

# The January 4 winter storm in eastern NY and western New England

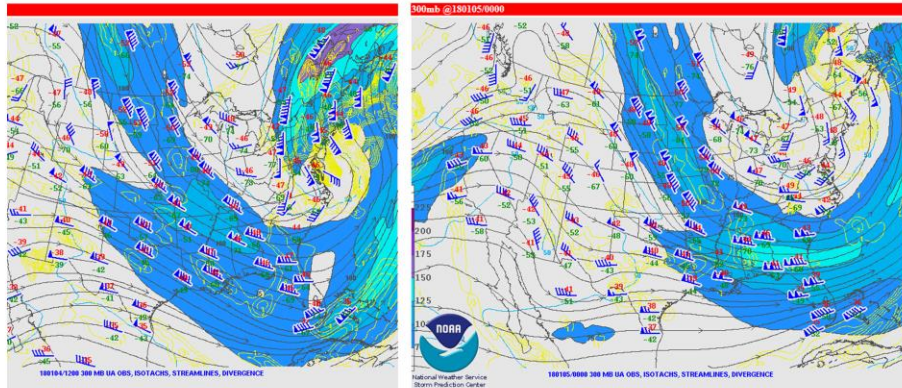
Mike Evans

▣ TechSmith Camtasia™

# Outline

- Large-scale pattern
- Banding
- High resolution models
- Radar and observations
- Hudson-Mohawk Valley Convergence
- Conclusion

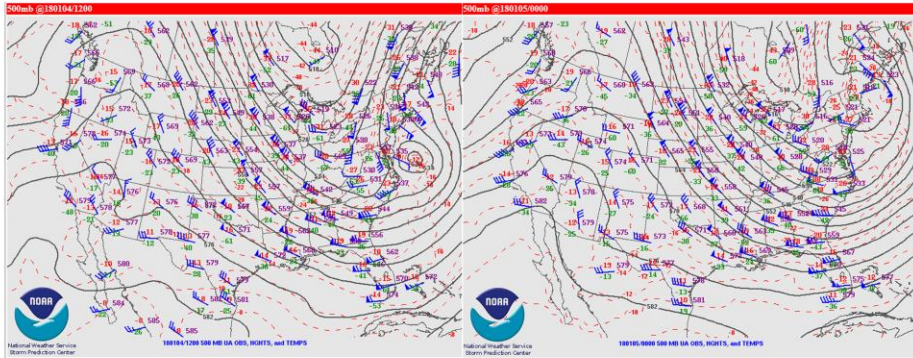
# 300 mb analysis



TechSmith Camtasia™

A major storm affected the east coast of the U.S. on January 4<sup>th</sup>. At 300 mb, a 165 kt jet can be seen at 12z on the 4<sup>th</sup> over eastern Quebec, with New York and New England in the right entrance region.

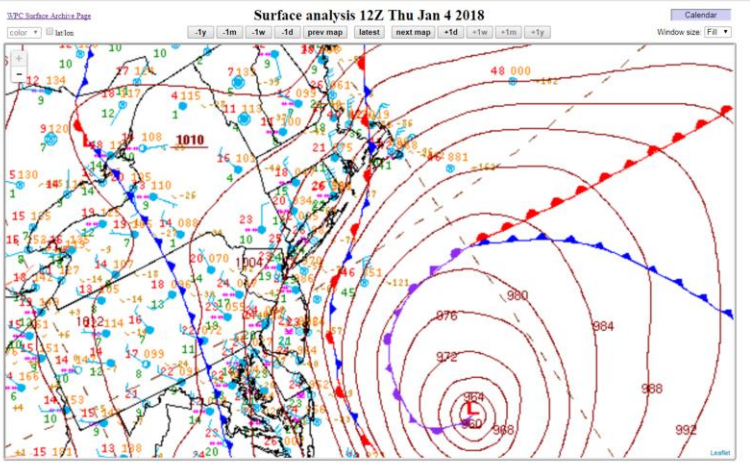
# 500 mb analysis



TechSmith Camtasia™

The 500 mb flow pattern on the 4<sup>th</sup> indicated an intense short-wave trough moving north-northeast along the east coast.

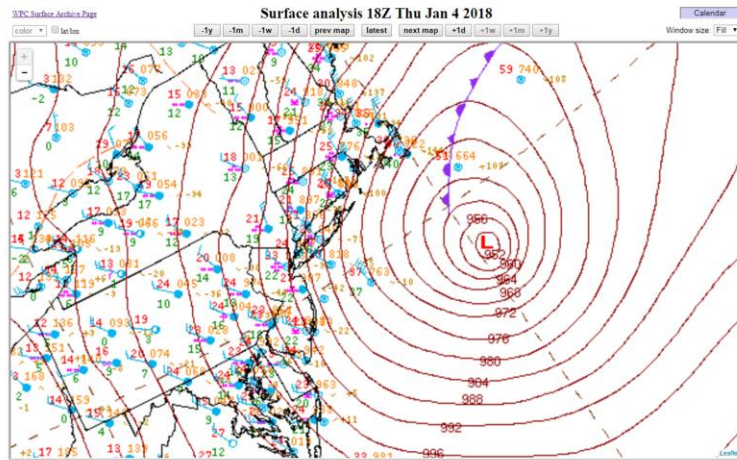
# Surface analysis -12z January 4



TechSmith Camtasia™

Low pressure values with the associated surface storm were quite noteworthy. At 12z, this analysis shows the central pressure down to 960 mb.

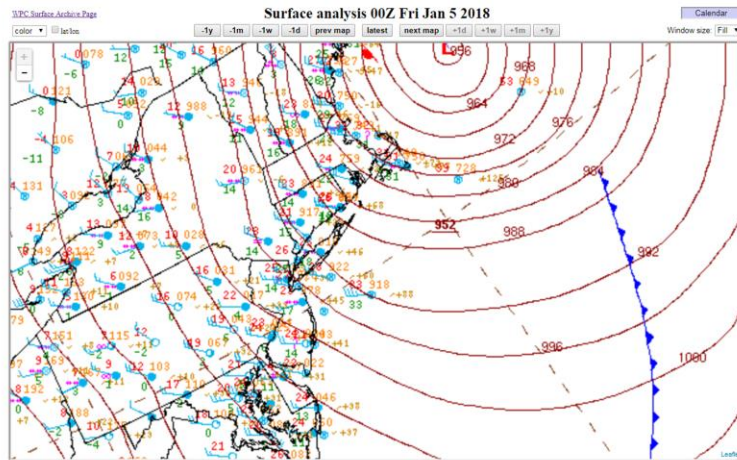
# Surface analysis – 18z January 4



TechSmith Camtasia™

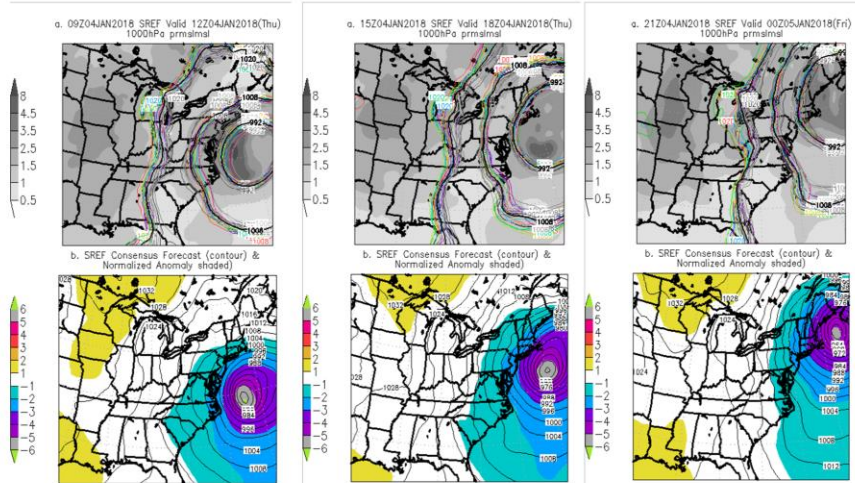
This analysis valid at 18z shows a central pressure of 952 mb.

# Surface analysis – 00z January 5



A central pressure of 956 mb was analyzed at 00z on the 5<sup>th</sup>.

# Sea-level pressure anomalies

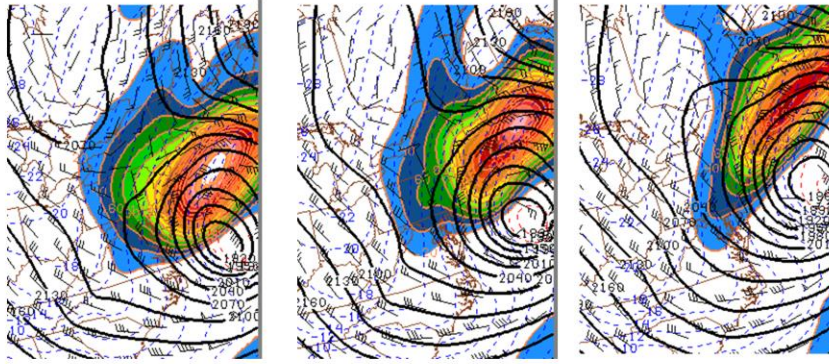


TechSmith Camtasia™

These pressure values were greater than 5 standard deviations below climatological normal values for the western Atlantic.



## SPC analysis of 850-700 mb frontogenesis



12z

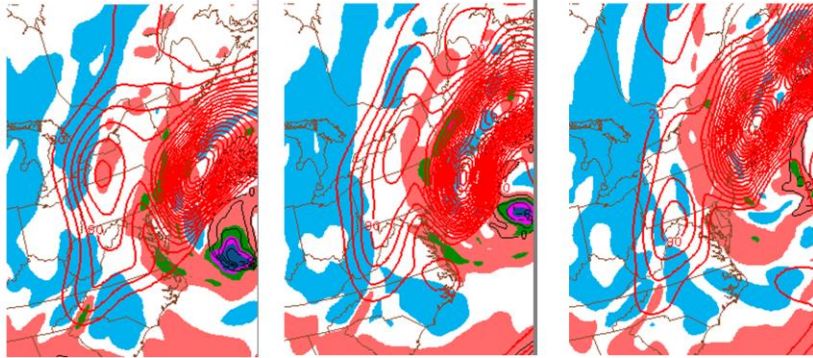
15z

18z

TechSmith Camtasia™

Very strong lower-to-mid level frontogenesis was analyzed north of the closed low at 700 mb over the northeast CONUS. Eastern New York and western New England were on the western edge of the strongest frontogenesis.

## SPC analysis – 700 mb frontogenesis and 650-500 mb EPVg



12z

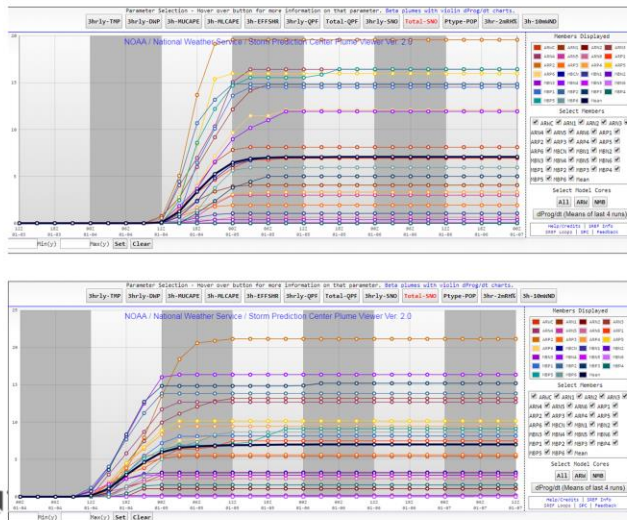
15z

18z

TechSmith Camtasia™

An SPC analysis of 700 mb frontogenesis and 650-500 mb equivalent potential temperature indicated that these factors were co-located over the northeast on the 4<sup>th</sup>. Strong meso-scale forcing for ascent co-located with reduced stability in the layer above the forcing is a favorable conditions for narrowing and intensification of frontal scale circulations, and often results in precipitation banding.

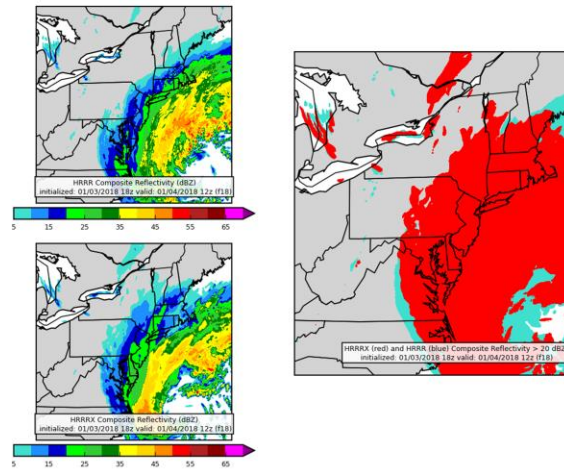
# SREF snowfall forecast at ALB – 09z and 21z runs on the 3rd



SREF forecasts on the 3<sup>rd</sup> indicated considerable uncertainty about how much snow would occur on the western edge of this system over eastern New York. Forecast snowfall at Albany ranged mostly from about 2 to 15 inches, with a mean of about 6 to 7 inches.



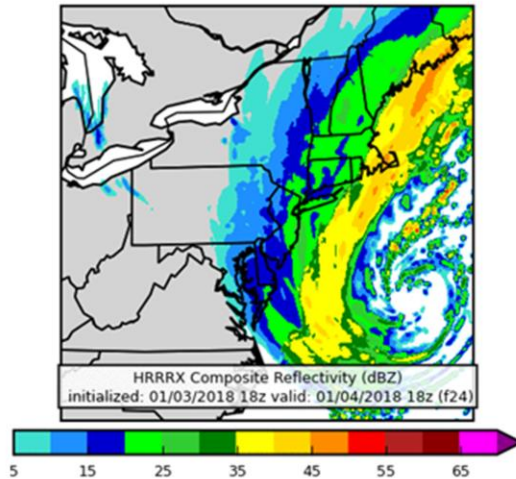
# 18z Jan 3 HRRR valid 12z Jan 4



TechSmith Camtasia™

An experimental version of the HRRR was running for this case along with the operational version. These two images compare 18 hour forecasts from the operational HRRR (top) and the experimental HRRR (HRRRX, bottom) valid at 12z on the 4<sup>th</sup>. The HRRRX is a bit faster spreading snow north up to into central New England and east central New York. Also, the HRRRX is showing more banding in the reflectivity pattern over southeast New York and Connecticut than the HRRR.

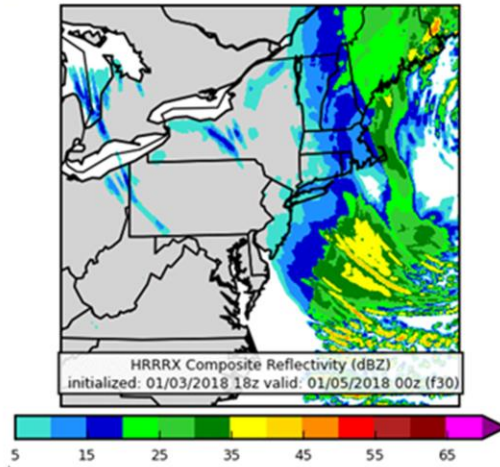
## 18z Jan 3 HRRRX valid 18z Jan 4



TechSmith Camtasia™

The experimental HRRR had forecasts run out to 36 hours, while the operational HRRR only had forecasts out to 18 hours. The reflectivity pattern shown by the 18z January 3<sup>rd</sup> run of the HRRRX valid at 18z on the 4<sup>th</sup> (24 hour forecast) implied that the rain / snow line at that time would be near Boston south-southwest to just east of Long Island. Farther west, reflectivity values gradually diminished with no clear sign of banding over western or central New England.

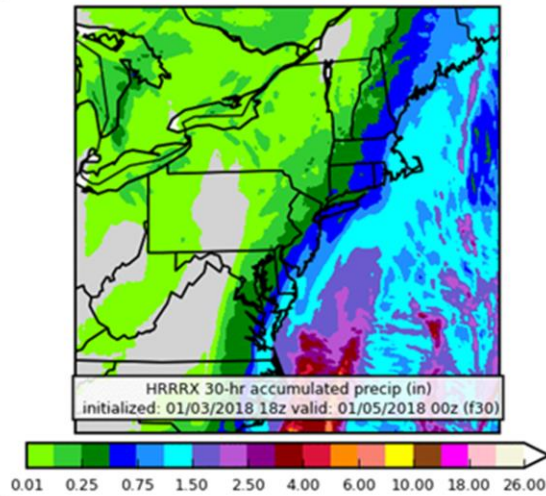
## 18z Jan 3 HRRR valid 00z Jan 5



TechSmith Camtasia™

By 00z on the 5<sup>th</sup> (a 30 hour forecast), most of the heavier precipitation forecast by the 18z January 3<sup>rd</sup> run of the HRRRX was confined to Maine. Some lake effect snow was beginning over central New York.

## 18z Jan 3 HRRR QPF valid 00z Jan 5

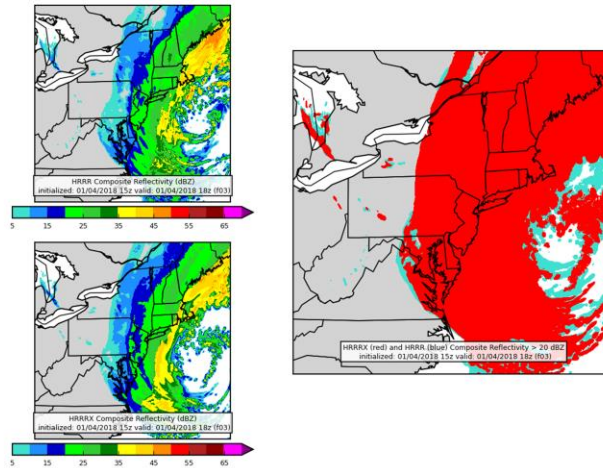


TechSmith Camtasia™

Total QPF from the HRRRX indicated amounts of 0.25 to 0.50 inches for western New England with less than a quarter inch for eastern New York. Accumulated snowfall was not available for this run. Assuming climatological snow / liquid ratios of around 12 to 1, this would imply 3 to 6 inches for western New England and about 1 to 3 inches for eastern New York.



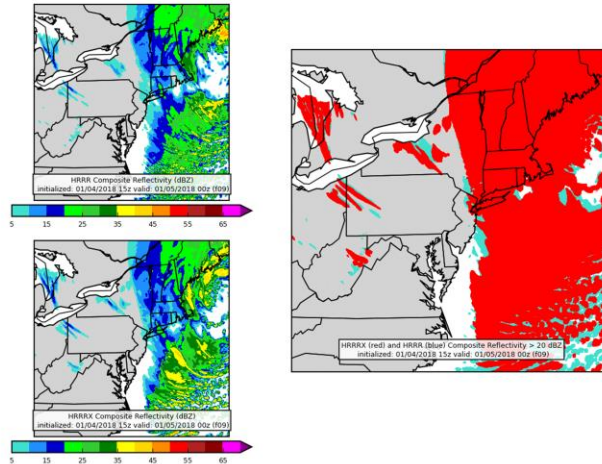
# 15z Jan 4 HRRR valid 18z Jan 4



TechSmith Camtasia™

The next run available for comparison between the HRRR and HRRRX was the 15z run on January 4<sup>th</sup>. Reflectivity valid at 18z on the 4<sup>th</sup> implied a rain / snow line near Boston. Some subtle, broad banding can be seen over Maine, New Hampshire and Massachusetts, however no strong banding is implied farther south or west from the reflectivity pattern.

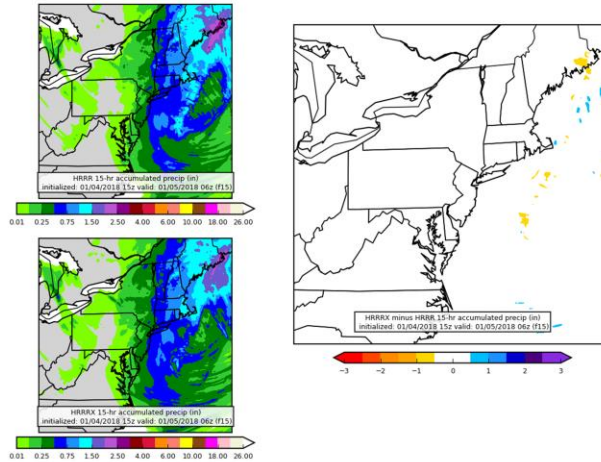
# 15z Jan 4 HRRR valid 00z Jan 5



TechSmith Camtasia™

Reflectivity valid at 00z indicates the heaviest precipitation over Maine, with light-to-moderate precipitation extending back into eastern New York. Some weak upslope enhancement of the snow can be seen on both model runs east of the Hudson Valley over extreme eastern New York.

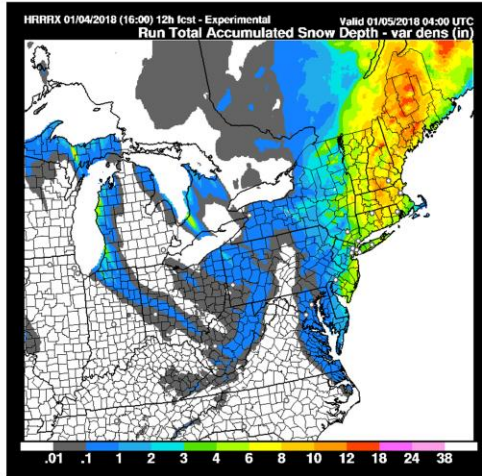
# 15z Jan 4 HRRR QPF valid 06z Jan 5



TechSmith Camtasia™

HRRR and HRRRX storm total QPF forecasts from 15z on the 4<sup>th</sup> through 06z on the 5<sup>th</sup> were quite similar. Amounts over western New England and eastern New York were heavier than the earlier run, with 0.5 to 0.75 inches forecast for western New England and 0.25 to 0.50 for much of eastern New York.

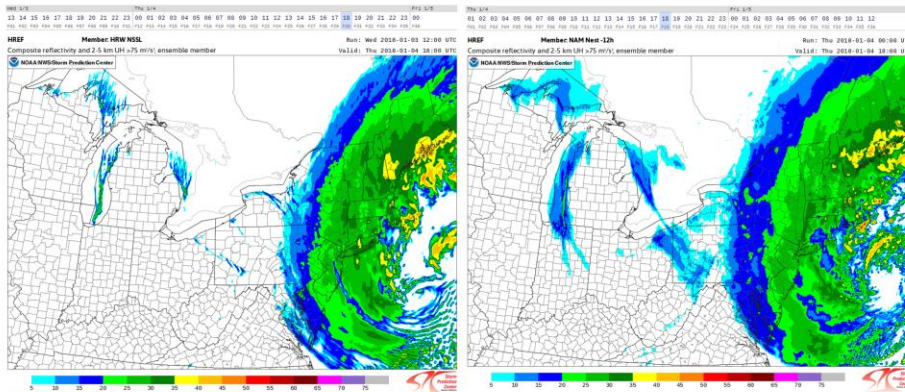
## 16z Jan 4 HRRR accumulated snowfall valid 04z Jan 5



TechSmith Camtasia™

Accumulated snowfall from the 16z January 4<sup>th</sup> run of the HRRRX was available for the storm. A little snow fell before 16z, but this probably covered about 80 percent of the storm for most of western New England and eastern New York. Forecast totals ranged from 6 to 10 inches in western New England and extreme eastern New York east of the Hudson river, to 2 to 6 inches for much of the rest of eastern New York.

# 12z 3<sup>rd</sup> and 00z 4<sup>th</sup> NAM nest runs valid 18z on the 4<sup>th</sup>



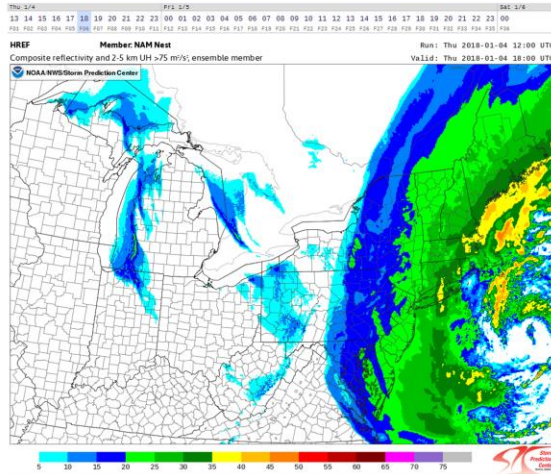
12z 3<sup>rd</sup> run valid 18z 4<sup>th</sup>

00z 4<sup>th</sup> run valid 18z 4<sup>th</sup>

TechSmith Camtasia™

This slide shows reflectivity forecasts from the 12z 3<sup>rd</sup> and 00z 4<sup>th</sup> runs of the NAM nest valid at 18z on the 4<sup>th</sup>. The forecasts are rather similar, with some enhanced banding indicated, especially on the 00z run over far western Massachusetts and Connecticut.

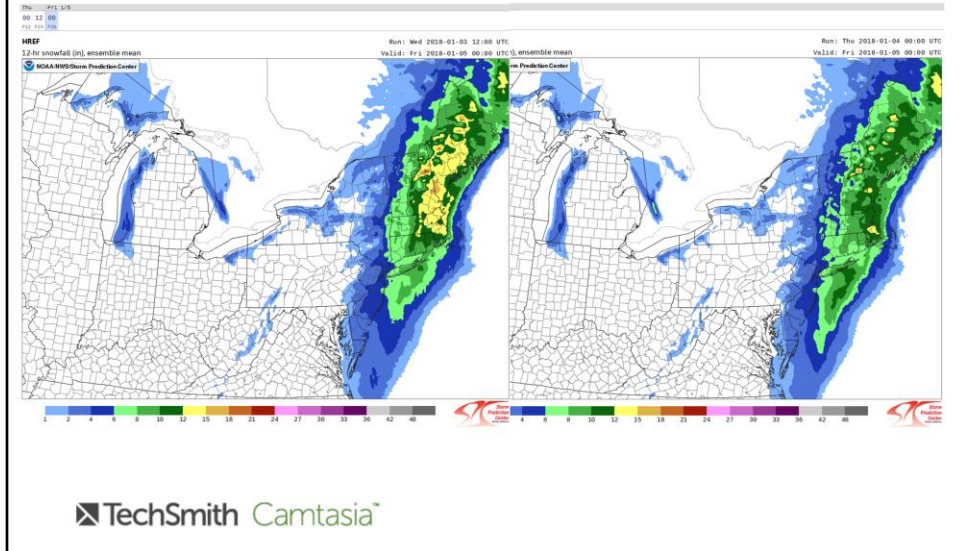
# 12z 4<sup>th</sup> NAM nest valid 18z on the 4th



TechSmith Camtasia™

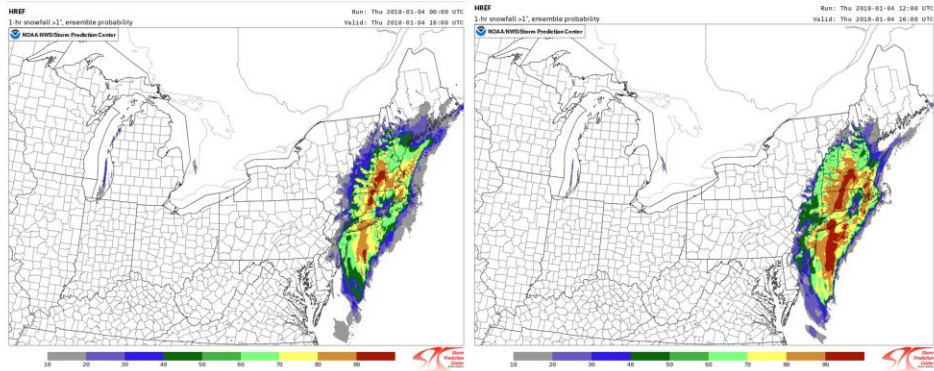
The 12z run of the NAM nest valid at 18z (a 6 hour forecast) shows banding over eastern New England, but no obvious banding over our counties in the west.

# 12z 3<sup>rd</sup> and 00z 4<sup>th</sup> HREF mean snowfall through 00z 5<sup>th</sup>



Total snowfall forecasts from the HREF mean run at 12z on the 3<sup>rd</sup> and 00z on the 4<sup>th</sup> were in good agreement and indicated snowfall totals of mostly 6 to 8 inches for western New England, 2 to 6 inches for the Hudson Valley and less to the west.

# 00z 4<sup>th</sup> and 12z 4<sup>th</sup> HREF probability of snowfall > 1 inch per hour valid 16z

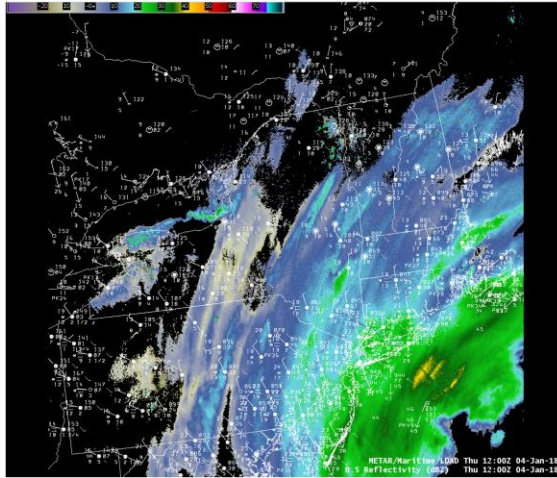


TechSmith Camtasia™

Banding could be implied by these probability of snowfall greater than 1 inch per hour forecasts from the 00z and 12z 4<sup>th</sup> runs of the HREF. Banding is implied over central New England in both cases, with very high probabilities for heavy snow.



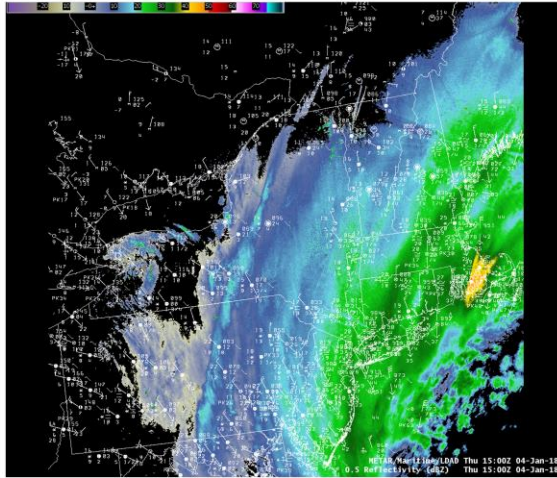
## Radar – 12z Jan 4



TechSmith Camtasia™

Radar imagery and observations on the 4<sup>th</sup> indicated that snow overspread much of western New England and eastern New York around 12z on the 4<sup>th</sup>.

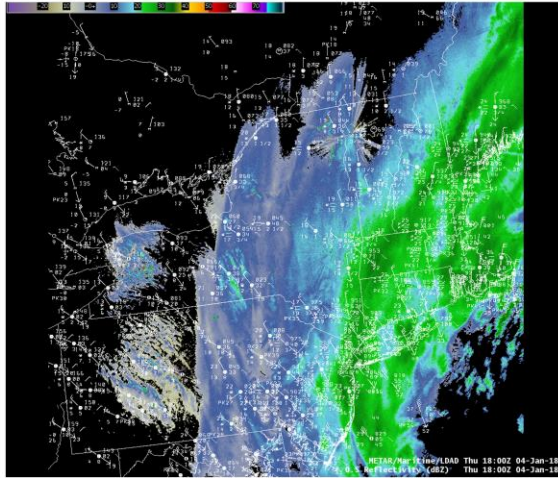
## Radar – 15z Jan 4



TechSmith Camtasia™

Mixed precipitation and rain was just south of Boston at 15z. Farther inland, a band of heavy snow extended from southeast New Hampshire to central Connecticut.

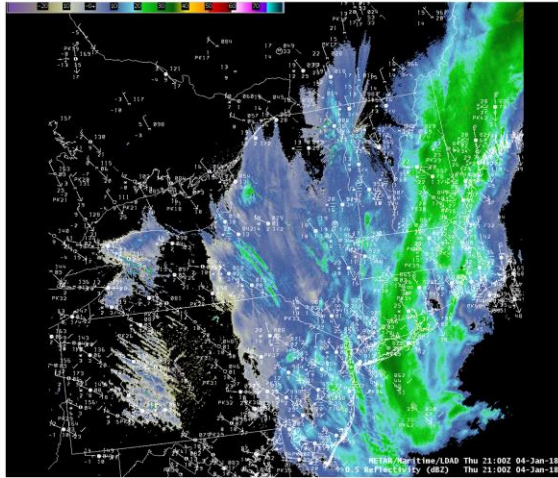
## Radar – 18z Jan 4



TechSmith Camtasia™

By 18z, the band of heavy snow rotated west to cover western Massachusetts, western Connecticut and the New York City area. Snowfall rates of 2 to 4 inches per hour were reported in this band.

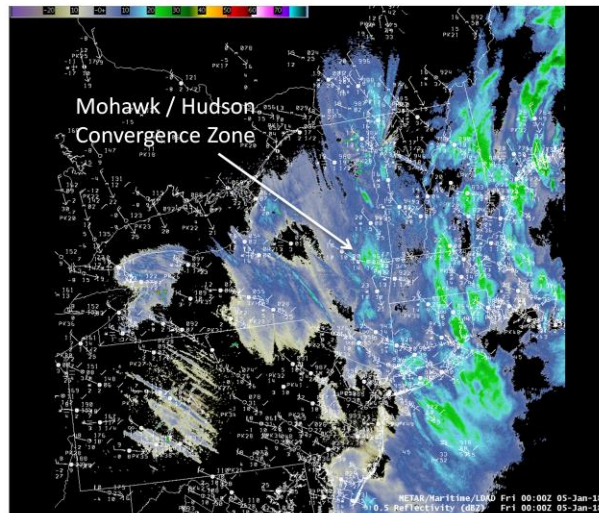
## Radar – 21z Jan 4



TechSmith Camtasia™

By 21z the band remained quite distinct but was beginning to pull back to the east, extending from southwest Maine, to central Massachusetts, central Connecticut and eastern Long Island.

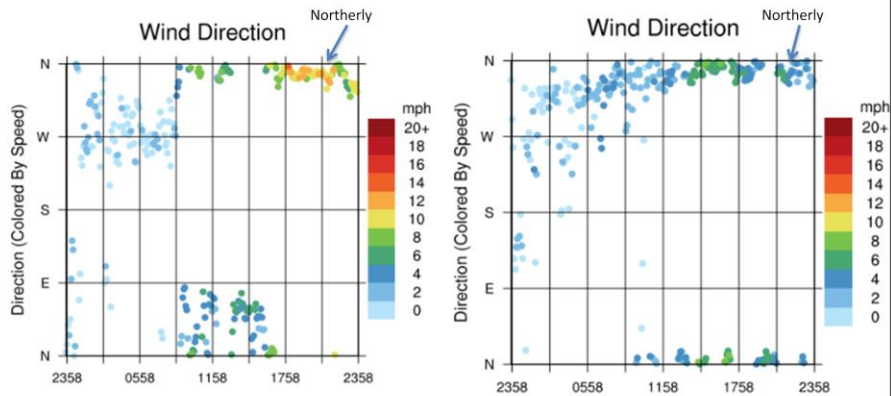
## Radar – 00z Jan 5



TechSmith Camtasia™

At 00z, the band was becoming more disorganized across the area. Of local interest, a “Mohawk / Hudson” valley convergence zone appeared to set up near Albany, enhancing the snowfall for a few hours in that area.

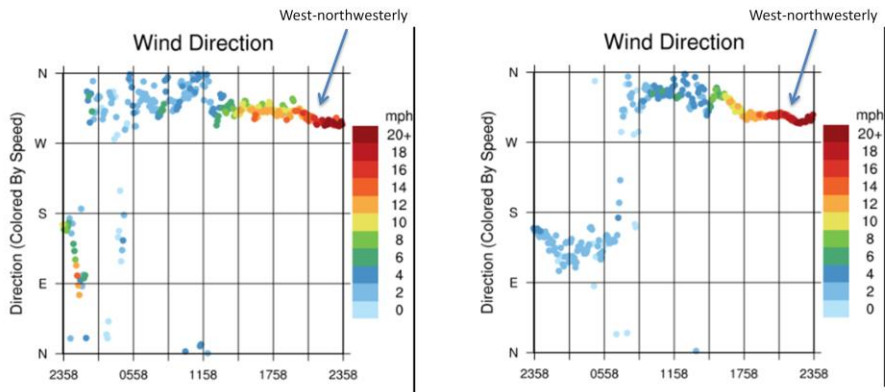
## Wind at Glens Falls (left) and Schuylerville (right)



TechSmith Camtasia™

The Mohawk – Hudson convergence around 00z on the 5<sup>th</sup> can be seen by comparing the northerly winds at Glens Falls and Schuylerville, north of the convergence zone, around 00z on this slide to the west-northwest winds at Voorheesville and Duaneburg, which were within the convergence zone, on the next slide.

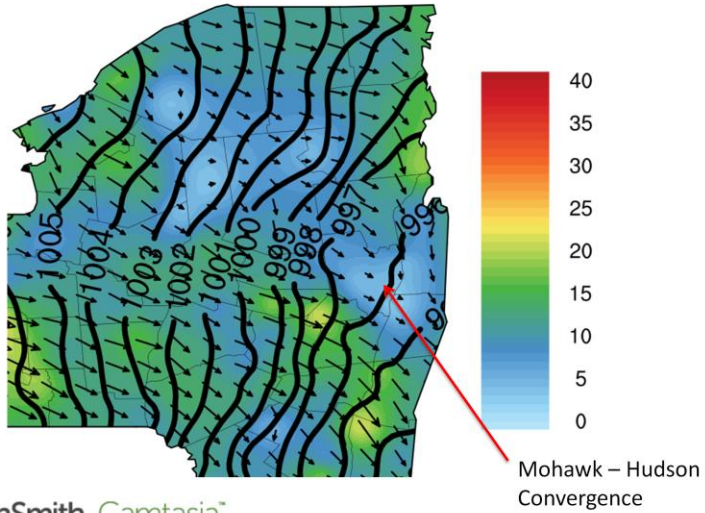
# Wind at Voorheesville (left) and Duanesburg (right)



TechSmith Camtasia™

Winds at Voorheesville and Duanesburg shifted to west-northwest during the day on the 4<sup>th</sup>, setting up the convergence with the northerly winds farther north.

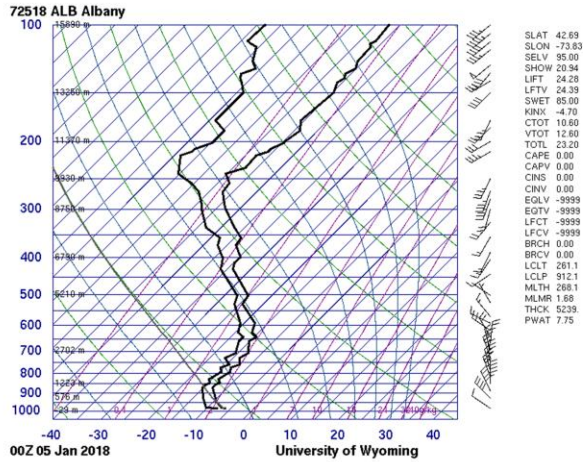
# Wind analysis from the New York meso-net at 2330 UTC on the 4th



TechSmith Camtasia™



# Albany sounding – 00z January 5th

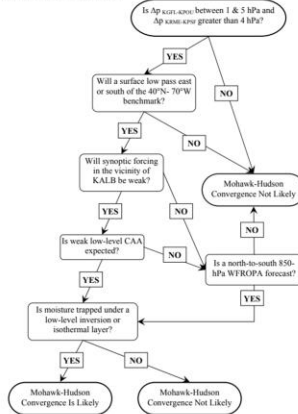


TechSmith Camtasia

The 00z Albany observed sounding indicated a weakly veering wind profile below 800 mb, indicative of warm air advection in that layer, with some weak backing from 800 to 700 mb, indicating weak cold air advection in that layer. An inversion can be seen at about the 850 hPa level with moisture beneath the inversion.

# Hudson – Mohawk Convergence Decision Tree

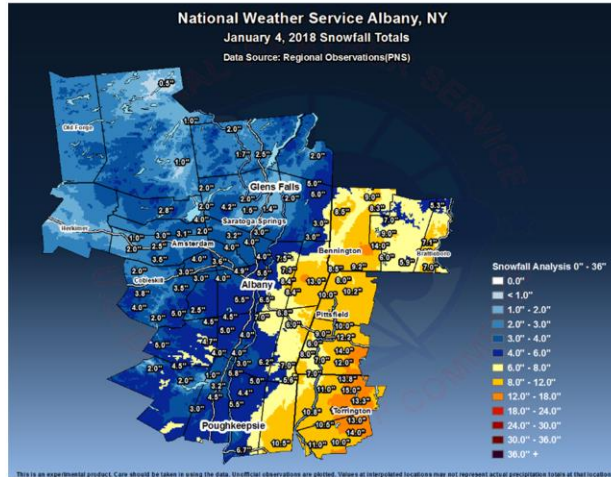
EAST WINDS AT 850L (3KTS OR MORE) versus NORTH TO NORTHEAST WIND AT KALB (3 KTS OR MORE) SEEMS TO BE AN IMPORTANT FACTOR CONTRIBUTING TO HUDSON-MOHAWK CONVERGENCE.



TechSmith Camtasia™

This checklist shows results from a local study on favorable conditions on enhanced snowfall in the Albany area from Hudson-Mohawk convergence. The pattern for this storm at 00z on the 5<sup>th</sup> appeared to be supportive of Hudson-Mohawk convergence, except that the veering wind profile on the Albany profile from the surface to 850 hPa indicated weak warm air advection in that layer, as opposed to the cold air advection indicated to be favorable on the flow chart.

# Observed snowfall



TechSmith Camtasia™

Snowfall across the area ranged from 8 to 14 inches for much of western New England, with heaviest amounts over northwest Connecticut that were effected by the heavy snow band during the early afternoon on the 4<sup>th</sup>. Localized amounts near a foot extended into the higher terrain east of the Hudson Valley in extreme eastern New York. Amounts fell off quickly west of the Hudson valley, with widespread 2 to 5 inch totals indicated.

# Summary

- An anomalously strong storm over the western Atlantic brought snow to western New England and eastern New York on January 4<sup>th</sup>.
- Strong lower-to-mid-level frontogenesis and reduced stability were highly favorable for heavy snow bands west of the storm track.
- SREF plume diagrams indicated large uncertainty for snowfall amounts over the western edge of the heavy snow area near Albany.
- The HRRRX was producing 36 hour forecasts for this storm. These forecasts initially did not extend the heavy precipitation far enough west over western New England.

## Summary and conclusions continued

- Forecasts from the HRRR and HRRRX improved and backed the heavier precipitation westward as the event began on the 4th.
- Reflectivity forecasts from the HRRR or the HRRRX did not give strong reflectivity signals for the significant snow band that effected western New England.
- The NAM nest did show banding signals in its reflectivity fields over western New England.
- The HREF 1 hour snowfall probabilities did give strong indications of heavy snow bands over central Massachusetts, a bit too far east from what actually occurred over western Massachusetts and Connecticut.
- Conditions were favorable for Hudson-Mohawk Convergence at the tail end of the storm. The New York meso-net provided an excellent source of data to analyze the convergence zone.