February 1-2, 2021 Nor'easter

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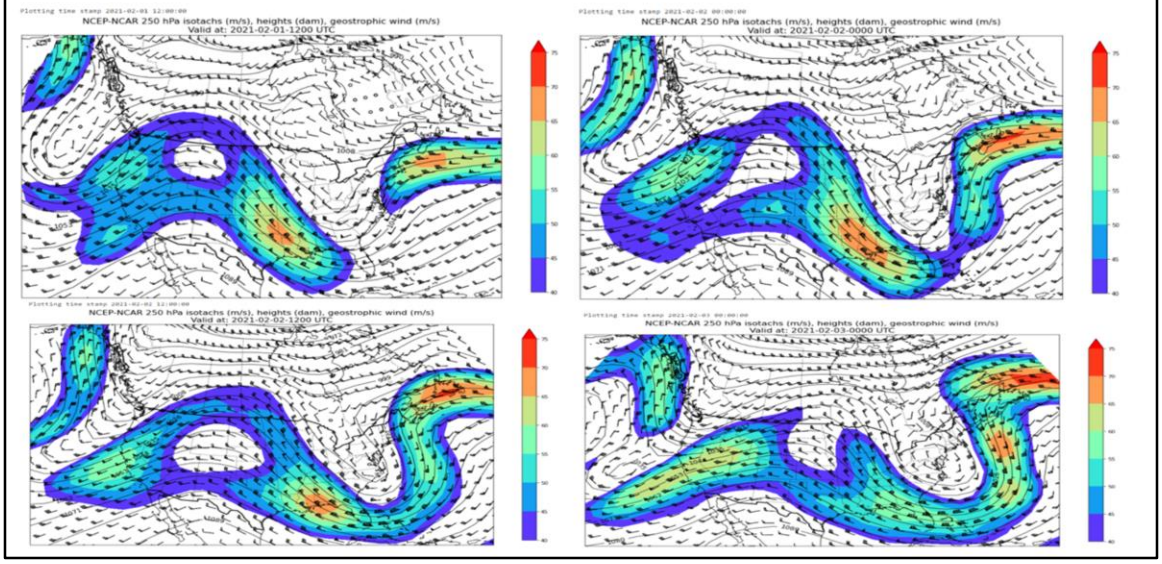
Outline

- Storm Overview
- Synoptic Overview
- Surface Analysis
- P-type Analysis
- NWS snowfall forecast vs. Verification
- Storm Impacts

Storm Overview

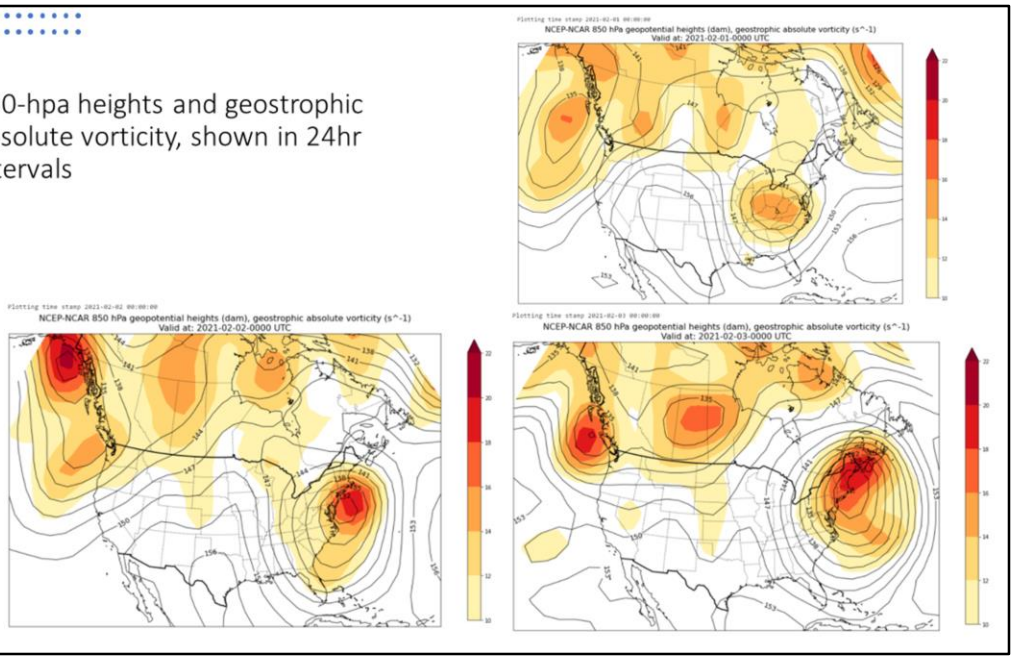
- The storm first developed as an extra-tropical cyclone off the Northwest US Coast, which resulted in an atmospheric river of moisture being directed into California
- The system encountered colder air as it moved through the Midwest, and most of the precipitation transitioned to snow. Once reaching the Ohio River Valley, the precipitation began to dissipate and re-develop along the East Coast as energy was transferred to develop a new surface low once again
- As the storm moved parallel to the Coast, a region of strong frontogenetical forcing increased in the Tri-State area and produced intense snowfall bands of 1-3 inches per hour.
- The low pressure became occluded after stalling near New Jersey, with the frontal boundaries remaining well offshore at the time. This allowed almost the entire Northeast to be entrained in a polar airmass with northerly winds, to receive all snow.

250-hpa isotachs(m/s) heights(dam), and Geostrophic winds(m/s)



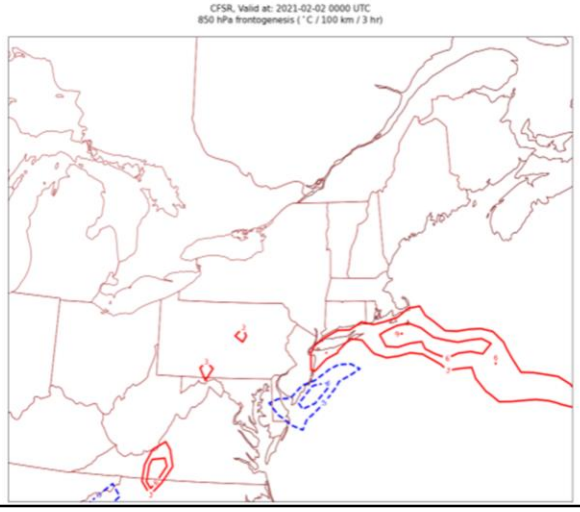
Phasing of two jet streaks can be seen at 00UTC Feb 2. Jet becomes enhanced and negatively tilted

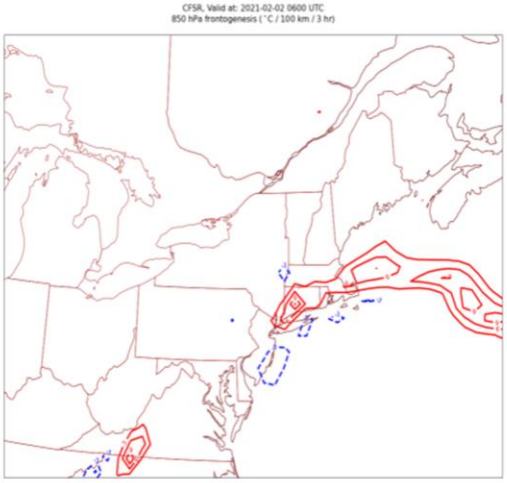
850-hpa heights and geostrophic absolute vorticity, shown in 24hr intervals



Strongest vorticity concentrated in New England as the storm was departing early on the 3rd

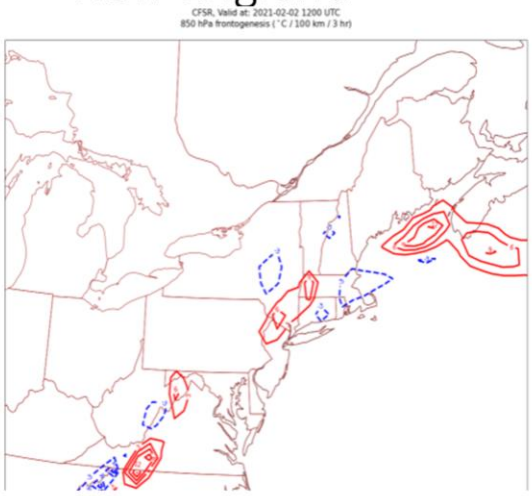
850-hpa Frontogenesis, shows intense frontogenetical band developing north of LI

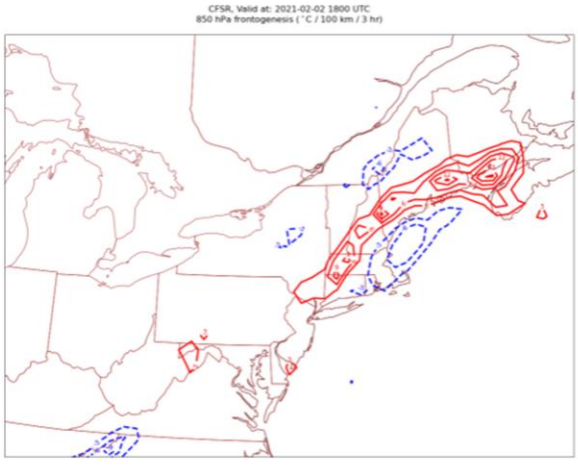




Strong Frontogenetical band develops over western CT and the Hudson Valley, with frontolysis occurring in the Mid-Atlantic

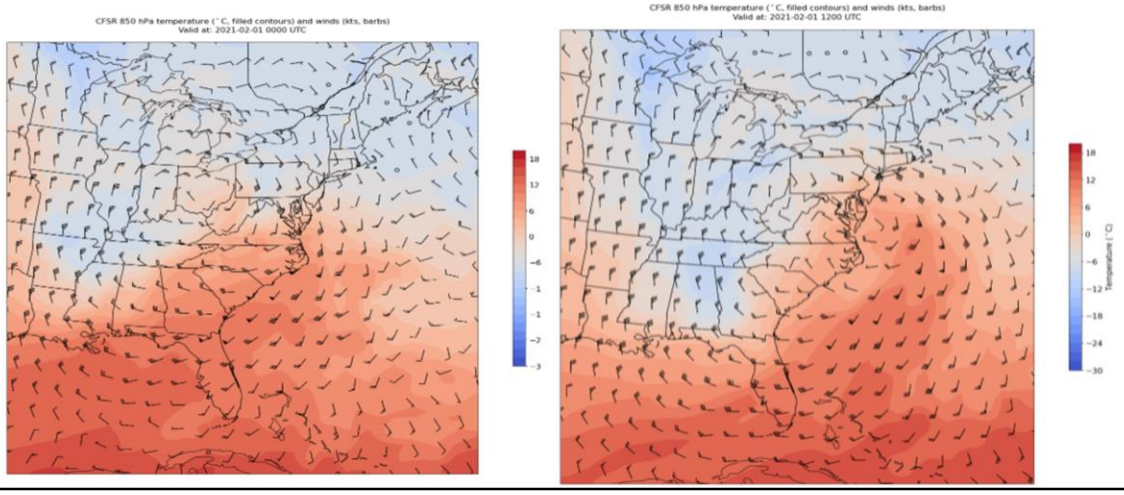
Secondary Frontogenic band develops across New England





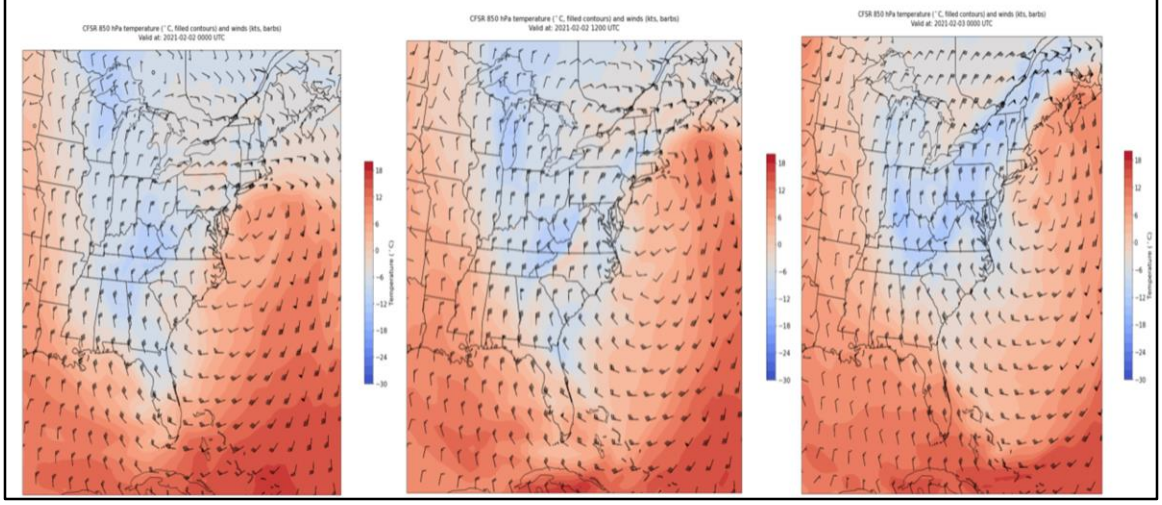
Primary band of frontogenesis begins to weaken and decay early on the 2nd, and a new stronger band develops over northern NE by the afternoon

850-hpa temps(°C) and winds(kts)

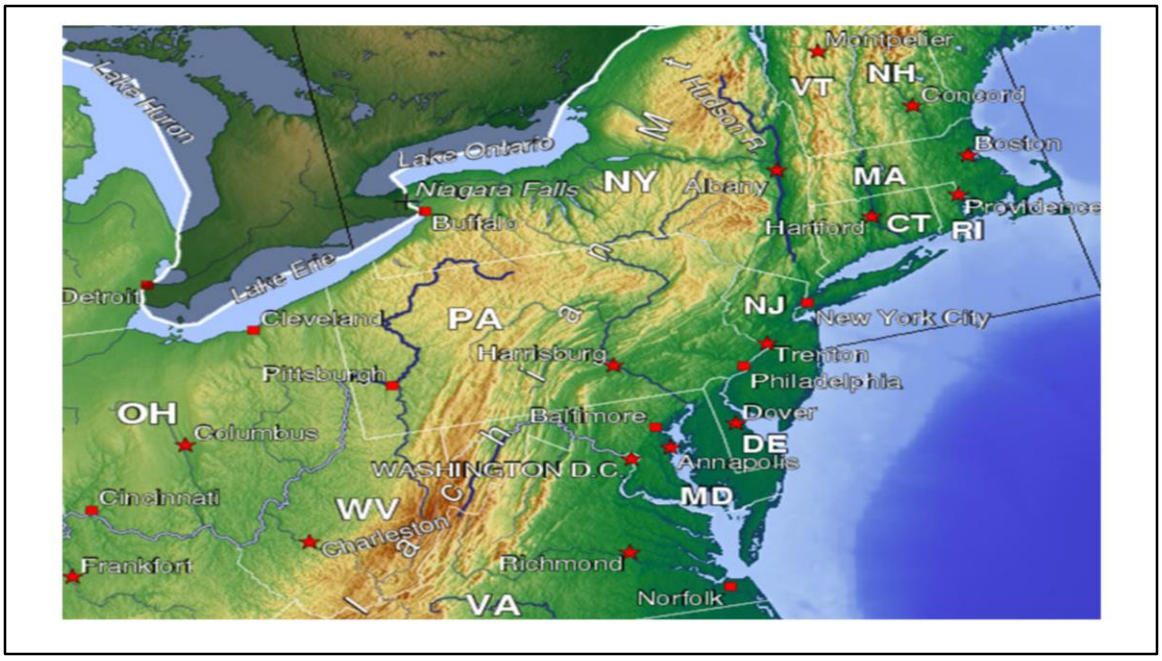


Indicating strong easterly winds over Upstate NY mountains. This caused subsidence to the west of the mountains, meaning drier air and lower snow totals.

Switch to Northeasterly winds evident

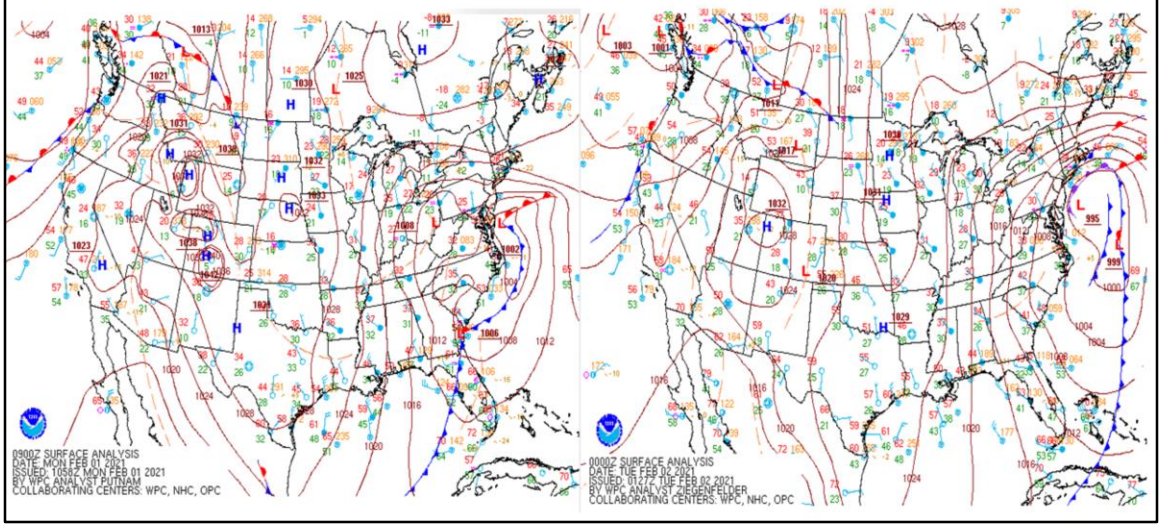


WAA continuing in SE New England. Now strong CAA for the rest of the Northeast



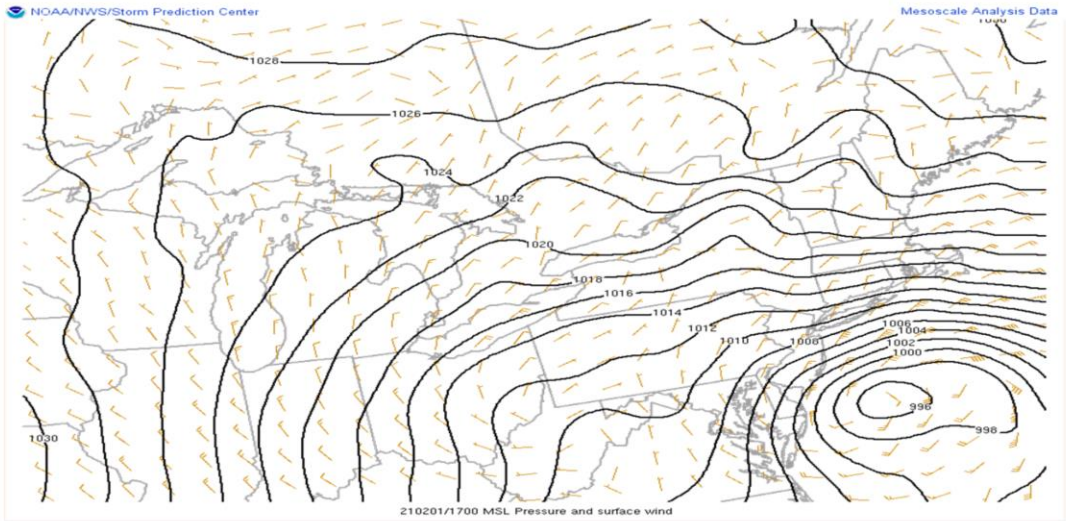
Topographic map shown to highlight the down sloping affects north of Albany

Low pressure develops and quickly occludes, with strong frontal zone developing on the north side



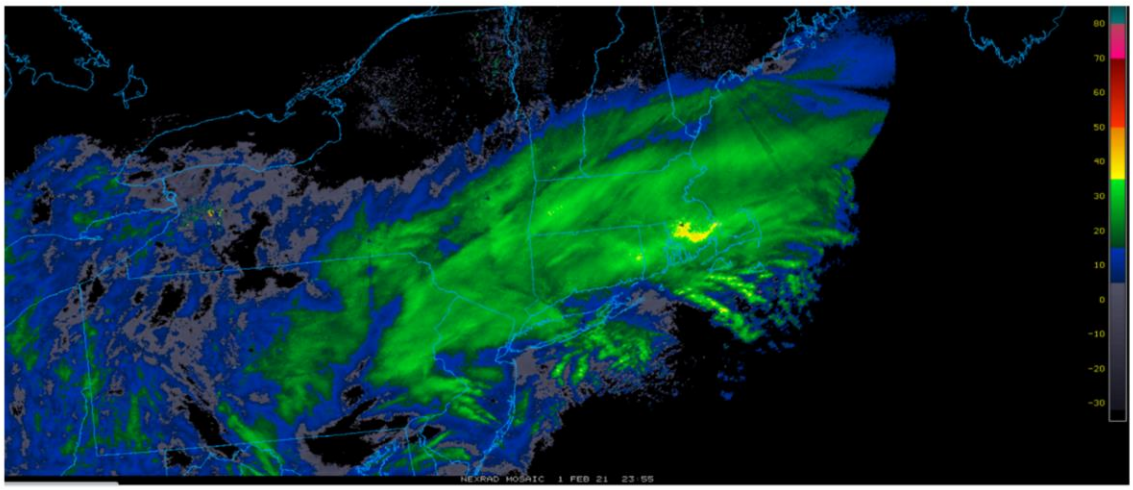
Strong PGF along the NY/NJ coasts as the Low pushed north into area of much higher pressure. Isobars closest along Long Island

NWS plot showing surface pressure and winds(kts) 2/1



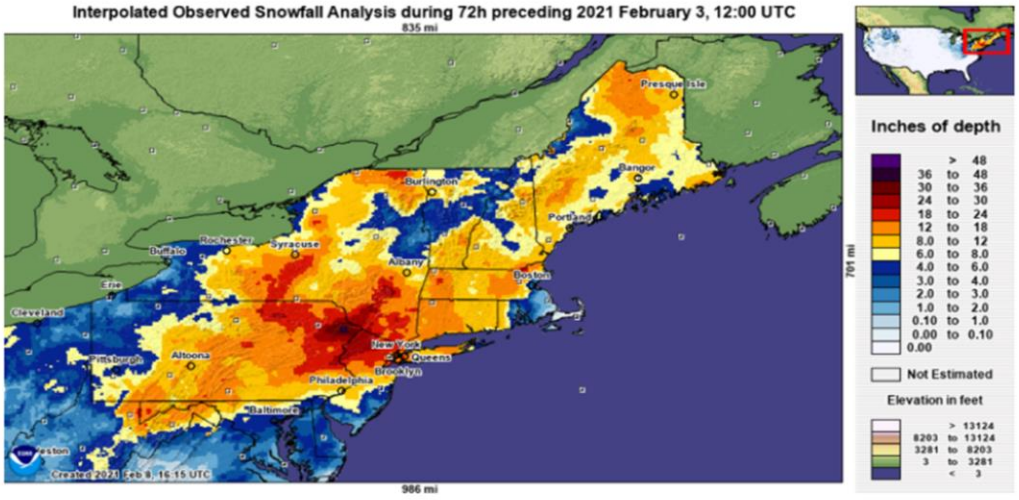
Northeasterly surface winds, with 996mb low off the coast. Very strong PGF along the Jersey Shore and LI.

Radar image from late February 1st

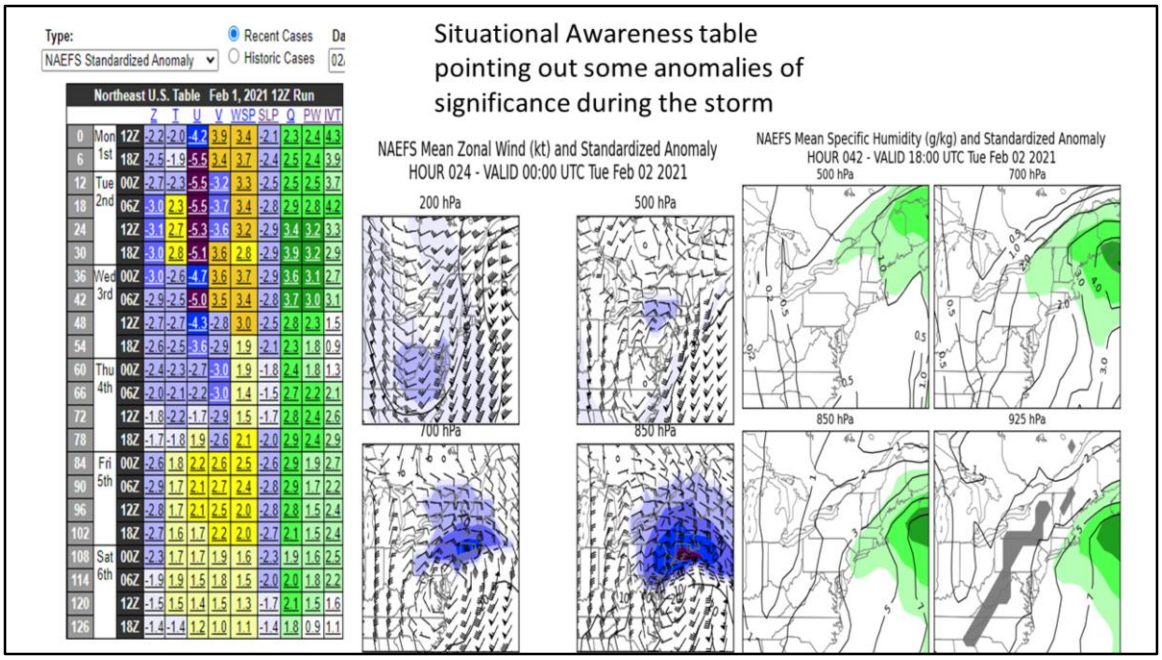


Main precip shield expanding inland, with dry slot evident in Long island and NJ resulting in the onset of mixing. Dry air cutting down totals in upstate NY

Local maxima in snow totals near PA/NY/NJ borders

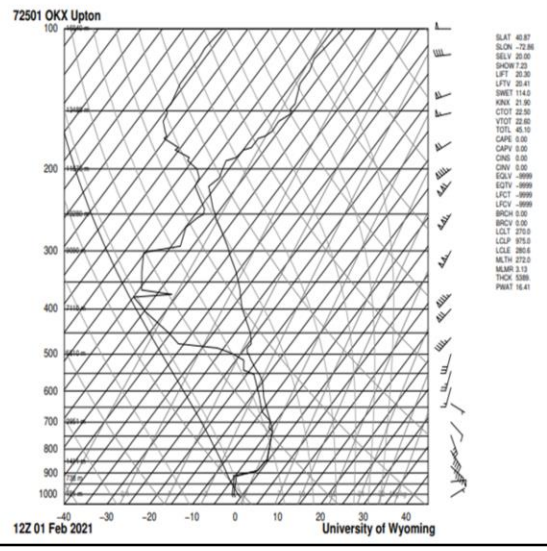


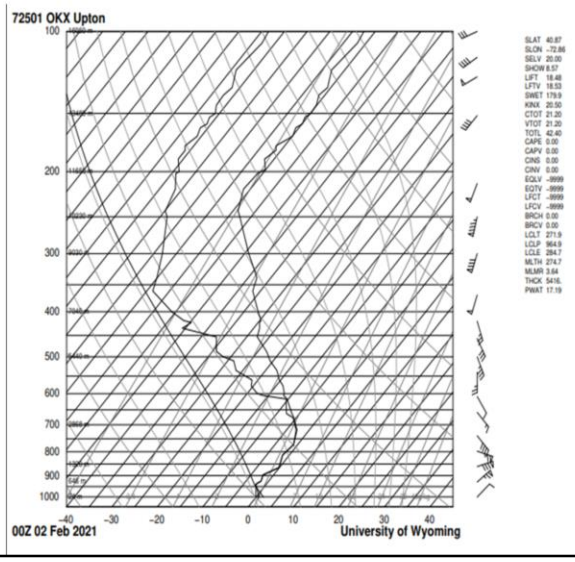
High totals for Tri-State area with “snowhole” evident in the Saratoga region. Maximum of 36 inches of snow reported in eastern PA.



Zonal wind is anomalously high at 850 hpa, indicative of strong easterly winds, while specific humidity is also anomalously high across New England.

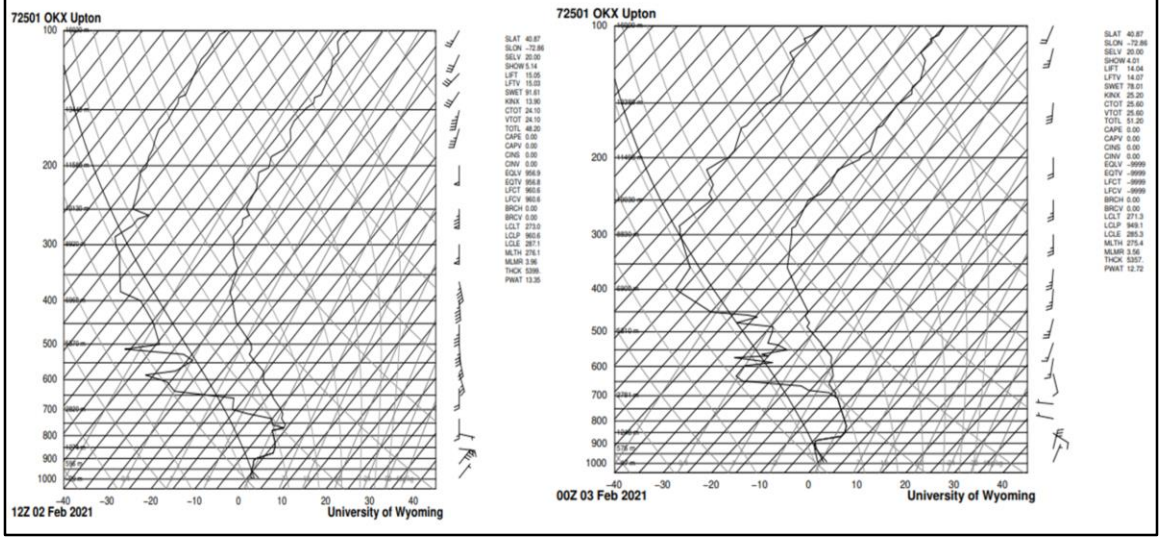
Soundings taken from the NYC NWS office on 1st 12z and 2nd 00z





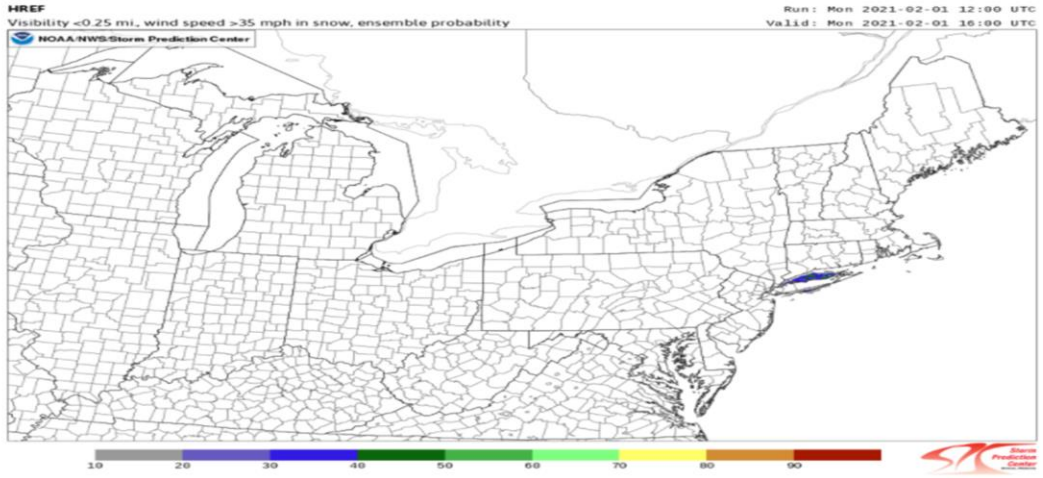
Veering winds indicate WAA. Barely showing snow soundings

More soundings taken from the NYC NWS office on 2nd 12z and 3rd 00z



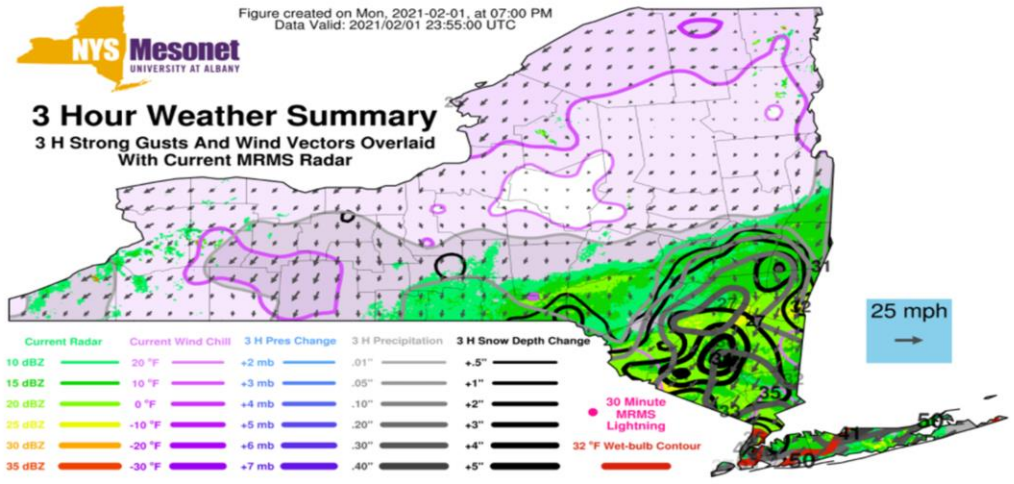
Winds continue to veer, with what appears to be Sleet soundings present

HREF model showing probability of seeing blizzard conditions



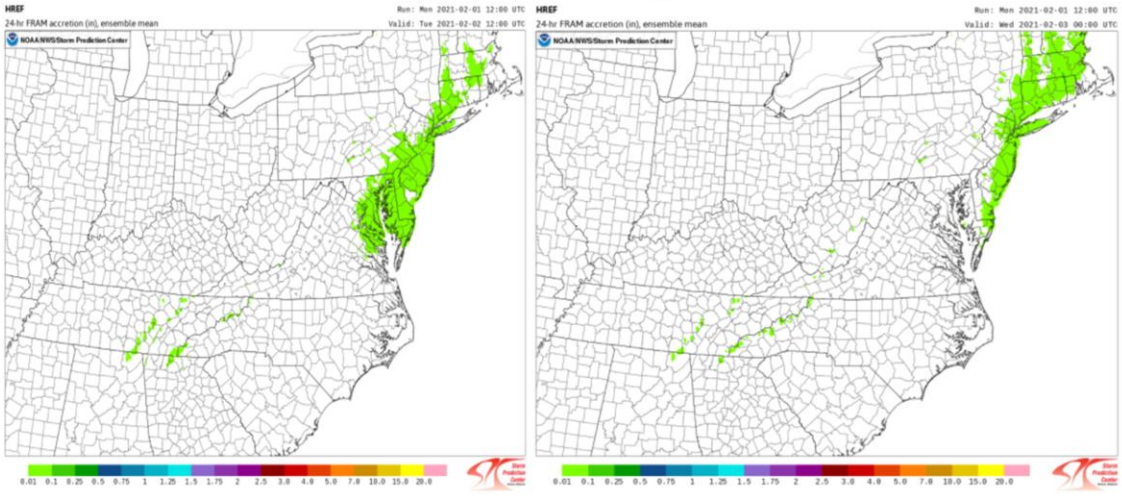
HREF indicated a 30-40% chance of seeing blizzard conditions across northern LI and southern CT

NYSM plot on the evening of the 1st highlighting the radar, 3H snow depth change, and the 32-degree wet bulb contour



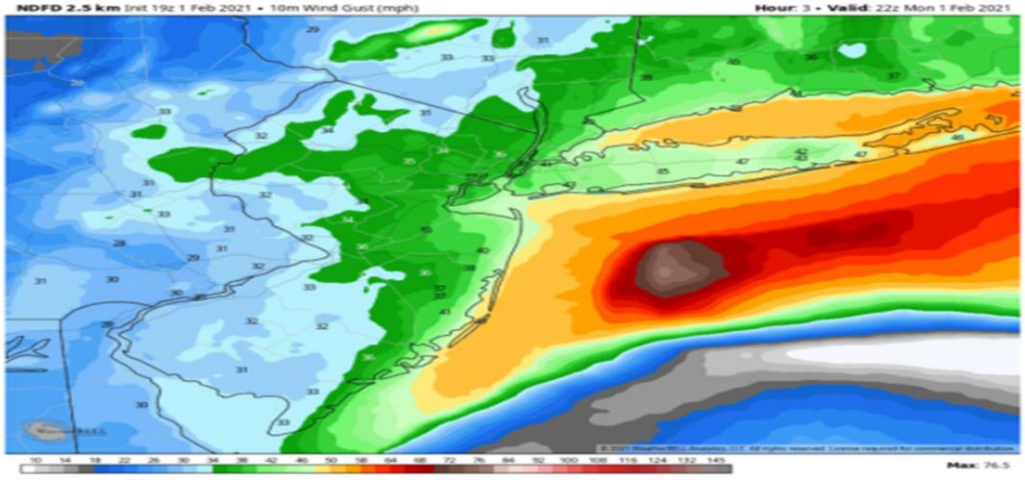
Showing 3+ inches of snow fell in 3 hours in parts of the Hudson valley. 32 contour right along NYC and LI

HREF modeling of freezing rain accretion. 1st-2nd on left, 2nd-3rd on right



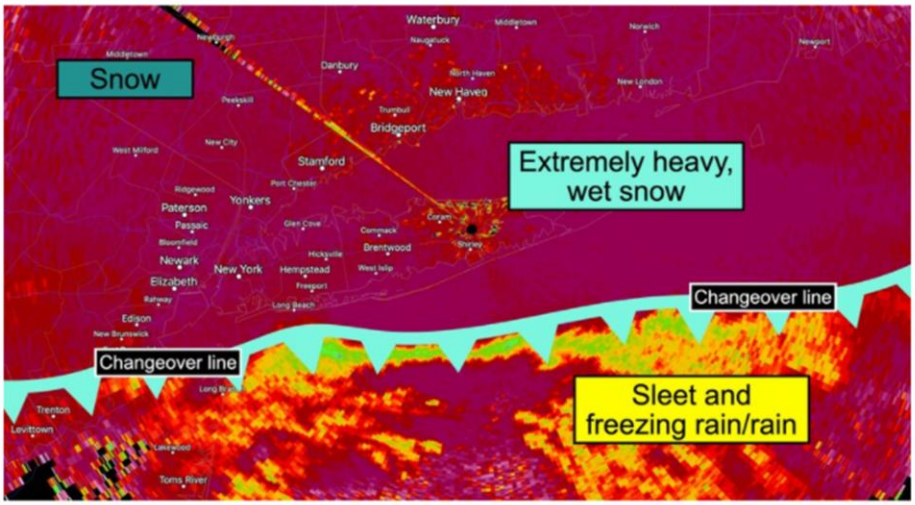
Showing a general 1-2 tenths of an inch of ice along I-95 corridor

10m Wind Gust model around the onset time of blizzard conditions



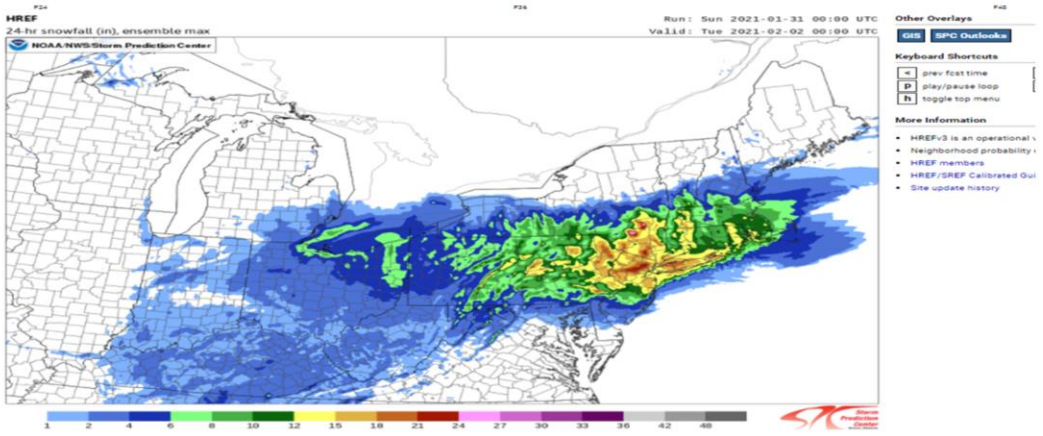
Widespread wind gusts of 40-50mph along all of LI and a majority of the NJ coastline.

Graphic showing the location of the changeover line early on February 2nd



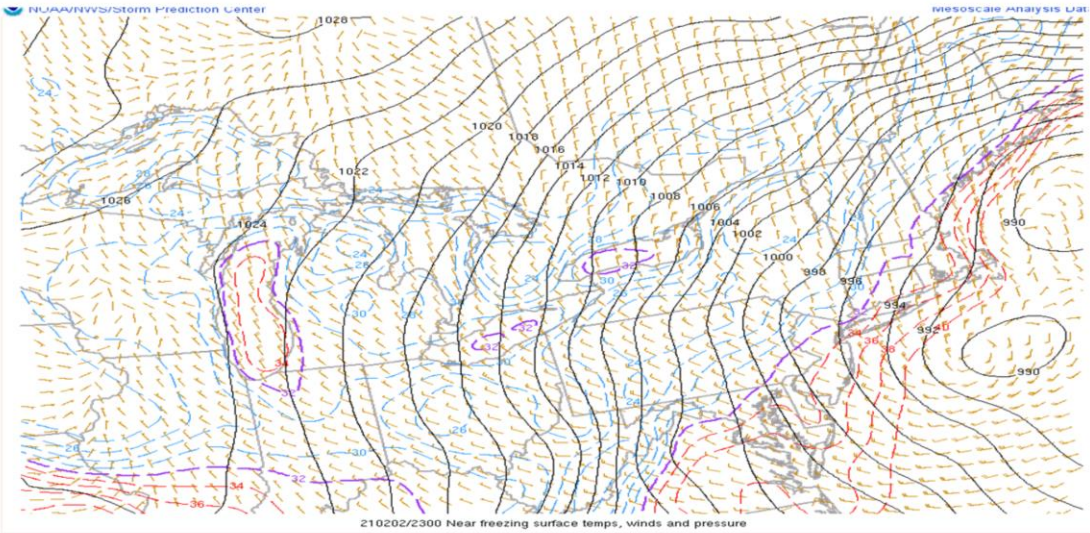
Heavy wet snow for the NYC metro at the time, with sleet/freezing rain occurring just offshore

HREF model of 24-hr snowfall

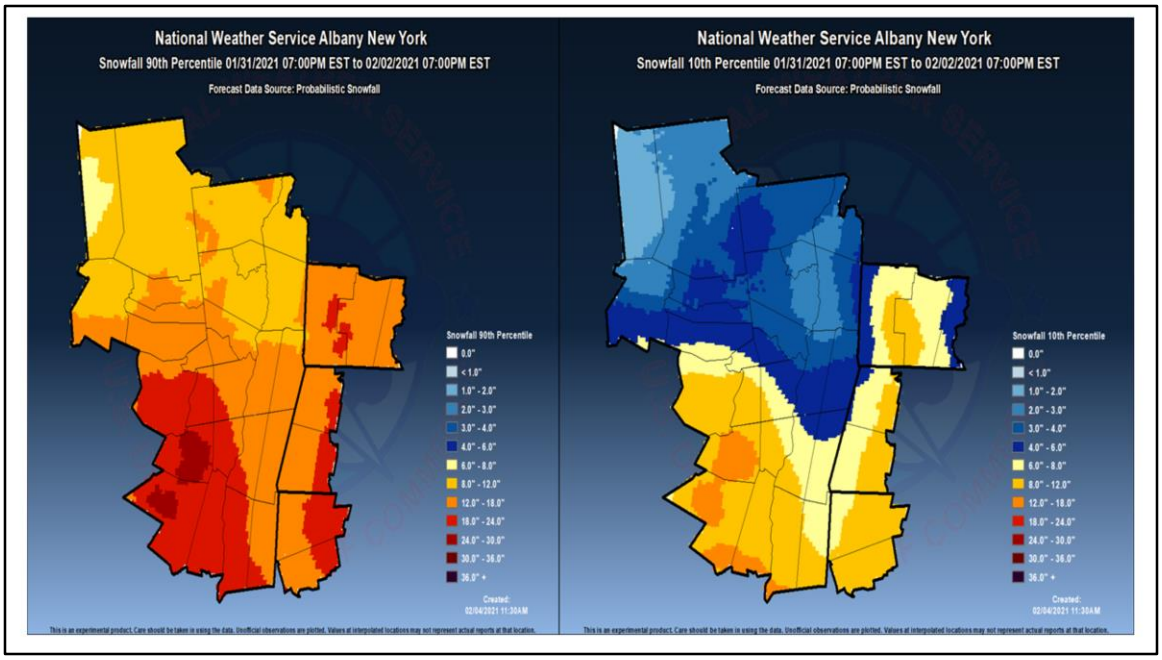


Shows a very well forecast storm for the Tri-State area. Northern edge of the precip shield appears to have verified well.

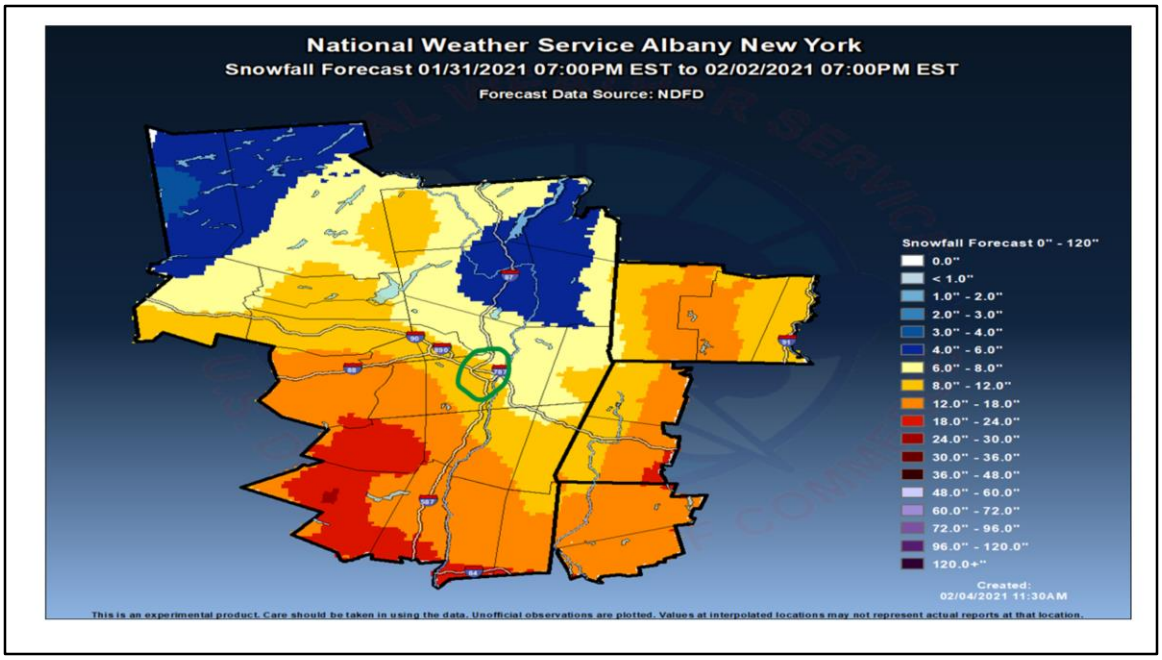
NWS mesoscale analysis plot showing near freezing surface temps, winds, and pressure with 32-degree line contoured



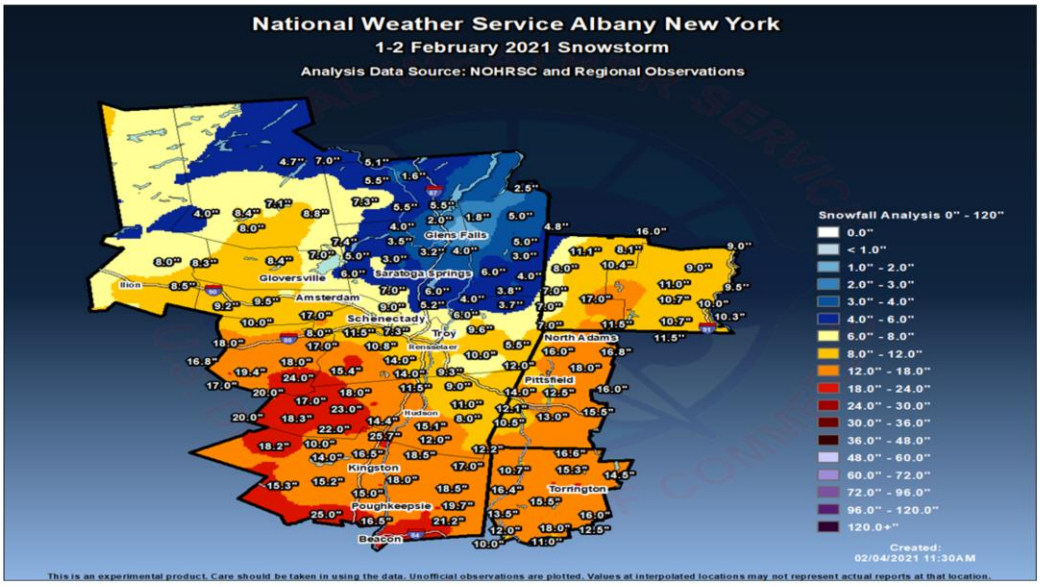
32-degree mark outlined, showing temperatures pushing above freezing for NYC and LI late on the 2nd. Cold air is locked in just further northwest.



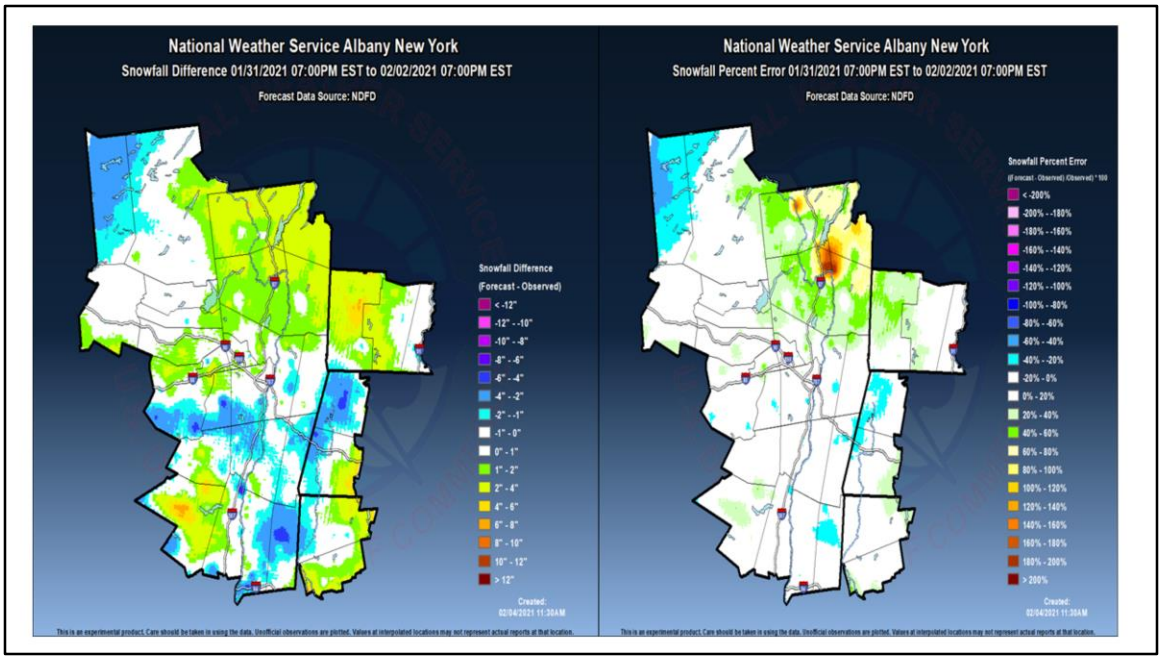
Comparison of both high end and low-end forecasts from NWS Albany. Showed 12-18 inches and 4-6 inches for Albany respectfully.



Official snowfall forecast for the NWS Albany forecast area. Sharp gradient with 6-8 inches just north of Albany and 12-18 inches just south. Albany outlined in green.



Snowfall analysis for the Albany forecast area. About 8 inches fell in Albany, with over 12 inches just south and under 6 inches just north.



NWS over forecasted snow totals for the Saratoga region, underestimating the amount of down sloping present

Impacts

- East Coast cities like Boston and New York City picked up widespread 18–24 inches of snow.
- The storm directly caused six deaths and is estimated to have caused at least $100 million in damages, in addition to over 575,000 power outages.
- New Jersey and New York City issued snow emergencies for the storm, with most in-person classes cancelled.
- It was the worst snowstorm to impact the I-95 corridor since 2016.
- In New York City, a Winter Weather Emergency Declaration was issued restricting all non-emergency travel after 6:00 am Monday February 1, 2021.
- Significant impacts on travel with multiple accidents across the area.
- The Long Island Railroad (LIRR) and PATH trains suspended service during the afternoon and evening on February 1, 2021.
- Significant impacts to air travel with many flight cancellations including LaGuardia suspending all flights on February 1, 2021.

Conclusions/Results

- The Nor'easter was formed due to two jet streaks that phased together over the Mid-Atlantic region. As the jet streaks phased together, they became negatively tilted, favoring the development of a surface low. This area of strong upward motion and upper-level divergence led to the quick deepening of the surface low and allowed colder Canadian air to be puller further south.
- The area of strong low-level frontogenesis progressing northwestward due to surface convergence resulted in enhanced precipitation rates and higher snow totals across the interior Northeast
- Cyclonic vorticity advection situated in the base of the trough allowed for stronger upward vertical motion and falling heights, which overlapped with the area of strong frontogenesis and coupled jet streaks.
- Snowfall forecast for the Albany area was generally very good, though NWS slightly under forecasted for the southern Capital Region, and over forecasted in the Saratoga/Glens Falls area.