

The May 15, 2020 severe weather event

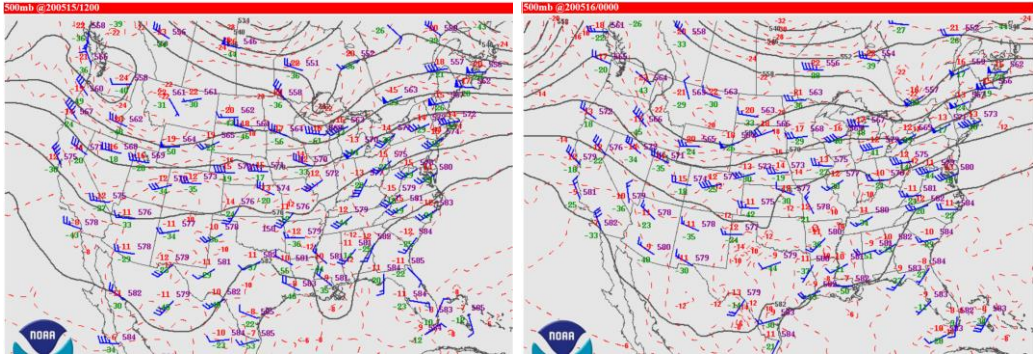
With an EF-1 Tornado in Wilton, NY

Mike Evans WFO ALY

Outline

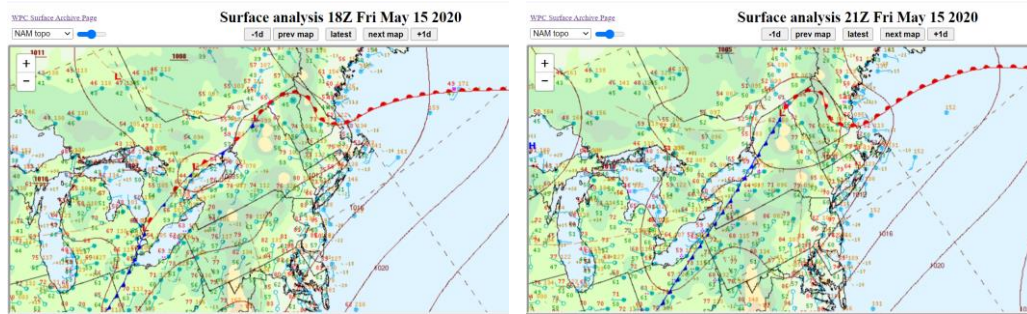
- Large-scale pattern
- Severe weather potential
- CAMS
- Radar analysis
- The Wilton tornado and application of tornado warning improvement project “confidence builders” and “nudgers”
- Summary and conclusion

500 mb analysis



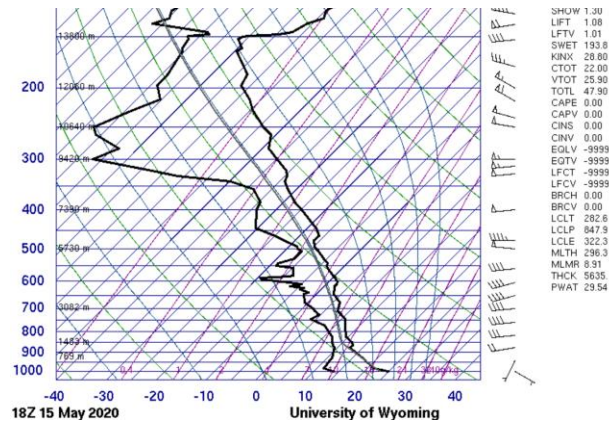
The mid-level pattern on this day was associated with a slowly weakening trough tracking east from the Great Lakes toward the northeast. The approach of the trough was associated with strengthening winds, increasing to 50 kts at ALB by 00z on the 16th.

Surface analysis



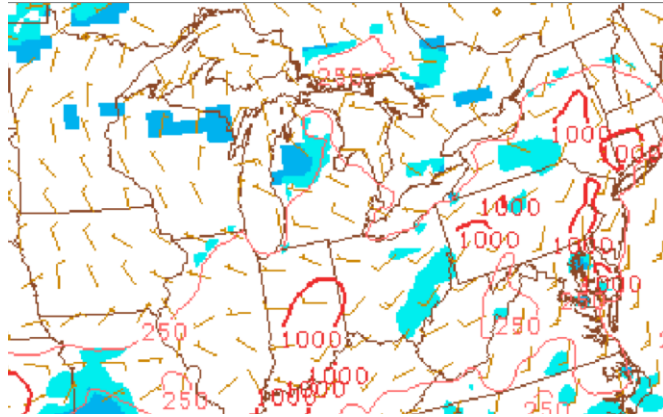
At the surface, the main synoptic-scale frontal boundary was located north and west of the ALB forecast area at 18z, however a wind shift from southeast to southwest can be seen over central NY. By 00z, the surface cold front was moving east across western New York and a pre-frontal trough can be seen from northern Vermont extending southward across eastern New York and eastern Pennsylvania.

18z ALB observed sounding



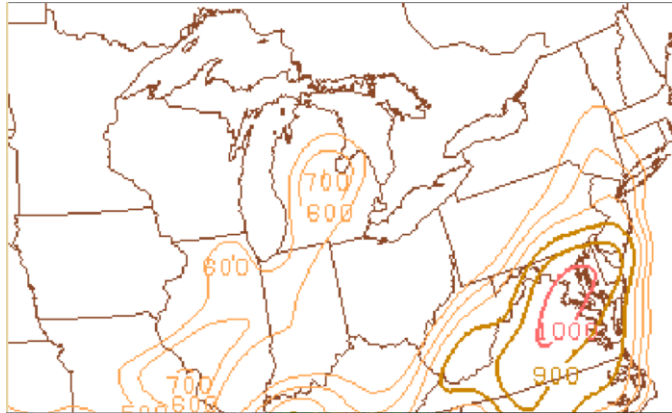
The observed sounding at 18z at Albany indicated no CAPE at that time with weak mid-level lapse rates. Mid-level westerly wind speeds had already increased to 50 kts.

SPC meso-analysis of SBCAPE at 21z



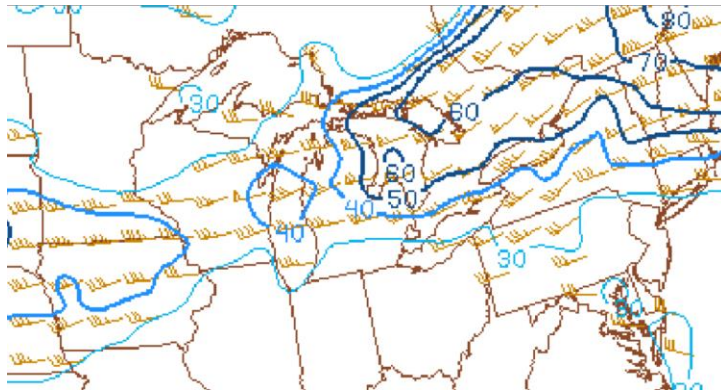
SPC meso-analysis at 21z indicated surface-based CAPE values had increased to around 1000 J/kg over eastern New York and western New England at that time.

SPC mesoanalysis of DCAPE at 21z



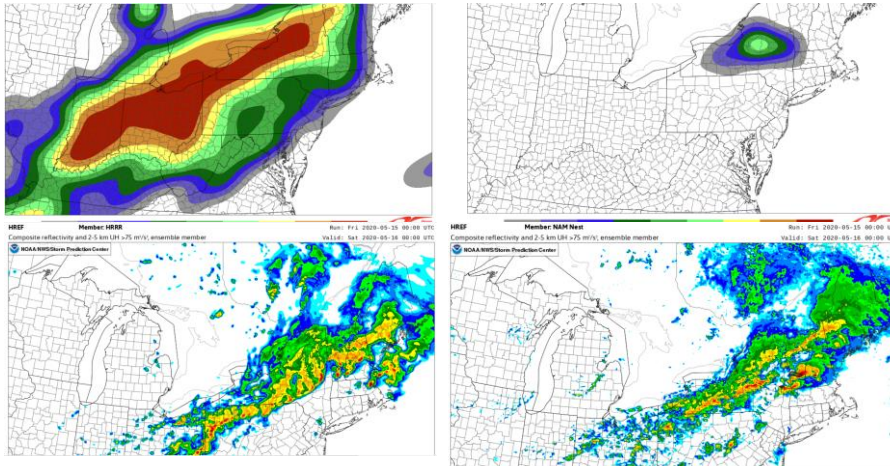
Downdraft CAPE values were only around 500 J/kg.

SPC mesoanalysis of 0-6 km shear at 21z



Deep layer shear values were up to 40 to 50 kts, with highest values across northern New York and northern New England.

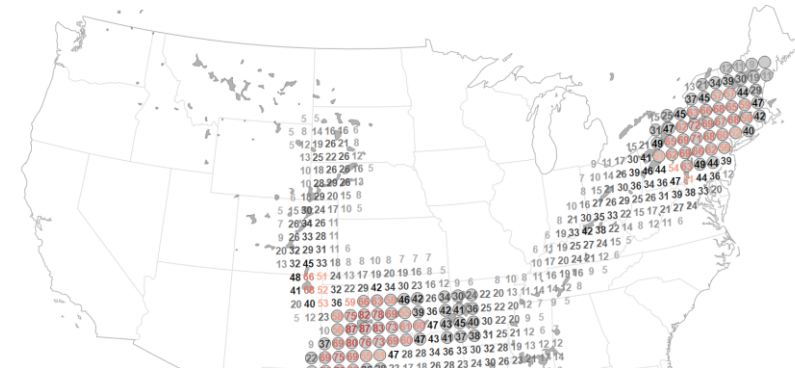
HREF – probabilities of convective precipitation and updraft helicity at 21z, HRRR and NAM nest reflectivity at 00z



High resolution model forecasts from the HREF indicated high probabilities of convective precipitation developing over northern and western NY by 21z. A maximum of 2-5 km updraft helicity can be seen in the Mohawk Valley. Forecast reflectivity from the HRRR and NAM nest at 00z showed a broken line of showers with some embedded thunderstorms moving across the area.

NCAR WRF machine-learning all-severe probabilities (derived from the neural net)

4-h (202-00Z) probability of any severe hazard within 120 km
Neural Network Forecast



This slide shows gridded probabilities for any severe hazard based on an NCAR machine-learning algorithm from a high resolution WRF run. A large area of 60 to 75 percent probabilities within 120 km of a point can be seen covering the northeast CONUS including the entire Albany forecast area.

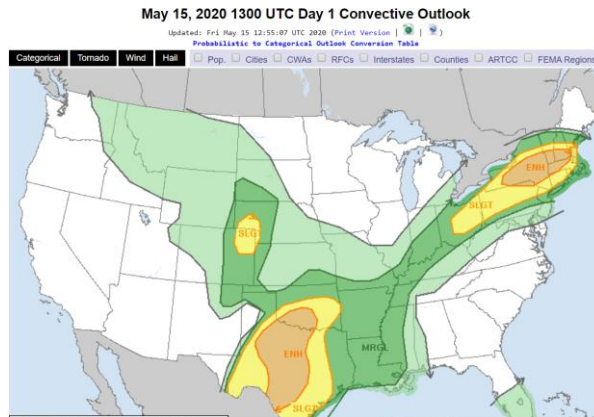
NCAR WRF machine-learning tornado probabilities (derived from the neural net)

4-h (20Z-00Z) probability of a tornado within 120 km
Neural Network Forecast



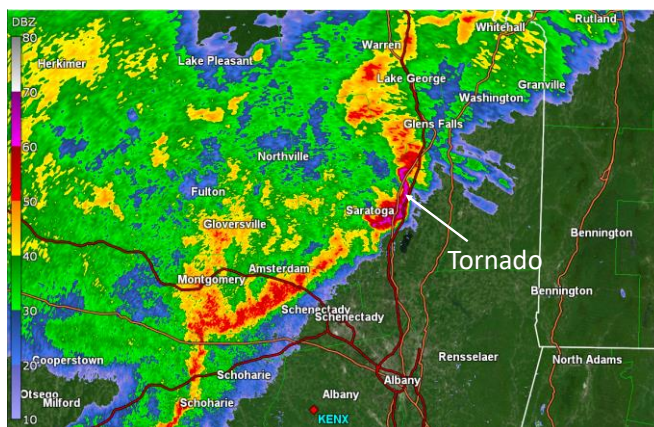
From the same application, a maximum probability of tornado occurrence can be seen over east-central NY, with a maximum probability of around 17 percent near Albany.

SPC severe weather outlook day 1



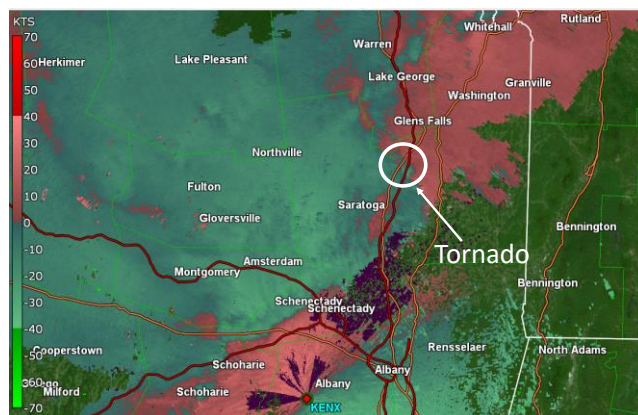
The storm prediction center was forecasting an enhanced risk of severe weather across much of eastern NY and western New England, with lower risks to the south of the lower-Hudson Valley into Connecticut.

Radar reflectivity – 2159z



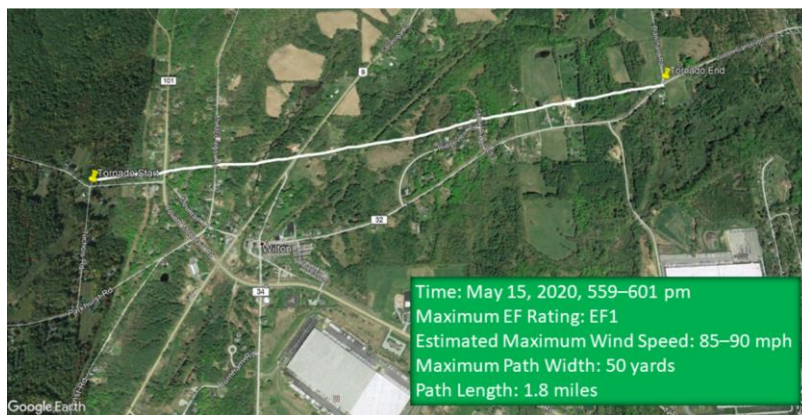
The remainder of this presentation will focus on the radar signatures associated with a small tornado that touched down near Wilton in Saratoga county north of Albany at around 22z. The reflectivity pattern at that time showed a pronounced bow echo moving across the area at that time

Radar storm relative motion – 2159z



A weak rotational couplet can be seen along the leading edge of the squall line north of Saratoga Springs.

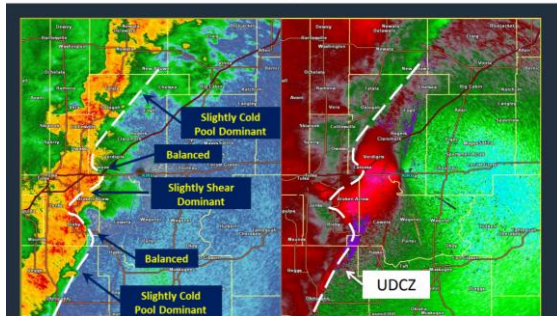
EF-1 tornado near Wilton New York



A tornado touched down just north of Wilton, NY at 2159 UTC. Damage was surveyed along a west-to-east path for 1.8 miles.

Review of 3 ingredients for meso-vortex intensification along a QLCS

This is a general description of the three ingredients methodology for Mesovortex Genesis and Intensification within a Quasi-Linear Convective System (QLCS).
Courtesy of Jason Schaumann and John Gagan
NOAA/NWS



Find Shear/Cold Pool Balance Regimes

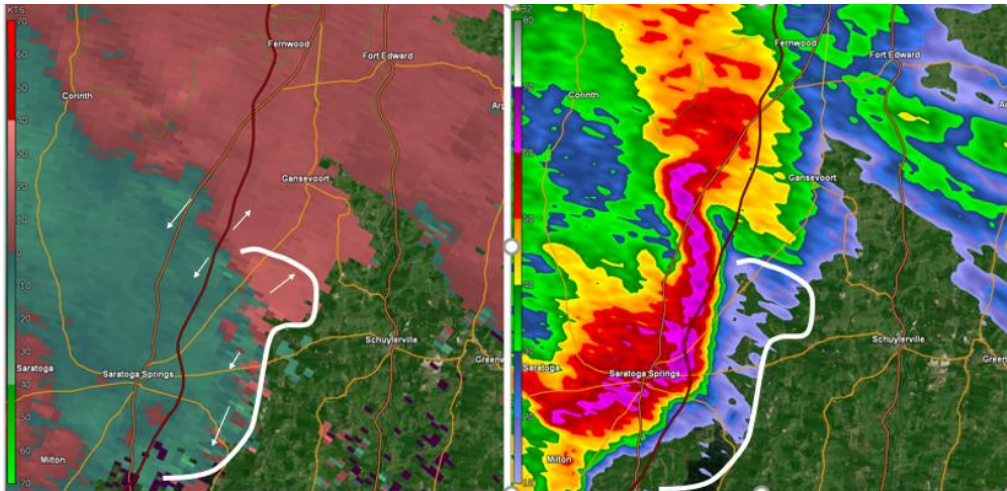
Compare the location of the UDCZ with updraft towers:

1

- **Cold pool dominant:** UDCZ out ahead of reflectivity updraft towers.
- **Balanced:** UDCZ within or even behind updraft towers.
- **Shear dominant:** UDCZ within or even behind updraft towers.

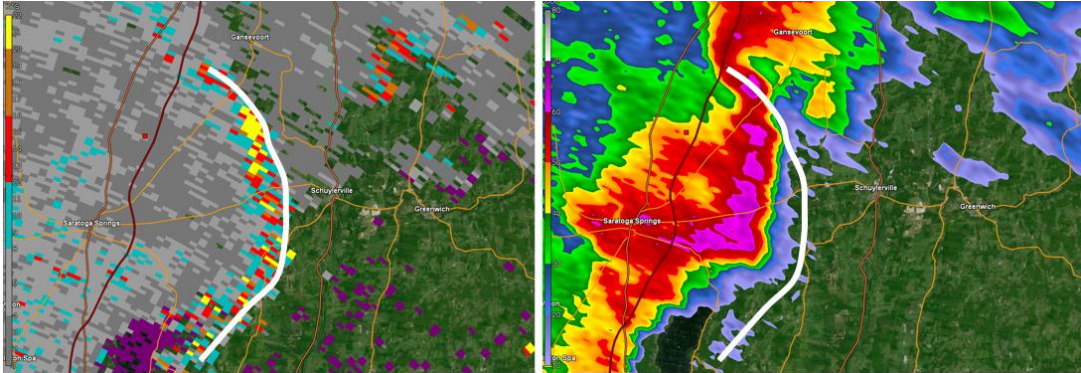
The tornado was associated with a meso-vortex along the line of convection. Intensifying meso-vortices often form in environments where the updraft convergence zone is well-co-located with the leading edge of high reflectivity, indicating a scenario where there is balance between the convective cold pool and the environmental shear. A less favorable scenario is when the convergence zone is ahead of the convection, indicating a cold-pool dominant structure.

Updraft convergence zone at 2159z



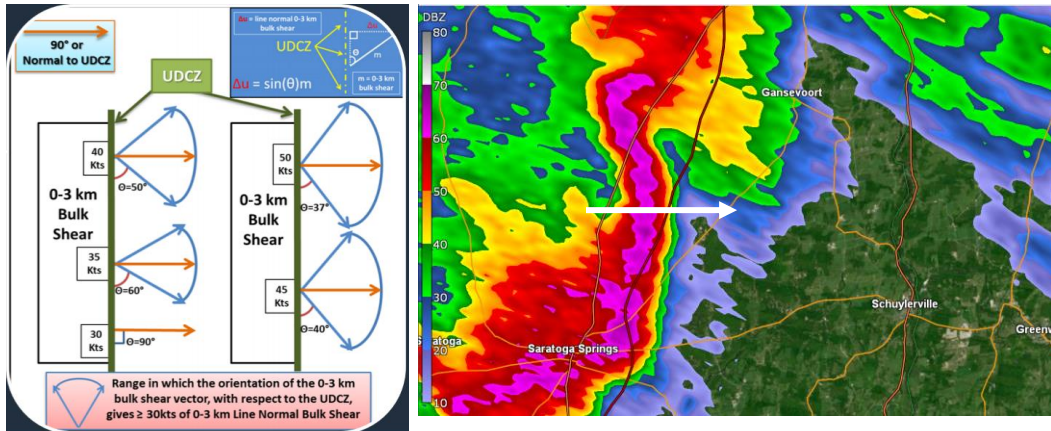
In this case, the line of thunderstorms was moving almost exactly perpendicular to the radar radial at the time of the tornado touchdown. Partially due to this factor, the updraft convergence zone was difficult to find. The storm relative motion image on the left of this slide shows that much of the area near and just downstream from the squall was dominated by divergence low-level flow. A convergence zone near the leading edge of this divergent outflow appeared to be well downstream from the leading edge of the high reflectivity associated with the squall line.

Identifying the updraft convergence zone by spectrum width



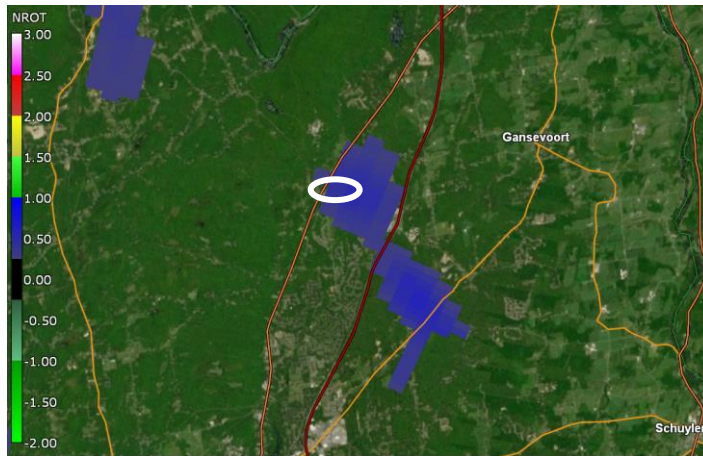
In this case, the updraft convergence zone (UDCZ) is best identified by spectrum width. Enhanced values of spectrum width can be seen along the UDCZ. The UDCZ is downstream from the squall line along the southern part of the line, but bends northwestward and intersects the line near where the tornado occurred.

Shear vectors and the UDCV



A second ingredient for intensifying meso-vortices are 0-3 km shear vectors with a strong (greater than 30 kt) component perpendicular to the updraft convergence zone. In this case the 0-3 km shear vectors were westerly. The vectors were perpendicular to the UDCV near the northern part of the line, in the inflection zone where the UDCZ changed orientation. Farther south, the shear vectors were less perpendicular to the line.

NROT at 2159z – 0.49 at 3000 feet



○ Tornado location

The radar-indicated rotation with this system was not impressive near the location where the tornado occurred. This slide shows normalized rotational velocity at 2159z at the time of tornado touchdown. The maximum value was 0.49 at an elevation of 3000 feet. Tornadoes are more often associated with values of at least 0.75.

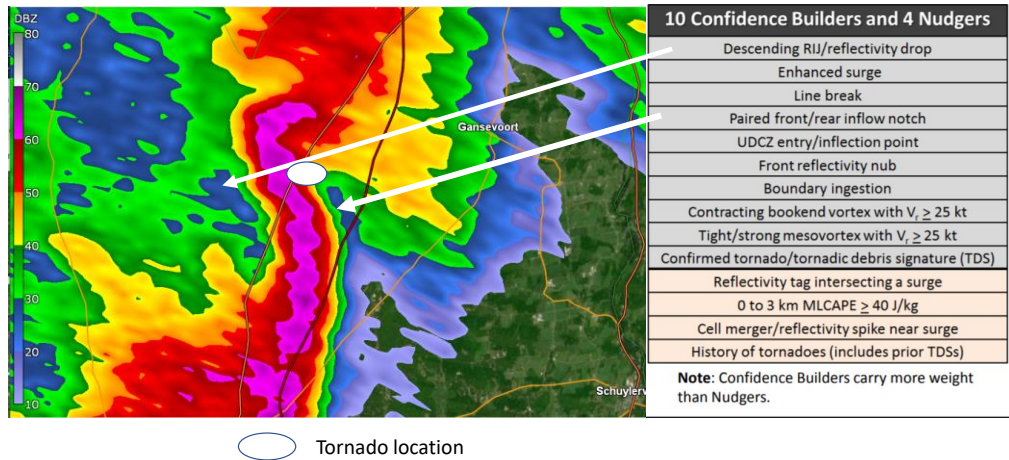
Confidence Builders / Nudgers

10 Confidence Builders and 4 Nudgers
Descending RIJ/reflectivity drop
Enhanced surge
Line break
Paired front/rear inflow notch
UDCZ entry/inflection point
Front reflectivity nub
Boundary ingestion
Contracting bookend vortex with $V_r \geq 25$ kt
Tight/strong mesovortex with $V_r \geq 25$ kt
Confirmed tornado/tornadic debris signature (TDS)
Reflectivity tag intersecting a surge
0 to 3 km MLCAPE ≥ 40 J/kg
Cell merger/reflectivity spike near surge
History of tornadoes (includes prior TDSs)

Note: Confidence Builders carry more weight than Nudgers.

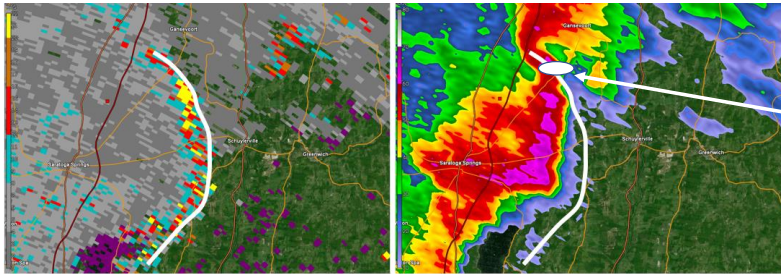
The factors listed on this slide are “confidence builders” and “nudgers” for tornado warnings as determined from the tornado warning improvement project (TWIP); a NWS study performed in the central region designed to improve tornado warnings

Confidence builders / nudgers



A couple of key factors in the “confidence builder” list are illustrated on this slide. Note the notch of reduced reflectivity on the rear side of the line indicating the potential for a rear inflow jet and associated reflectivity drop in that area. Also, a very pronounced front inflow notch can be seen near the location of the tornado.

Confidence builders / nudgers



10 Confidence Builders and 4 Nudgers

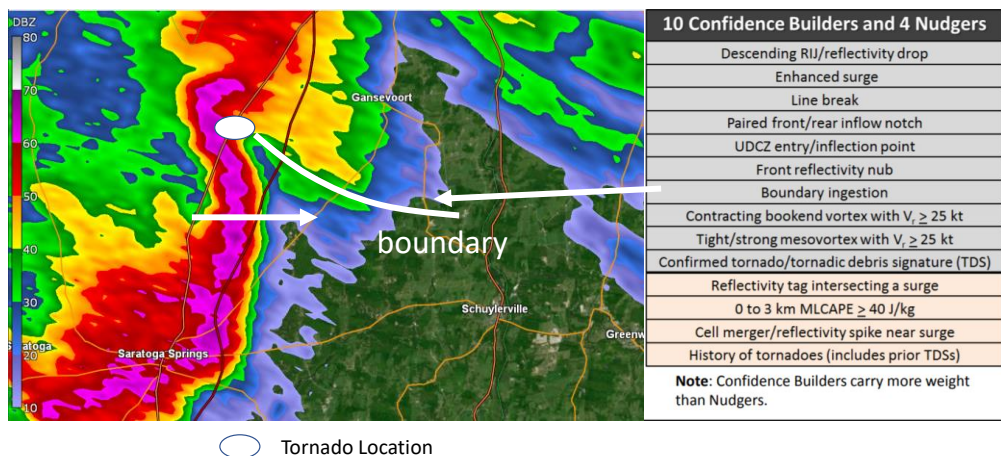
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○ Tornado Location

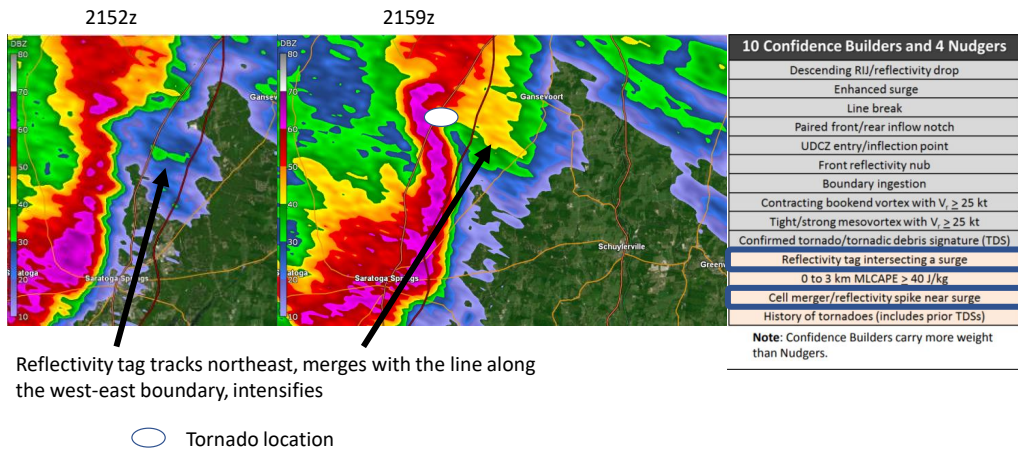
The location of the tornado was also at an UDCZ entry point, where the UDCZ intersects the squall line.

Confidence builders / nudgers



There may have been a west-east oriented boundary just ahead of the squall line in this case, which was intersected by the eastward moving line around the time of tornadogenesis. A batch of ordinary showers moving northeast ahead of the line may have laid down this boundary. The boundary can be inferred by the intensification of other cells that moved northeast just ahead of the line.

Confidence builders / nudgers



A “reflectivity tag” is a cell moving close to and roughly parallel to a squall line that sometimes appears in conjunction with tornadogenesis. In this case, a reflectivity tag appeared east of the boundary just prior to tornadogenesis, and appears to intensify upon reach the boundary laid out by previous cells. Note also that the reflectivity associated with the entire line appears to intensify at the time of tornadogenesis at 21z

Summary and conclusion

- A low-CAPE / high-shear severe weather event effected eastern New York and western New England on May 15, 2020.
- High resolution models including a new NCAR machine learning application gave signals for the event.
- A tornado touched down in Wilton New York. Radar-indicated rotation with this tornado was not impressive.
- However, indicators from the 3 ingredients method along with confidence builders and nudgers from the NWS CR tornado warning improvement project gave indicators for tornado potential in the area.