7 February 2018 Winter Storm with Mixed Precipitation

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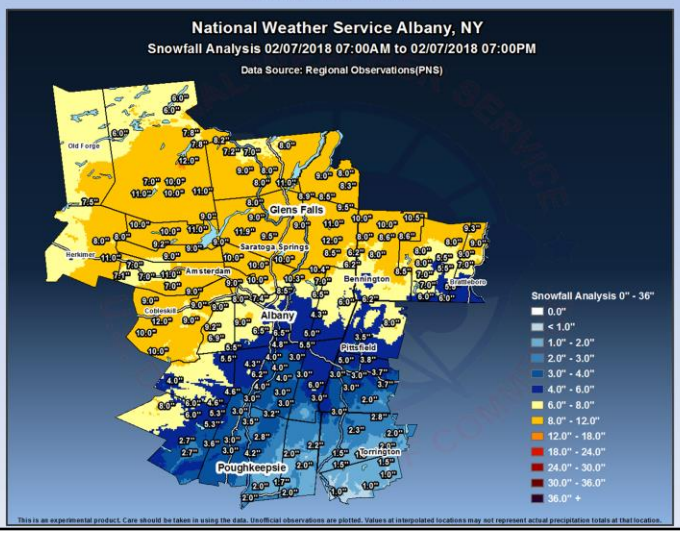
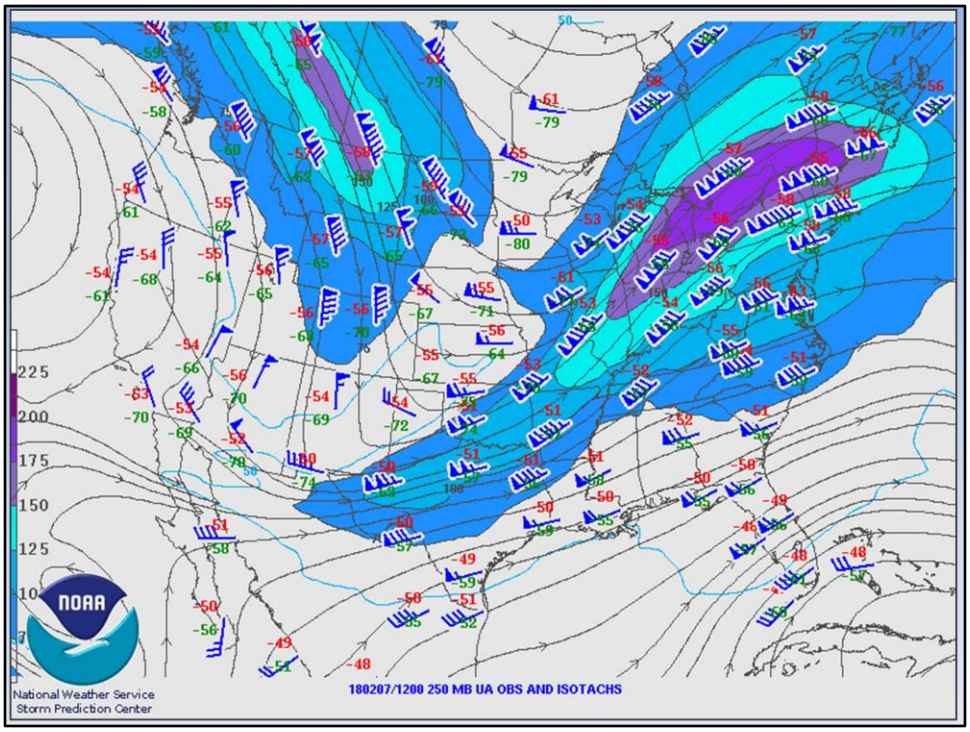
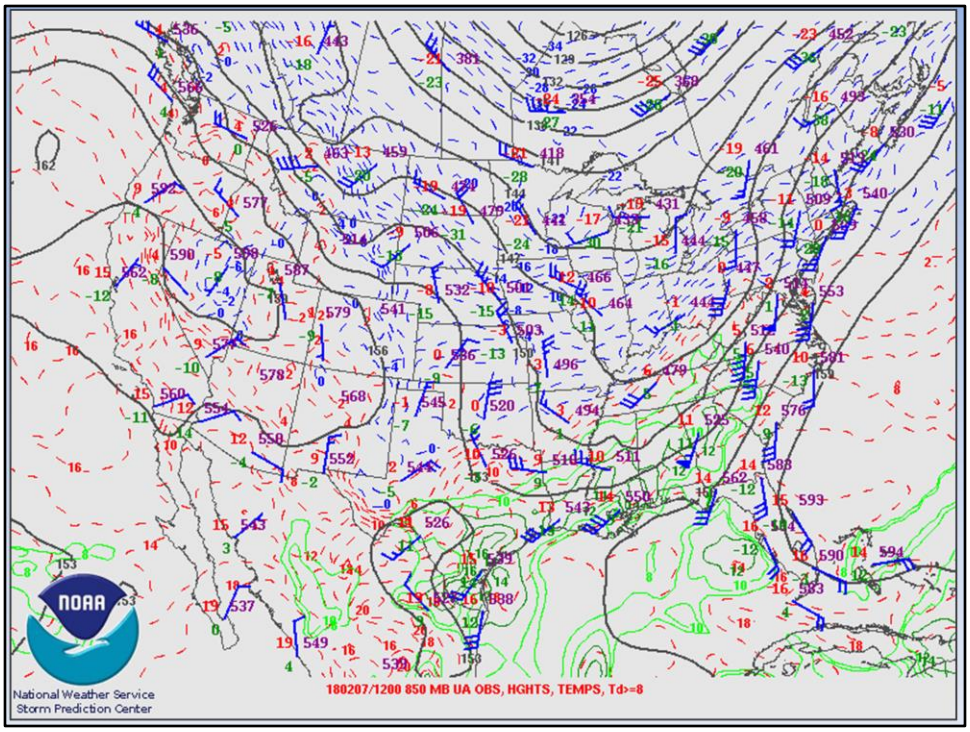


Outline

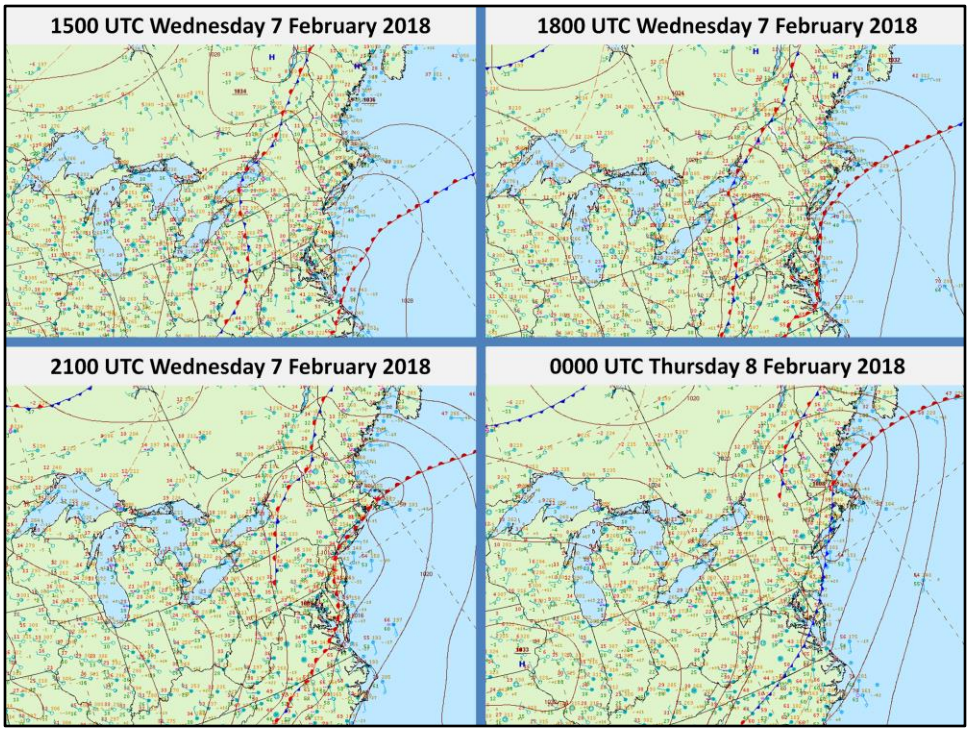
- Synoptic Overview
- Thermal Profiles
- HREF
- GFS Reanalysis Maps
- Radar P-Type Analysis
- Summary



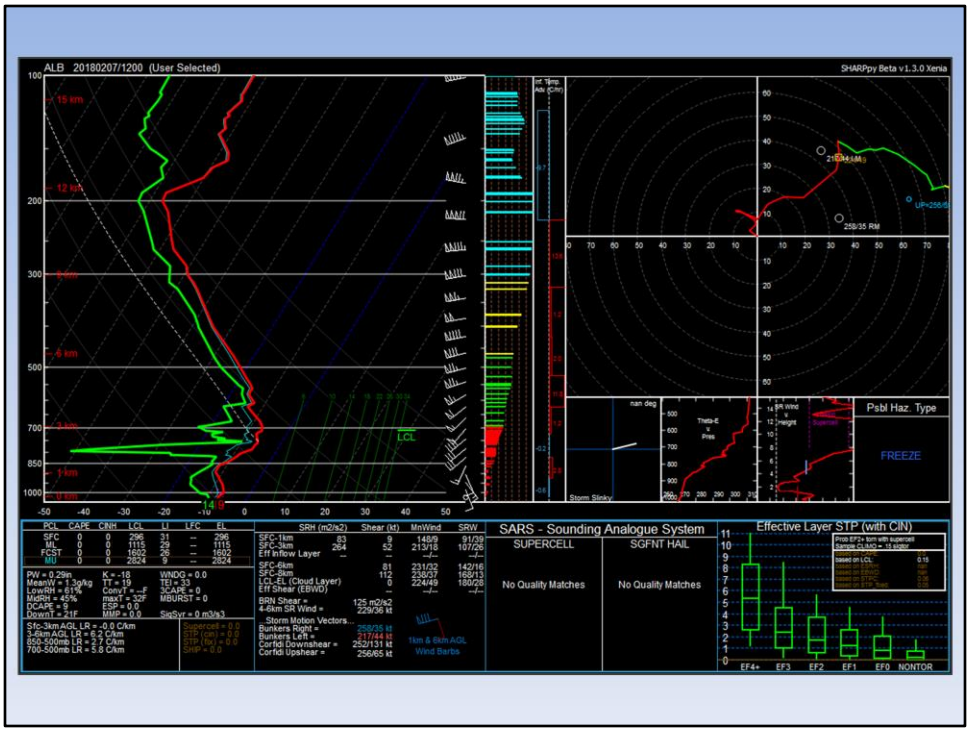
The right entrance region (favorable for ascent/upper tropospheric divergence) of an anticyclonically-curved 250-hPa jet streak (~175 knots) is approaching eastern NY and western New England on the morning of Wednesday 7 February 2018.



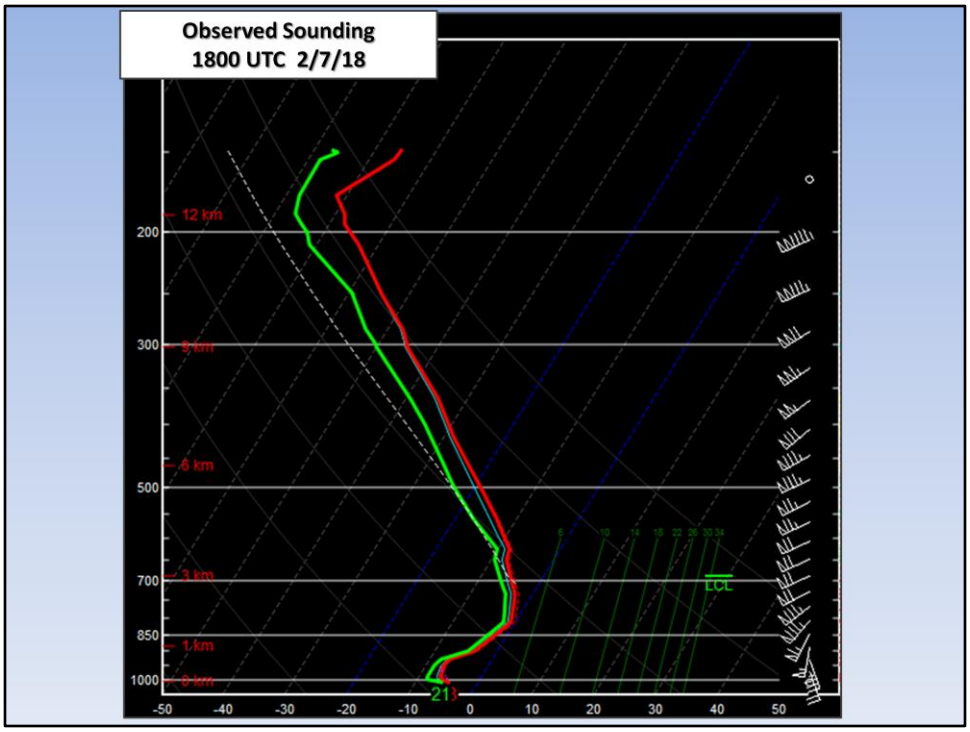
An 850-hPa trough is approaching the region as well on the morning of Wednesday 7 February 2018. The trough would later become negatively tilted over the region, suggesting very efficient dynamics. Also note the WAA (forcing for low-level ascent) approaching eastern NY and western New England.



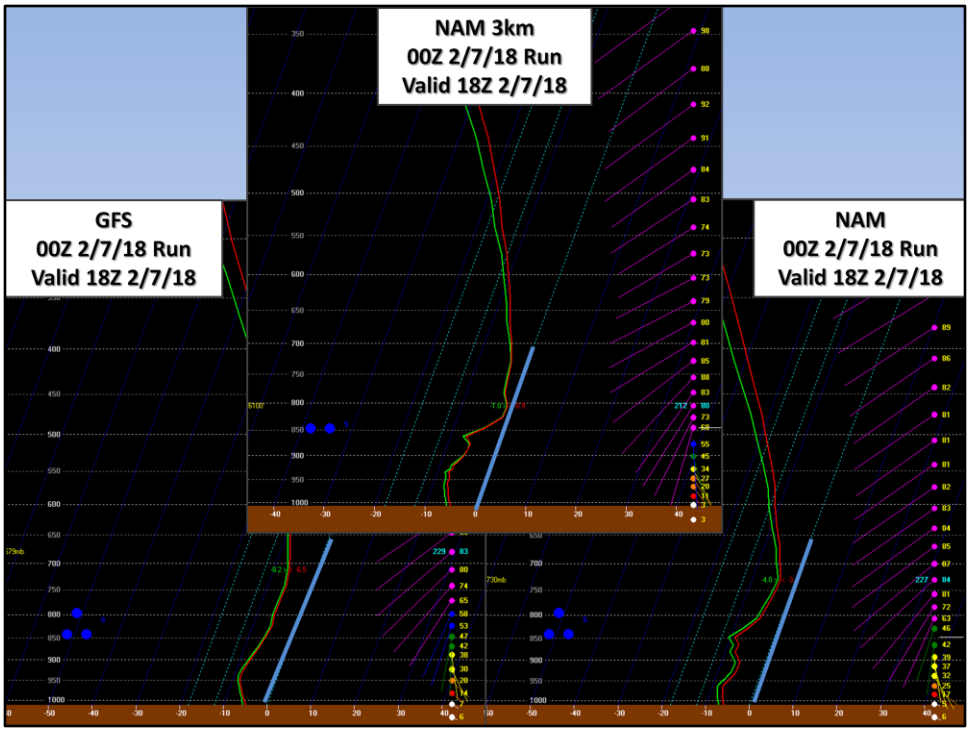
A quasi-stationary boundary remains over western NY throughout the entirety of the event with a separate warm front lifting north towards eastern NY and western New England. Coastal cyclogenesis and intensification commences along the warm front as the low traverses the Northeast coast. This allowed much of the cold air to stay in place over the region with the warm air surging into the Mid-Hudson Valley for a period.



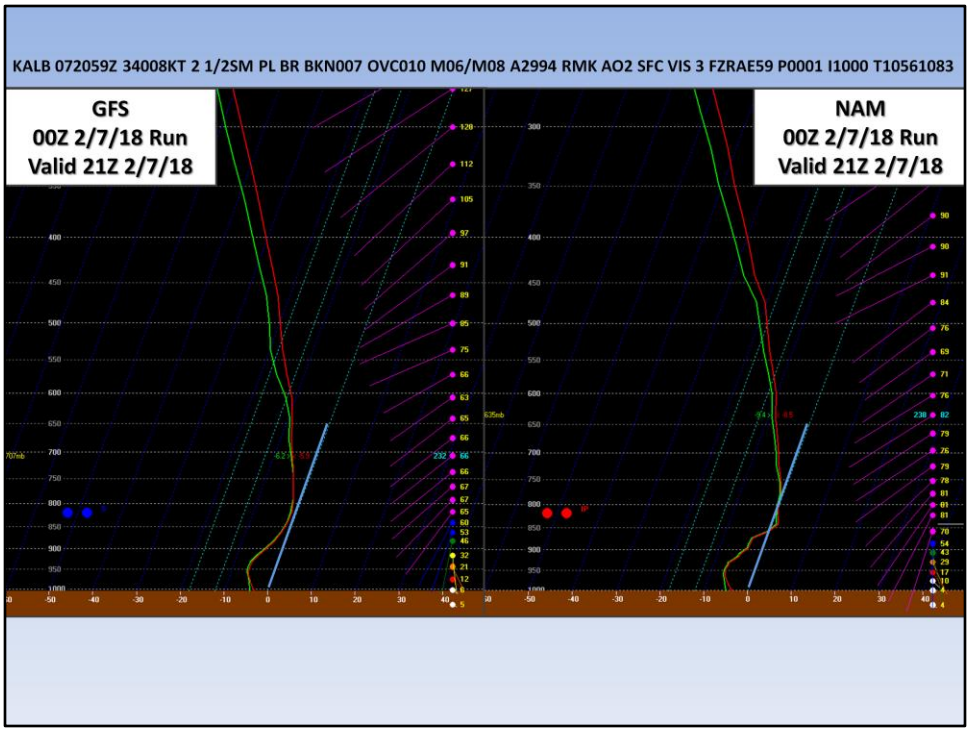
1200 UTC Wednesday 7 February 2018 sounding. This is a “snow sounding” with the entire column below freezing as the region of precipitation approached the region.



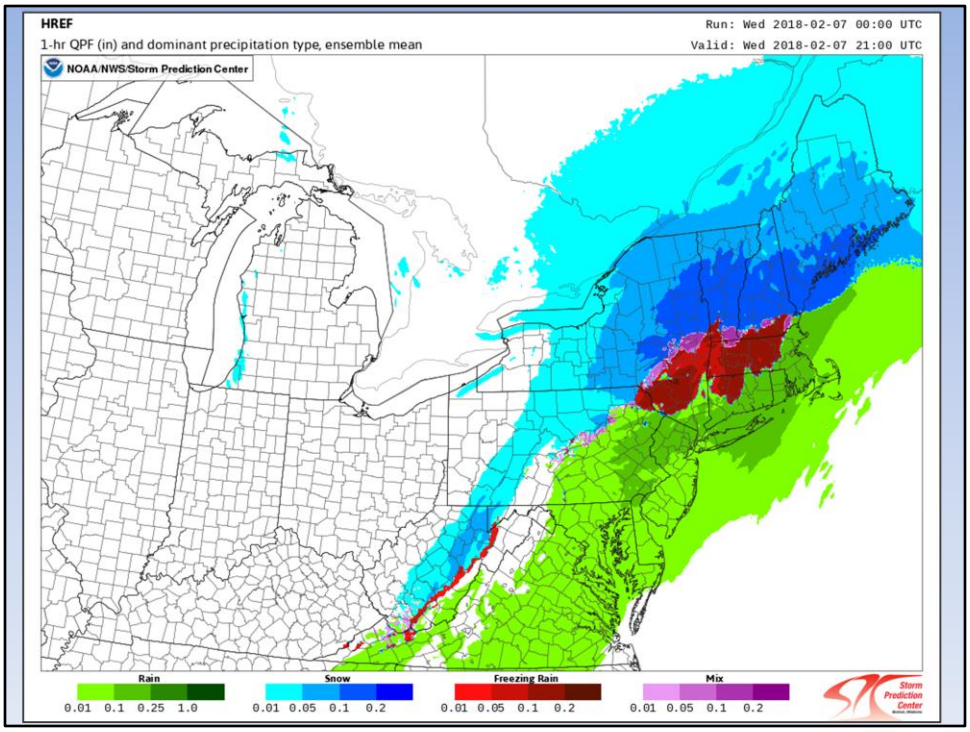
Observed ALB sounding from 1800 UTC 2/7/18.



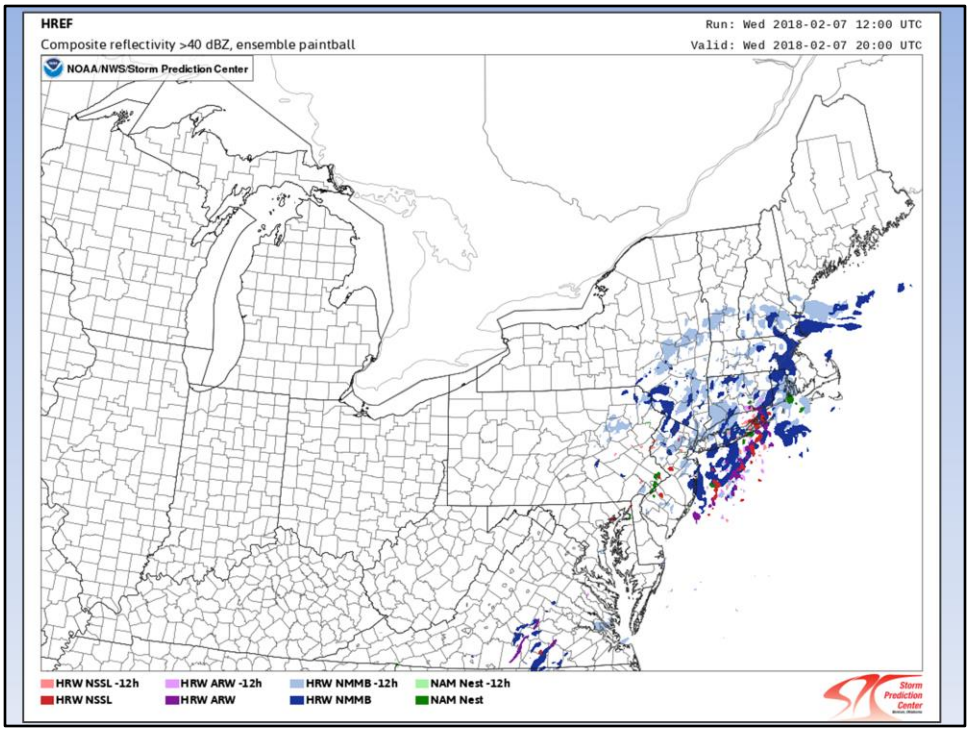
Neither the GFS or NAM forecasts (for ALB) resolved the warm nose adequately, while the NAM 3km forecast resolved the proper magnitude and level of the warm nose. The GFS actually doesn't even show a warm nose. Note that the NAM came close to properly resolving the warm nose while the NAM 3km resolved the warm nose very well.



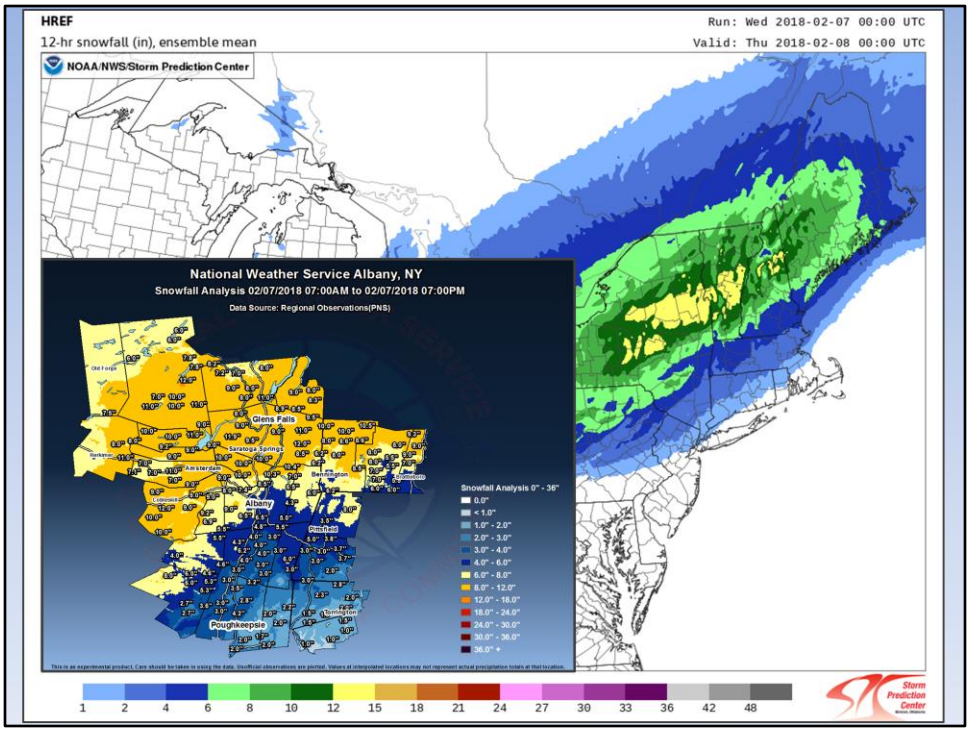
The GFS forecasts (across the board) never amplified the warm nose enough and therefore produced too much snow too far north. The NAM and NAM 3km (not shown due to similarity to NAM) warmed up a layer between 800-850 hPa to slightly above freezing at ALB therefore suggesting a period of sleet. This did end up happening during the event (see 21Z observation).



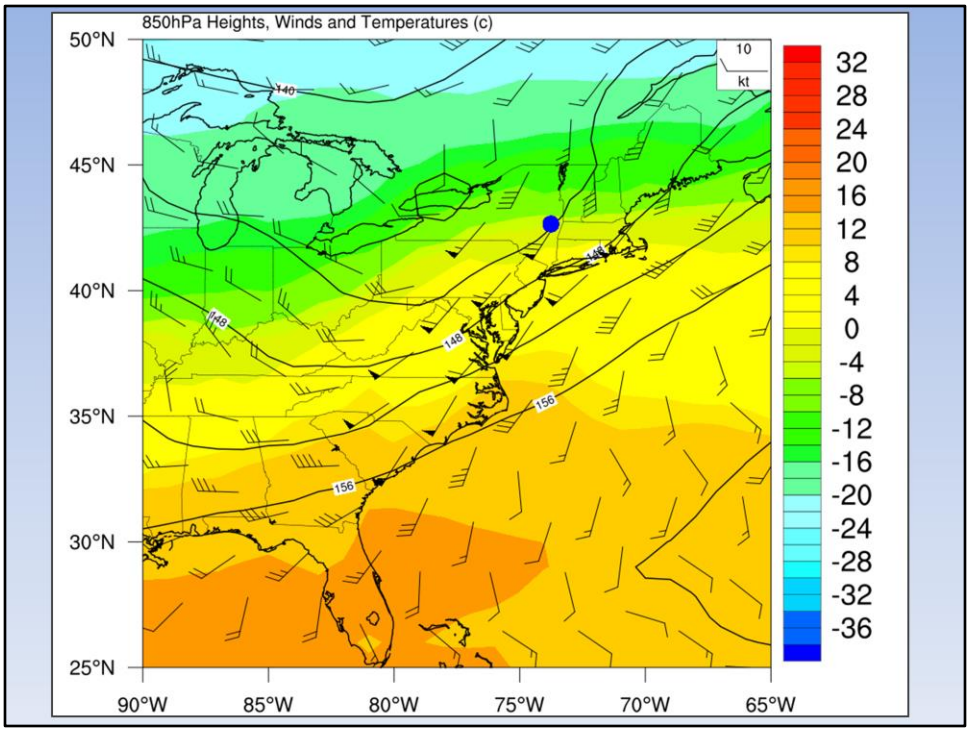
The HREF kept areas just north of I-90 all snow with the I-90 corridor (and just north) the approximate snow/mix line. This did end up coming to fruition almost exactly as shown with snow followed by a period of sleet/mix at ALB before transitioning back to all snow.



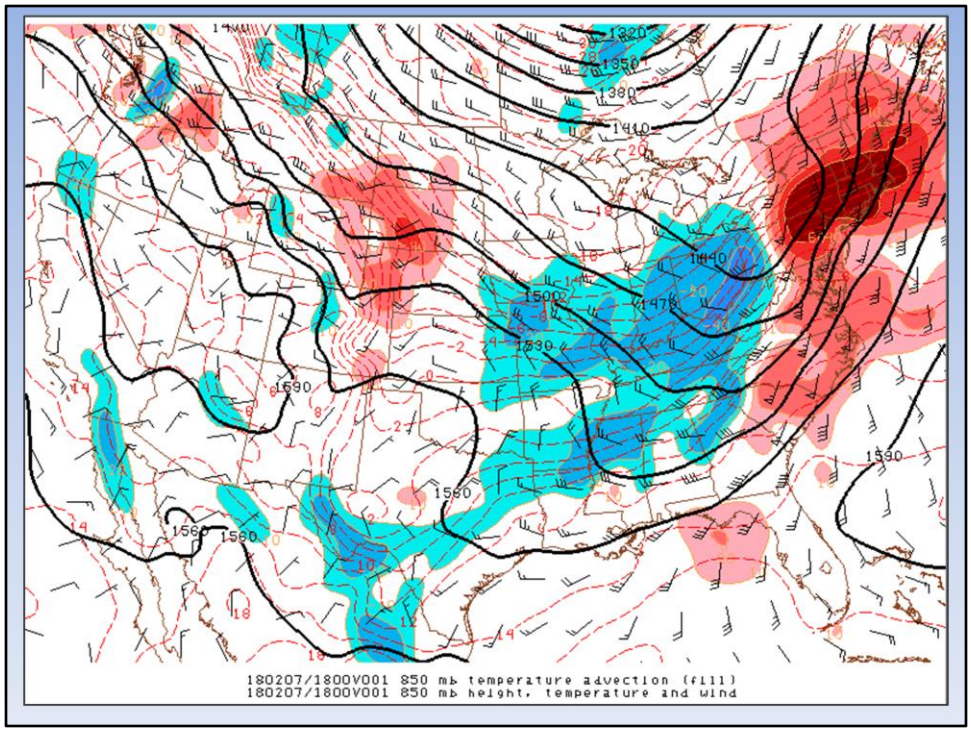
Note the NW extent of the composite Z >40 dBZ. This lines up with where the transition line was pretty well (it is as if the HREF is resolving “bright banding”?). Maybe this could be useful for identification of transition zones in future events where there is a rain/snow/mix line anticipated? Upon a very brief look at another similar event, it seems as if this could potentially be a useful tool.

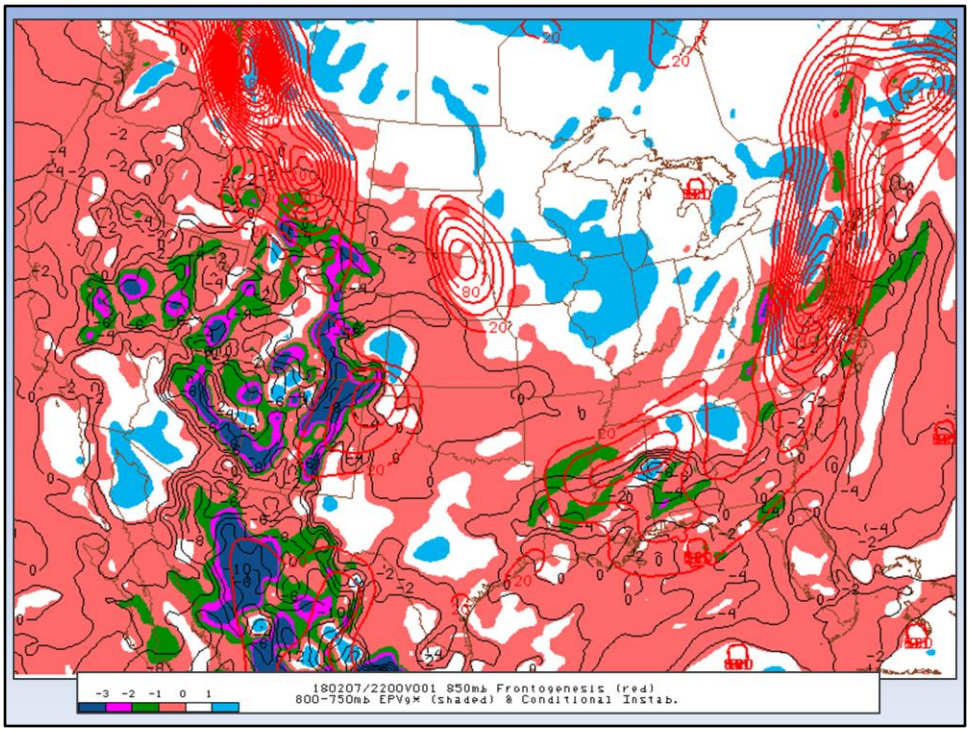


The HREF output a swath of 12-15 inches of snow over portions of north-central eastern New York decreasing to 2-6 inches as you head south into the Mid-Hudson Valley. Comparing this to the snowfall analysis, the HREF did well.

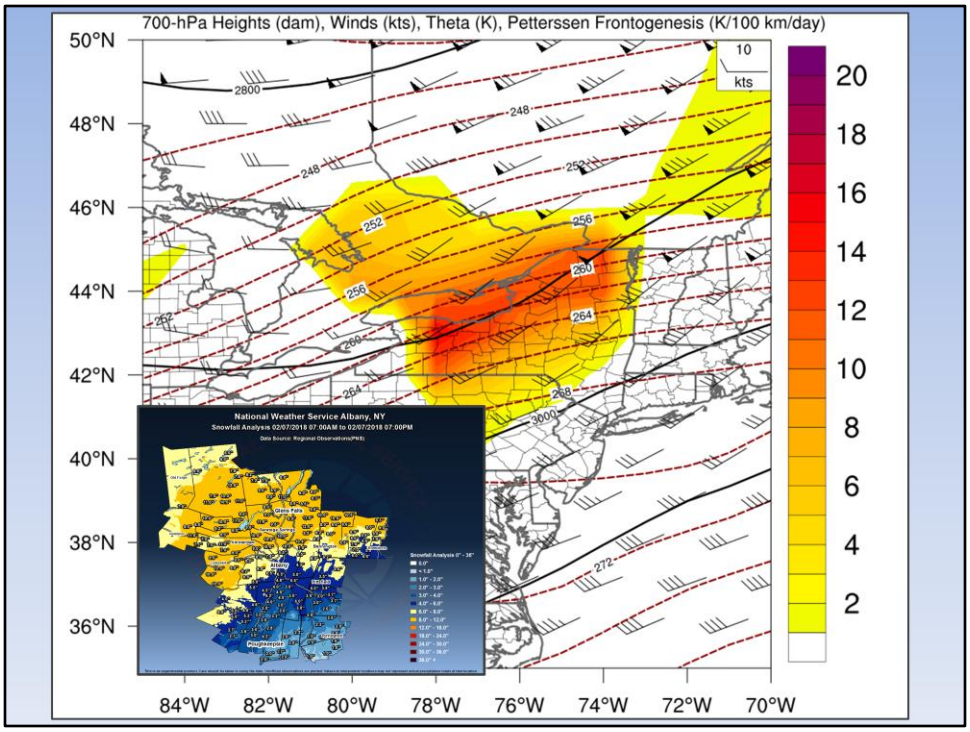


GFS reanalysis data. Valid at 1800 UTC 7 February 2018. Note the strong WAA (70 kt winds advecting warm air northward) into the greater Capital Region. This is why the warm nose around 850-hPa developed and changed over the precipitation to a mix/sleet up into the southern Capital Region for a brief period of time. This strong WAA also providing strong forcing for ascent in the lower troposphere.

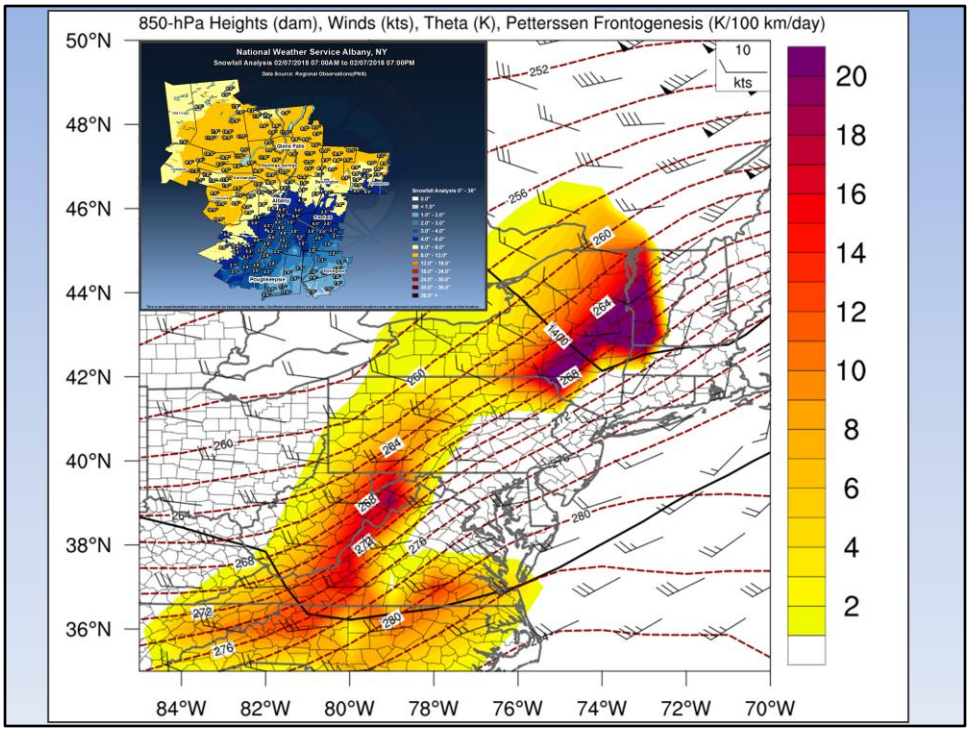

180207/1800V001 850 mb temperature advection (fill)
180207/1800V001 850 mb height, temperature and wind



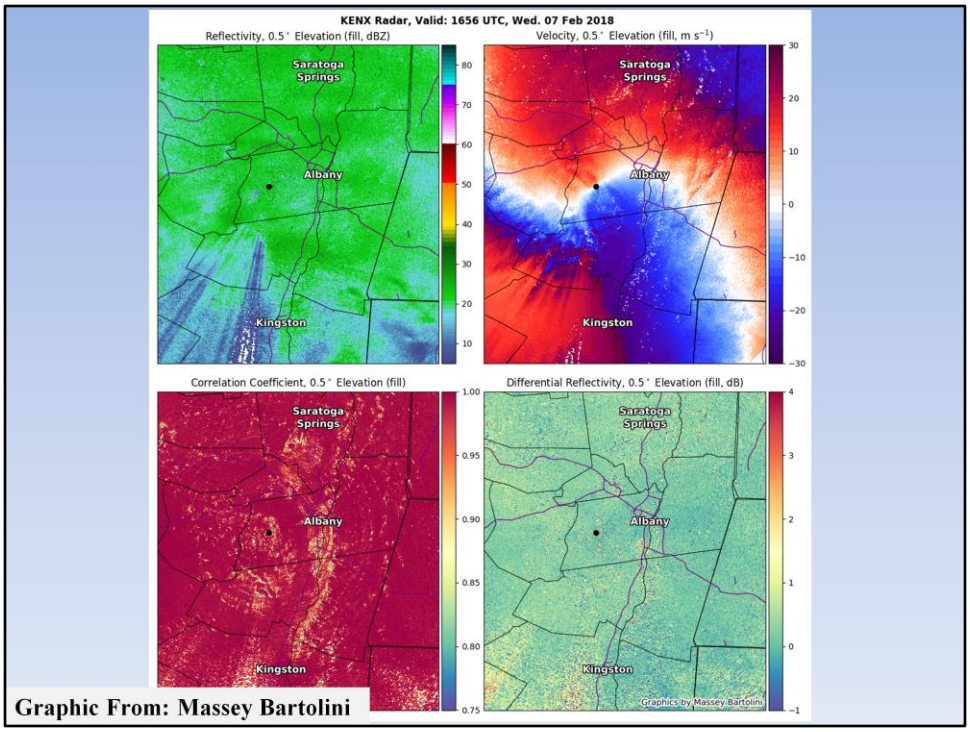
Note the region of strong FGEN overlapping the region of negative geostrophic equivalent potential vorticity (eastern New York and western New England), this releases the conditional instability and allows for intense precipitation and high snowfall rates.



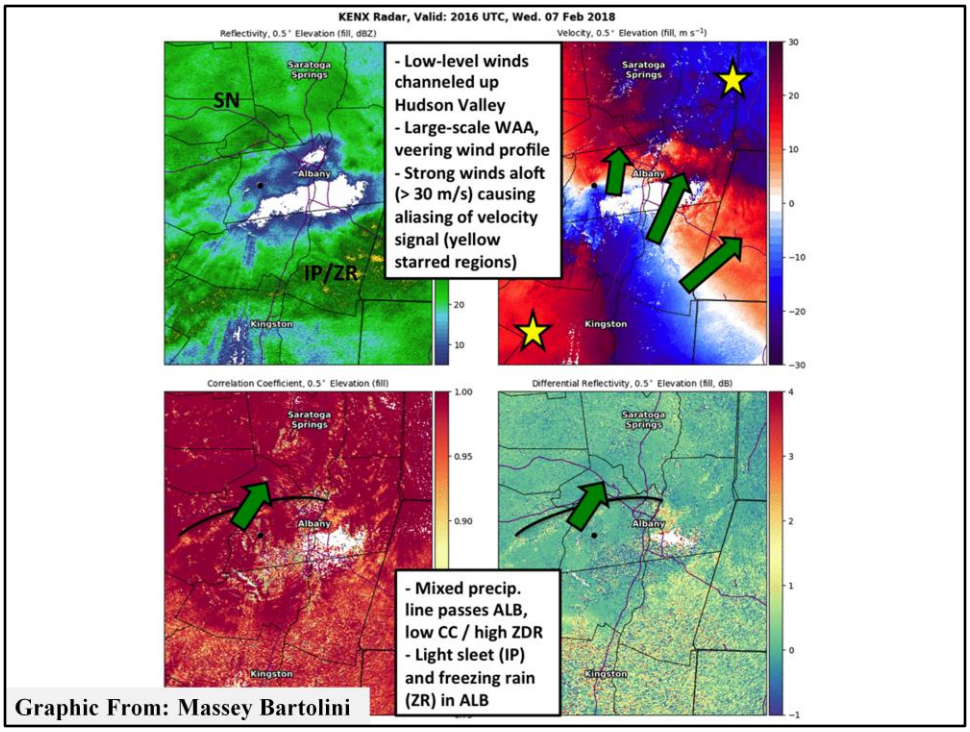
GFS reanalysis data. Valid at 1800 UTC 7 February 2018. Note that the region of strongest frontogenesis is partially collocated with the region that received the most amount of snow.



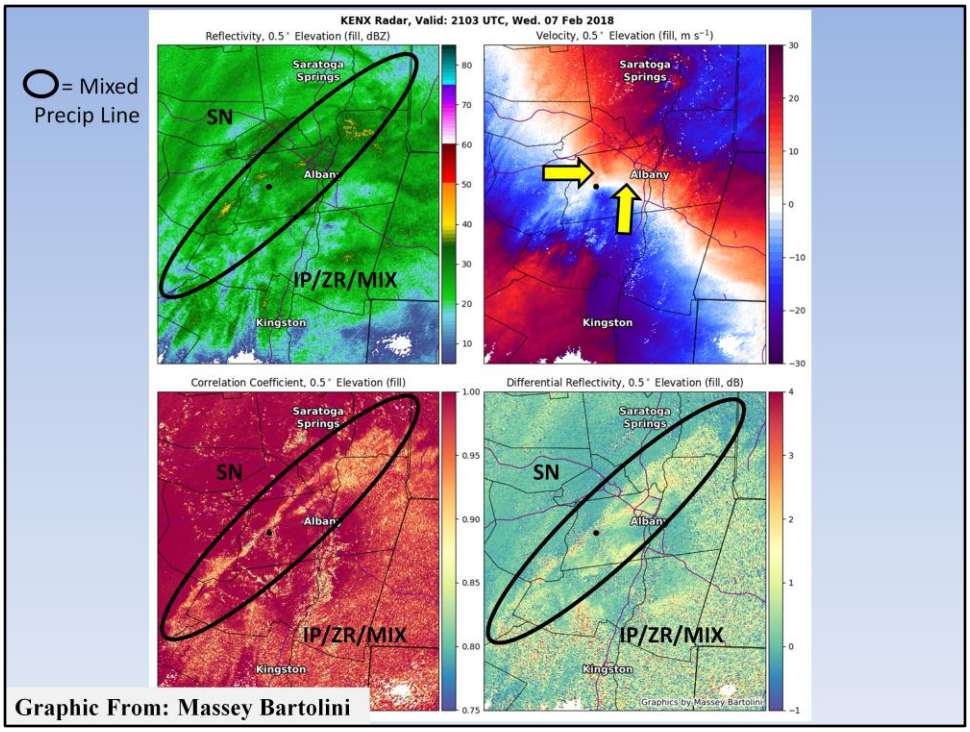
GFS reanalysis data. Valid at 0000 UTC 8 February 2018. Note that the region of strongest 850-hPa frontogenesis is collocated with the region that received the most amount of snow. High precipitation rates possibly cooled down the column in this region, resulting in mostly snow for the event. The area just south and west of the FGEN maximum saw a period of mixed precipitation, limiting snow accumulation totals.



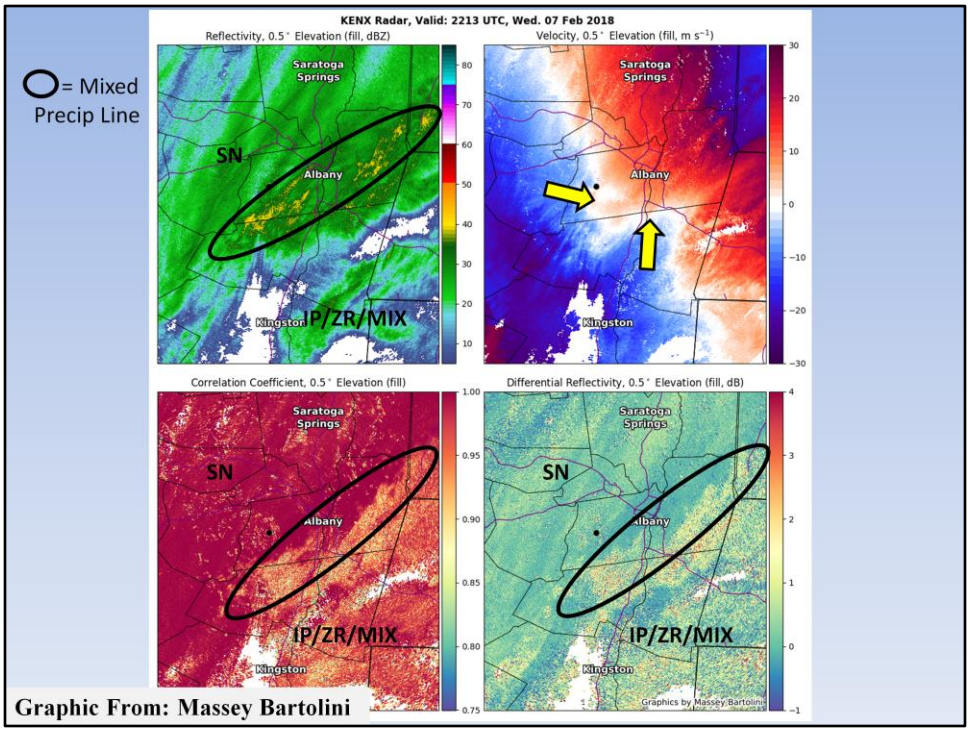
Smooth/fuzzy reflectivity in the upper 20/low 30 dBZs and uniform CC and ZDR fields all suggest widespread light-to-moderate snow.



Graphic From: Massey Bartolini



Note that the high Z/low CC/high ZDR region, indicating the mixed precipitation line, pivots over the capital region and begins to push east. Also note the wind shift visible in the velocity data.



The high Z/low CC/high ZDR region, indicating the mixed precipitation line, continues to push east. Uniform CC/ZDR fields and Z in the upper 20 to low 30 dBZs indicates a transition back to snow behind the line. Also note the WNW relatively cold flow behind the mixed precipitation line. This region of mixed precipitation is the reason for lower snow accumulations over the Mid-Hudson Valley and points east and south. The Dual-Pol Hydrometeor Classification (HC) scheme did not do a very good job identifying the mixed precipitation line with this event. It seemed to identify too large of a region of all snow and did not resolve much of a mixed precipitation "line". The HC scheme has been noted with other events (27 November 2018 for example) of resolving too much snow in the output, possibly due to the sampling height of the radar beam above the melting layer. A best practice could be to identify the melting layer on a sounding (observed or model forecast) and compare that to the radar sampling height and see if it is within the melting layer, this will give some input into the accuracy of the product for that event.

Summary and Lessons Learned

- Efficient dynamics allowed for coastal cyclogenesis/redevelopment along a baroclinic zone
- HREF suggested heavy snow with rates of 1-2 inches per hour were possible (not shown)
- HREF suggested the mixed precipitation line could reach as far north as a line extending from SW of the Capital Region, into the Capital Region, and east into southern Vermont
- Thermal profile forecasts were underdone with respect to the magnitude of the warm nose, although the NAM3km ended up resolving the warm nose vary well and the NAM/NAM3km PTYPE forecasts were pretty spot on.
- The biggest challenge with this event was determining exactly how far north the mixed precipitation line would extend. Choosing a middle ground and nudging that toward NAM thermal profiles seemed to be a good methodology for this event, since the GFS has been displaying a non-legitimate dry layer in the very lowest levels and often times misses the magnitude of the warm nose aloft
- HREF dominant precipitation type forecasts and composite Z>40 dBZ (ensemble paintball) are useful tools for determining where the rain/snow/mix transition line may come to fruition
- Strong WAA/isentropic lift resulted in widespread moderate snow but also allowed warm air and mixed precipitation to surge northward into the Mid-Hudson Valley and Capital Region
- FGEN in the low levels and layer averaged FGEN should be analyzed for regions of intense precipitation rates and possible cooling of the column
- WSR-88D products such as Z, V, CC, ZDR are very useful for determining PTYPE in mixed precipitation events and can be used for real time forecast updates and IDSS
- Continuous mesoanalysis proved useful in this event for updates/IDSS/social media updates