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WEATHER  
SERVICE**

# Science-to-Service Methods During a Violent Tornado in Southeast Iowa During the Historic 31 March - 01 April 2023 Tornado Outbreak

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February 1, 2024 ▪ 104th AMS Annual Meeting ▪ Baltimore, Maryland



# Outline

- **Tornado Outbreak Statistics**
- **Forecast and Science Review**
- **Keota, Iowa Supercell and EF4 Tornado**
- **Local Decision Support Services**



# Tornado Outbreak Statistics

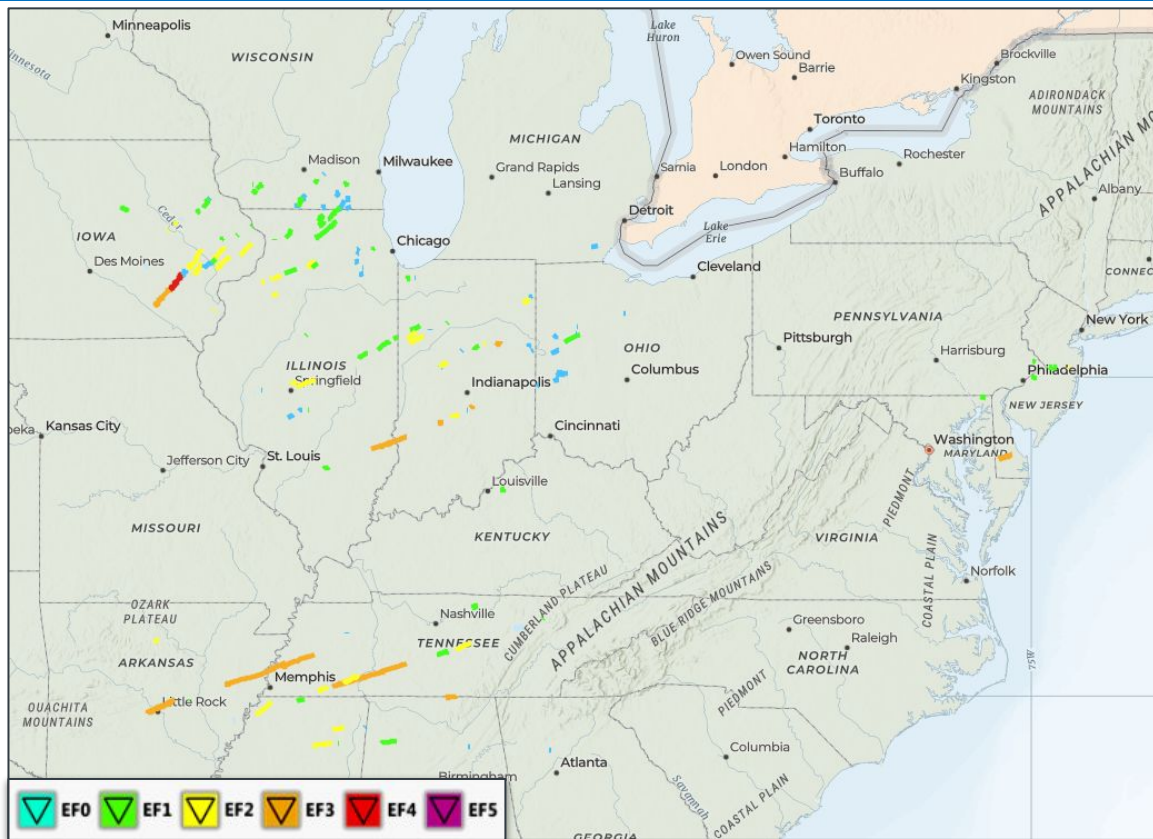


# National Tornado Outbreak Statistics

Historic Tornado Outbreak  
31 March - 1 April 2023

## 31 March - 1 April 2023

- 3rd most tornadoes for an event on record with 147 surveyed across 16 states
- 44 EF2+
- 29 severe weather-related fatalities and 200+ injured
- 175 total Tornado Warnings issued



NWS survey tornado tracks 31 March - 1 April 2023; source: NWS Damage Assessment Toolkit (DAT)



# Local Tornado Statistics

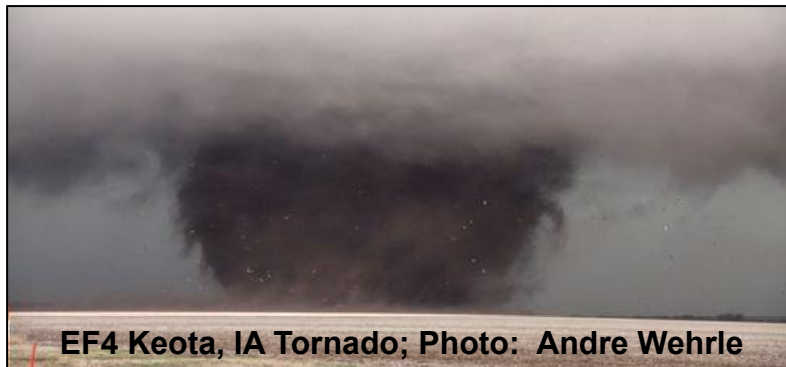
Historic Tornado Outbreak  
31 March 2023



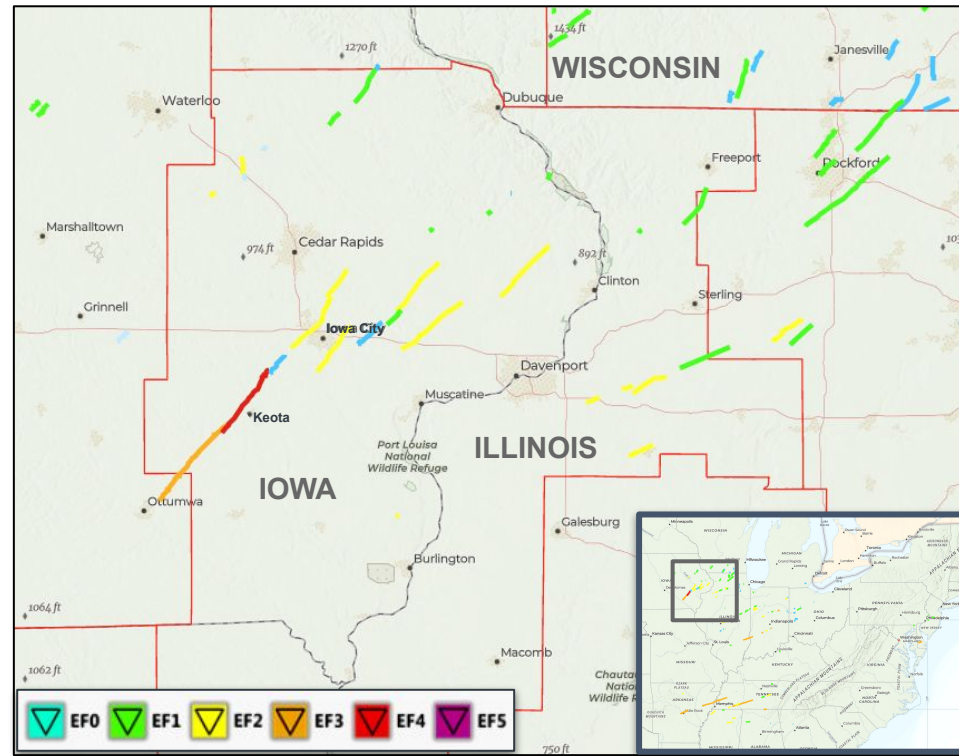
## 31 March 2023

### Quad Cities County Warning Area (CWA)

- 29 tornadoes - most for an event
- 15 EF2+ (34% of outbreak); most strong tornadoes in the CWA for an event
- 0 fatalities and 11 injuries



EF4 Keota, IA Tornado; Photo: Andre Wehrle



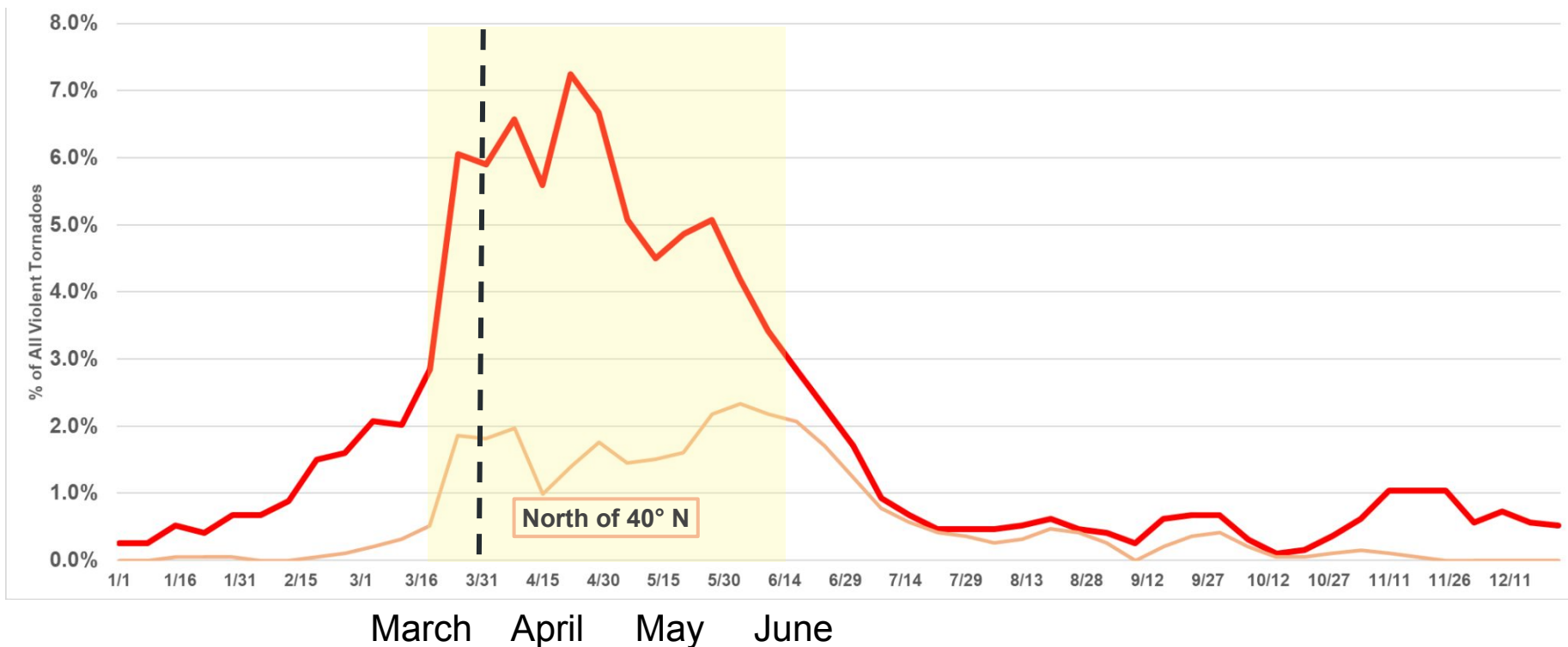
NWS survey tornado tracks from 31 March 2023; source: NWS DAT



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# U.S. Violent Tornado Climatology (EF4+)

Using a rolling 3 week average, 1950 - 2022



Data Source: SPC



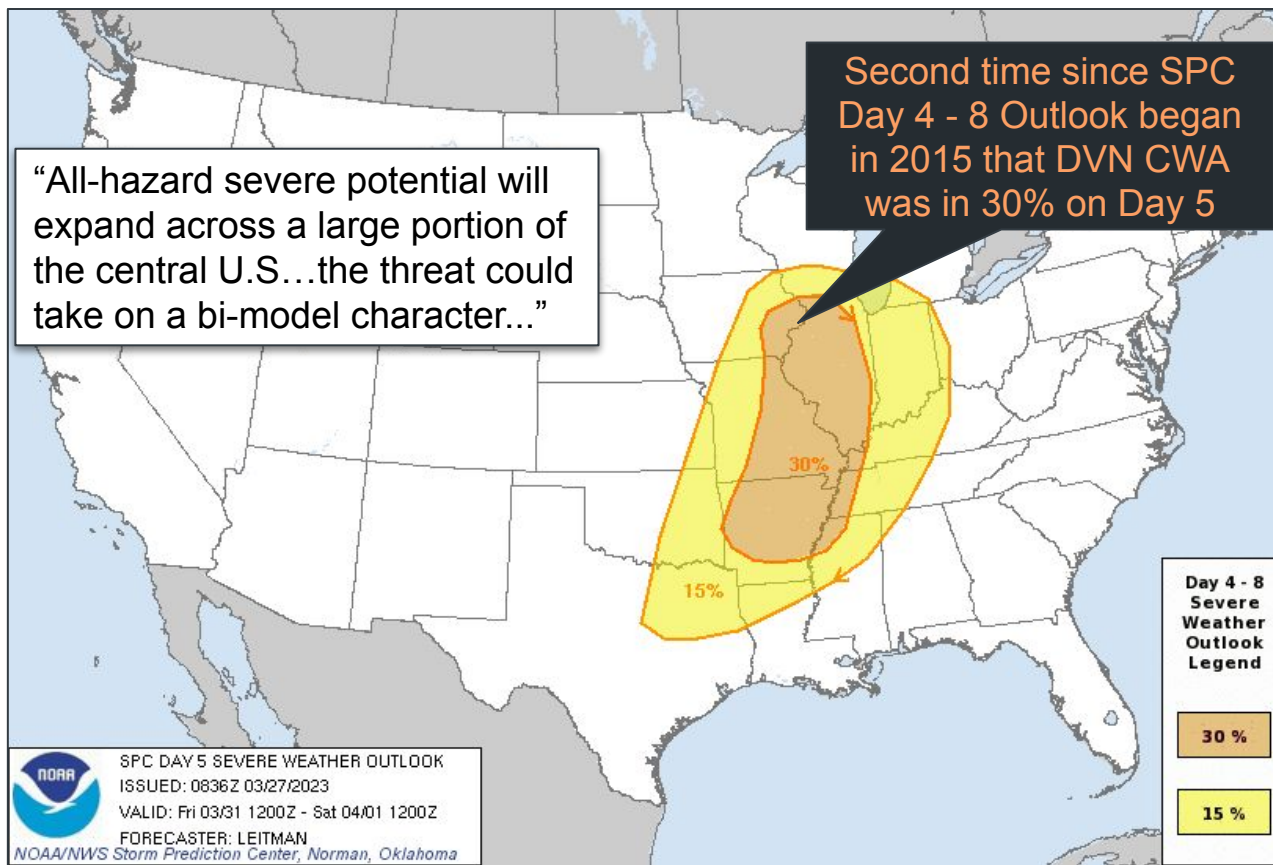
# Storm Prediction Center Outlooks





# SPC Outlook - Day 5

Historic Tornado Outbreak  
31 March 2023



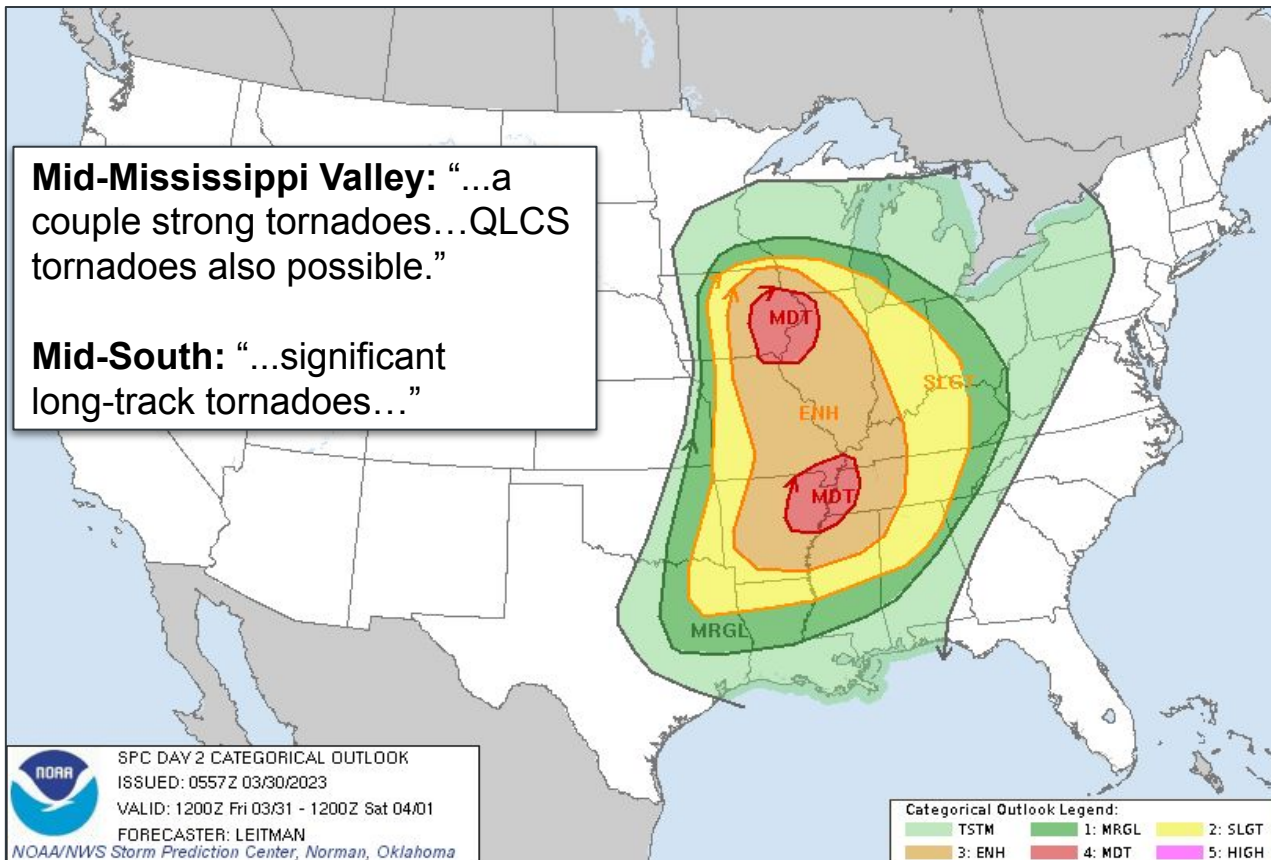
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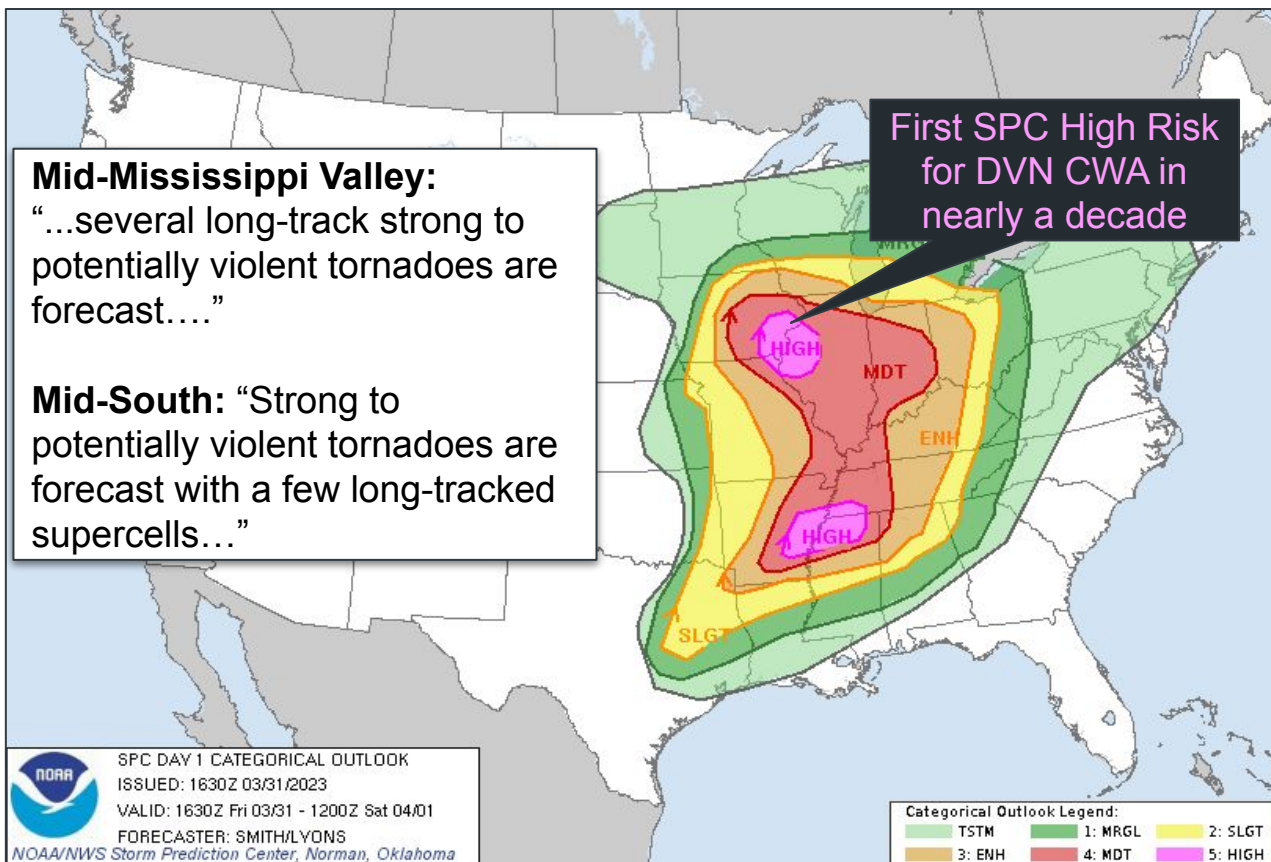




**Mid-Mississippi Valley:** "...a couple strong tornadoes...QLCS tornadoes also possible."

**Mid-South:** "...significant long-track tornadoes..."

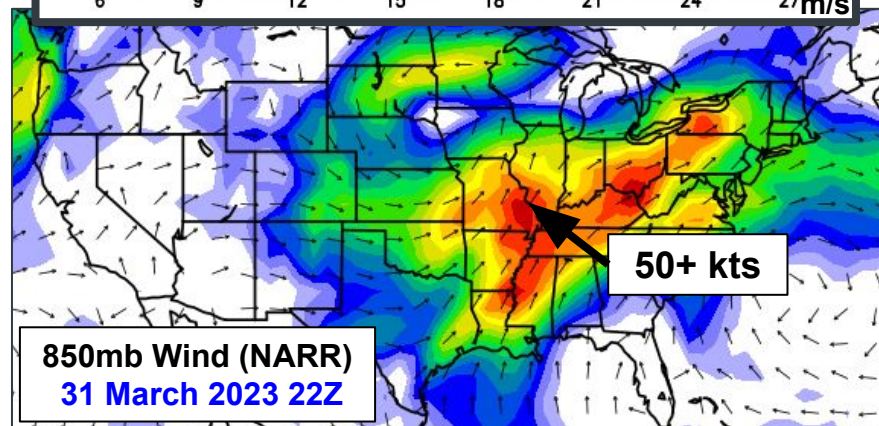
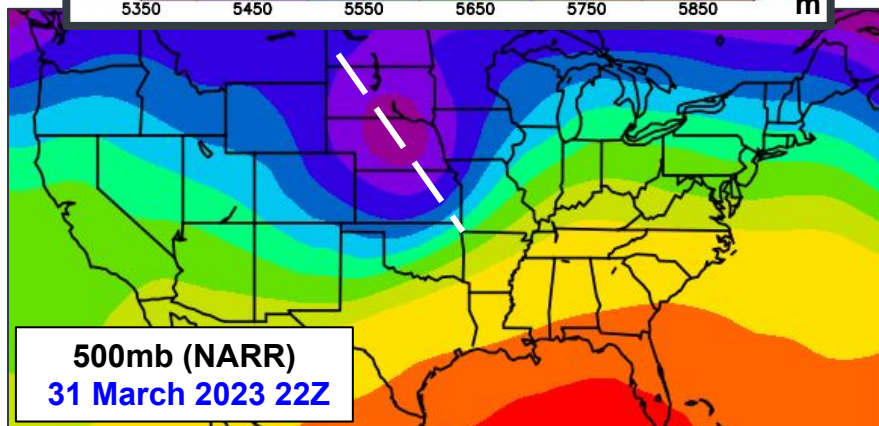
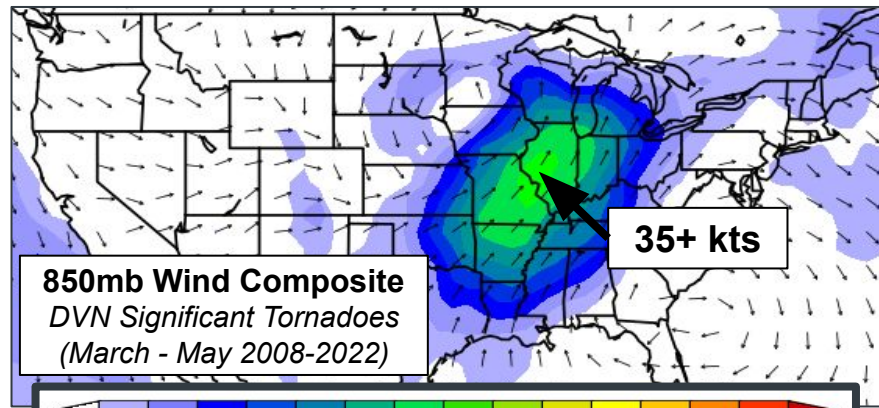
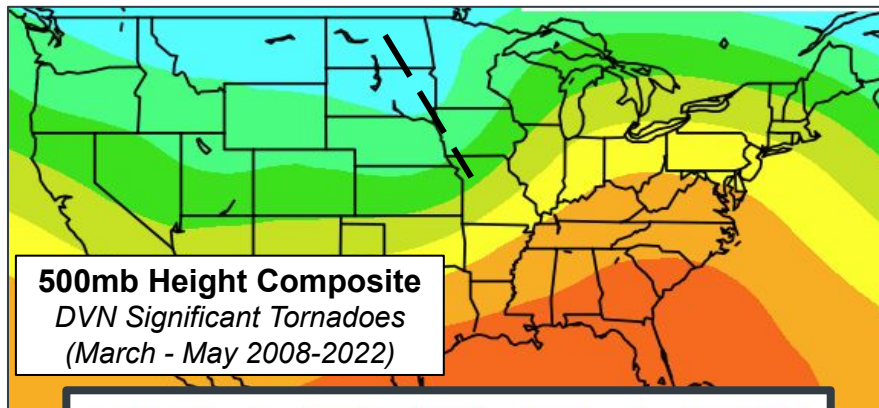




# Meteorological Setup



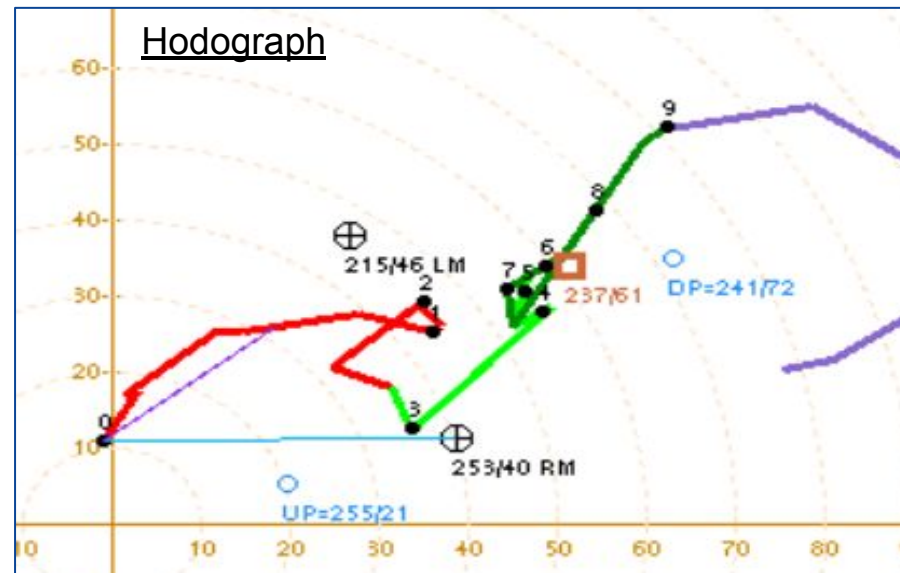
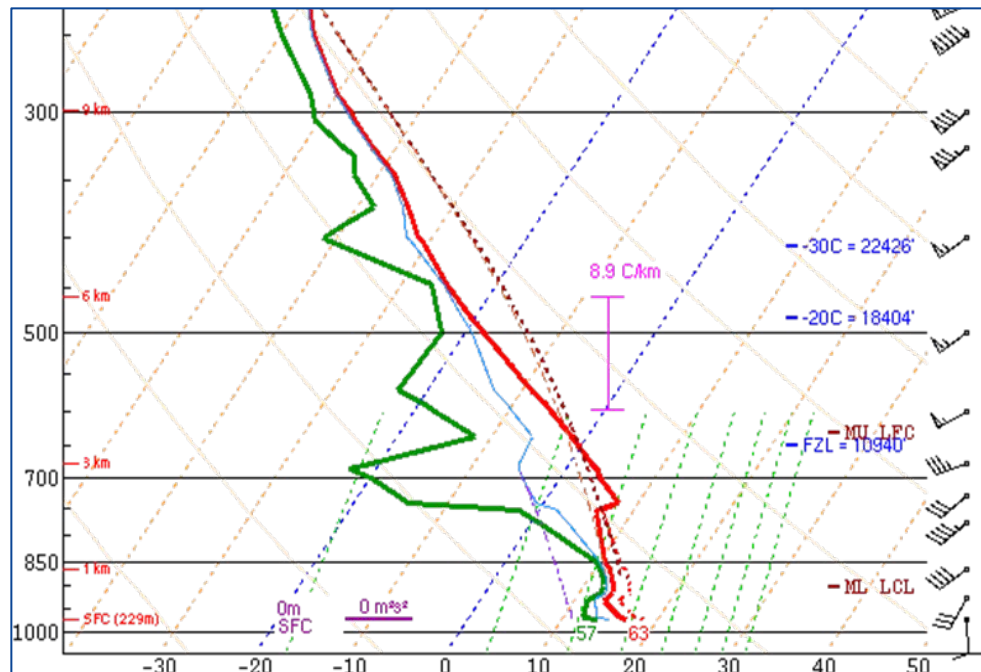
# Pattern Recognition





# DVN Sounding: 18Z 31 March 2023

Historic Tornado Outbreak  
31 March 2023



- Surface-based CAPE 1500 - 2000 J/kg
- 60° Tds only observed 1% of March days in the Quad Cities

- Effective bulk shear of 70 kts
- 40 kts 0-1 km shear
- SRH 259 m<sup>2</sup>/s<sup>2</sup> (0-1 km); STP 2 - 4

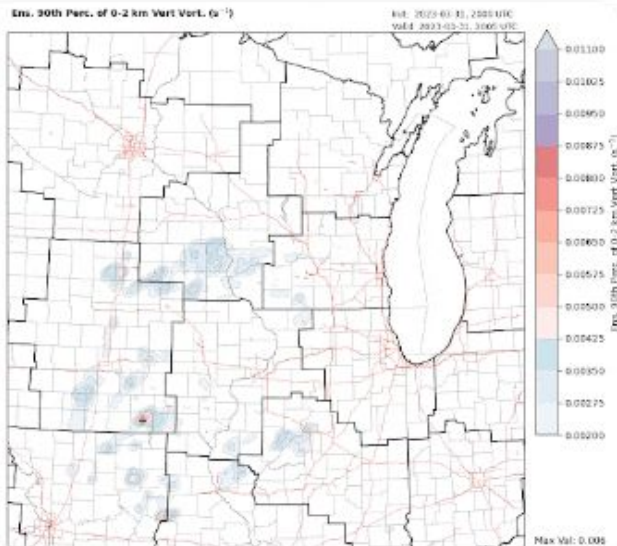


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Patrick Ayd - NOAA Federal Mar 31, 3:38 PM

DVN/DMX....Wapello county storm maintains, in addition to the Poweshiek and Tama county storm. It continues to have a far northern signal near the warm front, but, the mode is pretty messy up there.



Dan Baumgardt - NOAA Federal Mar 31, 3:39 PM

And those two VV tracks have been pretty consistent run-run.

- **NWS Central Region Remote Mesoanalysis mutual aid support chatroom**
- **Utilized NSSL's WoFS (Warn-on-Forecast System) 0 - 2 km vertical vorticity as a proxy for low-level mesocyclone strength and longevity**



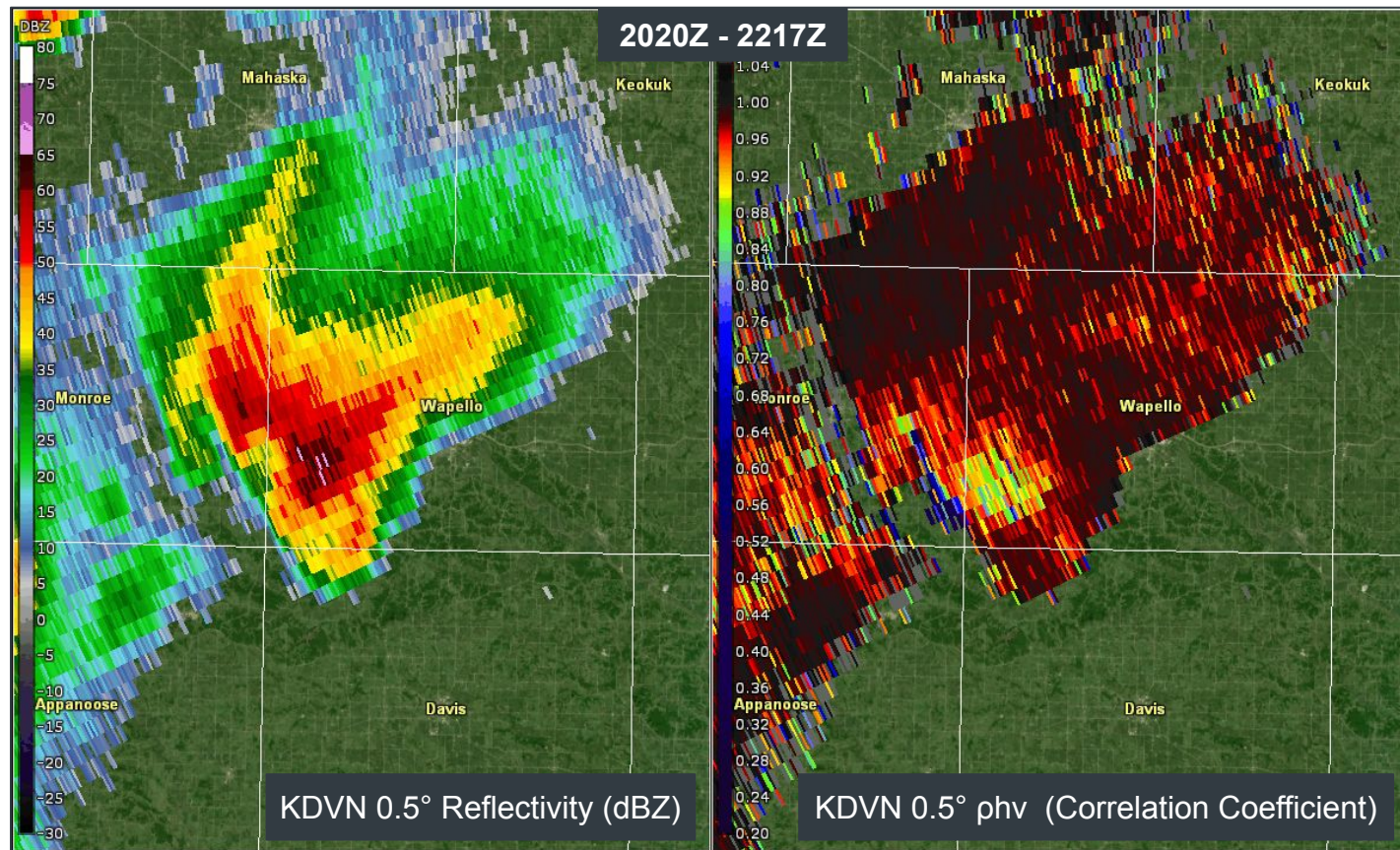
# Radar Analysis of Keota, Iowa Supercell (EF4 Tornado)





# Keota, Iowa Supercell Radar Loop

Historic Tornado Outbreak  
31 March 2023



## Points of Interest

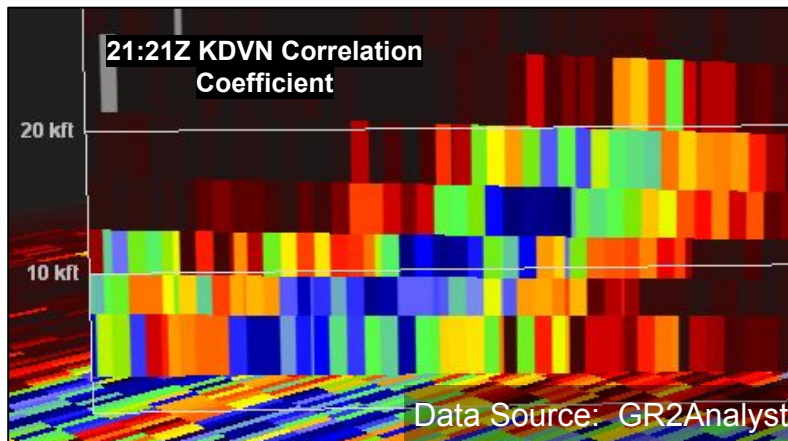
- Produced 5 tornadoes (1 EF4)
- Persistent tornadic debris signature (TDS)
- Small pieces of debris expand in the forward flank
- Supercell absorbed by a growing convective cluster



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# Keota, Iowa EF4 Tornado

Historic Tornado Outbreak  
31 March 2023



For 45 minutes,  
average TDS height of  
21,300 ft (EF4 tornado  
~25 minutes)

← EF4 tornado in  
rural Keokuk County, IA;  
courtesy Jared Schultz

NWS survey →  
damage photo of  
destroyed home  
from near Keota, IA



# Local Decision Support Services






# Critical DSS Provided by WFO Quad Cities

Historic Tornado Outbreak  
31 March 2023





## Severe Storms Today - Windy Tonight and Saturday

March 31, 2023  
11:42 AM

**FAST-MOVING STORMS WILL GIVE YOU LITTLE TIME TO SEEK SHELTER! HAVE A PLAN!**

### Key Messages


- Severe storms are expected this afternoon and evening
- The storms will be **FAST-MOVING** generally from the southwest to the northeast at up to 60 MPH! Strong long track tornadoes are possible today and this evening
- Strong winds up to 50 mph are expected Friday night behind a cold front
- Temperatures will fall into the 30s and 40s Friday night

**NEW** What Has Changed

- Upgrade to a High Risk for strong long tracked tornadoes for southeast Iowa.

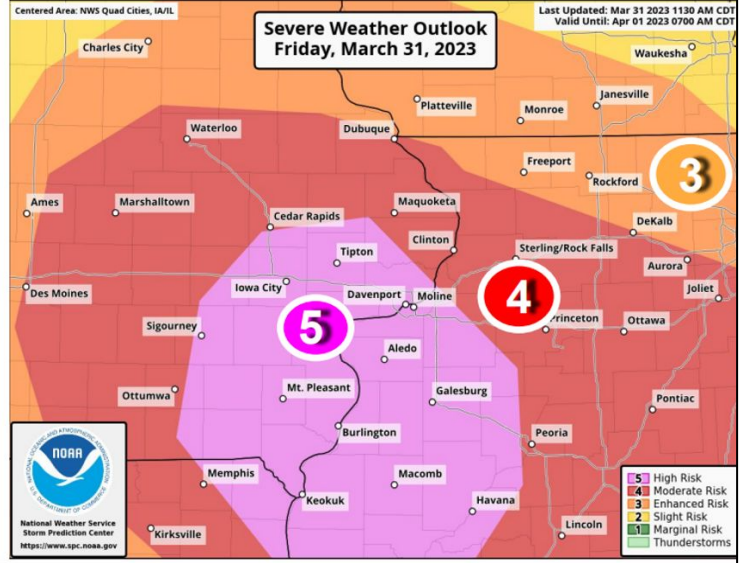
### Next Scheduled Update

- None unless something changes drastically.



National Weather Service  
Storm Prediction Center  
<https://www.spc.noaa.gov>

National Weather Service  
Quad Cities, IA/IL



### Live Tactical Webinar for Emergency Managers



➔ Area schools released several hours early to give families time to prepare for the High Risk of severe weather!



## NWS Quad Cities Partner Feedback

- **Washington and Keokuk County, Iowa EM:** “On a day when I was overwhelmed by multiple tornadoes hitting multiple counties I was serving, NWS Quad Cities always answered my call.”
- **University of Iowa Hospital and Clinics** on the tactical webinars: “This was great to have today, thank you all for setting it up and making yourselves available real time.”
- **Media Partner:** “Kudos to everyone at NWS and the other TV stations today!”



- Exceptional forecasts using pattern recognition for this event at the national and local levels led to invaluable DSS
- NWS partners depend on local expertise more than ever which can be provided through frequent DSS supported by equally frequent and sound environmental and radar analysis
- Tactical-style webinars can help core partners make critical decisions throughout an event
  - One to many DSS approach reduces workload for NWS staff
- Mutual aid is helpful not only during events (e.g. mesoanalysis) but after as we learned through extensive damage surveying and cataloging the event's impacts



# Thank you!

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← NWS Quad Cities Event Summary  
[weather.gov/dvn/summary\\_03312023](https://weather.gov/dvn/summary_03312023)

NWS Memphis →  
Event Story Map

