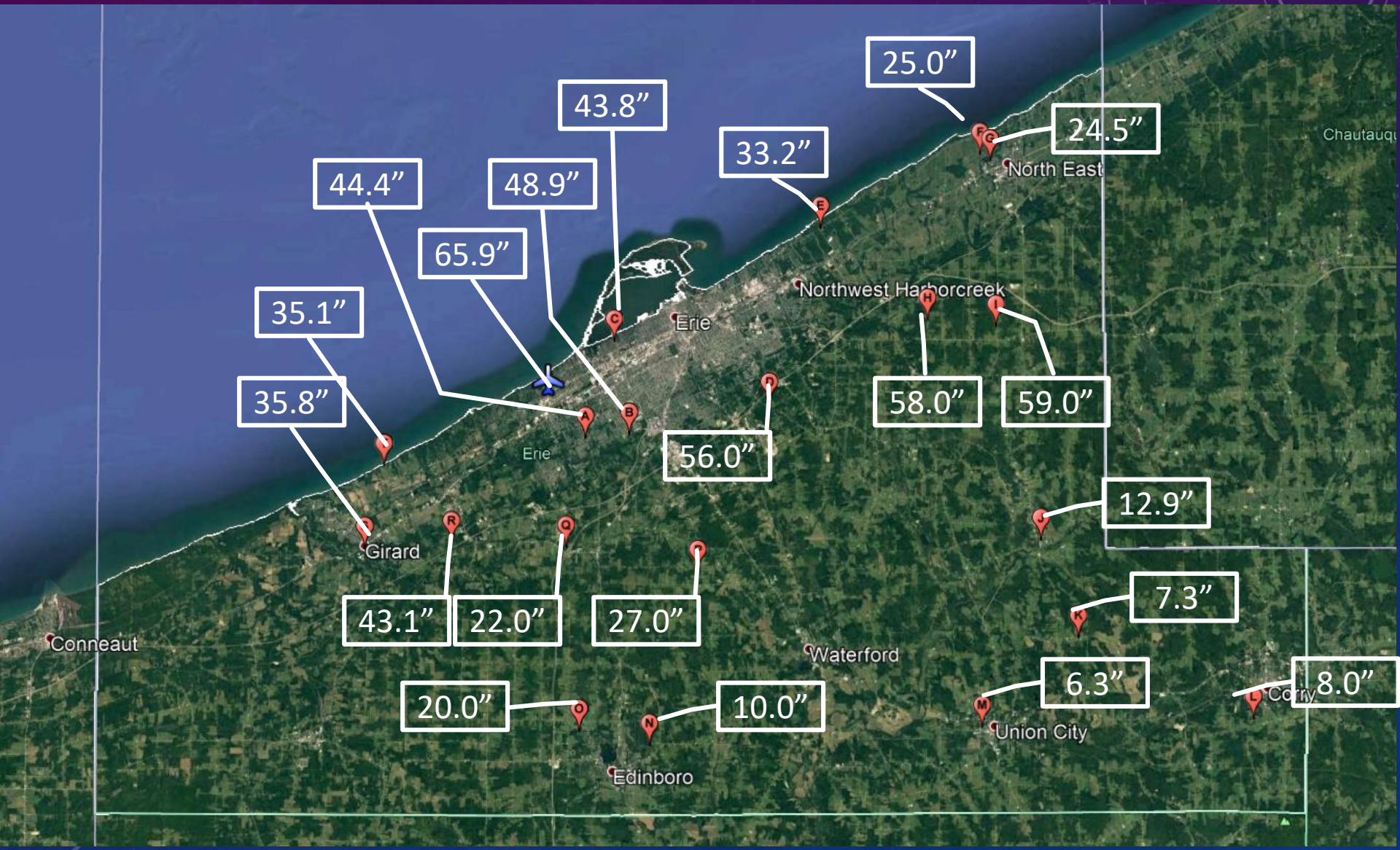
(7 PM 12/25 TO 7 AM 12/26)



MAP OF 24 HOUR TOTALS (7 AM 12/25 TO 7 AM 12/26)



MAP OF EVENT TOTALS- 24-28 DECEMBER 2017



WHY DID THE ERIE AREA GET MORE SNOW THAN FORECASTED/MODELED?

Some suggestions:

- Second band became anchored over the area- Convergence at the surface
- Models (especially the hi-res) tried to push the band south too quickly
  - (A whole different presentation in itself- However WPC had a webinar to discuss)
- Warmer lake temperatures allowed for better thermodynamics
  - Better snowfall rates (3-4”/hour vs. 1-2”/hour)

IMPACTS FROM THE 25-26 DECEMBER 2017 EVENT

- Significant impacts occurred due to snow on 25-27 December
- States of Emergency were declared for the city of Erie, Millcreek Township ("Suburban Erie"), and Erie County, PA
- Most roads, including Interstate 90, became impassable during the event
- Several roof collapses occurred during or shortly after this event due to the weight of snowfall
- Christmas Day plans ruined, as most stayed home
- Widespread National and International Media Coverage, including the Associated Press, Reuters, CNN, Wall Street Journal, among others

PHOTOS FROM ERIE AIRPORT DURING THE EVENT

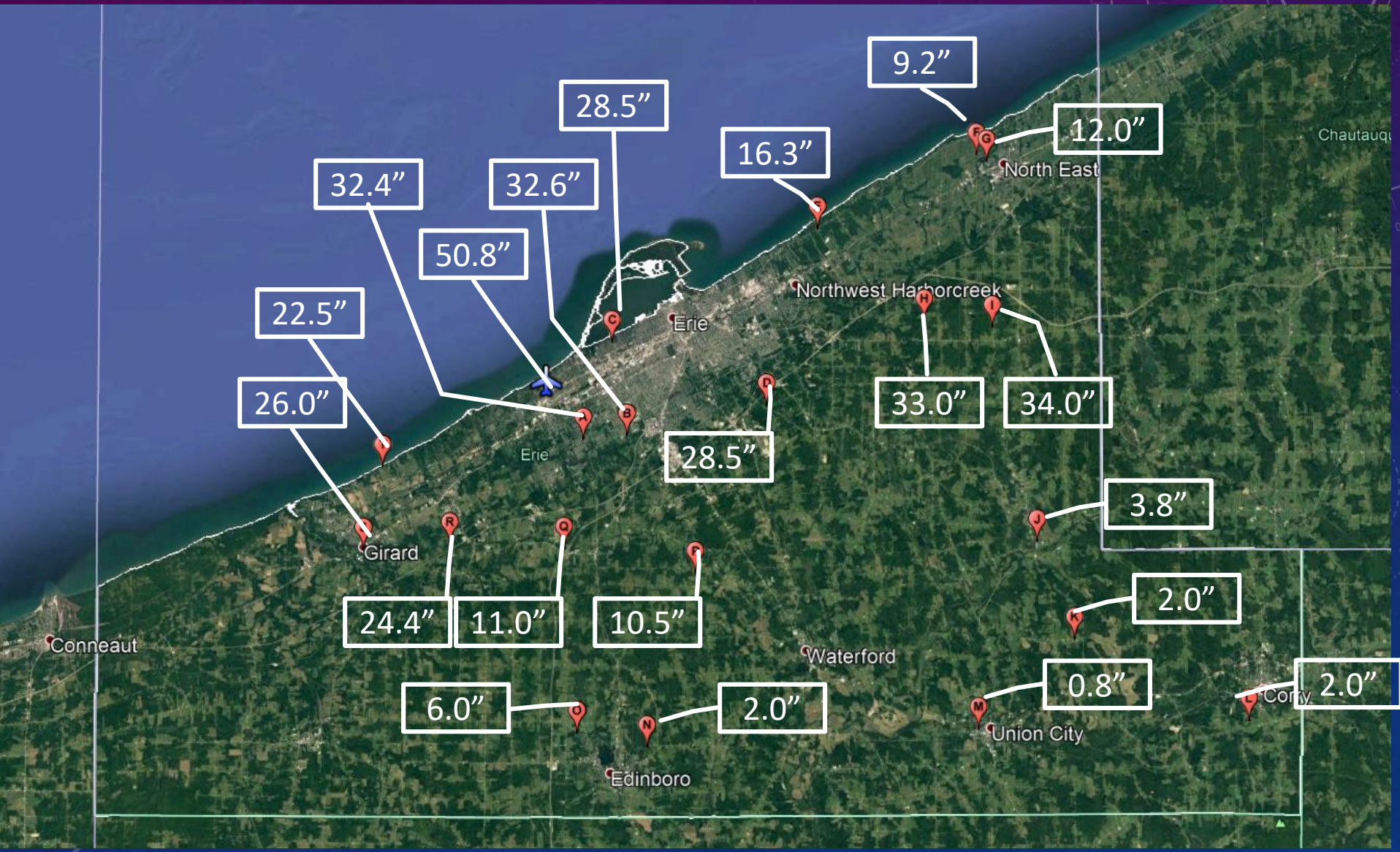
PHOTOS FROM ERIE AIRPORT DURING THE EVENT

SNOWFALL AT ERIE THROUGH DECEMBER 28TH

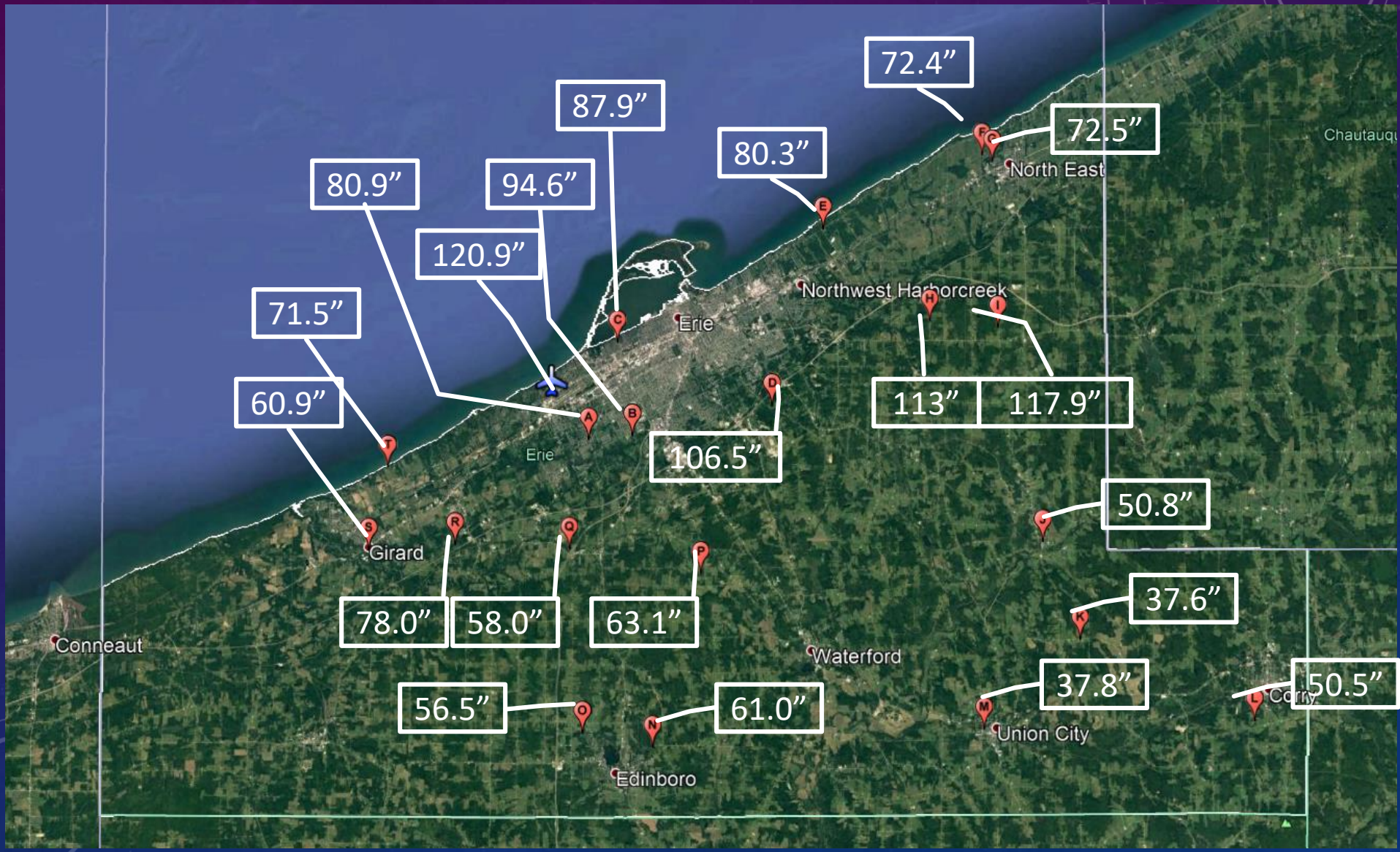
- December 2017 Monthly Snowfall: 103.1”
  - Average Snowfall through December 28th: 24.3”
  - Average December Snowfall: 27.5”
  - Record December Snowfall: 66.9”
- Winter 2017-2018 Seasonal Snowfall: 103.6”
  - Average Winter Season Snowfall: 100.9”
  - Record Winter Season Snowfall: 149.1”

DECEMBER 2017, ONE FOR THE RECORD BOOKS….

MAP OF 24 HOUR TOTALS (7 AM 12/25 TO 7 AM 12/26)



MAP OF MONTHLY TOTALS



STATE CLIMATE EXTREMES COMMITTEE (SCEC)

- NWS formal committee to analyze record-breaking events at the state and national levels
- Can look at any parameter, but there are specific time frames
- Committee Members include:
  - Local NWS Office
  - Impacted NWS Regional Climate Specialist
  - Impacted State Climatologist
  - Impacted Regional Climatologist
  - National Center for Environmental Information (NCEI) Representative

RECORDS UNDER CONSIDERATION – TBD

- 24 hour snowfall for the state of Pennsylvania
  - Previous Record: 38.0”- Morgantown, PA on 20 March 1958
  - Proposed New Record: 50.8”- Erie, PA beginning at 7 AM 25 December 2017 and ending at 7 AM 26 December 2017

- All time monthly snowfall for the state of Pennsylvania
  - Previous Record: None Officially in SCEC Database
  - Potential Previous Record: 113.0”- Laurel Summit, PA- February 2010
  - Proposed New Record: 120.9”- Erie, PA- December 2017

SUMMARY

- Lake-effect snow is challenging to forecast
- Extreme lake-effect snow events are even more difficult…
- Still some limitations to models on the mesoscale level
- This event will live in Erie PA lore and will be one for the record books for generations

- Finally… Be careful what you wish for… you just might get it!

THANKS FOR LISTENING!

ANY QUESTIONS?

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