The July 20, 2019 Severe Weather Event

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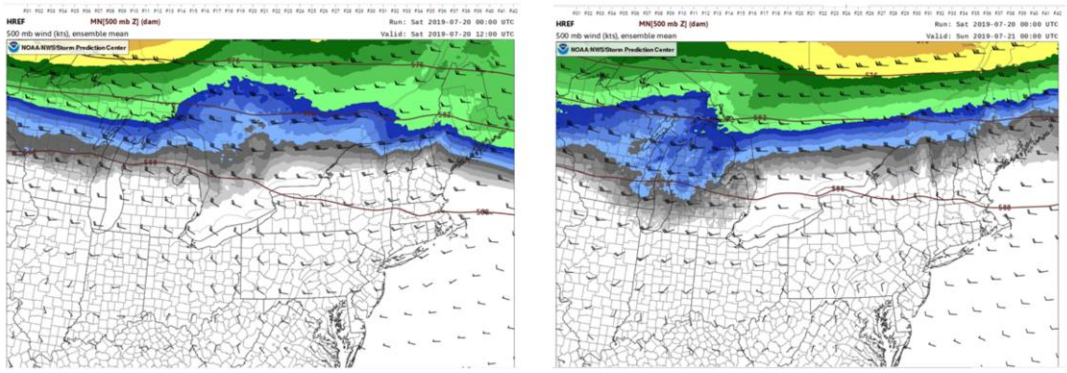
Outline

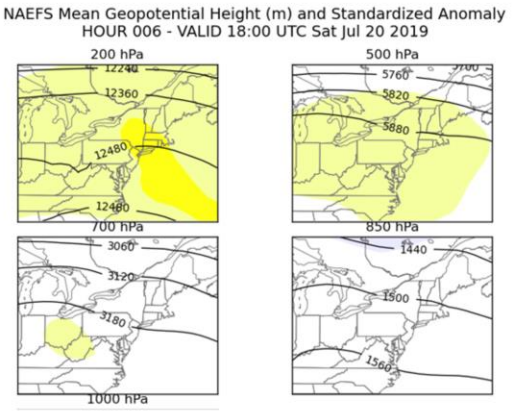
- Large-scale pattern
- Previous research
- High resolution guidance and forecasts
- Observations
- Summary and conclusions

500 mb heights and wind on July 20th



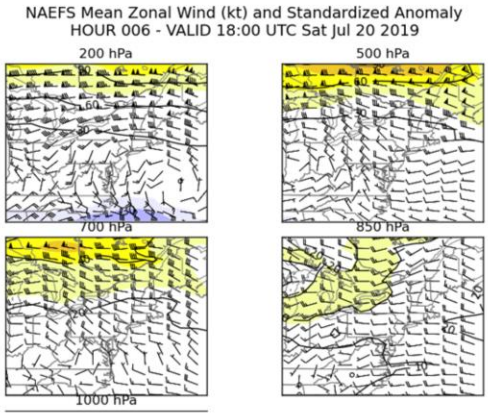
A 500 mb ridge covered much of the eastern U.S. on July 20th. The northern rim of the ridge was located across southern Canada. The forecast mid-level flow at ALB at 00z was from the northwest at about 20 kts.

Geopotential Height anomalies – 18z July 20th



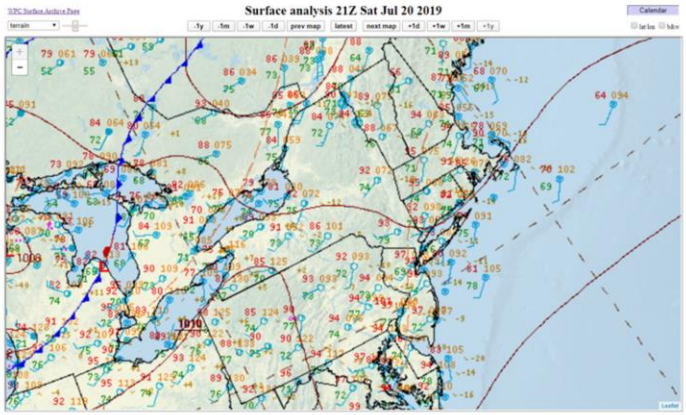
Mid-and-upper level heights across the northeast U.S. were about 1 to 2 standard deviations above normal for late July.

U Wind Anomalies – 18z July 20th



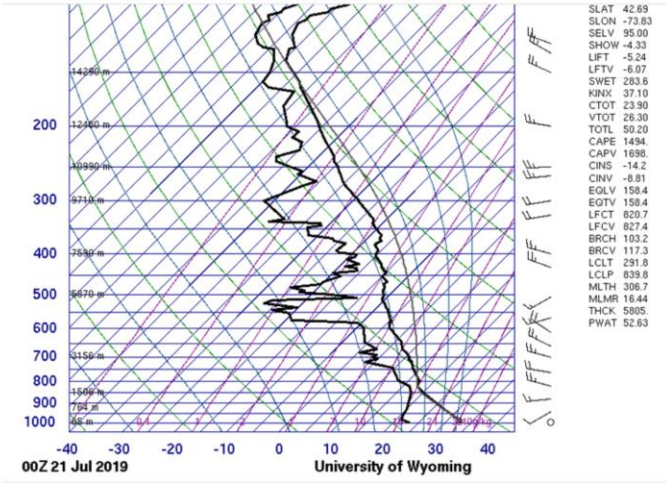
Westerly winds were seasonably light for late July across the mid-Atlantic and northeast, with stronger winds to the north.

Surface plot – 21z July 20th



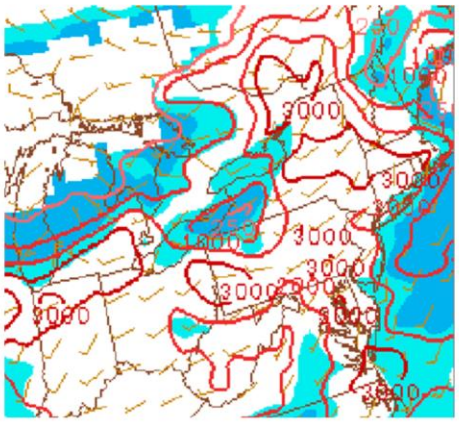
At the surface, the atmosphere was unseasonably warm and humid. Temperatures in the Hudson and Mohawk Valley were near to just above 90, and dew points were in the mid 70s. A weak surface trough can be seen on this analysis near the east end of Lake Ontario.

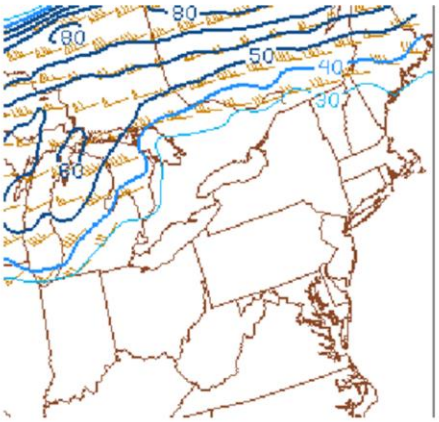
Observed sounding at ALB valid 00z July 21st



The observed sounding at ALB at 00z on the 21st showed steep low-level lapse rates below 800 mb with an inverted V profile. A layer of northwesterly winds from 20 to 30 kts can be seen centered around 700 mb, otherwise winds are 20 kts or less from the surface through 500 mb.

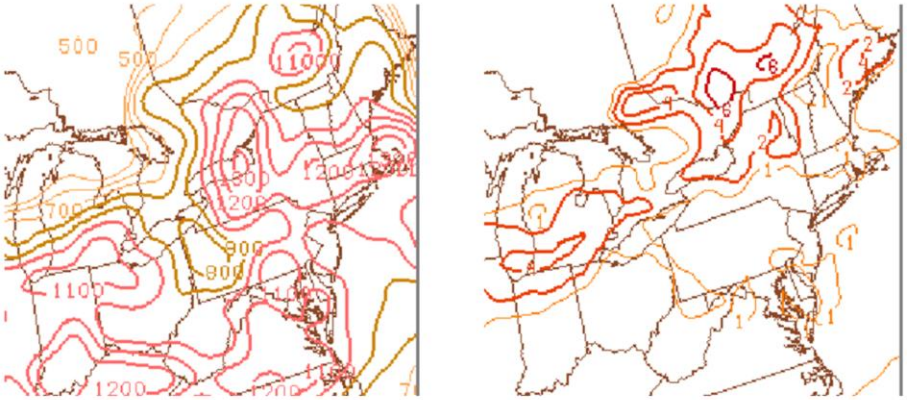
SPC MLCAPE and 0-6 km shear – 22z July 20





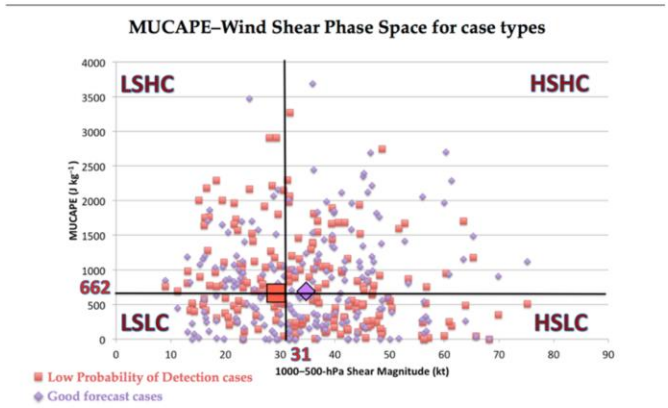
The Storm Prediction Center's meso-analysis at 22z indicated lots of deep-layer instability, with MLCAPE values over eastern NY and western New England near 3000 J/kg. Strongest deep layer shear was well to the north of New York and New England.

SPC DCAPE and Derecho composite – 22z



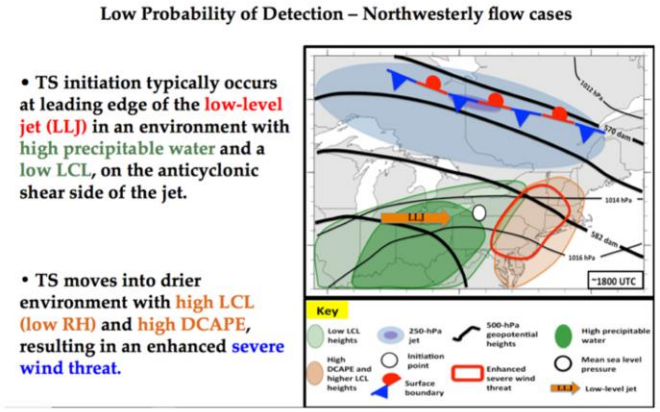
Downdraft CAPE values across upstate NY and New England were over 1000 J/kg, indicating plenty of potential for enhanced downdrafts and wet microbursts. The derecho composite value on the right is a function of downdraft CAPE, most unstable CAPE, deep layer shear and deep layer mean wind. Values greater than 1 indicate enhanced potential for derechos.

CAPE / shear phase space for poorly detected vs. well-forecast cases



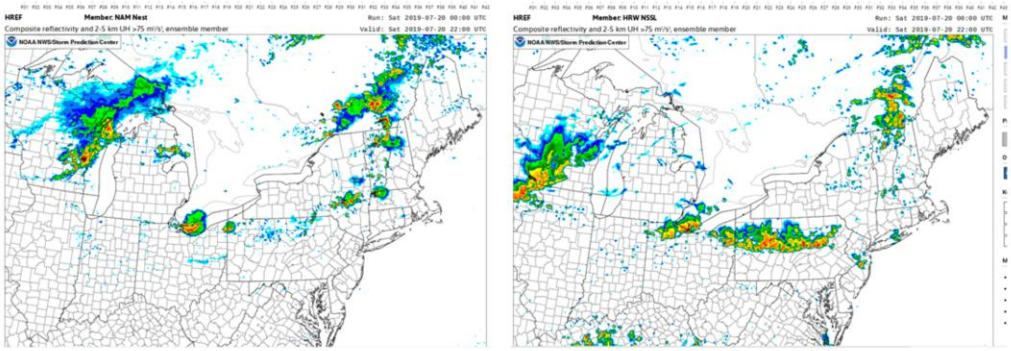
The environment on this day across eastern New York and western New England could be characterized by high CAPE and low shear, which would be in the upper left of the diagram shown above. This area on the graph is frequently associated with poorly detected severe weather events, as indicated by the large number of red squares in the upper left portion of the graph.

Schematic for low shear high CAPE events



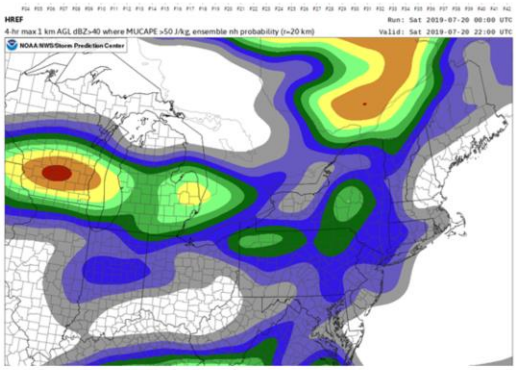
A synoptic composite of the environment for these types of events is shown on this slide. The composite is not very different than the pattern on the 20th; weak forcing with synoptic-scale frontal zones well to the north and west and large downdraft CAPE values in place across the region. Strongest mid-level winds were north of the area, with a light west-northwest flow in place across New York. Also similar to this composite, enhanced low-level westerly flow at 850 mb (30 to 40 kts) was acting to bring in an unseasonable moist air mass (not shown).

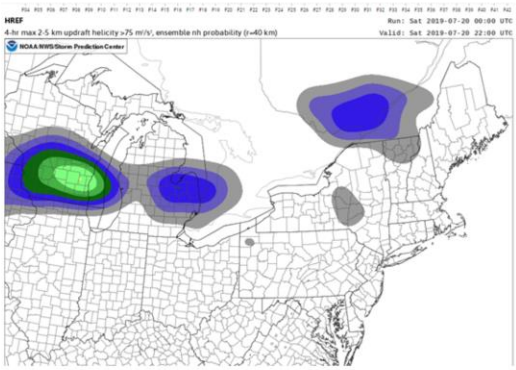
00z NAM nest and NSSL WRF valid 22z



Substantial differences can be seen in the high resolution model forecasts of reflectivity and convective evolution for this event. This is typical of events characterized by weak large-scale forcing. The two images on this slide are 22 hour forecasts from the NAM nest and NSSL WRF valid at 22z on the 20th. The NAM nest showed some weakly organized storms over eastern NY, while the NSSL WRF showed very little over eastern NY, and a more significant convective complex over Pennsylvania.

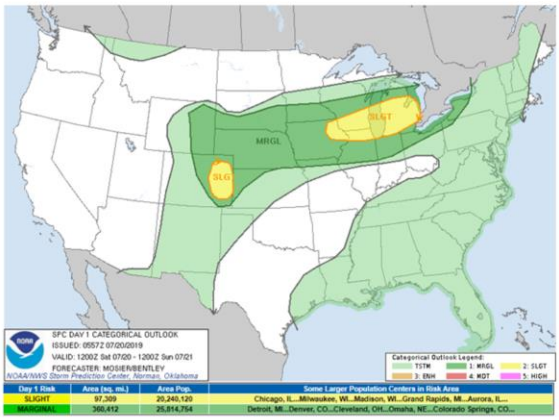
HREF reflectivity probability and updraft helicity probability valid 22z





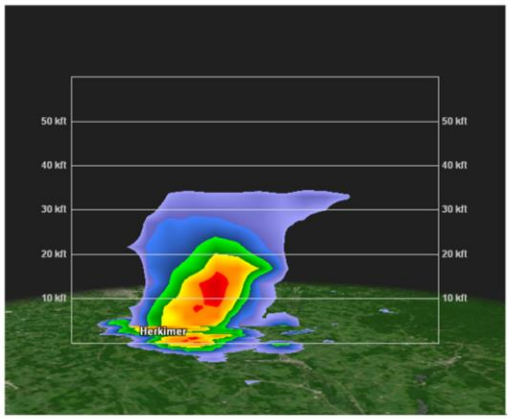
Mean and probability forecasts from the high resolution ensemble (HREF) showed a slightly enhanced probability of convection over eastern NY on the 20th, however much higher probabilities can be seen to the west over Wisconsin and Michigan. Updraft helicity forecasts, which are often useful for identifying areas of enhanced severe weather probability, showed little to nothing over upstate New York.

SPC day 1 outlook for July 20



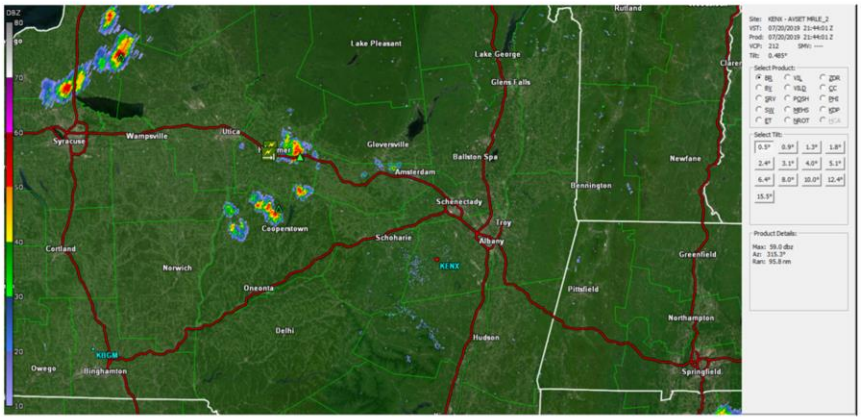
The storm prediction center day one outlook for this event indicated best chances for severe weather over Wisconsin and Michigan. A marginal risk extended eastward to far western New York, while eastern New York and western New England were only in a general thunder area.

Reflectivity cross-section 2130z



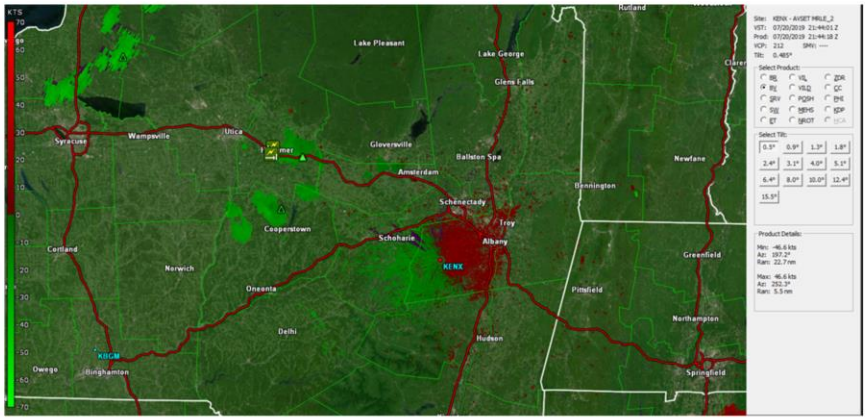
Storms initially began to develop over the Mohawk Valley around 21z on the 20th. By 2130z, a small storm had developed over the western Mohawk Valley with a 50 dbz core extending up to around 18000 feet.

WSR-88D reflectivity at 2144z



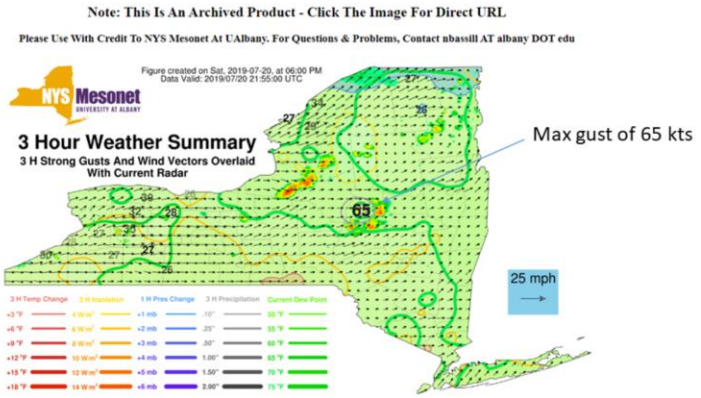
0.5 degree reflectivity from the ENX WSR-88D showed isolated, discrete storms near the Mohawk Valley west of Albany at 2144z.

WRS-88D velocity 2144z – inbound max 29 kt



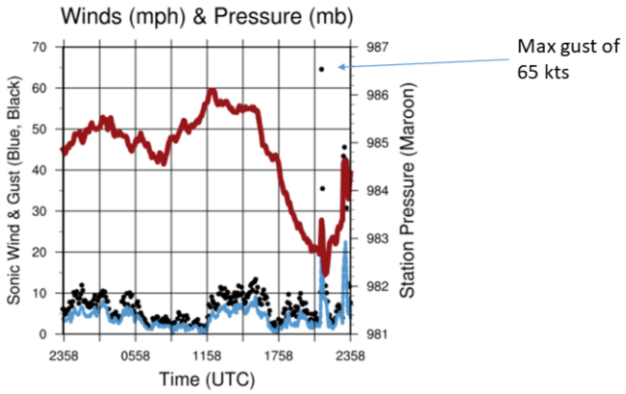
Radar-indicated inbound velocities from the ENX radar near Albany indicated maximum values of around 29 kts with the storm located just east of Utica. Despite these rather unimpressive signatures, a damaging wind report was received from the area east of Utica, southern Herkimer county, around that time.

New York Mesonet radar and max wind gusts – 2155z



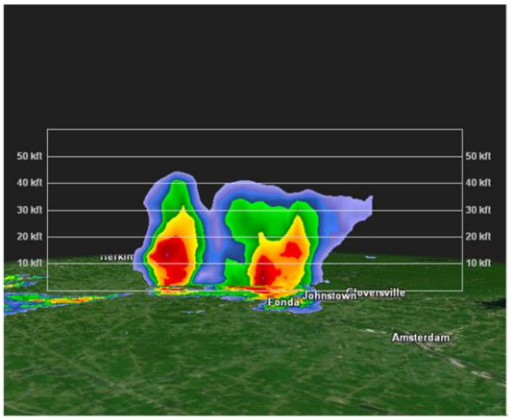
The strong winds occurred at the New York mesonet site near Herkimer. A 65 kt wind gust report was received from that site between 2130z and 22z.

Meteogram – wind and pressure at Herkimer



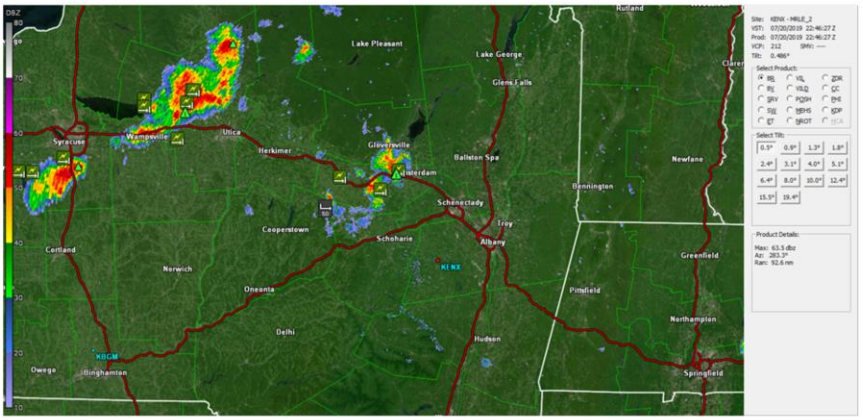
This meteogram from the Herkimer site also shows the maximum wind gust value of 65 kts occurring shortly after 21z.

WSR-88D reflectivity cross-section -2230z



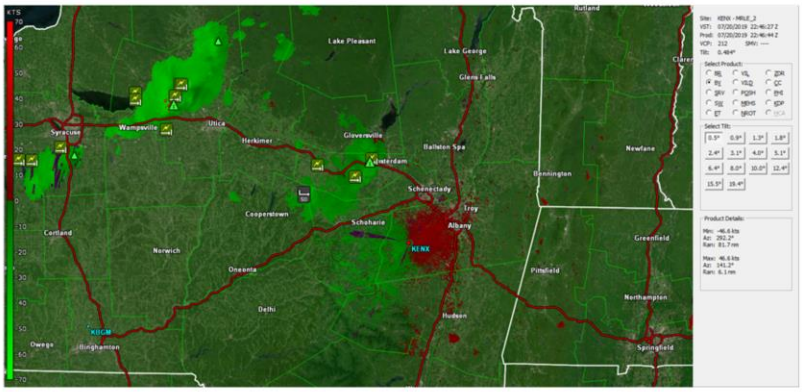
By 2230z, two small clusters of storms had developed, with maximum 50 dbz core heights around 20000 feet. Given that freezing levels on this day were above 25000 feet, these data were not indicative of much large hail potential, however wind could still be a concern given the steep low-level lapse rates.

WSR-88D reflectivity at 2246z



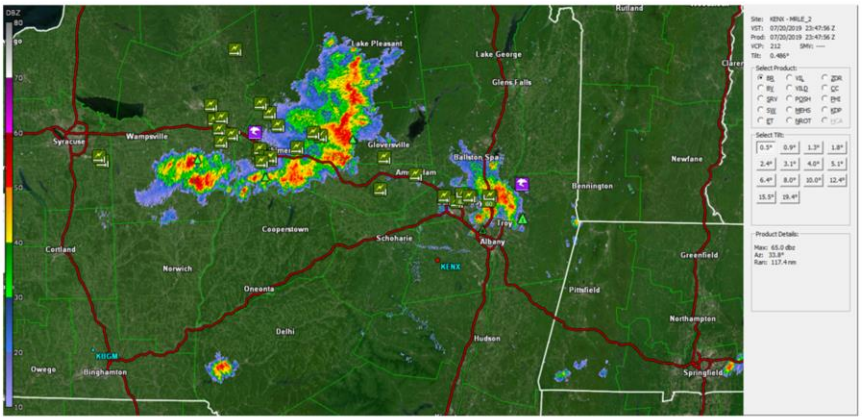
Reflectivity across the area at 2246z indicated a small cluster of storms just west of Albany, with a more significant cluster of storms farther to the west. This cluster of storms appeared to be taking on a linear structure, and damaging winds were becoming an increasing concern.

WSR-88D velocity – inbound max 42 kts



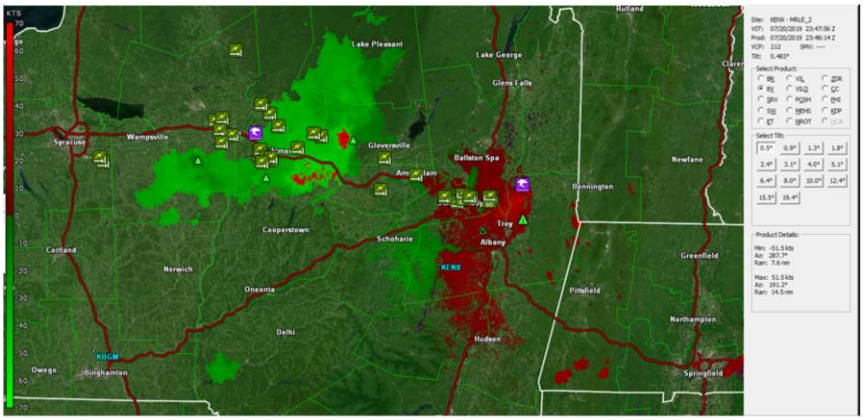
Maximum inbound wind velocities with these systems were 42 kts with the storm just west of Albany at 1500 feet AGL, and 47 kts inbound with the storm near Utica at 7000 feet AGL.

WSR-88D reflectivity at 2347 UTC.



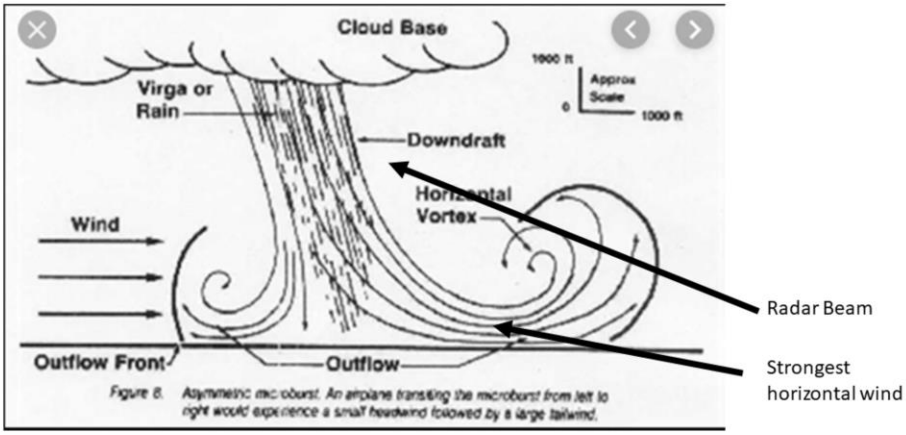
By 2347 UTC, the first cluster of storms was passing north of Albany, while the primary convective system will moving east-southeast down the Mohawk Valley to the west. Both systems were producing damaging wind gusts.

WSR-88D velocity – inbound max of 58 kts



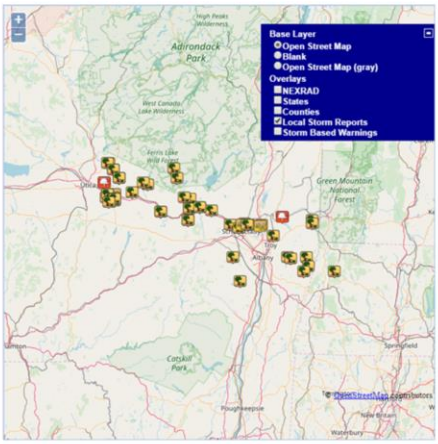
Strong winds were now being sampled by the KENX WSR-88D radar. Inbound values as high as 58 kts were being measured with the storm cluster moving southeast down the central Mohawk Valley.

Wet microbursts



Wet microbursts occur as cool, moist downdrafts descend to the ground, then spread out along the ground. Strongest wind speeds often occur near the ground and can be easily overshot by radar, especially when they are a significant distance from the radar. This most likely occurred during the early and mid-stages of the storms on this day. Eventually, the wind signatures became deep enough and close enough to the radar to be well-sampled, however this was not until lots of severe weather had already occurred.

Severe wind reports



A series of damaging wind events occurred along the Mohawk Valley eastward to just north of Albany as the storms moved east-southeast across the area.

Summary and conclusion

- Convection developed in the Mohawk Valley late on July 20th in an environment characterized by large CAPE, steep low-level lapse rates, weak shear and weak large-scale forcing.
- High resolution models varied considerably on forecast details, and a significant severe outbreak was not expected.
- Damaging winds occurred as two clusters of storms moved down the Mohawk Valley. Strongest winds were initially not well-sampled by radar.
- A timely observation from the New York state mesonet at Herkimer combined with good situational awareness was critical for accurate warnings.