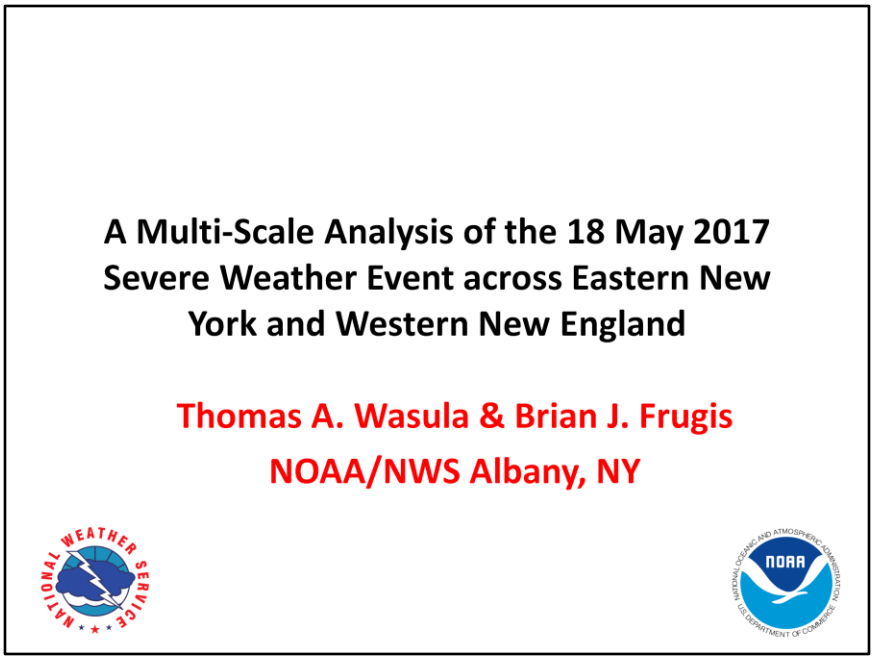
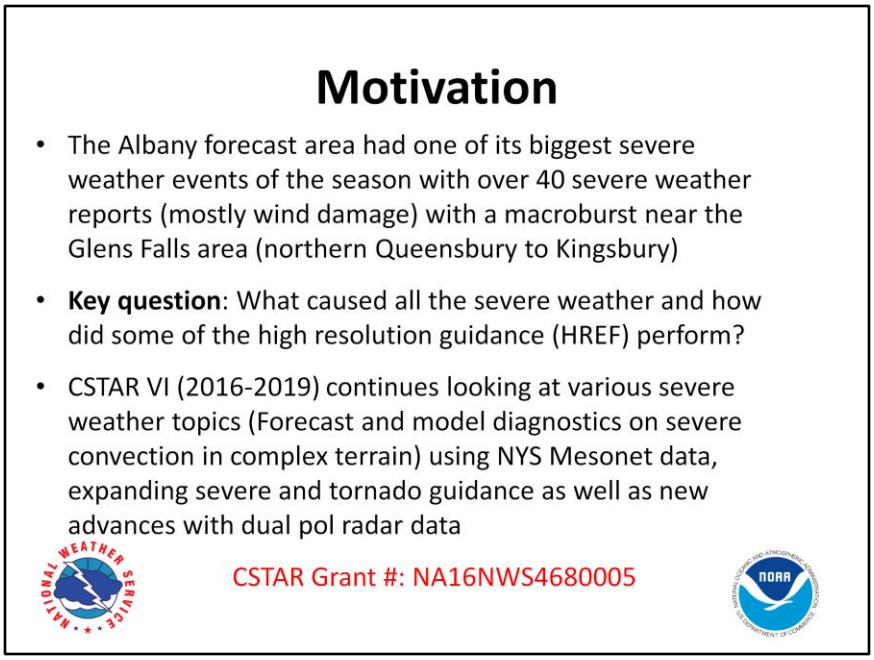
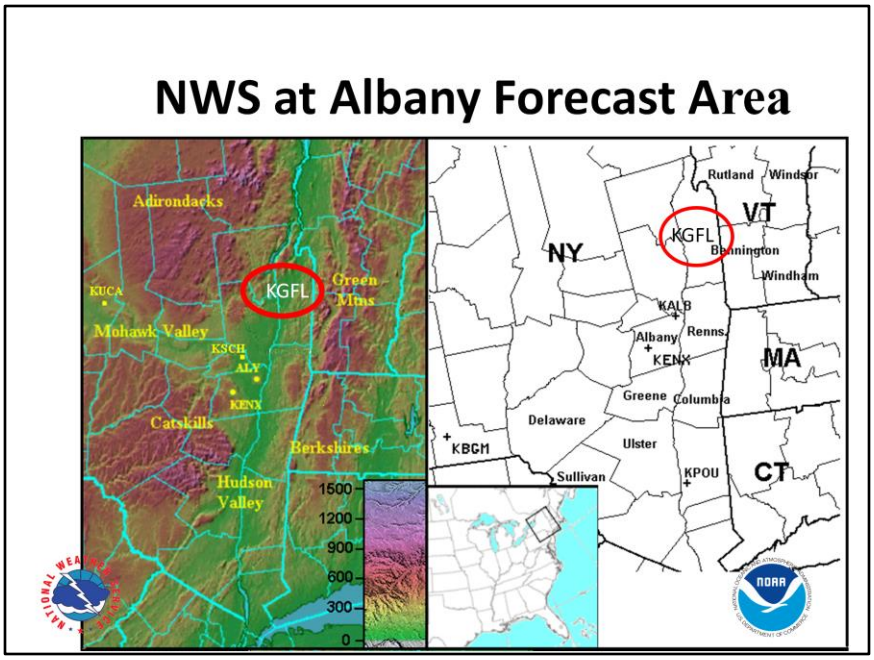


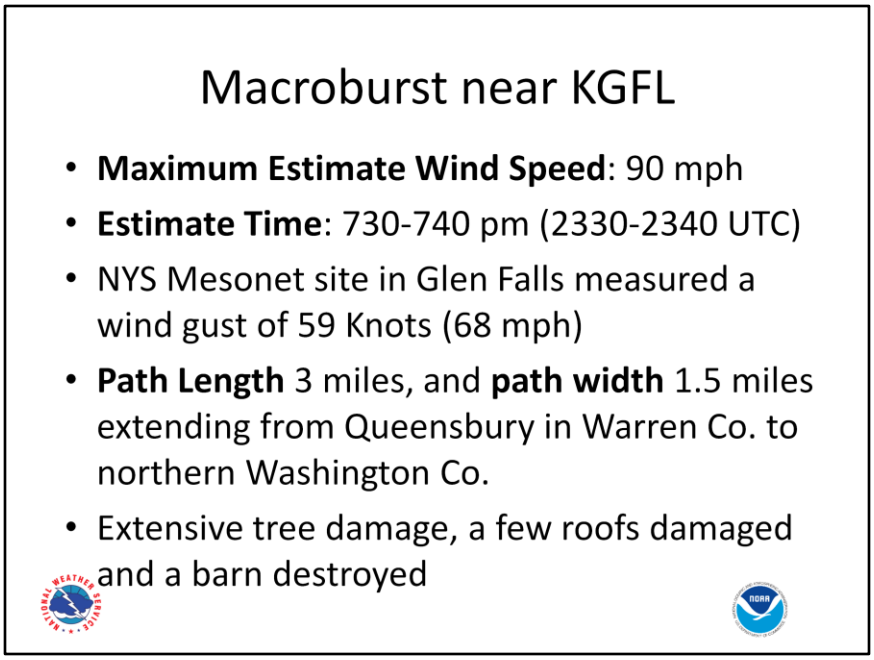
My name is Tom Wasula, a lead meteorologist here at the National Weather Service at Albany. This is a case study on a significant severe weather event that impacted eastern NY and western New England in May of 2017. My co-author is Brian Frugis where some 1" hail study work that I did with him, and recent dual pol severe wind analysis research he is doing is applied. This case study was first shown at the 1-2 November 2017 18th Northeast Regional Operational Workshop



The motivations for this talk are above. A large number of severe reports occurred (~40). A macroburst occurred near Glens Falls, NY in the northern Queensbury area to Kingsbury. The key questions are what caused all the severe weather, and how well did the HREF guidance perform? This case addresses some of the topics in CSTAR VI such as forecast and model diagnostics on severe convection in complex terrain, using the new NYS Mesonet data, as well as expanding severe and tornado guidance as well as new advances in dual pol data. The CSTAR Grant number is also listed.

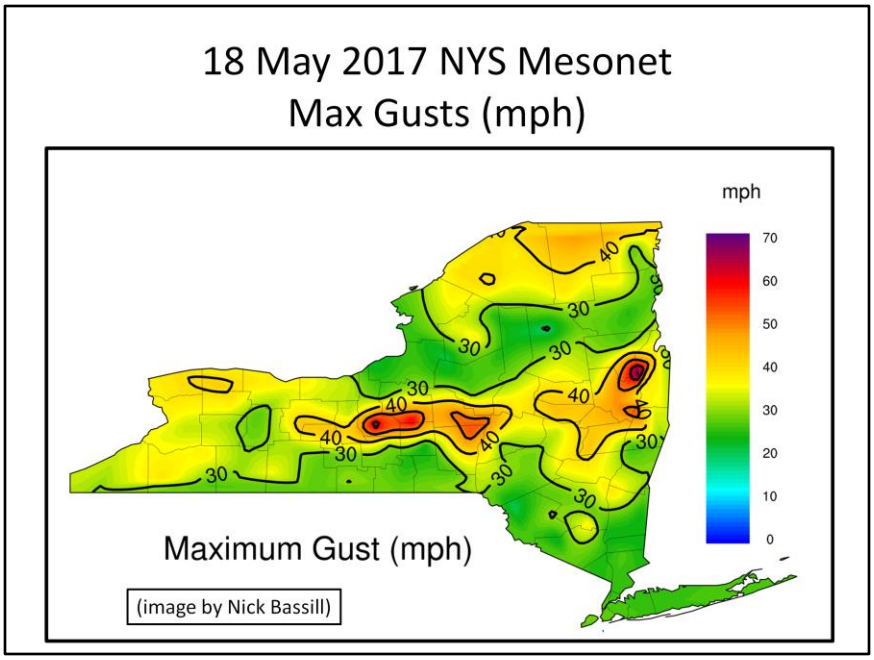


This is a map of the WFO at Albany Forecast Area that covers eastern NY and western New England. KGFL is highlighted on the maps. Notice the complex terrain in the forecast area with the two major river valleys (Mohawk and Hudson) surrounded by the Adirondacks, Green Mountains, Catskills, and Berkshires (as well as the Litchfield Hills of NW CT, and Taconics not listed)

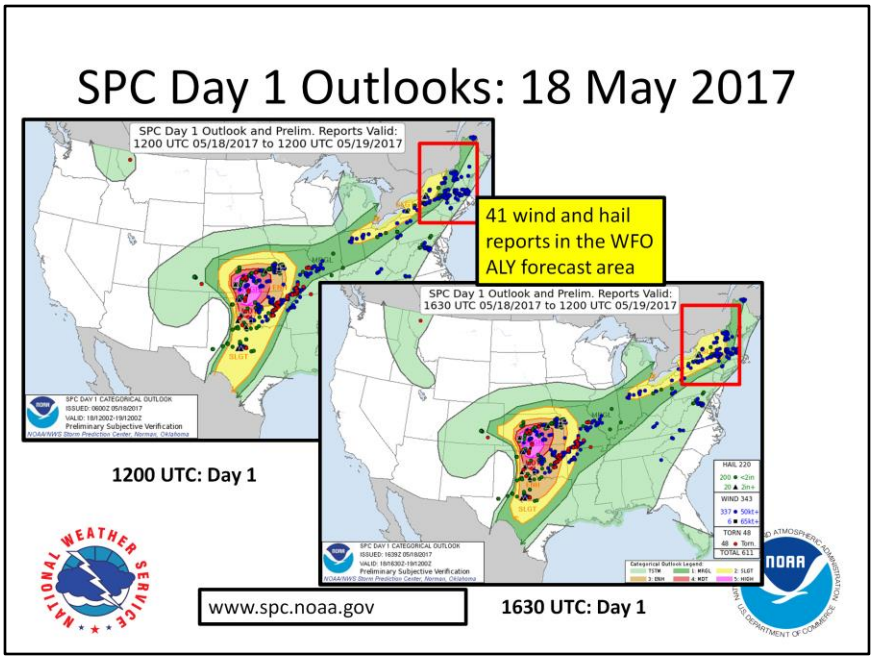


The macroburst information is shown. The peak estimated wind speeds were 90 mph. The NYS Mesonet site at KGFL recorded a peak gust of close to 60 knots. There was extensive tree damage, a few roofs severely damage, and a barn destroyed. The path length was about 3 miles with a path width of 1.5 miles going from Queensbury in Warren Co. To Kingsbury in northern Washington Co.

Here a few photo's from the damage survey done by Washington Co. Emergency Manager Tim Hardy. The destroyed barn is shown in the upper left with the other 2 pictures showing the extensive tree damage with numerous downed power lines.



This NYS Mesonet graphic was created by Nick Bassill with the peak wind gusts for the event. The maximum wind gusts were across central NY in the mesonet, and also across the Mohawk Valley, Capital Region, and the Lake George Saratoga Region from the severe weather event. The macroburst area stands out with the wind gust "bullseye" north of Albany (68 mph gust at the Glens Falls mesonet) on the map.

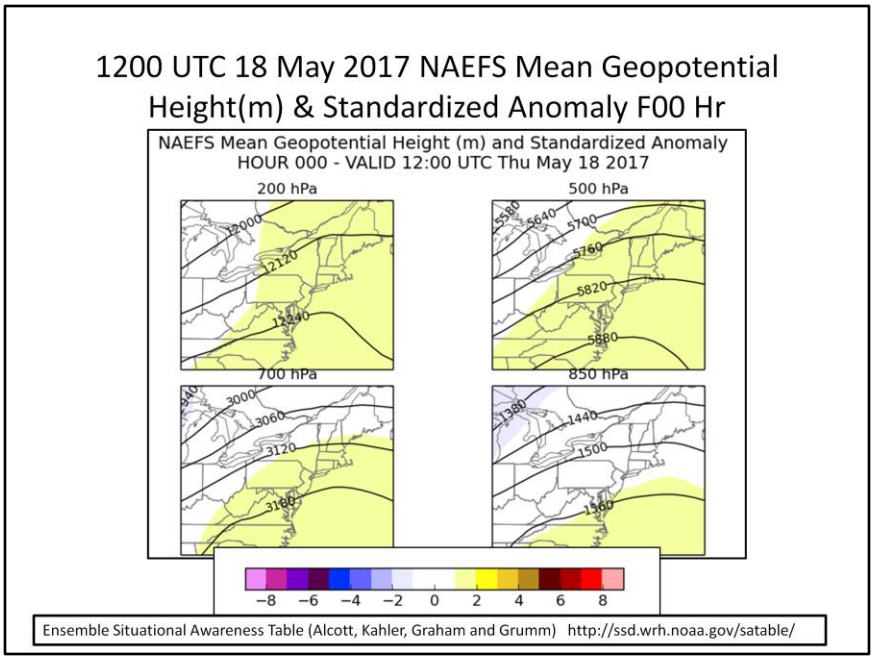


The 18 May 2017 SPC Day 1 1200 UTC, and 1630 UTC outlooks are shown with the severe weather reports overlayed. The challenge with this event was how far downstream would severe convection hold together for severe weather. Most of the Albany forecast area was in General Thunder to a Marginal Risk at 1200 UTC. An extrapolation downstream of the "Slight Risk" area was done with 1630 UTC outlook compared to the 1200 UTC Outlook, which captured a better percentage of the severe weather reports that did occur across upstate NY and New England. Still many reports occurred just east of it, but a smaller percentage. The total severe reports in the Albany forecast area was 41, with the vast majority of them wind damage.

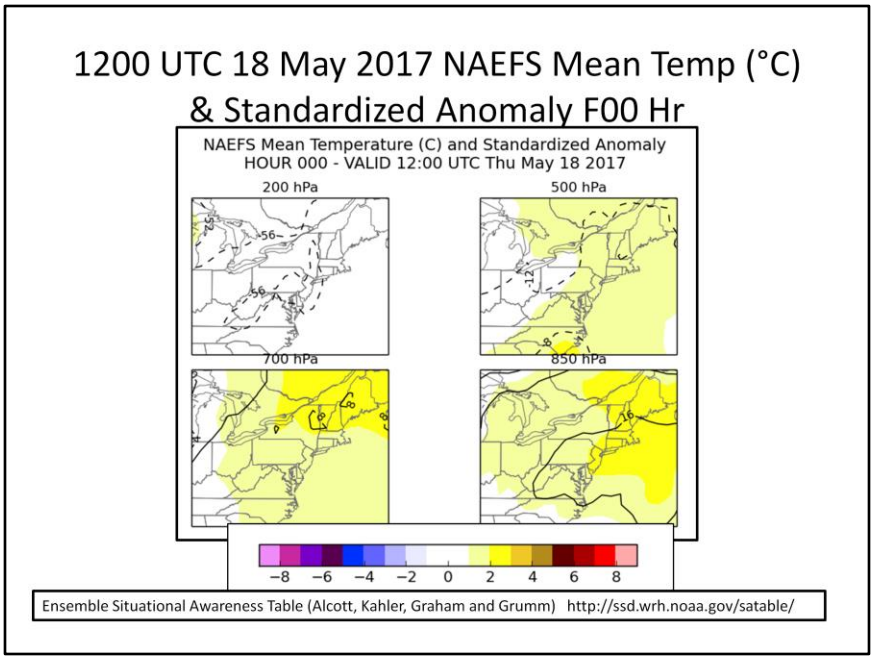
Outline

- Brief Review of the North American Ensemble Forecasts (NAEFS) Standardized Anomalies
- Brief Synoptic Overview 18 May 2017 Case
- Mesoscale Analysis (SPC Meso-analysis data (Rapid Refresh))
- Application of WFO at ALY 1"Hail Study and current Dual-Pol work (ZDR Arches and K_{DP} Spikes) with a Storm-Scale Analysis of a few storms using GR-2Analyst
- HREFv2 Performance

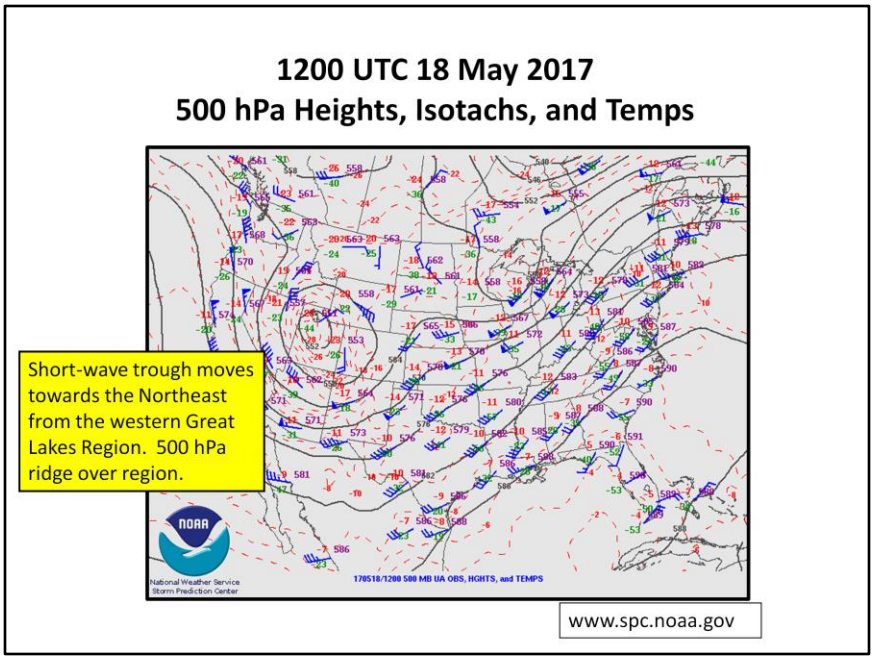
Here is the outline for the talk, as we will briefly review some NAEFS standardized anomalies for the case. A quick synoptic overview of the 18 May 2017 case will be shown. We will review some of the Mesoscale analysis data from the SPC Meso-Analysis page. Applications of some radar examples will be done with the WFO ALY 1" hail study from 2010. Current Dual-Pol research lead by Brian Frugis will be shown applying Z_{DR} Arches, and K_{DP} Spikes/Columns with a storm-scale analysis of a few storms using GR2-Analyst. Finally, a quick review on the performance of the HREFv2 for the event with be shown in a few slides.



The 12Z 18 May 2017 F00 HR NAEFS standardized height anomalies at 200, 500, 700, and 850 hPa are shown. Anomalous ridging was over the East Coast extending into the Northeast. Height anomalies at 500 and 700 hPa were 1 to 2 standard deviations above normal.

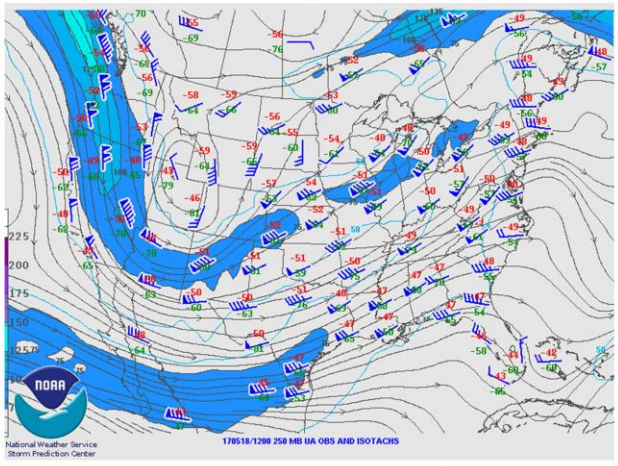


The NAEFS 1200 UTC 18 May 2017 700 hPa and 850 hPa temperature standardized anomalies were +1 to +3 standard deviations above normal in the hot air mass.



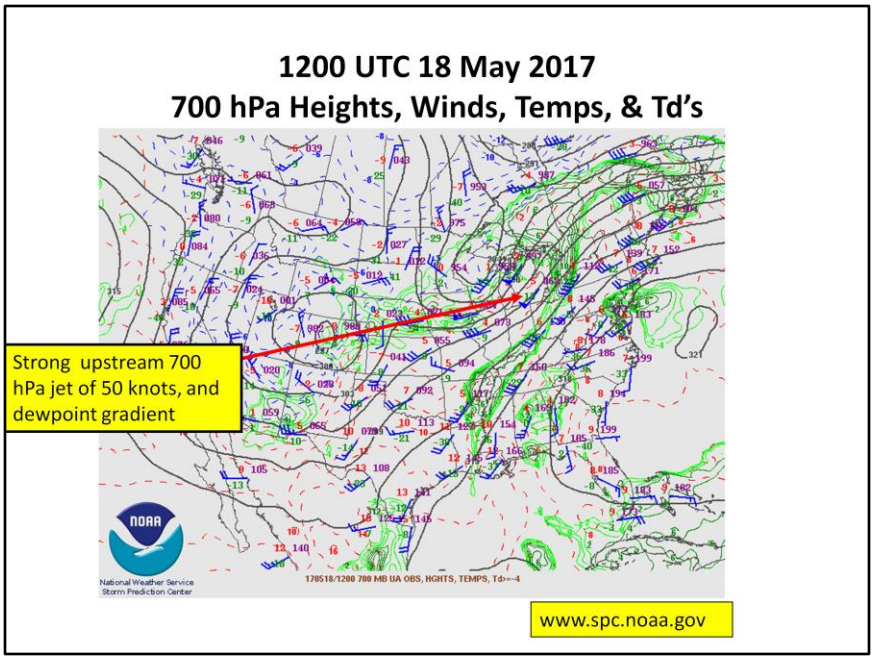
At 500 hPa, at short-wave trough was moving towards the Northeast from the Upper Midwest and western Great Lakes Region. A 500 hPa ridge was over the Northeast, and the East Coast with broad southwest flow aloft.

1200 UTC 18 May 2017
250 hPa Upper Air Obs, Streamlines & Isotachs

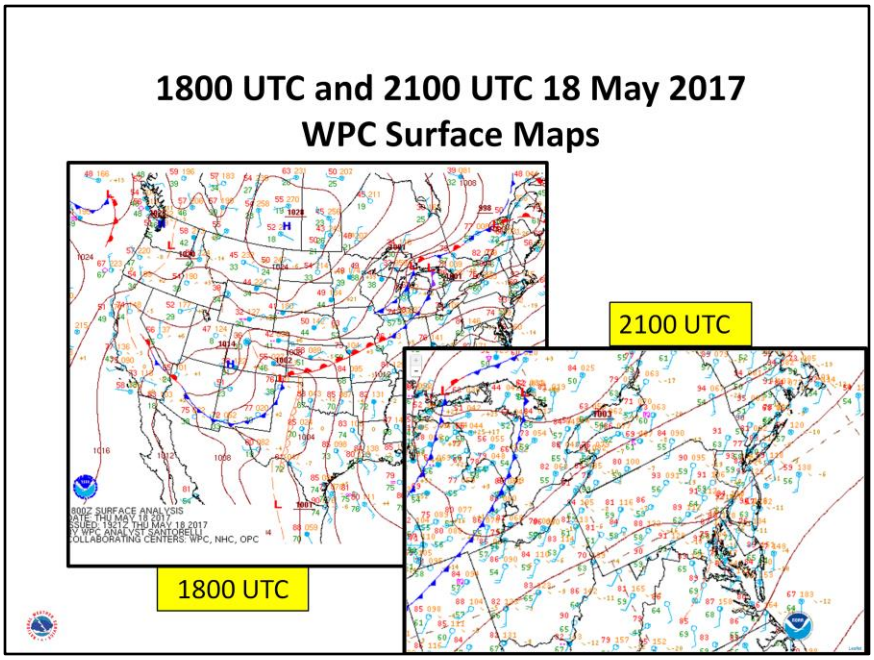


www.spc.noaa.gov

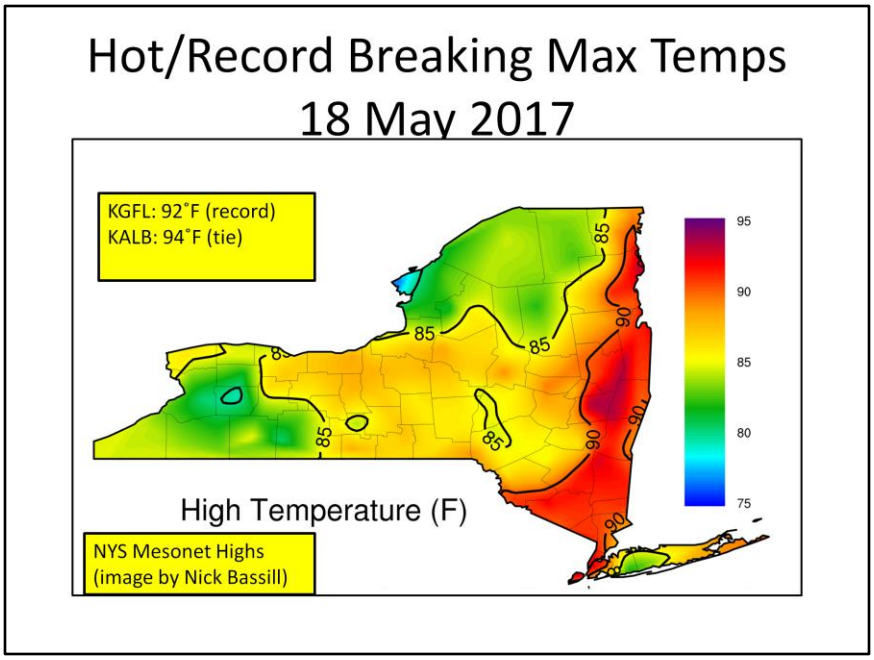
The 250 hPa jet was upstream of eastern NY and western New England with a strong jet streak of 75-95 knots moving from eastern IA into the central and eastern Great Lakes Region.



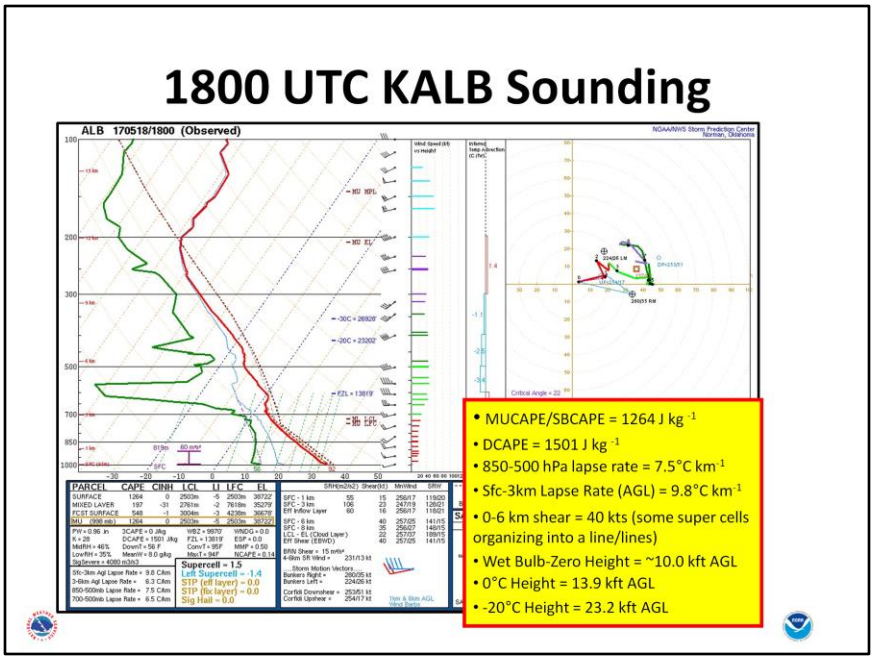
At 700 hpa, a strong low-level southwesterly jet of 50 knots was moving across MI and towards the eastern Great Lakes Region. A strong dewpoint gradient existed ahead of the low to mid level front moving towards western NY and Lake Ontario.



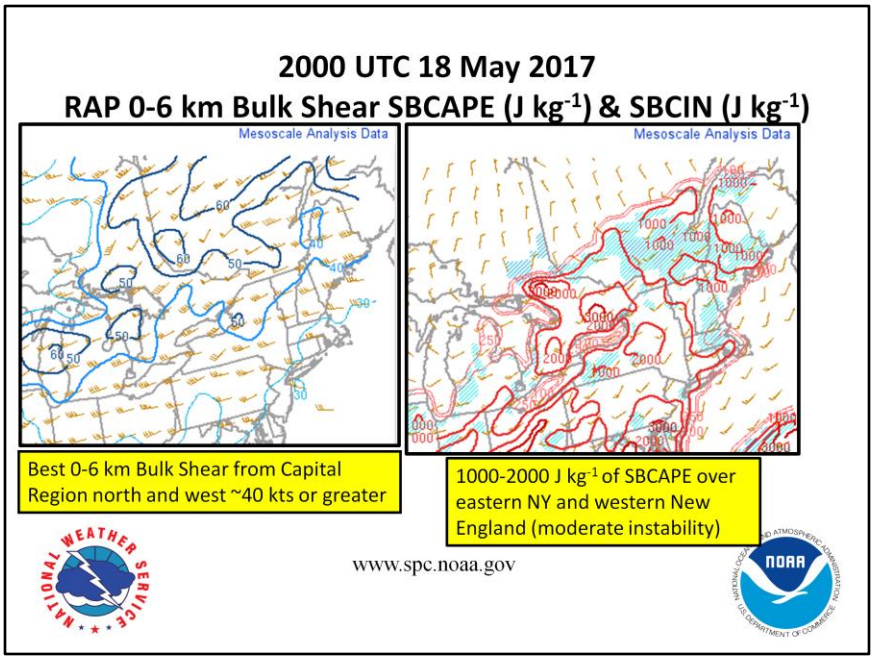
The 1800 and 2100 UTC surface maps indicated a pair of cold fronts approaching NY state with surface dewpoints in the 50s to lower 60s, as air temperatures over eastern NY and portions of western New England were in the 90s. An anomalously hot air mass was in place ahead of the cold front and a developing lake breeze boundary.



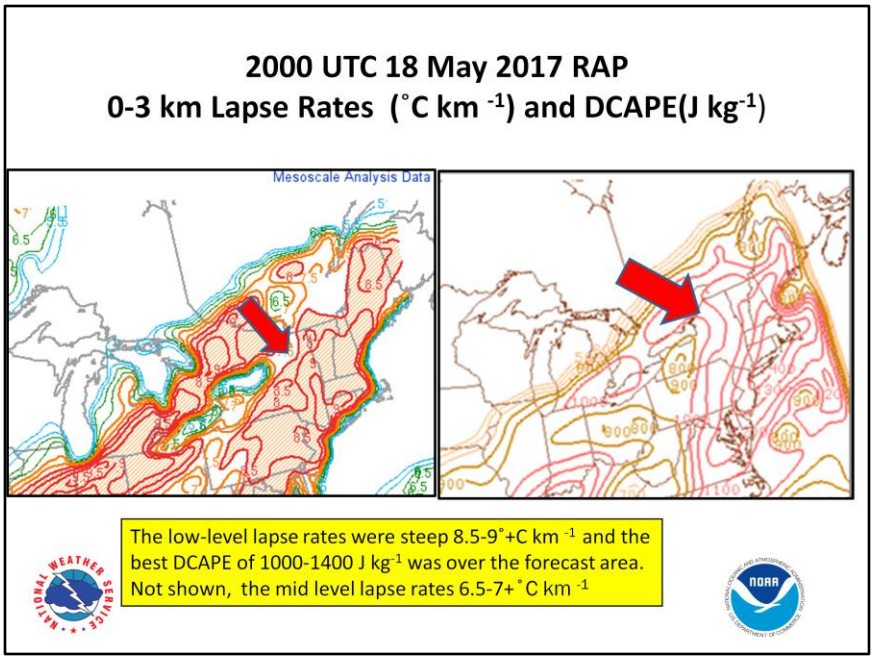
Several high temperature records were broken across eastern NY with a notable record high of 92°F at Glens Falls, and a tie of 94°F at Albany. Many high temps in the lower to mid 90s occurred from the Hudson River Valley eastward based on the NYS Mesonet high temperature map.



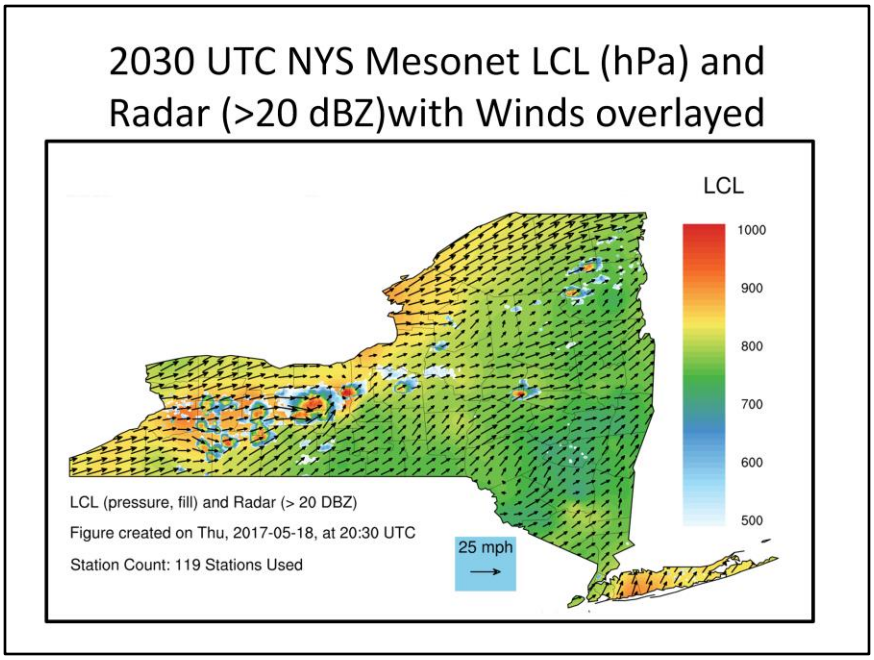
The NWS at Albany did a 1800 UTC special KALB upper air release. It was very helpful diagnosing the severe weather potential. Moderate amounts of instability were in place with MUCAPE/SBCAPE's of 1264 J/kg. The DCAPE was very extreme being just over 1500 J/kg. The mid-level and low-level lapse rates were very steep. The low-level lapse rates were close to dry adiabatic. The 0-6 km shear of 40 knots indicate some supercells were possible organizing into a squall line or multiple lines. The steep mid-level lapse rates with wet-bulb zero heights were indicative of the possibility of some large hail, though damaging winds looked to be the main threat. The 0°C and -20°C heights are noted for the large hail analysis.



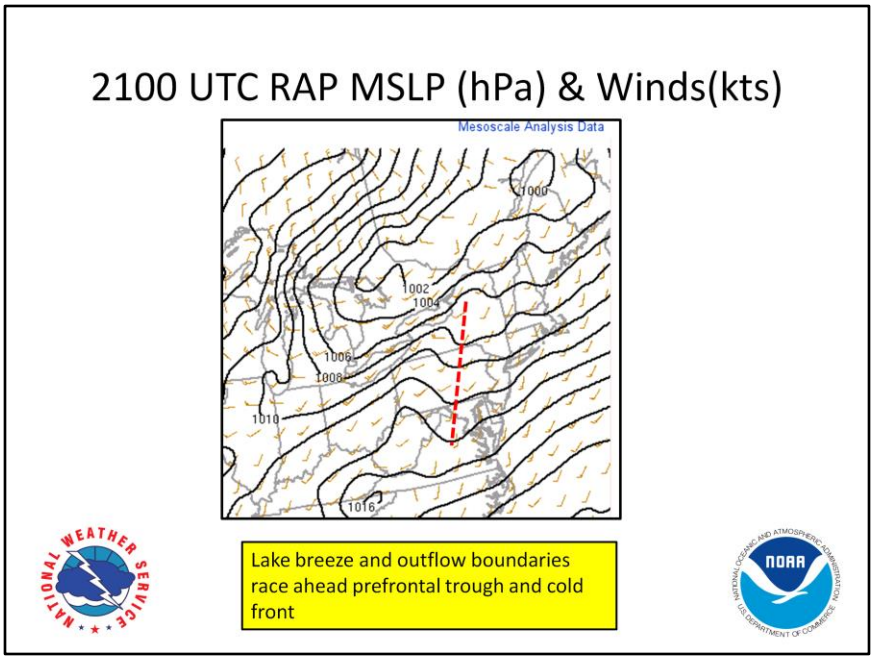
The 2000 UTC SPC Meso-analysis data from the RAP showed the best 0-6 km bulk shear from the Capital Region north and west. The SBCAPE over central NY into eastern NY and western New England was in the 1000-2000 J/kg range which was basically moderate instability.



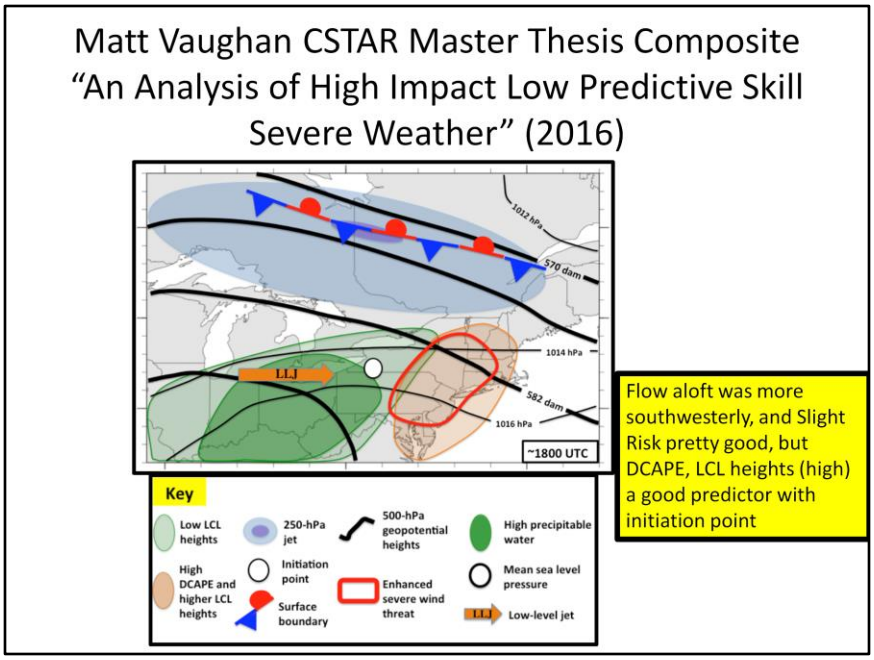
The 2000 UTC SPC RAP Meso-analysis data showed steep low-level lapse rates in the 8.5-9+°C/km range over the vast majority of the forecast area with DCAPE values in the 1000-1400 J/kg range. The mid-level lapse rates were also very steep (in excess of 7°C/km)



The 2030 UTC NYS Mesonet LCL (hPa) and radar (>20 dBZ's) with winds overlayed showed the lower LCL's just downstream of the Great Lakes over western NY into the Finger Lakes Region. The higher LCL's were over eastern NY, where some convection began to fire over the Mohawk Valley, and northern Adirondacks.

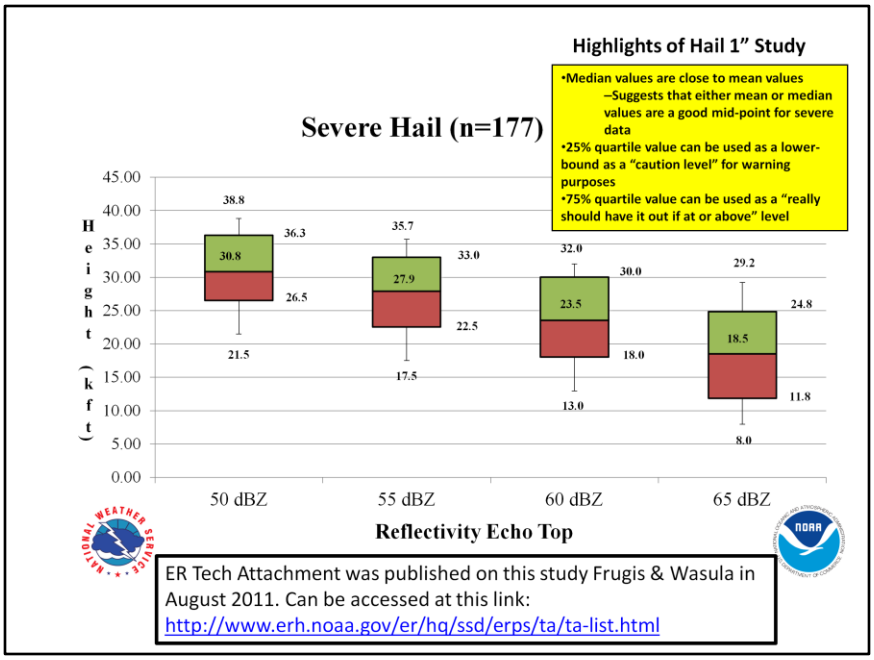


The 2100 UTC RAP MSLP (hPa) and surface winds analysis showed the low pressure system moving east of Georgian Bay with a cold front extending south and west through Michigan. Further downstream, a lake breeze and associated outflow boundaries raced ahead of a prefrontal trough getting close to the eastern Great Lakes.

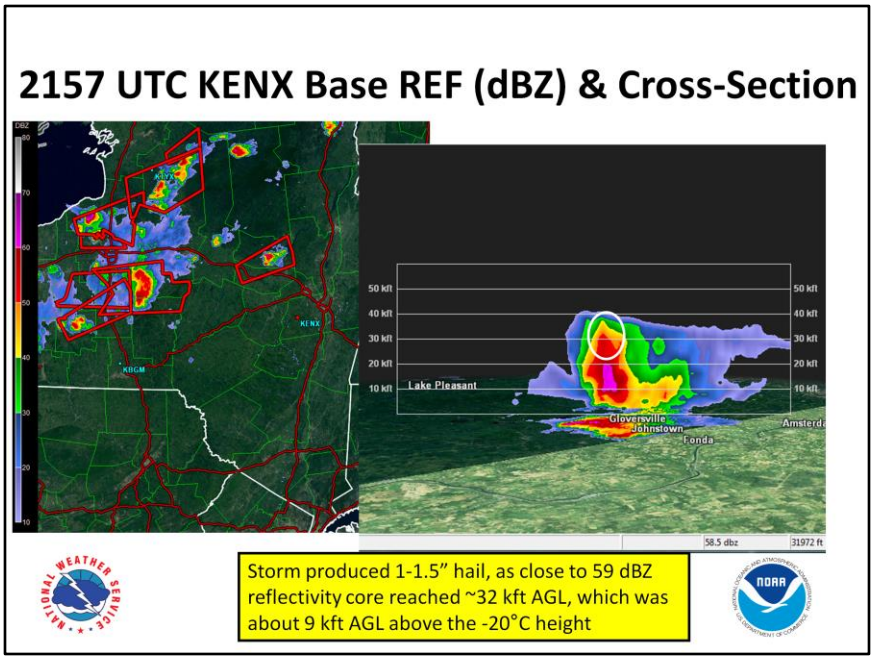


A recent CSTAR student, Matt Vaughn, published his Master Thesis in a AMS Weather and Forecasting journal article in 2016, "An Analysis of High Impact Low Predictive Skill Severe Weather". This schematic composite diagram was in his thesis and the paper. Some of the parameters tied into this case where the LCL heights were high with large values of DCAPE. The flow was more southwesterly aloft, and not northwesterly. SPC also adjusted the Slight Risk area within a portion of the severe weather threat area for the event. The overlay of the DCAPE and LCL heights were good predictors for a severe weather initiation point in the Albany area.

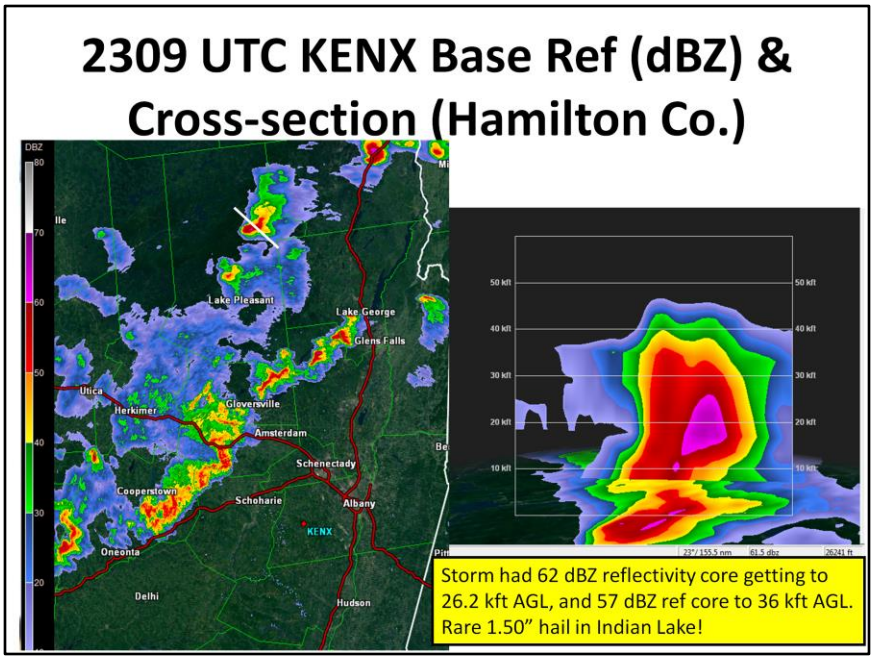
KENX STORM-SCALE HIGHLIGHTS
18 MAY 2017 SEVERE EVENT



Results from a recent 1" Hail Study completed by Brian Frugis and I in 2011 will be applied with the case. Severe warning guidance was established using the 50, 55, 60, and 65 dBZ reflectivity echo top or core height with median values established with box and whisker diagrams. 75% quartile value is typically a good indicator to have at least a warning issued for large hail based on the study.



At 2157 UTC, severe thunderstorm warnings were issued upstream of the Albany forecast area over central NY and east of Lake Ontario. One cell quickly formed over the Mohawk Valley in southern Fulton County. A cross-section through the cell indicated a 59 dBZ reflectivity core reached 32 kft AGL, which was 9 kft above the -20°C height of ~23 kft AGL based on the 1800 UTC KALB sounding.



Another severe thunderstorm formed over the northern portion of Hamilton Co. in the southern Adirondacks. The storm over Indian Lake had a tall updraft at 2309 UTC with a 62 dBZ reflectivity core getting to 26.2 kft AGL, and the 57 dBZ reflectivity core to 36 kft AGL! A rare 1.50" or ping pong ball hail-stone was reported at Indian Lake.

Z_{DR} "Arch" (not arc)

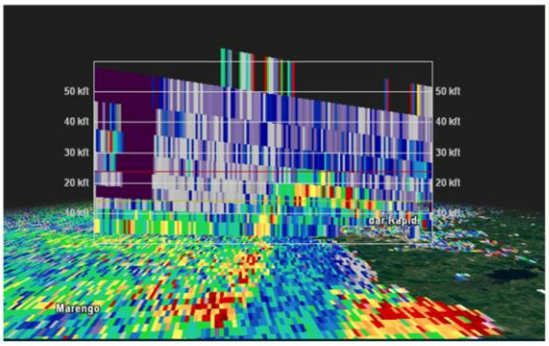
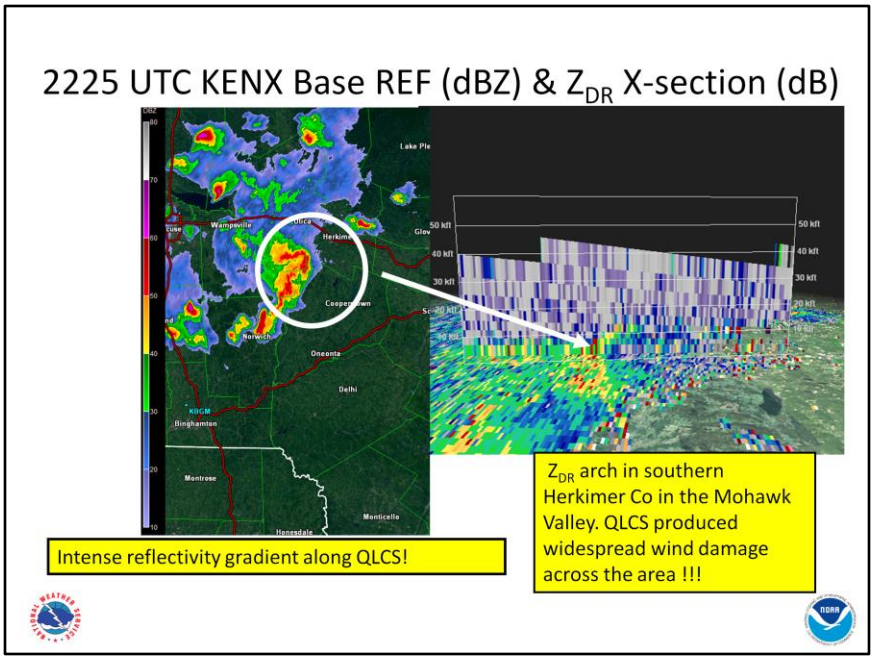


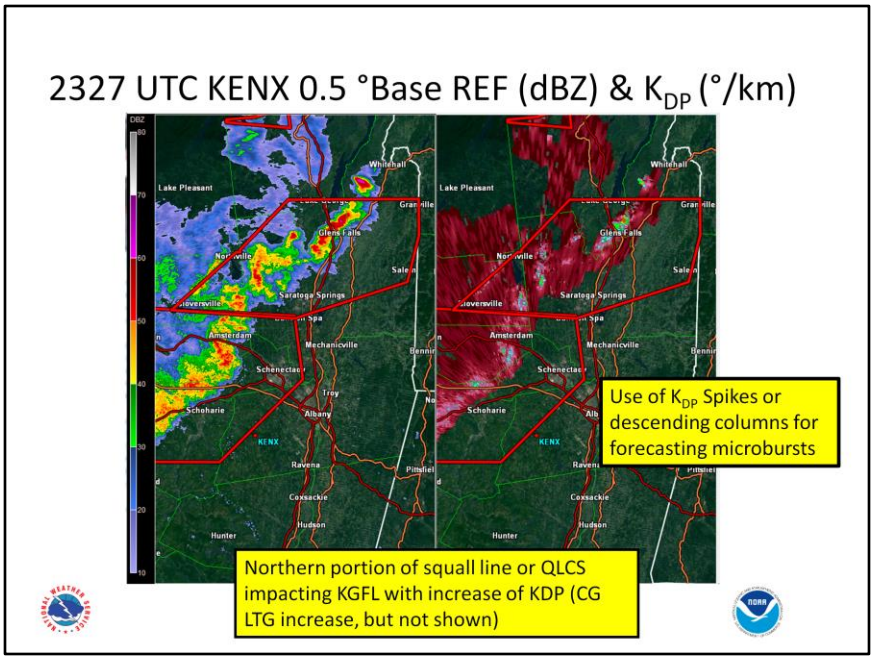
Image of Z_{DR} Arch from 30 June 2014 at 1940Z from a severe thunderstorm produced by a strong QLCS over Iowa (Trogdon 2015).

Research done by Trogdon 2015 shows that size sorting of hydrometeors within a QLCS sometimes takes on arch shape within Z_{DR} when viewed in a cross-section. The backside of arch shows the interaction of the rear-inflow jet with the surface and could be used as a warning indicator for severe winds with a strong QLCS.

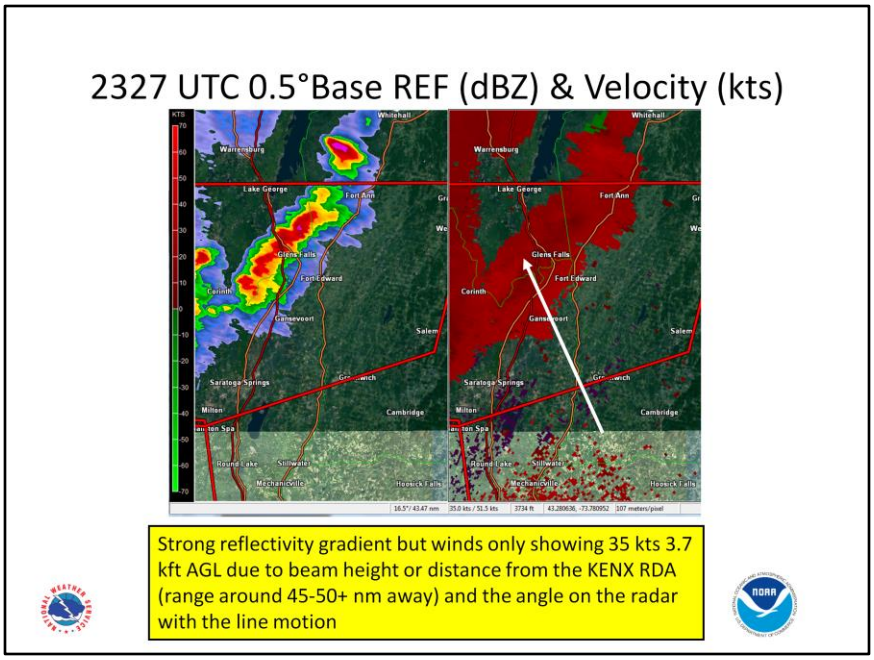
Differential Reflectivity (Z_{DR}) "Arches" have been documented with QLCS 's by Trogdon (2015). The hydrometeors sort within a QLCS and sometimes take on an arch shape within the QLCS. The back of the arch indicates a rear-inflow jet descending to the surface and could be a warning indicator for severe damaging winds.



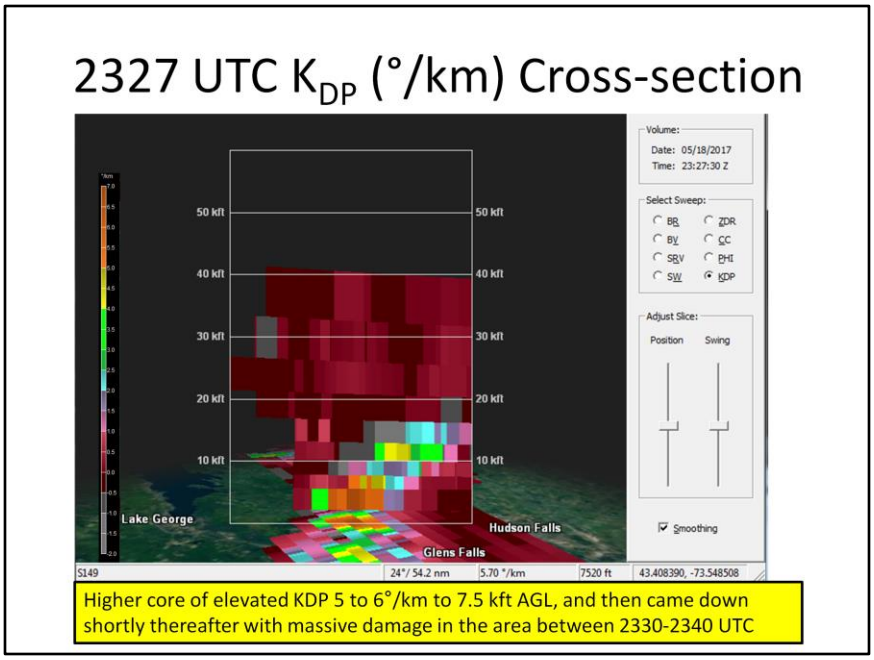
At 2225 UTC, a QLCS with an intense reflectivity gradient was approaching extreme southwest Herkimer County. A Z_{DR} cross-section through the QLCS indicates a potential Z_{DR} arch in southern Herkimer County. The QLCS and associated ZDR arch produced widespread wind damage across the area.



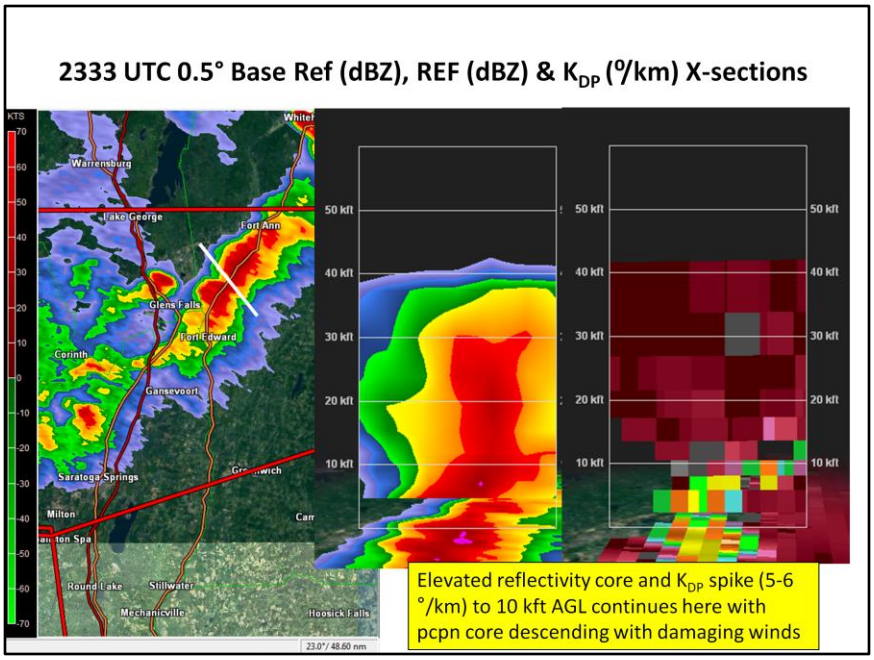
At 2327 UTC, a broken squall line was moving across a large portion of the Albany forecast area. Several severe thunderstorm warning polygons were out. The northern portion of the squall line or a QLCS segment began to impact KGFL with an increase in the reflectivity gradient and the specific differential phase (K_{DP}). There was also an increase in CG lightning which was not shown. KDP spikes or descending columns are used to forecast damaging winds or microbursts.



At 2327 UTC, the KENX radar imagery zoomed in, shows a strong reflectivity gradient, but the 0.5° velocity data only shows 35 knots 3.7 kft AGL due to the beam height/distance from the RDA (range of 45-50+ nm), and the angle on the radar with the line motion. This area was near the macroburst.

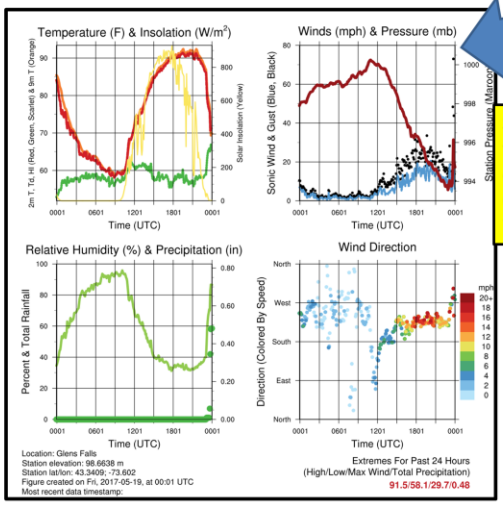


2327 UTC KENX KDP cross-section shows a higher core of elevated KDP aloft of 5 to 6°/km to 7.5 kft AGL, and with values of 4-5°/km to close to 12 kft AGL.



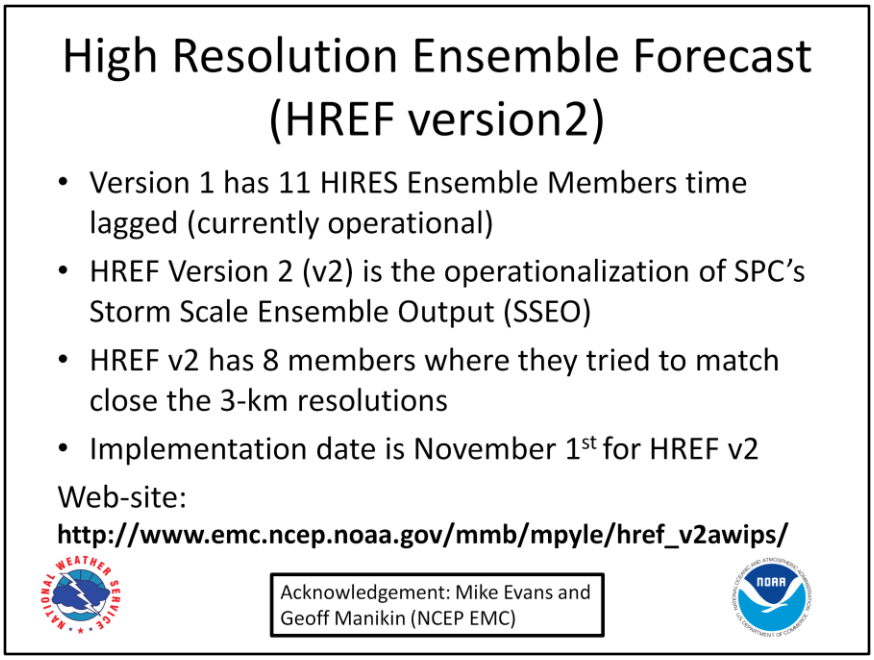
The 2333 UTC KENX 0.5° Base reflectivity image is shown for cross-sections of reflectivity and $K_{DP.}$ The cross-sections show a strong updraft with a 50 dBZ reflectivity core to 30 kft AGL with a K_{DP} spike or column to 10 kft AGL. It shows the K_{DP} column descending with the precipitation core and subsequent damaging winds. The core came crashing down between 2330-2340 UTC producing the macroburst damage near KGFL.

18 May 2017 NYS Mesonet Glen Falls Meteogram

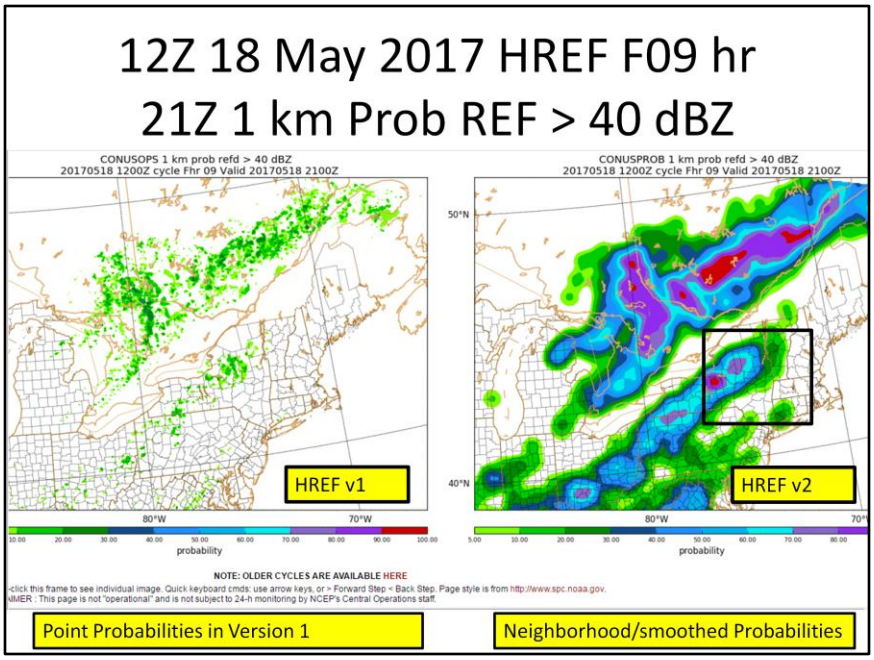


Sonic Anemometer wind gust looked close to 70 mph !!! Occurred between 730-740 pm

The NYS Mesonet site for Glens Falls shows a meteogram of Wind(mph) & Pressure (mb) in the upper right. The sonic anemometer clocked a wind gust close to 70 mph with a pressure fall than rise. This occurred between 730-740 pm with the macroburst.

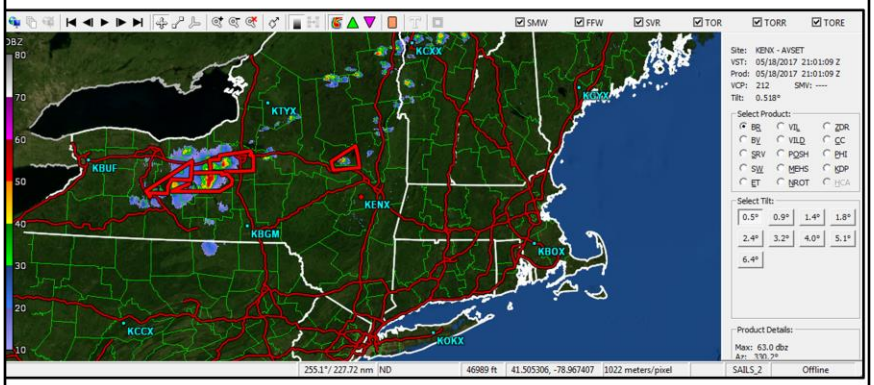


The HREF version 1 and version 2 descriptions are here. Version 2 was implemented November 1, 2017.



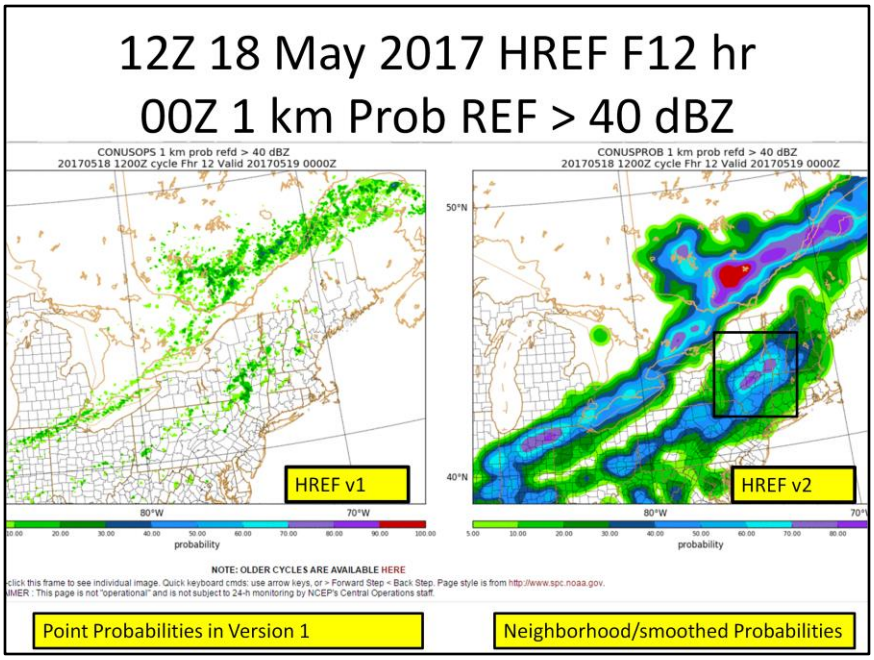
The 12Z 18 May 2017 HREF forecasted 9-hour 1-km Probabilities of REF > 40 dBZ for 21Z are shown. The HREF version 2 neighborhood or smoothed probabilities forecasted 60-80% probabilities over the western Adirondacks and western Mohawk Valley, which is the right side of the boxed area.

2101 UTC 0.5^{o} KENX Base REF (dBZ)



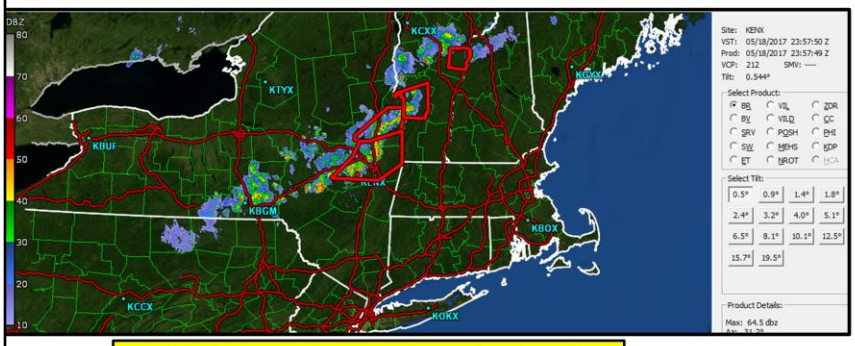
Severe convection was quickly progressing across central NY with new cells beginning to fire over and just west of the southern Adirondacks.

The model reflectivity did a pretty good job matching with the observed reflectivity, as the convection initiated or blossomed quickly between 21Z-22Z over the Adirondacks and the west/central Mohawk Valley.



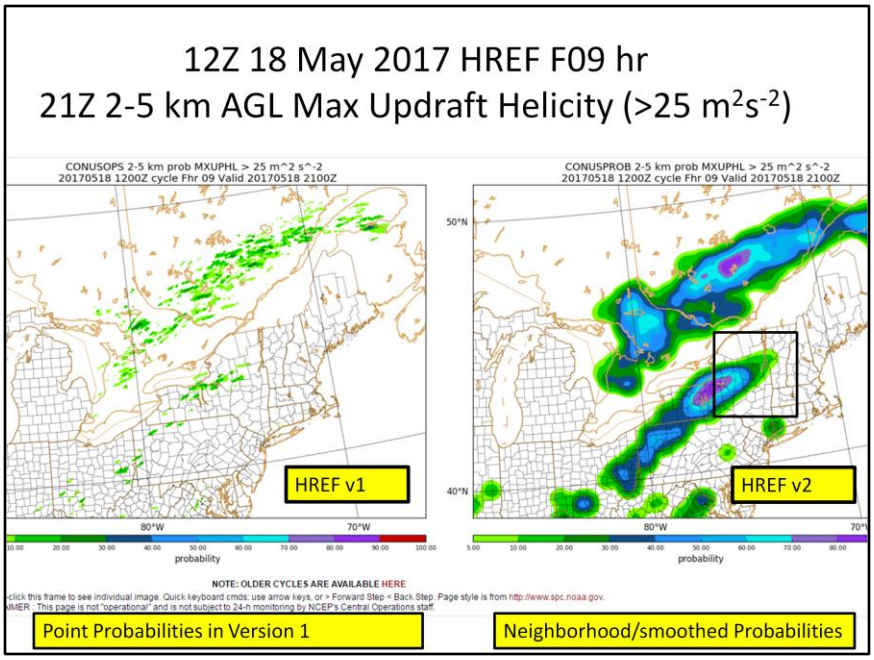
The 12Z 18 May 2017 HREF forecasted 12-hour 1-km Probabilities of REF > 40 dBZ for 00Z are shown. The HREF v2 neighborhood or smoothed probabilities forecasted 60-80% probabilities into much of eastern NY, the Berkshires of western Massachusetts and southern Vermont. The next slide will show the KENX reflectivity image for close to 00 UTC 18 May 2017.

2357 UTC 0.5^{o} KENX Base REF (dBZ)

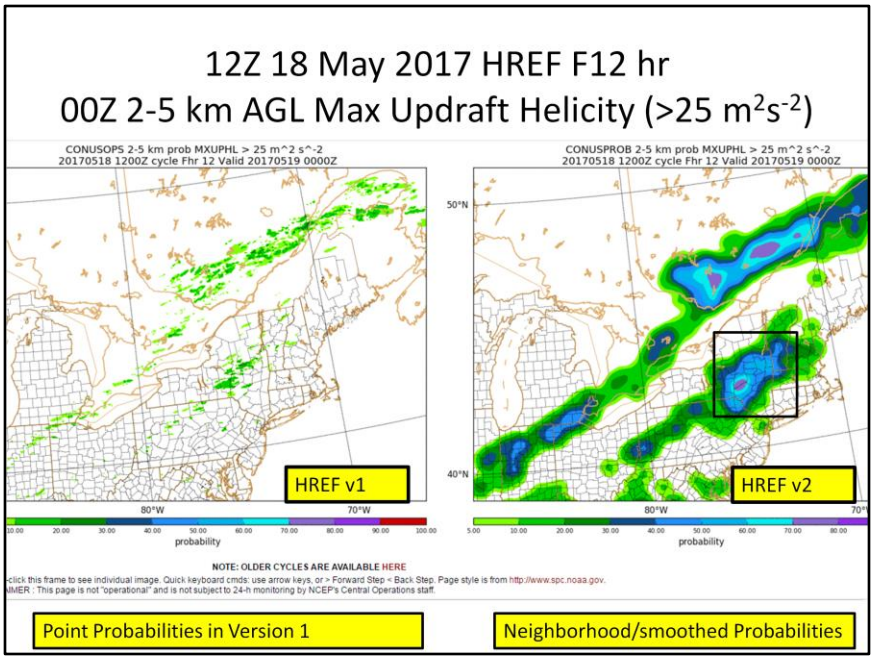


Squall line is progressing across the northern Catskills, Capital Region, Upper Hudson Valley and into Vermont

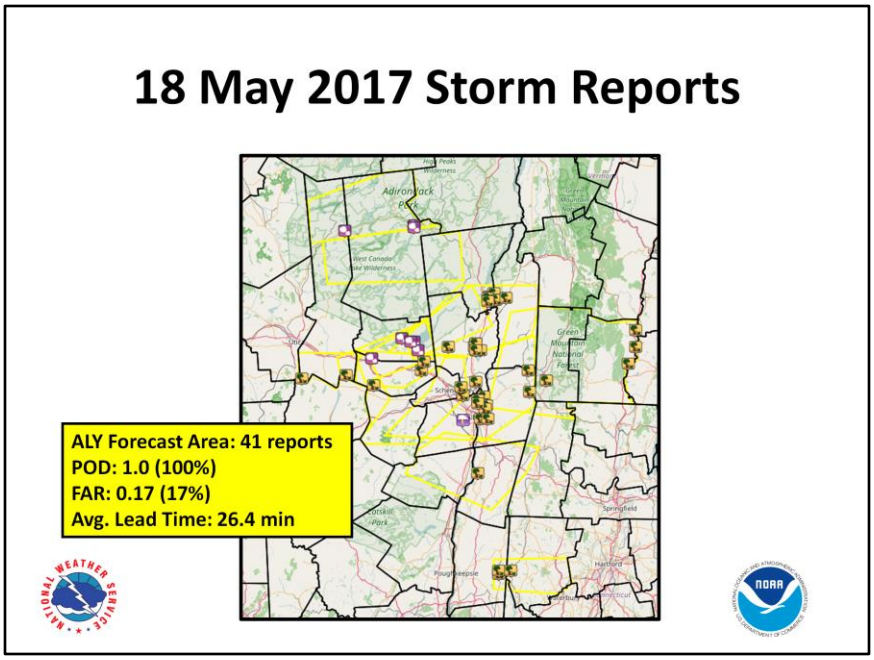
The model reflectivity did a pretty good job matching the observed reflectivity with the forecast.



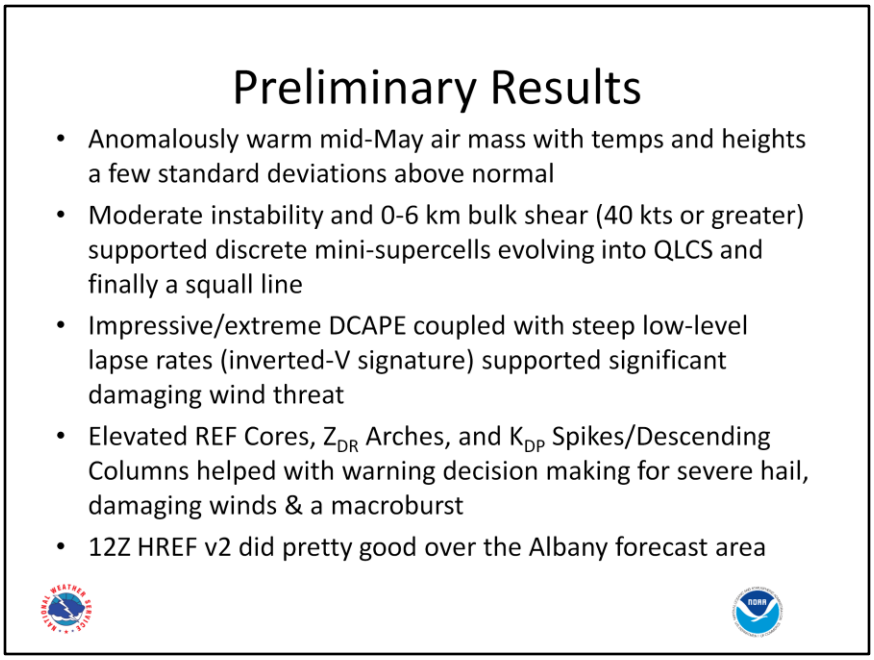
The 12Z 18 May 2017 HREF forecasted 9-hour 2-5 km AGL Max Updraft Helicity Probabilities (> 25 m^2s^{-2}) for 21Z are shown. The HREF version 2 neighborhood or smoothed probabilities forecasted 30-70% probabilities over the western Adirondacks and western Mohawk Valley, as these probabilities were co-located well with severe weather reports.



The 12Z 18 May 2017 HREF forecasted 12-hour 2-5 km AGL Max Updraft Helicity Probabilities (> 25 m2s-2) for 00Z are shown. The HREF version 2 neighborhood or smoothed probabilities forecasted 30-60% probabilities over the Mohawk Valley, Greater Capital Region, northern Catskills north and east into the Lake George Saratoga Region, southern Adirondacks, and southern Vermont.



The storm reports are shown above with the warning polygons. The updraft helicities did a solid job matching with the storm reports. The vast majority of the reports were from the Mohawk Valley and the Capital Region north and east. The GPRA goals were excellent for the office with this event with an average lead time just over 26 minutes!



The initial results are shown above with the severe weather event.

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