The Multi-Hazard Severe Event of 21 August 2019 across eastern New York and western New England

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Motivation

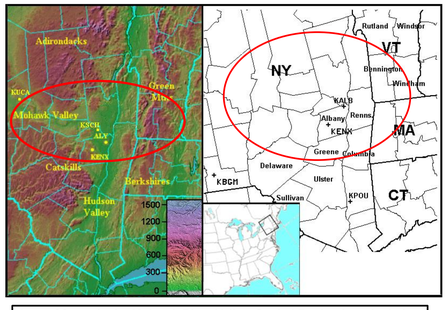
- Tornadoes in the Albany Forecast Area are rare (~85% are EF0/EF1) with ~ 3 per year.
- CSTAR V - VI Goals (2010 – Present)

(1) To examine severe weather cases with application of the new (April 2012 to 2019) dual polarization radar data (differential reflectivity, correlation coefficient, and specific differential phase)

(2) Expand ALY Tornado V_r-R Shear Climatology from 1998-2000 in COMET partners project

CSTAR Grant #: NA16NWS4680005

NWS at Albany Forecast Area



Area of focus is the Mohawk River Valley, Capital Region into the Lake George and southern Vermont corridor

August 21, 2019 Tornadoes

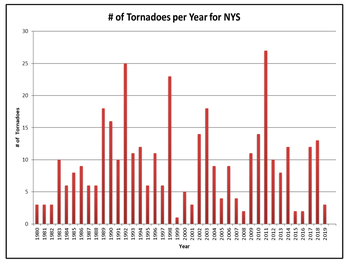
EF0 tornado with peak winds of 70 to 80 mph that touched down at 1824 UTC in Johnstown, Fulton County. Picture: RT 67E between Johnstown and Tribes Hill by Shelley Brienza

EF1 tornado with max estimated winds of 105 mph that touched down at 1935 UTC. Damage near a home east of Saratoga Springs, NY. Picture: Mike S. Evans

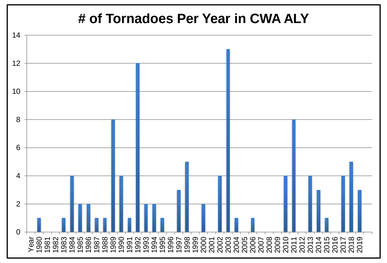
Tree damage in Johnstown, Fulton Co. Picture: Marcia Oddy

EF1 damage in Windham, Windham Co., VT Picture: Raymond O'Keefe

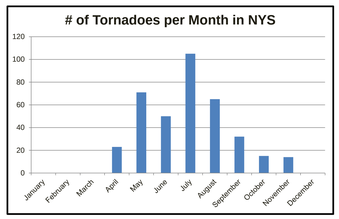
Tornado Climatology 1980 - 2019

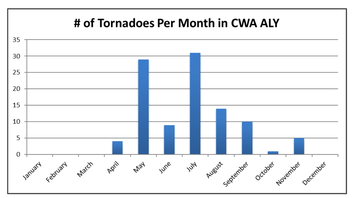


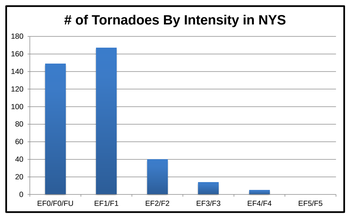
N = 375 tornadoes

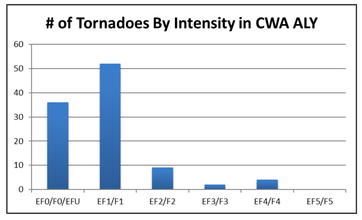


N = 103 tornadoes

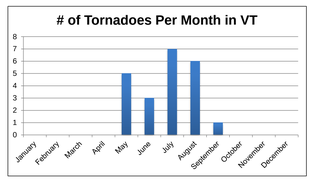


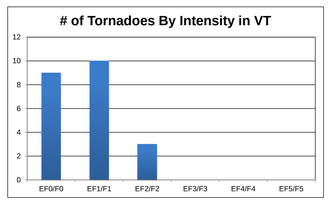






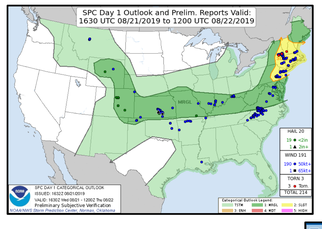
VT Tornadoes (n = 21)



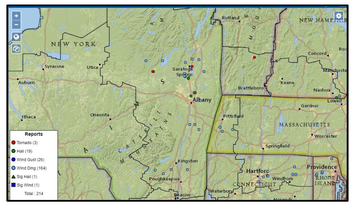


First tornado in VT since 2012 and the first one in southern VT in the ALY CWA since 21 Jul 2003

Storm Reports



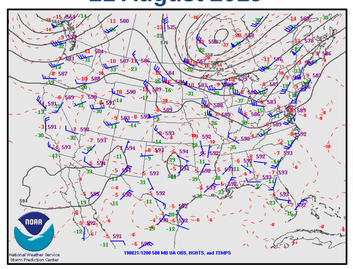
SPC Day 1 1630 UTC Outlook



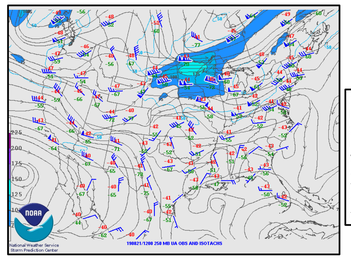
SPC Experimental Storm Reports Viewer for 21 August 2019

Synoptic Overview

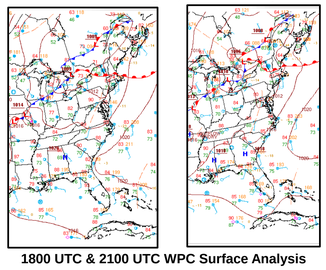
21 August 2019



1200 UTC 500 hPa Heights, Winds & Temps



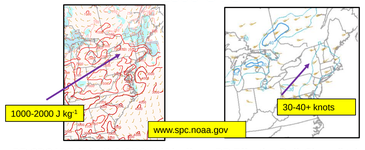
1200 UTC 250 hPa Heights, Isotachs & Temps



1800 UTC & 2100 UTC WPC Surface Analysis

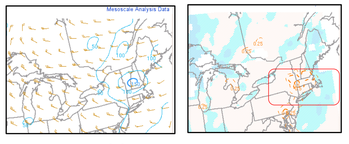
Mesoscale Analysis

1800 UTC

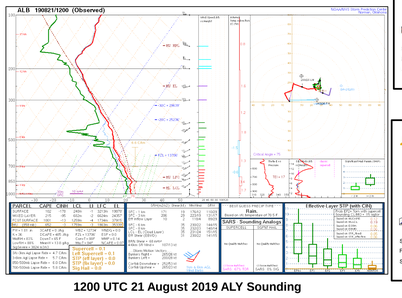


RR SBCAPE (J kg^{-1}) & SBCIN (J kg^{-1}) **RR Effective Bulk Shear (kts)**

1900 UTC



RR 0-1 km SRH (m^{2}s^{-2}) **RR Significant Tornado Parameter**



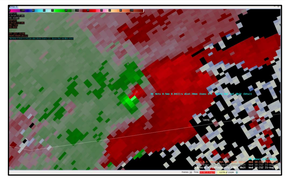
1200 UTC 21 August 2019 ALY Sounding

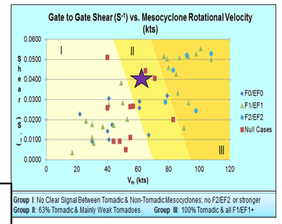
Storm-Scale Analysis

1808 UTC

N_{tot} value = 1.05 at 1808 UTC in Fulton Co. Local research study Frugis and Wasula (2015) showed tornado occurrence (median value 0.81and mean value of 0.90)

1808 UTC KENX SRM should a low-level couplet over south central Fulton Co. A severe thunderstorm was issued at 1804 UTC mentioning the tornado possibility





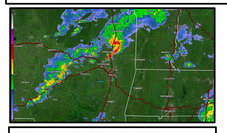
1821 UTC 0.5° KENX SRM data with the V-R Shear tool had a low-level rotational velocity of 36.5 knots gate to gate with a shear value of 0.0422 s^{-1} over a 0.5 nm radius at distance of 30 nm from the RDA. A tornado warning was issued within a few minutes. An initial severe thunderstorm warning issued at 1803 UTC had a tornado possible tag, and an SVS statement was issued at 1818 UTC with winds increased to 70 mph, and the tornado possible tag continued.

V-R Shear Nomogram (CSTAR IV-V Frugis & Wasula Research)

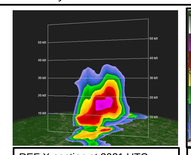
Nomogram: Gate to Gate Shear vs. Mesocyclone Rotational Velocity for 41 ALY Cases (2003-13)
V_m= 65 kts and S = 0.422 S^{-1} Johnstown, Fulton County EF0

1910 UTC 1917 UTC 1924 UTC 1931 UTC

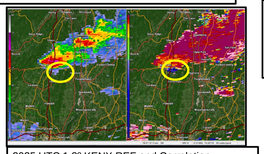
A microburst occurred near Saratoga Springs with a descending KDP column that collapsed with values of 3-5 deg/km rose above the freezing level (~13.5 kft AGL), and descended with widespread wind damage at 1925-1935 UTC. The tornado occurred at the end of the life cycle.



1945 UTC 0.5º KENX Base REF shows bow echo/bookend vortex



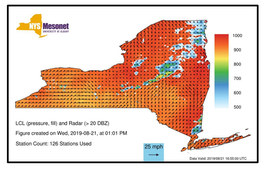
REF X-section at 2021 UTC showed an elevated core of 60 dBz at 20 kft AGL in Ulster Co.



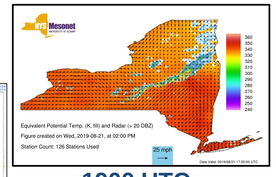
2035 UTC 1.3º KENX REF and Correlation Coefficient. Depressed CC values south/southeast of storm indicate TBSS and possible hail. Wind damage occurred in Ulster Co.

NYS Mesonet

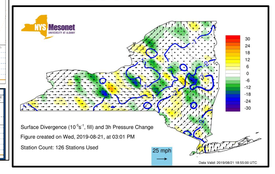
1700 UTC



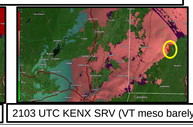
1800 UTC



1900 UTC

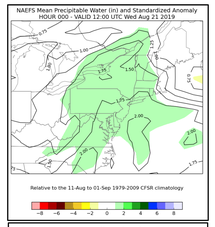


2103 UTC KENX Base Velocity

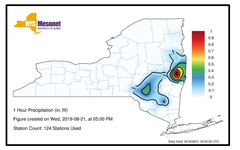


2103 UTC KENX SRV (VT meso barely detected)

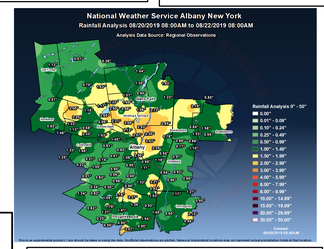
Flash Flood Analysis



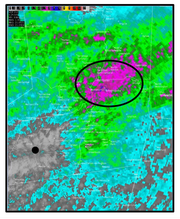
12Z KALY sounding had a PWAT 1.81". 12Z NAEFS had anomalies +1 to +2 STDEVs above normal

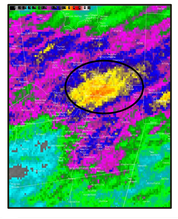


NYS Mesonet indicated rainfall rates 1+inches/per hour near Troy in northern Rensselaer Co. This area to the north was hit with 1-2+ inches of rain earlier in the day. Soils were saturated!



21 Aug 2019 GAZPACHO Rainfall Analysis





21 AUG 2019 KENX Dual Pol Storm Total Accumulation (STA) product underestimated the rain amounts in northern Rensselaer County

21 AUG 2019 MRMS data showed heaviest rain heaviest rain north of Troy with several rounds of rain this day

21 AUG 2019 photo in downtown Troy with flooding at 6th and Federal Street. A total of 1-3" of rain fell during the day and the sewers backed up and the drainage system had major issues with man hole/sewer caps popping. **Photo:** Amy Zawistociski

Summary

- **3 tornadoes in the ALY forecast area (last time was 29 May 2013)**
- **Moderate CAPE – Moderate Shear pre-convective environment for mini discrete supercells & bows. 0-1 km SRH increased to 100-200 m^2/s^{-2}**
- **Along low-level theta-e and CAPE gradient; severe convection migrated along in the Mohawk River Valley, Capital Region, Saratoga Region and southern VT**
- **A bow echo and a well defined northern bookend vortex to a line produced widespread wind damage with descending K_{DP} column(s) present. EF1 spin-up tornado occurred with bow echo**
- **Applied collaborative research from CSTAR for tornado warning decision (V_r – R Shear Study) showed high confidence for a weak EF0/EF1 tornado in Fulton Co.**
- **Windham, VT tornado difficult to detect due to beam height close to 7 kft AGL, and obstruction of mountains**
- **Flash flood(s) were isolated, but anomalous PWATs, intense rain rates, quickly saturated soils and repeated rounds of rainfall due to "training" echoes were plausible reasons**