



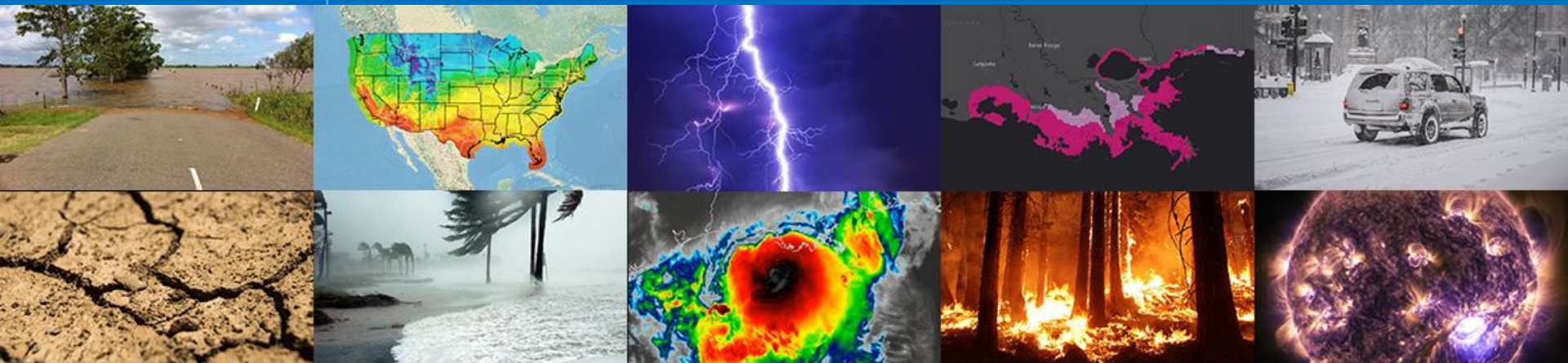
**NATIONAL
WEATHER
SERVICE**

31 March 2023 Tornado Outbreak

Presenters: Patrick Ayd, SOO ▪ NOAA/NWS Duluth, MN | Kristy Carter-Mauss, Meteorologist ▪ NOAA/NWS Des Moines, IA | Matthew Friedlein, SOO; Timothy Gunkel, Meteorologist ▪ NOAA/NWS Quad Cities IA/IL

Co-Authors: Mike Fowle, SOO ▪ NOAA/NWS Des Moines, IA | Zachary Uttech, Lead Meteorologist ▪ NOAA/NWS Quad Cities

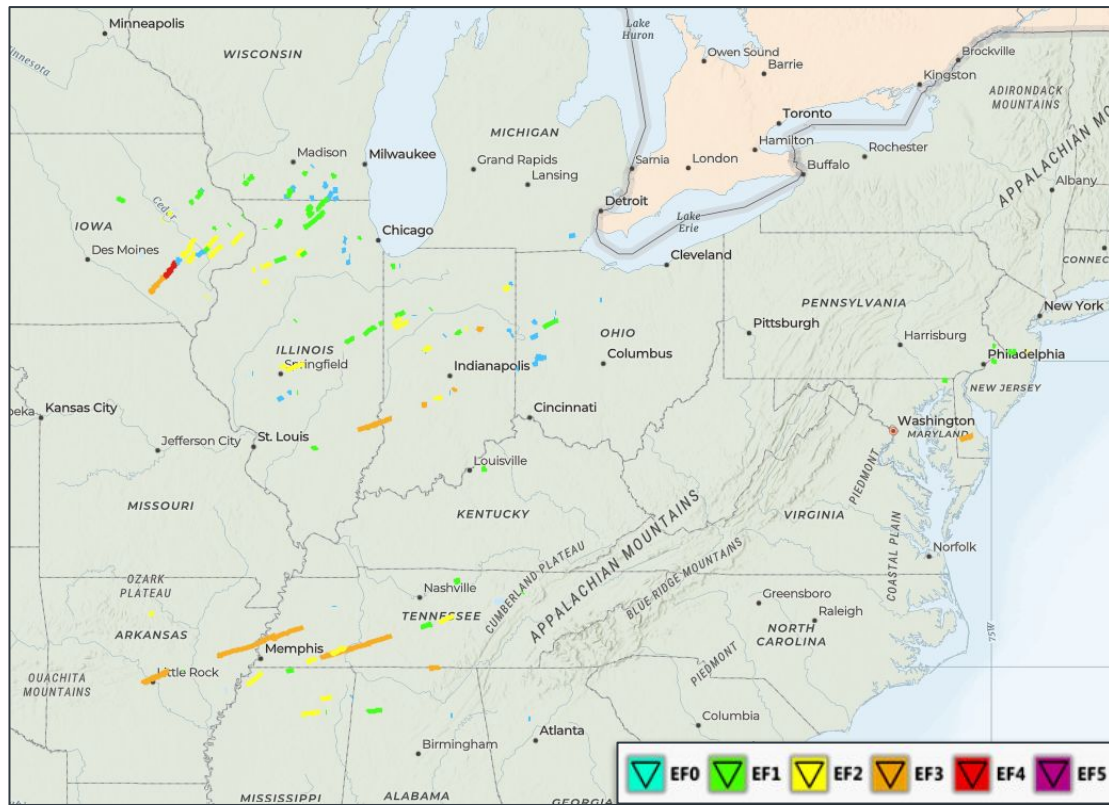
March 28, 2024 ▪ Central Iowa NWA Conference ▪ Ankeny, IA



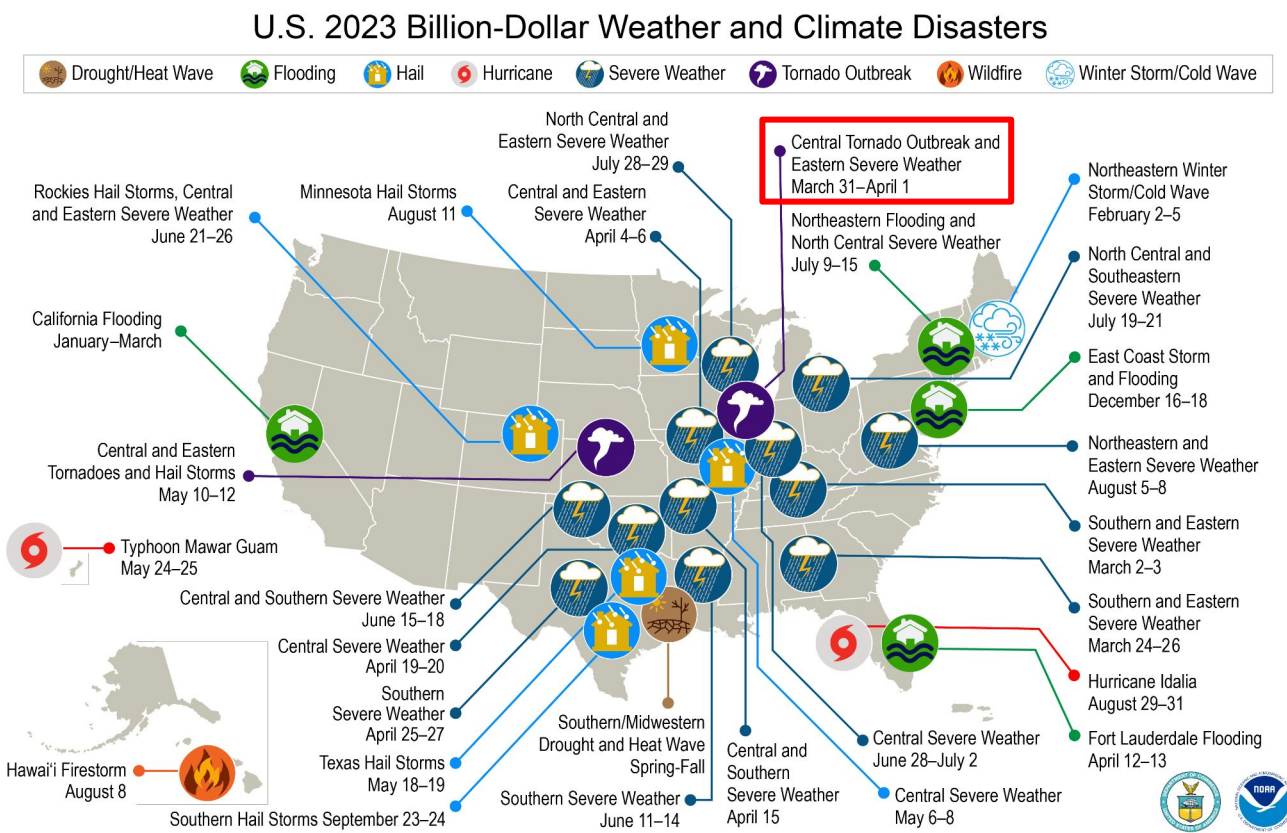
Overview of March 31-April 1, 2023 Tornadoes

March 31 - April 1, 2023

- 3rd most tornadoes for a 24-hour period on record (since 1950) with 147 surveyed across 16 states
- 44 EF2+
- 29 severe weather-related fatalities and 200+ injured
- 175 Tornado Warnings issued



Overview of March 31-April 1, 2023 Tornadoes



This map denotes the approximate location for each of the 28 separate billion-dollar weather and climate disasters that impacted the United States in 2023.



Before the Event



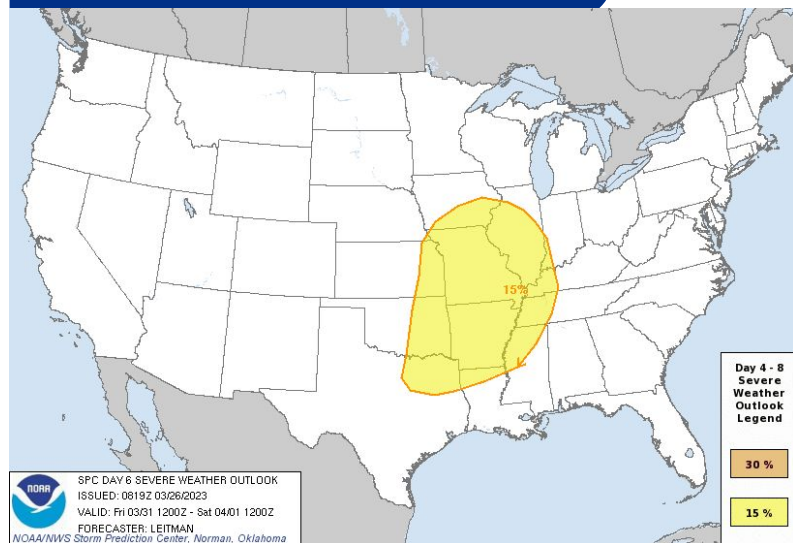
Sun-Mon March 26/27

Before
The Event

During
The Event

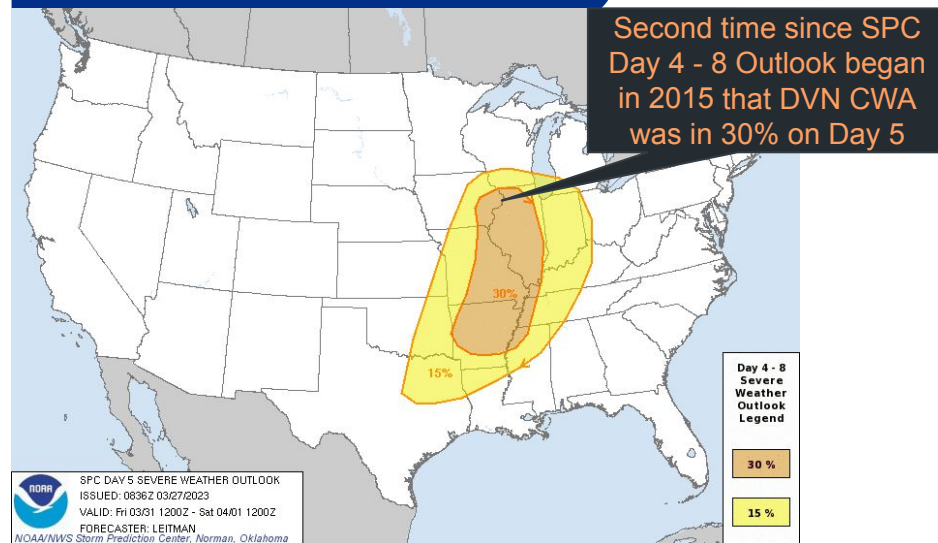
After The
Event

Sunday March 26 - Day 6



- SPC: "...Severe potential will increase markedly on Days 5-6/Thurs-Fri"
- SPC: "...Support severe thunderstorms capable of all severe hazards shifting east/northeast with time..."

Monday March 27 - Day 5



- SPC: "By Day 5/Fri, all-hazards severe potential will expand across a large portion of the central U.S."
- SPC: "The severe threat could end up taking a bi-modal character with an area of enhanced potential focused near a strong surface low over the IA/IL vicinity."



NATIONAL WEATHER SERVICE

Wednesday March 29 AM

FRIDAY SEVERE OUTLOOK

March 29, 2023
4:56 AM

Potential for Severe Weather Increasing for Friday

HIGHEST LOCAL RISK

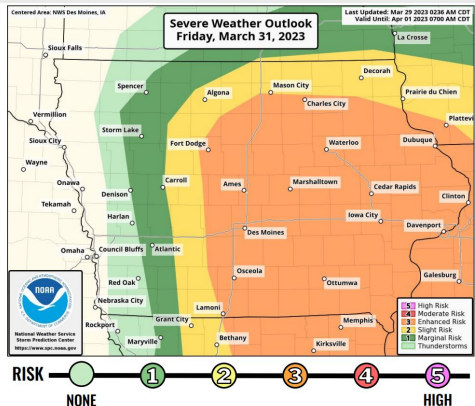
3

WHAT THIS MEANS:
NUMEROUS severe
storms possible

TIMING

FRIDAY 11 am to 8 pm

PRIMARY THREATS



What To Expect

- Thunderstorms developing by late morning to mid afternoon.
- Storms may quickly become severe.
- Fast storm motions of 50+ mph will lead to storms translating quickly across central Iowa.

What To Do?

- OUTDOOR PLANS? STAY WEATHER AWARE
- MULTIPLE WAYS TO RECEIVE WARNINGS
- NEARBY STURDY SHELTER

National Weather Service
Des Moines, Iowa

Thursday March 30 Early AM

Severe Storm Expected Friday

March 30, 2023
4:31 AM

Severe Threat Continues to Ramp Up for Friday

HIGHEST LOCAL RISK

4

WHAT THIS MEANS:
Widespread severe
storms possible

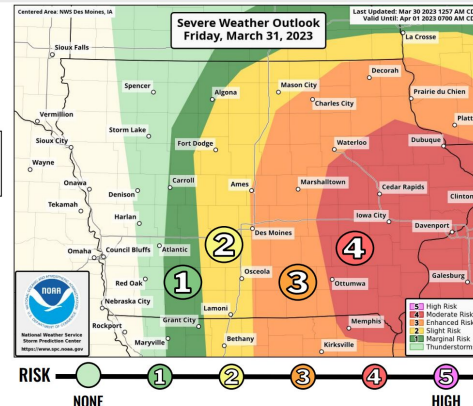
TIMING

FRIDAY 1 to 7 pm

PRIMARY THREATS



SECONDARY THREATS



What To Expect

- Thunderstorms developing by early afternoon.
- Storms likely to become severe quickly with damaging winds
- Fast storm motions of 50+ mph will lead to storms translating quickly across central Iowa and provide little time to seek shelter.

What To Do?

- OUTDOOR PLANS? STAY WEATHER AWARE
- MULTIPLE WAYS TO RECEIVE WARNINGS
- NEARBY STURDY SHELTER

National Weather Service
Des Moines, Iowa

- “There is increasing confidence in severe weather potential from late Friday morning and into the afternoon.”
- SPC Day 3: “Damaging gusts and tornadoes will be the main hazards...upscale growth into a QLCS expected”

- “Confidence is becoming high for severe weather from midday Friday into the early evening in portions of central Iowa.”
- “Fast storm motions over 50 mph are likely....provide little time to seek shelter.”



NATIONAL WEATHER SERVICE

Thursday March 30 - Midday

Before
The Event

During
The Event

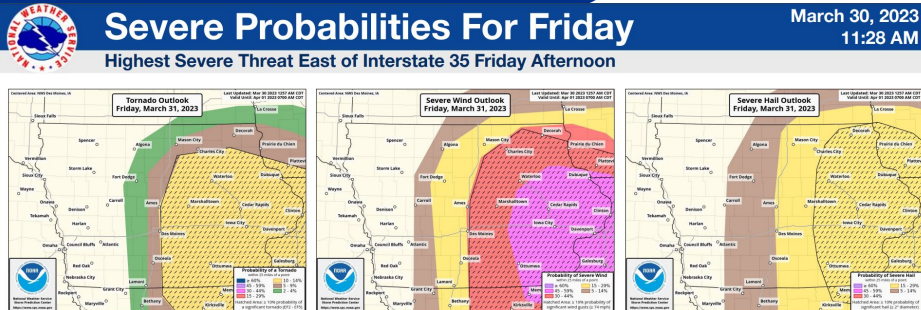
After The
Event

Thursday March 30 Midday

Severe Probabilities For Friday

March 30, 2023
11:28 AM

Highest Severe Threat East of Interstate 35 Friday Afternoon



Tornadoes

Unlikely Possible Likely

• A few tornadoes are possible as the storms develop. Any tornado would be moving rapidly so be prepared to take cover quickly.

Damaging Winds

< 60 mph 60 mph 70 mph 80 mph 90+ mph

• Damaging winds are expected to be the highest threat from the storms with numerous damaging wind gusts possible.



Large Hail

0.75" (peppercorn) 1.00" (baseball) 1.5" (ping pong ball) 2.00" (baseball) 2.75" (baseball)

• Hail remains a secondary threat with the storms, however hail up to ping pong size may still occur.

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

National Weather Service
Des Moines, Iowa

Thursday March 30 Midday

Multi-faceted Storm System Friday

March 30, 2023
11:28 AM

Severe storms, Strong winds, Blowing Snow



Hazards:

SEVERE: Damaging wind and tornadoes are the main hazard. Hail is a secondary concern.

Along and east of I-35 corridor around noon-2pm, reaching eastern Iowa by early evening.

WIND: Gusts 40-50+ mph tonight through Saturday morning.

SNOW: Light accumulations, but strong winds could result in visibility reductions due to blowing snow.

FIRE WEATHER: Gusty winds, warmer temperatures, and low humidity will make for very high fire danger today and tomorrow.



Certainty & Considerations:

There is a chance that storm could develop further east, reducing the threat to central Iowa.

National Oceanic and Atmospheric Administration
U.S. Department of Commerce

National Weather Service
Des Moines, Iowa

- “Damaging winds are expected to be the highest threat.”
- “A few tornadoes are possible as the storms develop. Any tornado would be moving rapidly so prepare to take cover.”

- “Along and east of I-35 around noon-2pm, reaching E IA by early evening.”
- SPC Day 2 AM Outlook: “...a couple strong tornadoes, intense damaging gusts & large hail...upscale growth into linear convection... QLCS tornadoes also possible.”



NATIONAL WEATHER SERVICE

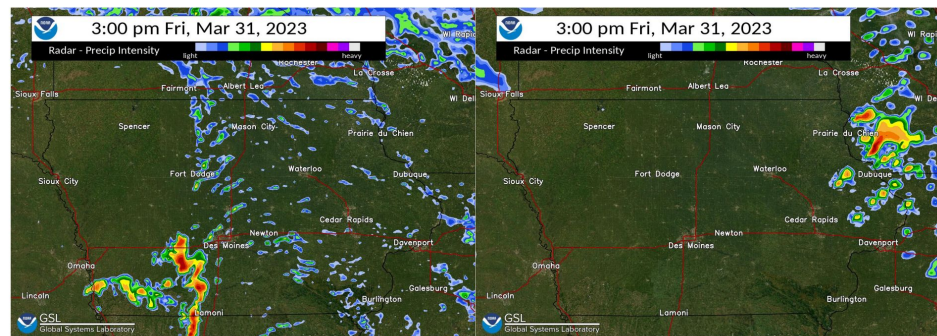
Thursday March 30 - Midday

Thursday March 30 Midday



Model 1

Model 2



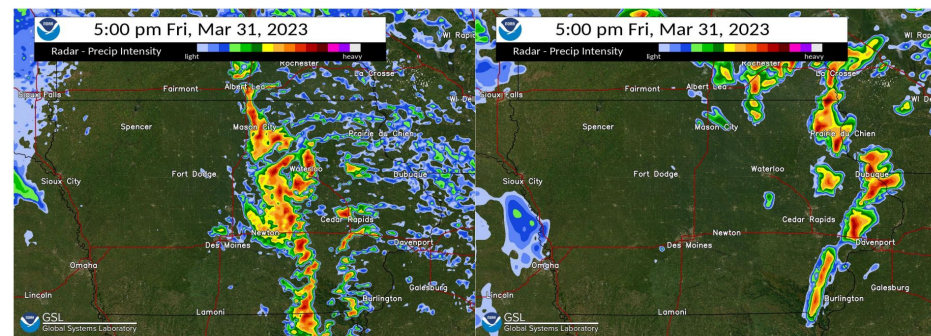
- Highlighted possible radar scenarios on Thursday March 30 during a midday webinar.
- Messaging: “There is a chance that storms could develop further east, reducing the threat to central Iowa.”

Thursday March 30 Midday



Model 1

Model 2



- SPC Day 2 1730 - Increased Tor (15% hatched) & Hail (30% hatched) - mainly over eastern Iowa.
- SPC: “A few semi-discrete supercells are expected to move into an environment with stronger low-level shear/SRH across eastern IA into northwest IL by late afternoon posing a threat for a couple strong tornadoes.”




Friday March 31 - Morning/Midday

Before
The Event

During
The Event

After The
Event

Friday March 31 Early AM




Two Rounds of Severe Storms


March 31, 2023
4:33 AM

Round 1: Scattered storms are possible between **12 PM - 3 PM**; these could be severe with tornadoes, some strong, damaging winds and large hail east of the line to the right.


Round 2: **3 PM - 8 PM**; higher threat for ALL types of severe weather area-wide.



Round 1 Threat Area




2 - 4 PM
4 - 6 PM
6 - 8 PM




Damaging Winds
Up to 75 MPH

Tornadoes
Some strong tornadoes possible

Large Hail
Up to golf ball size




National Oceanic and Atmospheric Administration
U.S. Department of Commerce



National Weather Service
Quad Cities, IA/IL

- SPC Day 1 6Z: Moderate risk expanded back to I-35 corridor.
- Confidence in severe weather high.
- Timing remains nuanced.

Friday March 31 Midday



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

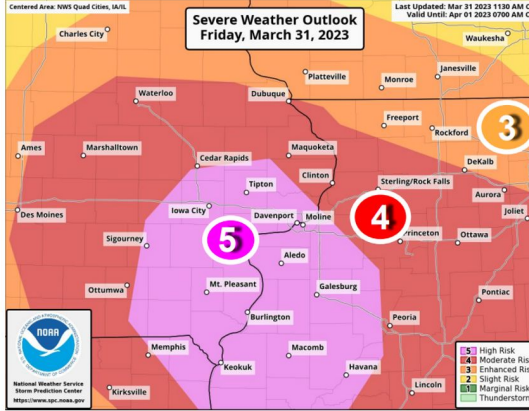
- Severe storms are expected this afternoon and evening
- The storms will be **FAST-MOVING** generally from the southwest to the northeast at up to 60 MPH! Strong long track tornadoes are possible today and this evening
- Strong winds up to 50 mph are expected Friday night behind a cold front
- Temperatures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




Severe Weather Outlook Friday, March 31, 2023


Centered Area NWS Quad Cities, IA/IL
Last Updated: Mar 31 2023 11:00 AM CDT
Valid Until: Apr 01 2023 07:00 AM CDT

5 High Risk
4 Moderate Risk
3 Enhanced Risk
2 Slight Risk
1 Marginal Risk
0 Thunderstorms

5 High Risk
4 Moderate Risk
3 Enhanced Risk
2 Slight Risk
1 Marginal Risk
0 Thunderstorms



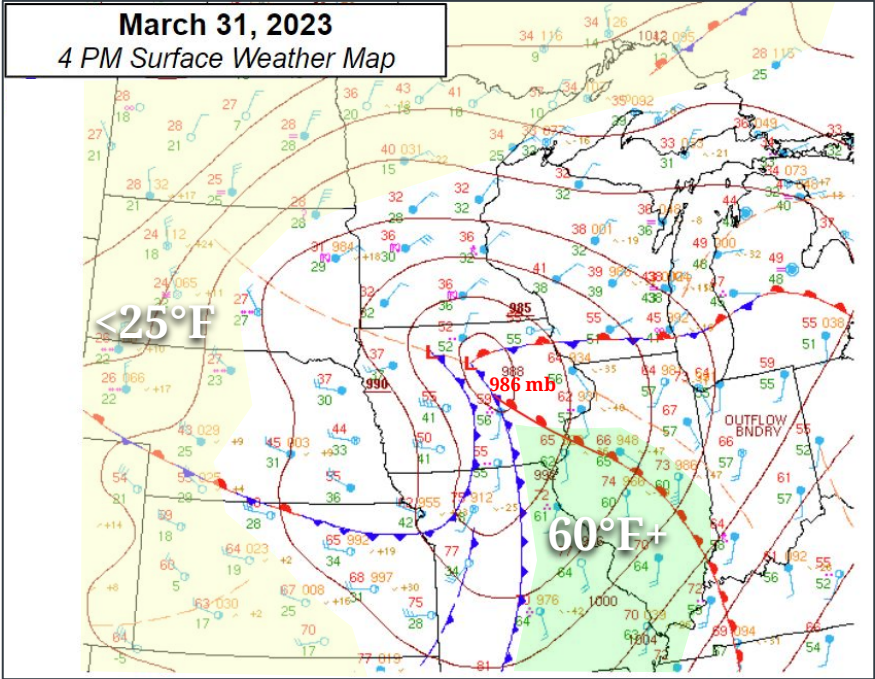
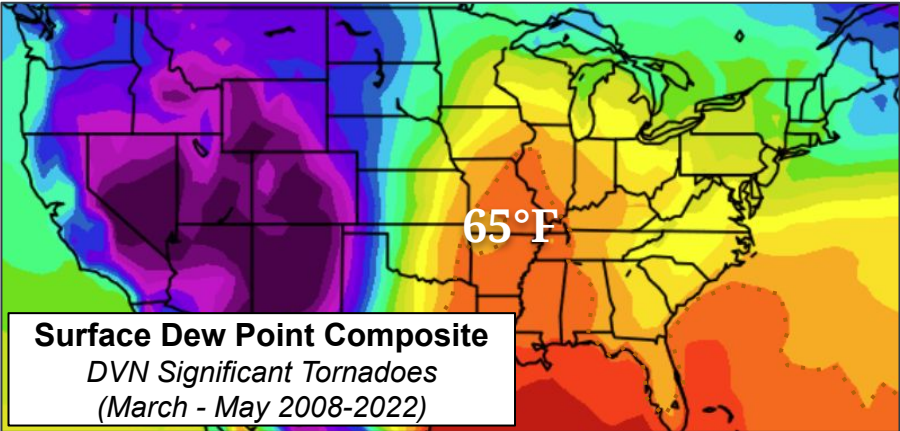
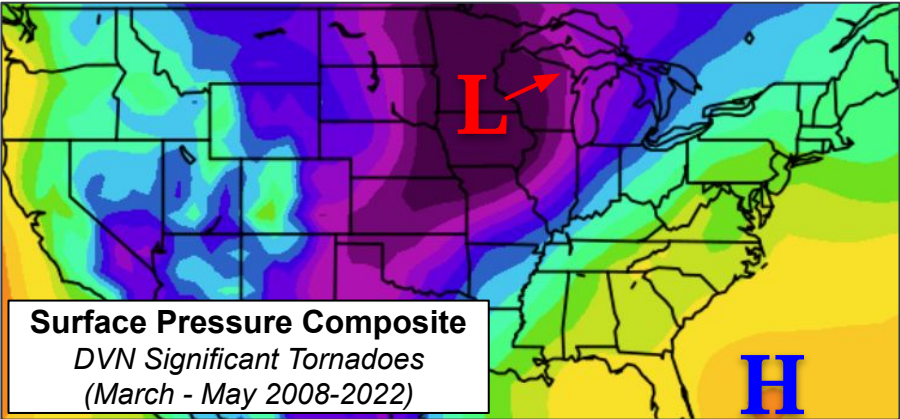
National Oceanic and Atmospheric Administration
U.S. Department of Commerce



National Weather Service
Quad Cities, IA/IL

- “Upgrade to a High Risk for strong, long-tracked tornadoes in SE IA”
- “Fast-moving storms will give you little time to seek shelter! Have a plan!”

Surface Pattern Recognition



Only 1% of March days have had dew points of 60°F+ in the Quad Cities, IA/IL (KMLI)



Central Region Remote Mesoanalysis (RMA)



RMA Quick Overview

Central Region (CR) Remote Mesoscale Analysis (RMA)

Fundamentally, it is **Mutual Aid**

This **crowd sourced remote mesoanalysis initiative** was born out of renewed emphasis on mesoanalysis:

- Operations Proving Ground (OPG) Mesoanalyst Boot Camp
- Mesoscale Environmental Assessment (MEA) Course


The RMA is ultimately the **culmination of a CR SOO group suggestion of enhancing operational mutual aid**

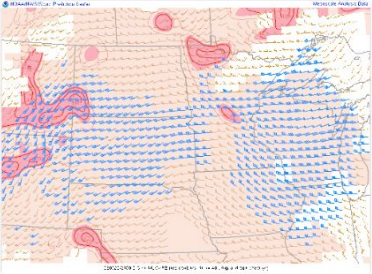



RMA Quick Overview


The RMA consists of an **often facilitated chatroom to directly support severe weather operations and IDSS** at requesting offices through remote mesoanalysis


Officially launched in 2021


 **Jason Schaumann - NOAA Federal** May 28, 4:27 PM
If a cold pool can continue to become established with that loose line of cells across far northeast WY, 0-3 km shear vectors oriented northeast in a line-normal fashion would favor constructive interference and continued upscale growth. This would promote an increasing and more widespread damaging wind threat over the next 1-2 hours.




 **Brian Barjenbruch - NOAA Federal** May 11, 14 UTC surface analysis



 **Keith Sherburn - NOAA Federal** May 28, 4:27 PM
We've noticed a clear downward trend in the coverage of 50+ kt paintballs in recent WoFS runs up here in UNR, along with a consolidation of the threat farther northwest. This seems consistent with recent radar/satellite trends across eastern WY/southwestern SD/northwestern NE.



 **Jordan Thies - NOAA Federal** May 11, 10:13 AM
[@Brian Barjenbruch - NOAA Federal](#) Am concerned about a highly conditional, but potentially significant, hail threat out ahead of this MCV as early as 17-18Z along our border given decent insolation on the E/NE side of it. Your 12Z sounding had significant MUCAPE and steep lapse rates. Plus, RAP runs show small, but intense, mid level jet streak associated with the MCV. My experience is that these often initiate earlier than expected.

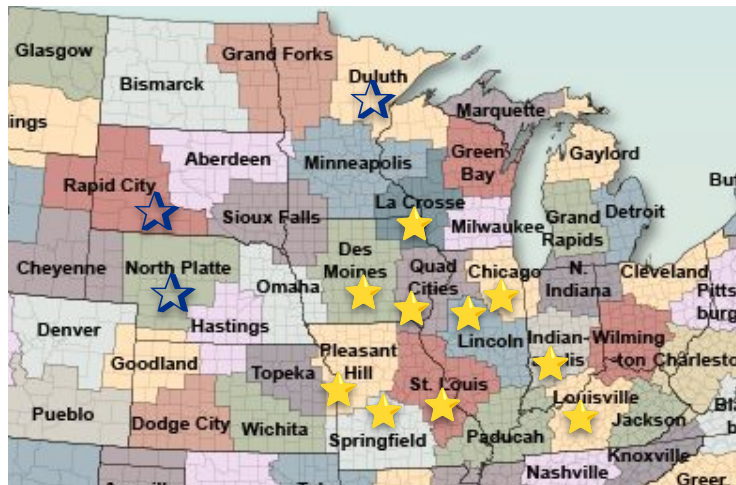


NATIONAL WEATHER SERVICE

Long Duration High Tempo Operations

RMA was active for approximately 15 hours!

- Spun up at **10AM** on **3/31**, with continuous support **until 1AM** on **4/1**!



★ Two Sectors Supporting 10 Offices

- DVN
- DMX
- ILX
- ARX
- LOT
- IND
- SGF
- LSX
- EAX
- LMK

★ = Facilitator Locations

RMA and Warn On Forecast (WoFS)

Part of the **initial challenge of WoFS in RMA** operations was **honing in on what was the right WoFS information** to feed into operations remotely

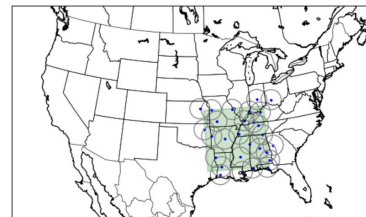
- This is where having the **real time interaction with the WoFS team was essential** for helping us quickly uncover the most useful information

WoFS By The Numbers:

- 36 member analysis, 18 member forecast
- Assimilation, w/ radar, satellite, 15 min
- New forecast run launched every 30 min, projected 3-6 hours
- Targeted regional domain, 3km grid

3/31/2023 WoFS Domains

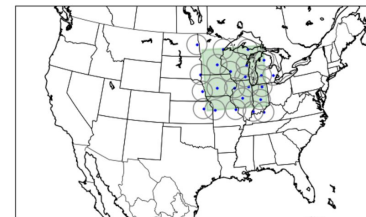
3-km HRRRE background and nested experimental WoFS grid



Radar locations within experimental WoFS grid shown as blue dots with 150-km range rings

SYSTEM STATUS: RUNNING

3-km HRRRE background and nested experimental WoFS grid



Radar locations within experimental WoFS grid shown as blue dots with 150-km range rings

SYSTEM STATUS: RUNNING



NATIONAL WEATHER SERVICE

Environment Applied To Warning Strategy

Brian Barjenbruch - NOAA Federal Mar 31, 2023, 12:25 PM



A few thoughts on how the mesoscale environment might be applied to warning polygon strategies in Iowa today, FWIW:

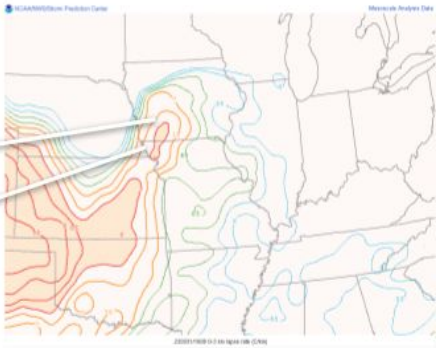
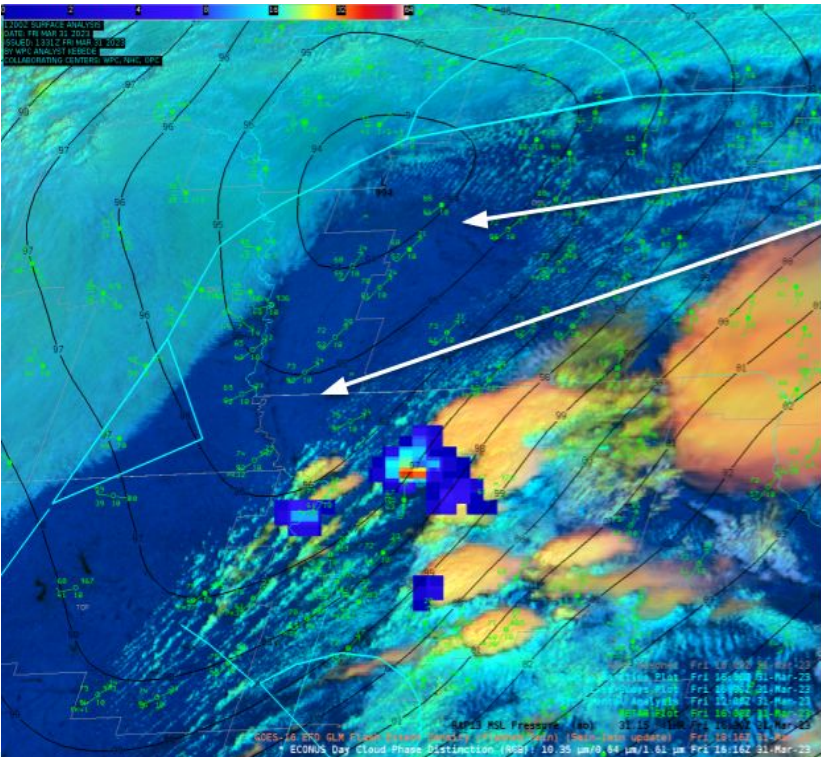
- As storms become severe, they will be more likely than normal to persist. Long-tracked persistent severe features lend themselves to longer-duration warnings as being a reasonable option, especially as storms become established
- These wind profiles lend to fairly narrow storms. We've already seen some cell mergers in the warm sector, with temporary disruption but ultimately a continuation of the core parent storm.
- Where surface winds have a southwesterly component, some splitting storms will be possible BUT the LM storm motion doesn't veer a whole lot off of the RM motion due to the long hodograph.
- Long hodographs will support sig hail potential and impressive wind fields could support wind accompanying that hail in the downdraft regions
- Lead Time will be challenging. With 50+ kt storm motions at times, getting downstream lead time will require issuance while the core of the storm is still well back in the existing warning.



Early RMA Support - March 31

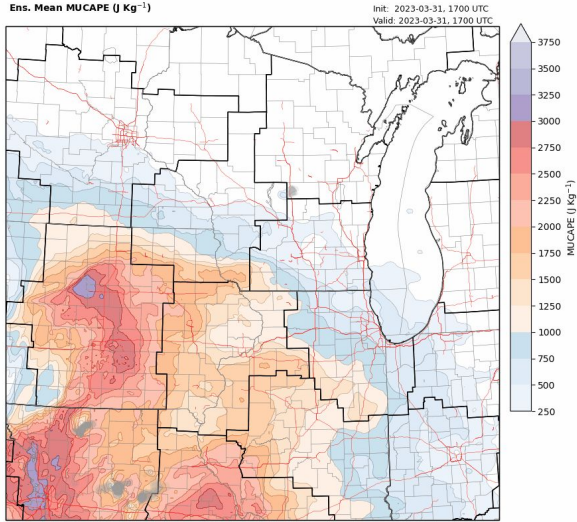
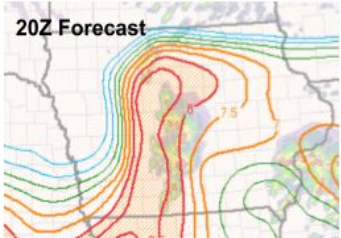


Friday March 31 11:30 AM



Tracking the Low Level Plume of Steep Lapse Rates

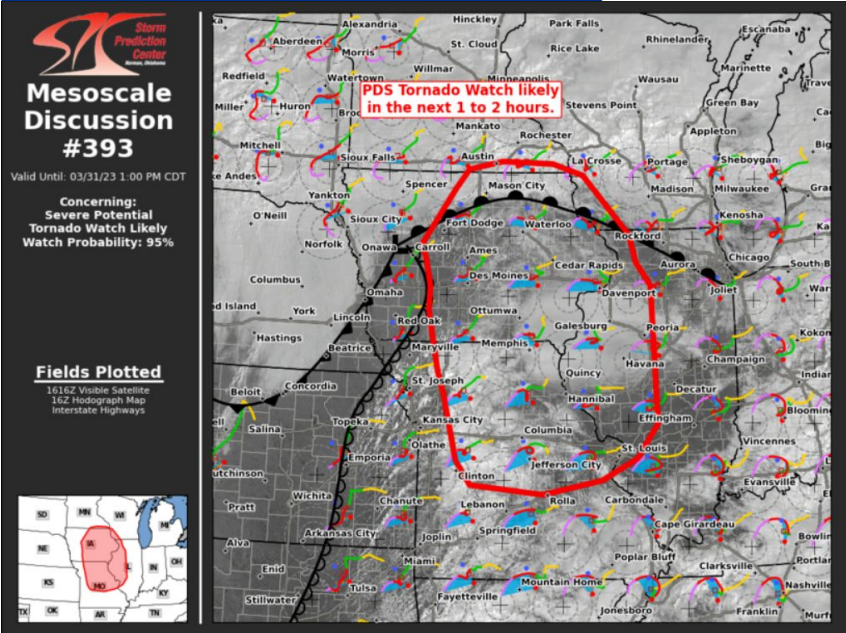
16Z SPC Mesoanalysis and associated Satellite



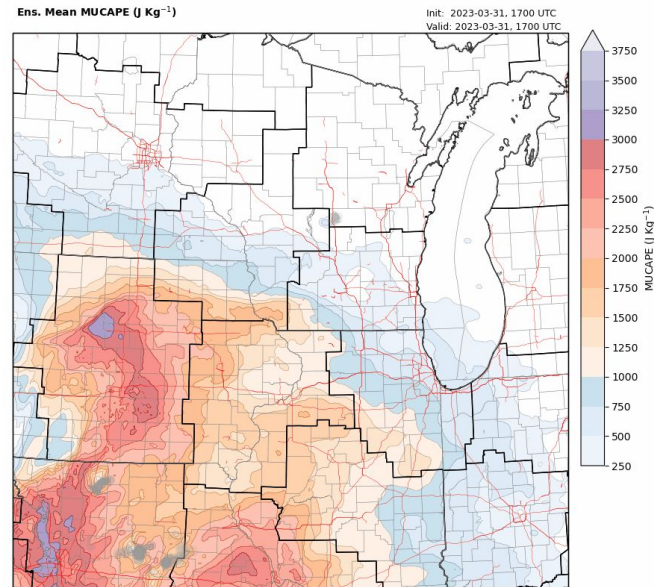
- 17Z WoFS (First Run) MUCAPE and Reflectivity Paintballs
- Two rounds of convection with CI along the steep low level lapse rate gradient
- First WoFS run, so we will need to watch run to run trends as it assimilates in satellite and radar trends

Friday March 31 - Midday

Friday March 31 11:24 AM



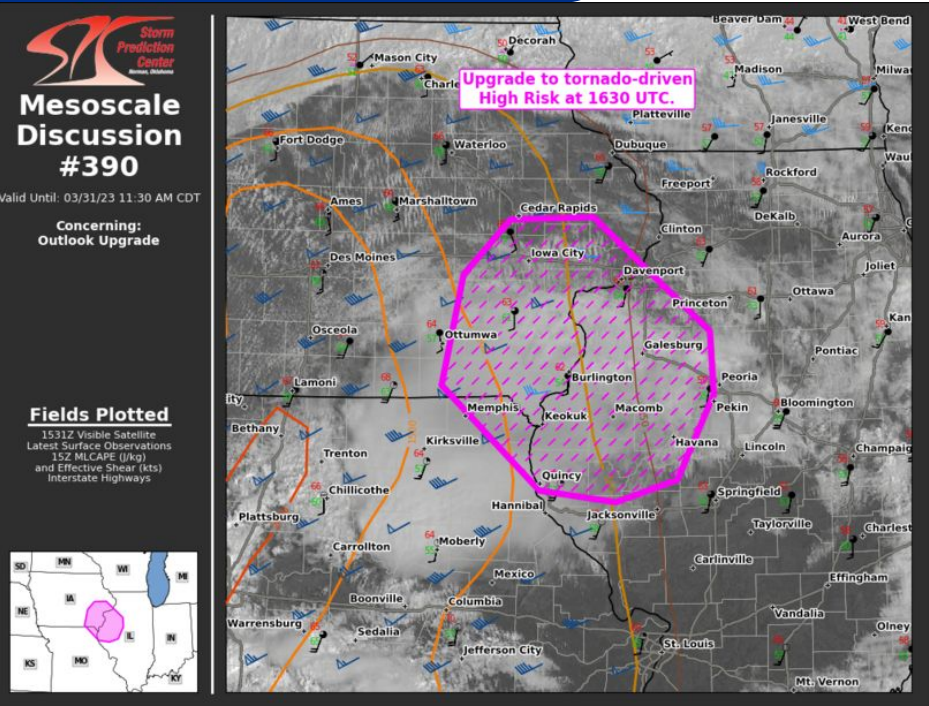
17Z WoFS



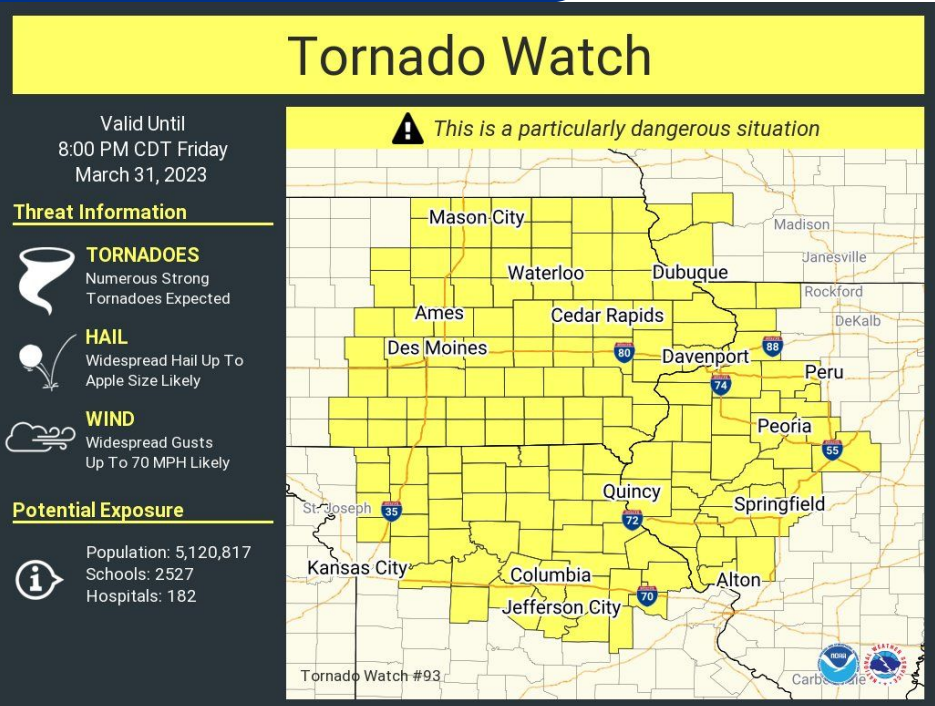
- SPC: “Rapid supercell development is expected over the next 1-2 hours across portions of SW IA...

- SPC: “The current observational trends match consistently with recent HRRR and WOFS guidance which shows numerous, potentially tornadic, supercells moving across eastern IA this afternoon.”

Friday March 31 11:30 AM



Friday March 31 11:45 AM



Friday March 31 - First Warnings



Friday March 31 12:30 PM

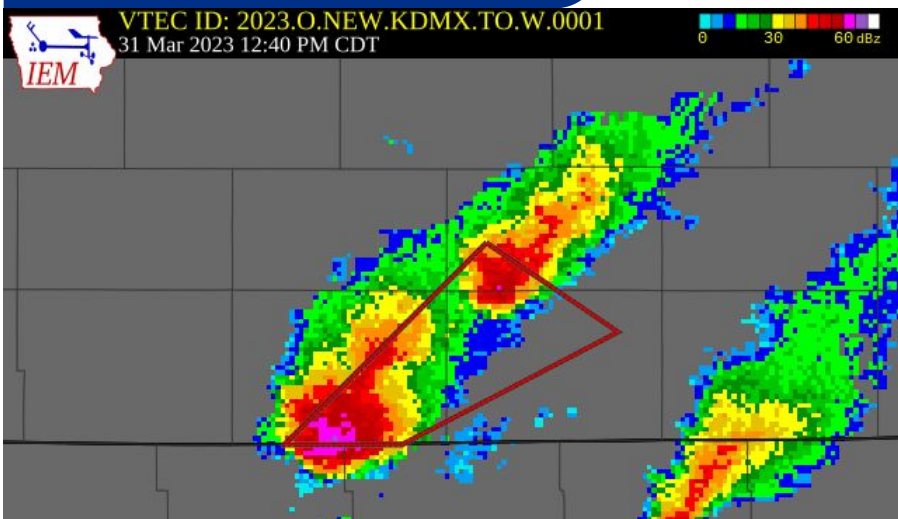


* At 1229 PM CDT, a severe thunderstorm was located over Irena, or 12 miles southwest of Mount Ayr, moving northeast at 50 mph.

HAZARD...60 mph wind gusts and quarter size hail.

SOURCE...Radar indicated.

Friday March 31 12:40 PM

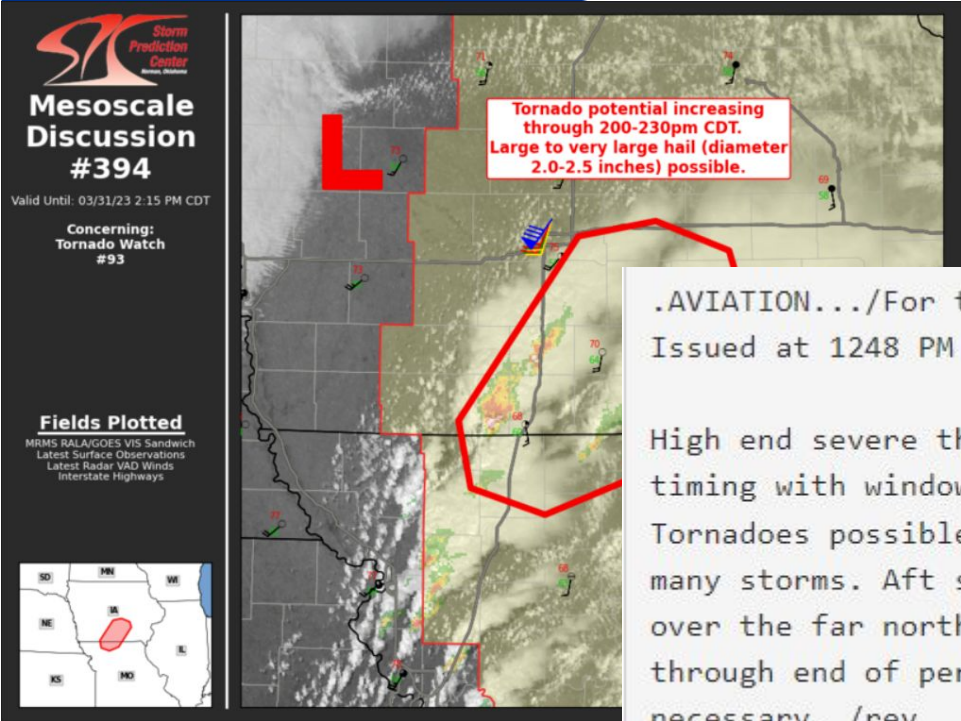


* At 1240 PM CDT, a severe thunderstorm capable of producing a tornado was located 5 miles northwest of Hatfield, or 8 miles south of Mount Ayr, moving northeast at 50 mph.

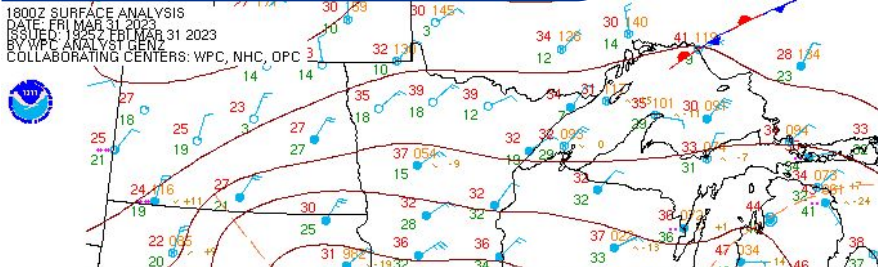
HAZARD...Tornado and golf ball size hail.

SOURCE...Radar indicated rotation.

Friday March 31 12:51 PM



Friday March 31 1:00 PM



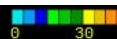
.AVIATION.../For the 18Z TAFS through 18Z Saturday afternoon/
Issued at 1248 PM CDT Fri Mar 31 2023

High end severe threat through 00z. Ramped up TSRA impacts and timing with window of 2-3 hours expected for highest end wind. Tornadoes possible and large hail also expected with passage of many storms. Aft severe threat ends, snow and wind will increase over the far north and wind will increase for most of the region through end of period. Will continue to make adjustments as necessary. /rev

Friday March 31 - Tor Warning #2

Friday March 31 3:02 PM

VTEC ID: 2023.O.NEW.KDMX.TO.W.0002
31 Mar 2023 03:02 PM CDT



301 PM CDT Fri Mar 31 2023

...BLIZZARD WARNING IN EFFECT FROM 11 PM THIS EVENING TO 7 AM CDT SATURDAY...

* WHAT...Blizzard conditions expected. Total snow accumulations of up to 2 to 4 inches. Winds gusting as high as 50 mph.

* WHERE...Far northwest Iowa

* WHEN...From 11 PM this evening to 7 AM CDT Saturday.

Photo Credit: Frances Pineda

* Tornado Warning for...

Southeastern Monroe County in south central Iowa...

Wapello County in southeastern Iowa...

Northwestern Davis County in southeastern Iowa...

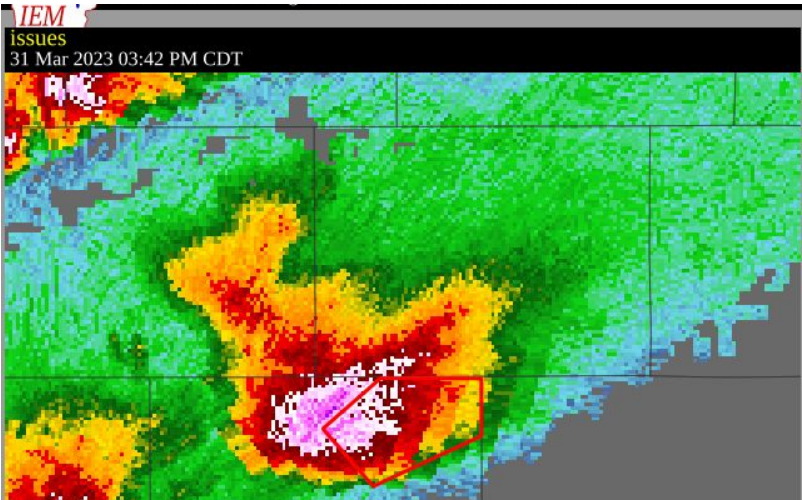
Northeastern Appanoose County in south central Iowa



NATIONAL WEATHER SERVICE

Friday March 31 ~18Z

Friday March 31 3:42 PM



* At 341 PM CDT, a confirmed tornado was located near Hedrick, or 8 miles northeast of Ottumwa, moving northeast at 55 mph.

HAZARD...Damaging tornado and baseball size hail.

SOURCE...Weather spotters confirmed tornado.



NWS Des Moines @NWSDesMoines · Mar 31, 2023
Confirmed tornado just northeast of Ottumwa. #IAwx



Noah Emmert @noah_emmert · Mar 31, 2023
@NWSDesMoines TOUCH DOWN!!!

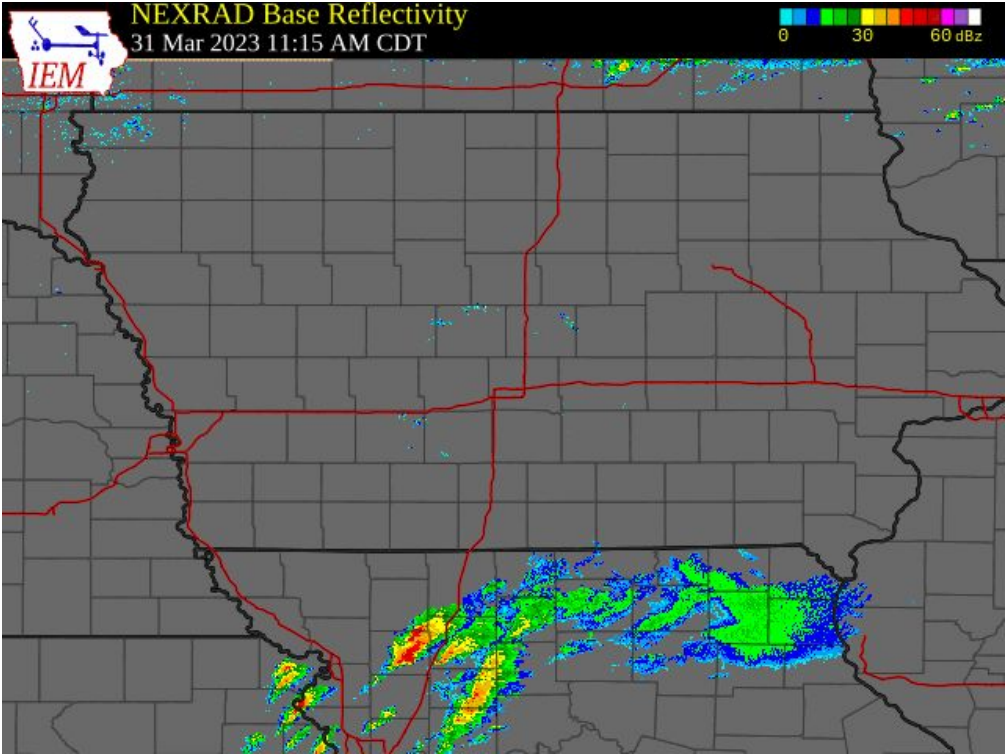
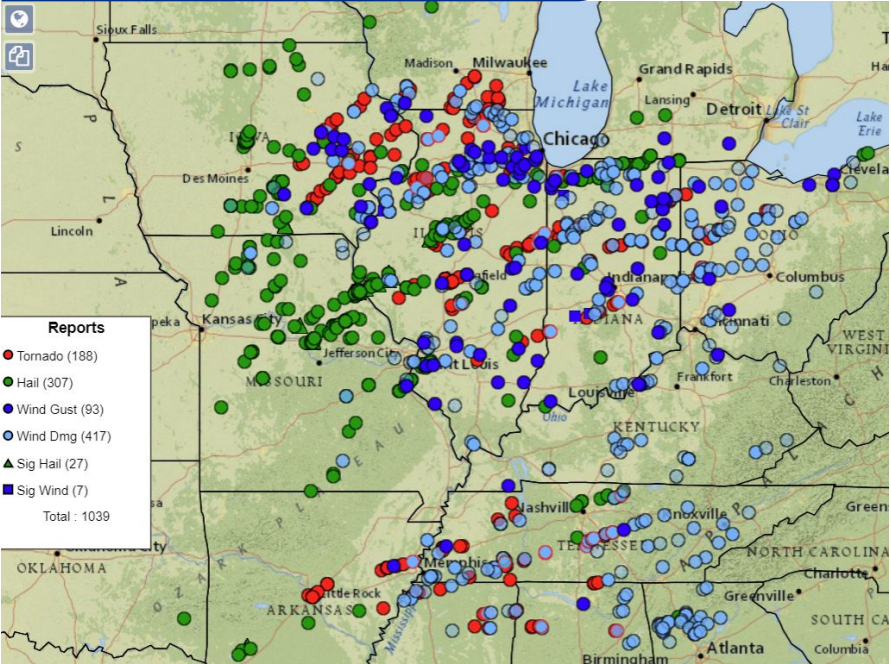


11 122 321 76K



Friday March 31 - Event Overview

SPC Event Reports 3/31/23



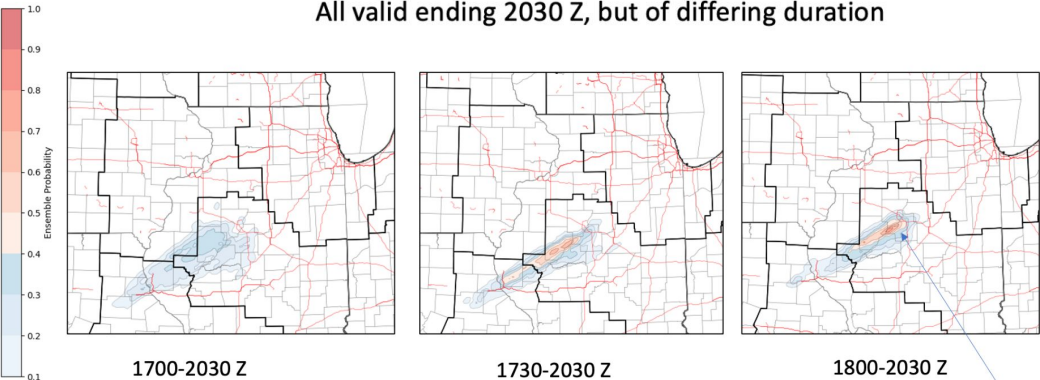
Friday March 31 1:44 PM

Mar 31, 2023, 1:44 PM

ILX....From WoFS @Patrick Burke - NOAA Federal: "Noting how the small neighborhood (more precision) 0-2 km UH probabilities are becoming more focused with each run. Still don't think WoFS is accurately resolving the individual severe warned storm and carrying IT forward, but WoFS is pretty confident that a severe storm will be in the vicinity along this swath"

0-2 km UH Exceedance Probability

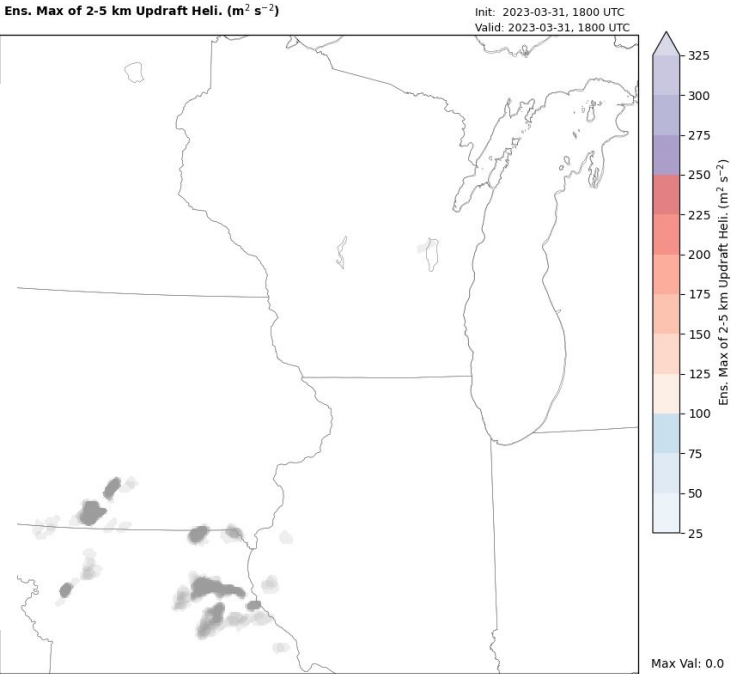
All valid ending 2030 Z, but of differing duration



Mid to high probabilities, becoming focused toward end of this time window

Friday March 31 1:44 PM

DVN, DMX... from @Patrick Skinner - NOAA Affiliate "another thing WoFS is showing in both the southern and northern domains is the most intense storms occurring with a secondary round of CI - not with the ongoing convection. I think I would have more confidence of this scenario in IA since the secondary CI is along the western boundary in the southern domain" (i.e. better assimilated by WoFS)

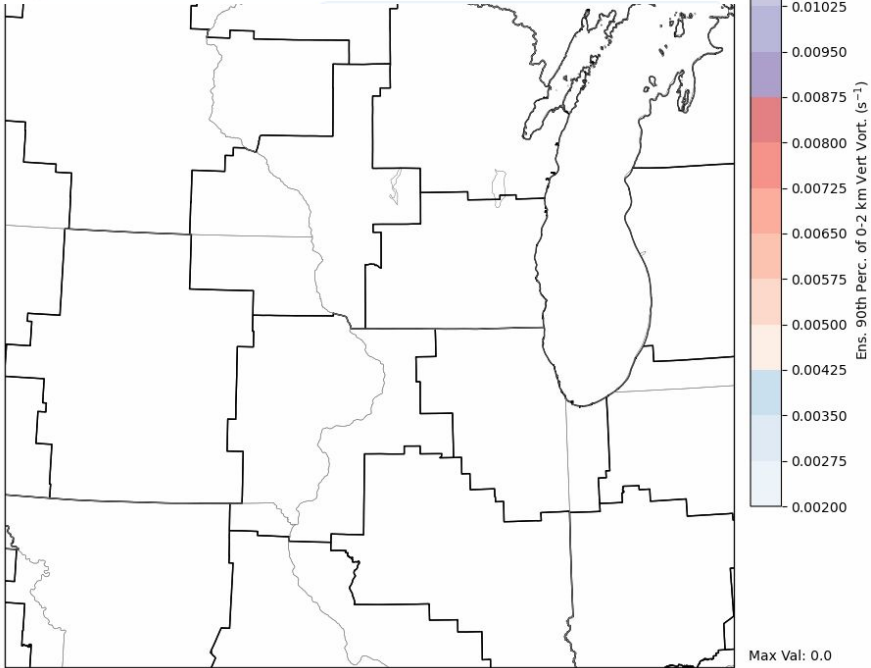


Friday March 31 2:58 PM

Ens. 90th Perc. of 0-2 km Vert Vort. (s^{-1})

Init: 2023-03-31, 1930 UTC
Valid: 2023-03-31, 1930 UTC

DMX and DVN...WoFS looks to be locking in on Appanoose supercell, and really ramps up its vertical vorticity as it moves into Walpelo, Keokuk and Jefferson counties and points northeast.

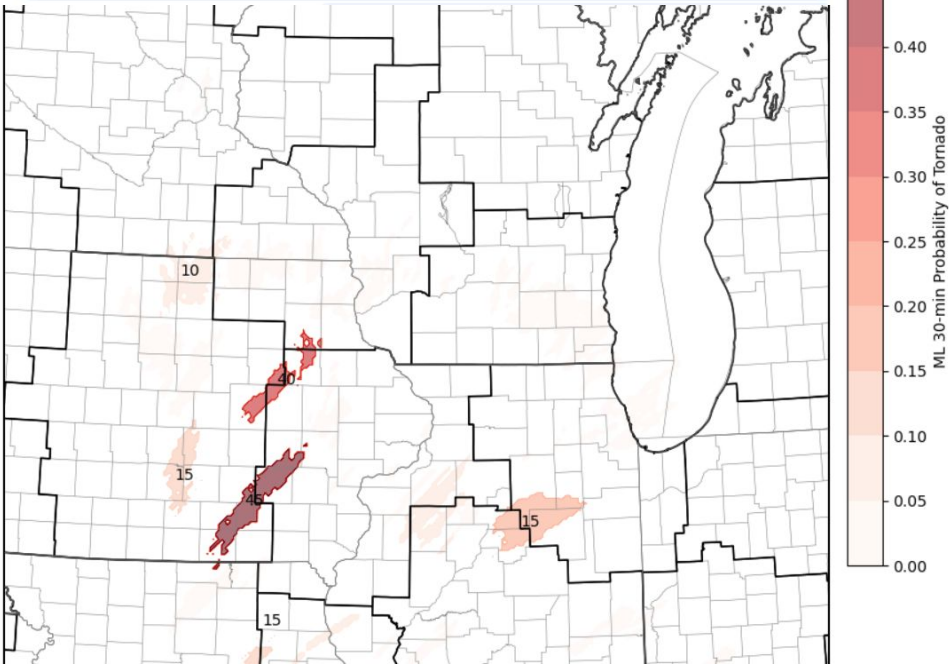


Friday March 31 3:06 PM

ML 30-min Probability of Tornado

Init: 2023-03-31, 2055 UTC
Valid: 2023-03-31, 2115 UTC

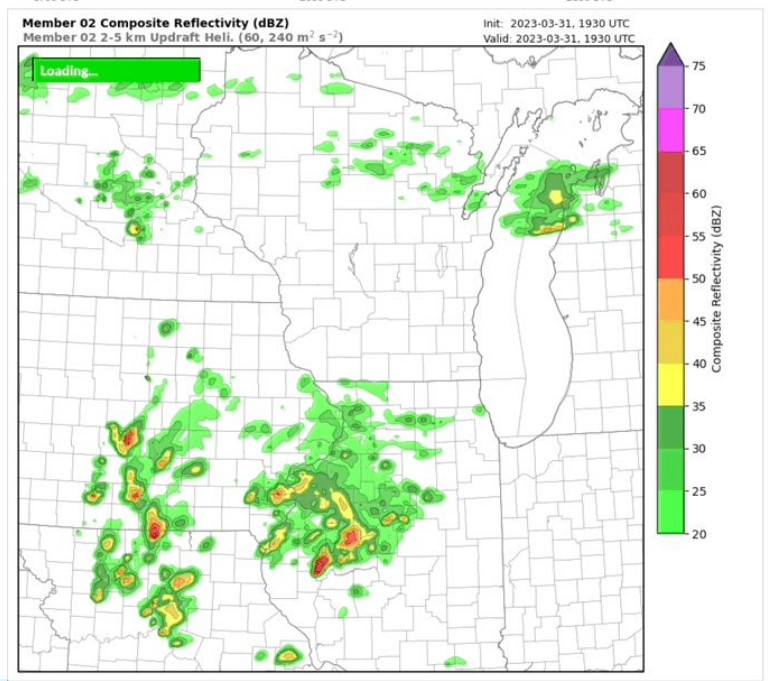
DMX and DVN...WoFS Machine learning Tornado probs really ramp up with the Appanoose storm as it moves into DVN's area.




Friday March 31 3:04 PM

Date: 2023-03-31 Domain: North Run: 19:30 UTC

Environment Paintball Rad/Sat Severe Rotation ML Products QPF



 Patrick Burke - NOAA Federal Mar 31, 2023, 3:04 PM

Agree with @Patrick Ayd - NOAA Federal . At 1930 WoFS was initialized well for the storm along the MO/IA border. I'd have more confidence in its predictions of that storm. I think the storm exiting Randolph County, MO, we'll see better performance in the 20Z run. WoFS was just catching up to that one.

Member Selection

| |
|---------|
| WoFS 1 |
| WoFS 2 |
| WoFS 3 |
| WoFS 4 |
| WoFS 5 |
| WoFS 6 |
| WoFS 7 |
| WoFS 8 |
| WoFS 9 |
| WoFS 10 |
| WoFS 11 |
| WoFS 12 |
| WoFS 13 |
| WoFS 14 |
| WoFS 15 |
| WoFS 16 |
| WoFS 17 |
| WoFS 18 |

Keyboard Shortcuts

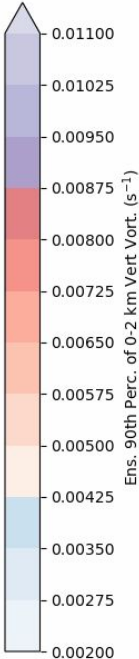
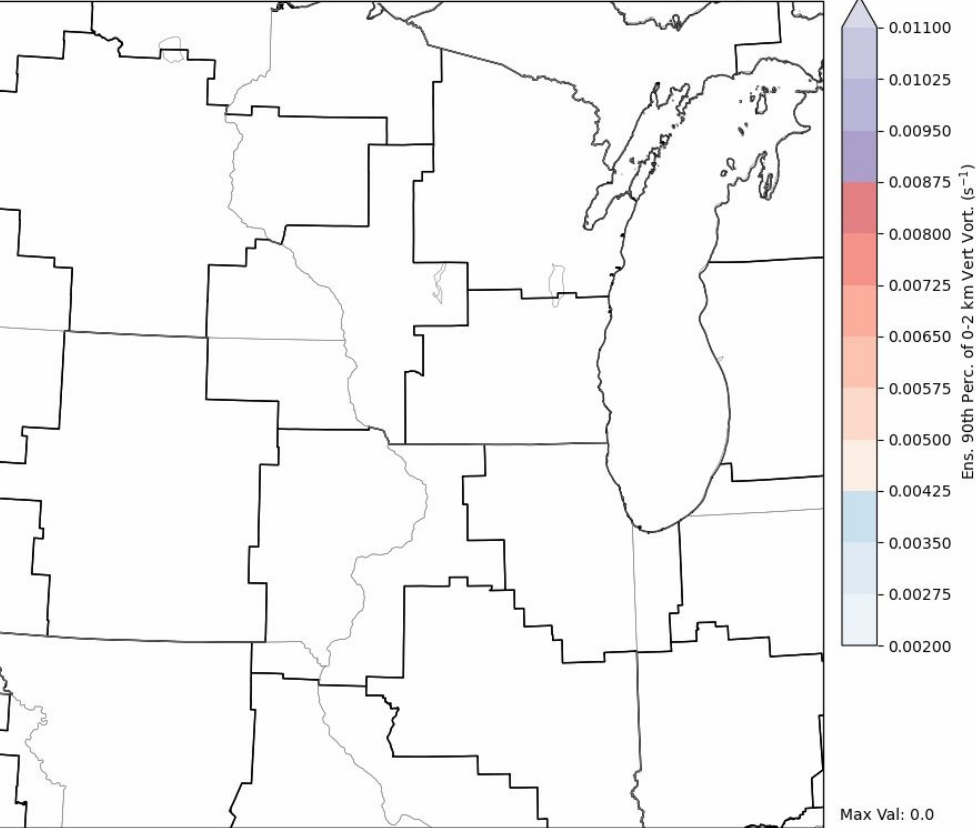
| | |
|-------------------------|------------------------|
| < prev fcst time | > next fcst time |
| p play/pause loop | h toggle top menu |
| n prev ens member* | m next ens member* |
| e prev product | r next product |
| t toggle neigh./perc. | o toggle obs* |
| v toggle sounding links | b last run (hold down) |

- A big workload is keeping pace with WoFS:
- How it is initializing
 - How this may impact it downstream fields
 - Run to run trends (is the system honing in on a signal)
 - Communicating this to the meso-a and warning teams

Friday March 31 ~20Z

Ens. 90th Perc. of 0-2 km Vert Vort. (s^{-1})

Init: 2023-03-31, 1930 UTC
Valid: 2023-03-31, 1930 UTC



Max Val: 0.0

Friday March 31 3:13 PM

Patrick Burke - NOAA Federal Mar 31, 2023, 3:13 PM



WoFS tends to do well at predicting a storm's ramp up and down in intensity. This makes me pretty concerned for Ottumwa and points northeastward through Keokuk County, based on the 1930Z run and that loop that Patrick shared. The 0-2 km vertical vort ramps up right around Ottumwa, which would be very soon per current radar.

Friday March 31 3:13 PM

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During the Event: NWS Quad Cities (DVN)

© Hunter Fowkes
March 31, 2023
Keota, Iowa area



NATIONAL WEATHER SERVICE

DVN Tornado Numbers

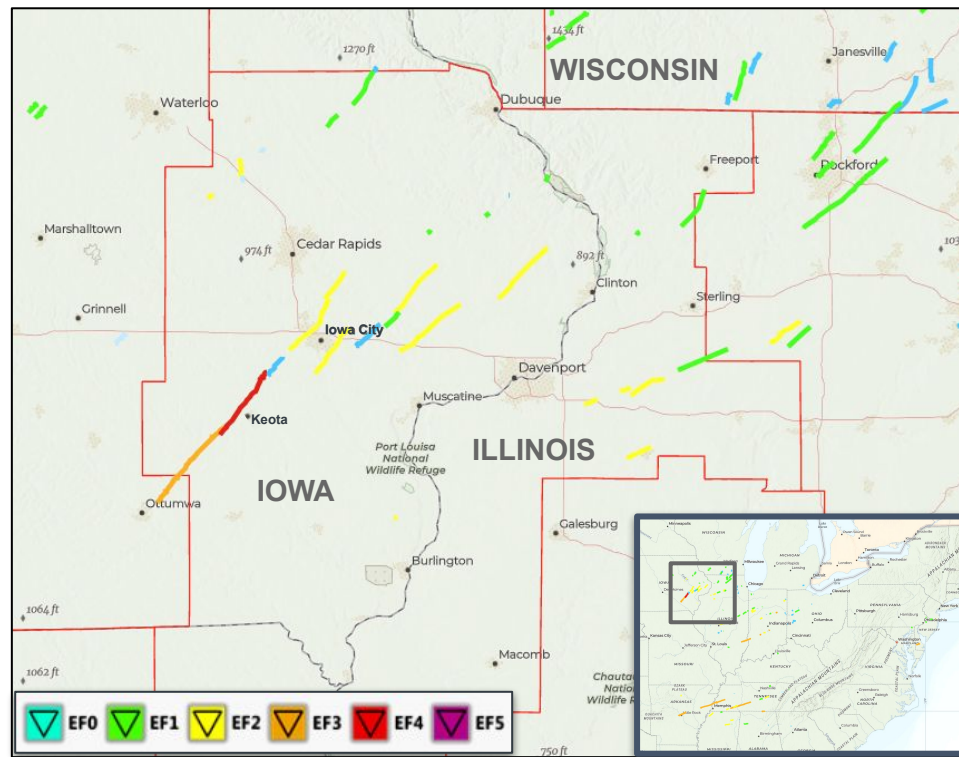
31 March 2023

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

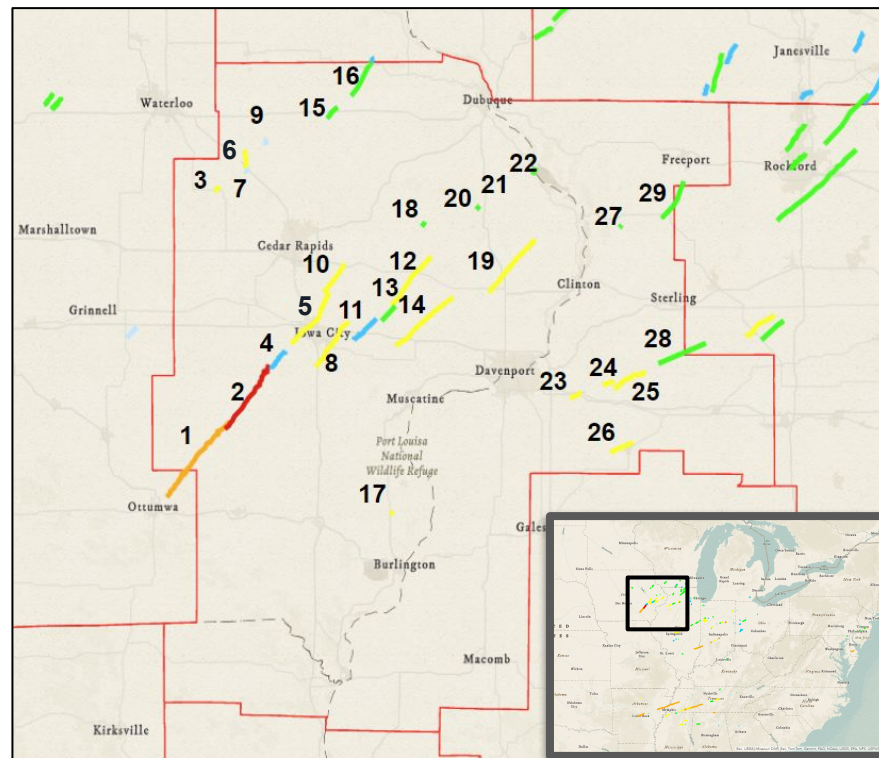


NATIONAL WEATHER SERVICE

DVN Tornado Numbers

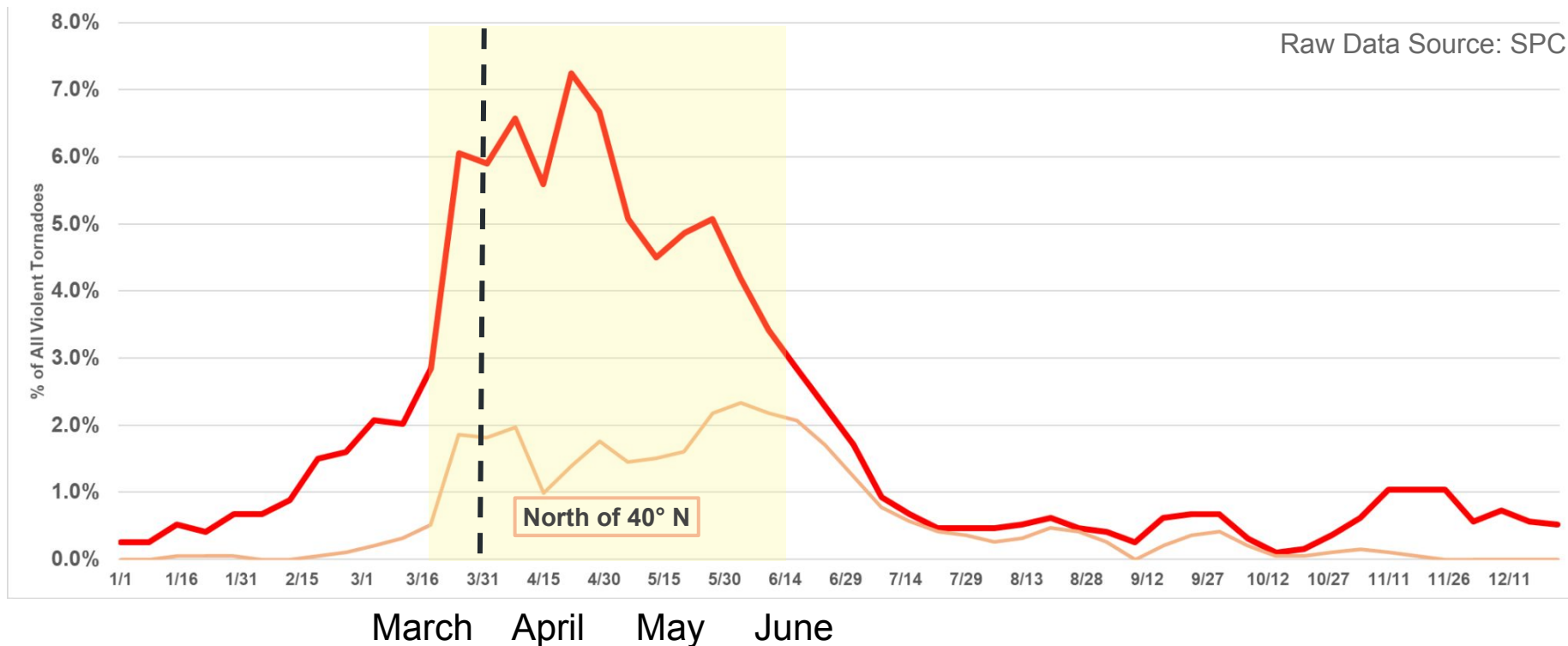
Location and Intensity

| | | | |
|----|--|----|--|
| 1 | Martinsburg, IA EF-3 150 mph | 16 | Oneida-Greeley, IA EF-1 110 mph |
| 2 | Keota-Wellman, IA EF-4 170 mph | 17 | Mediapolis, IA EF-2 120 mph |
| 3 | Vinton, IA EF-2 115 mph | 18 | Wyoming, IA EF-1 100 mph |
| 4 | Amish-Frytown, IA EF-0 85 mph | 19 | Charlotte, IA EF-2 120 mph |
| 5 | Coralville-Solon, IA EF-2 125 mph | 20 | Fulton, IA EF-1 100 mph |
| 6 | Mt. Auburn, IA EF-2 115 mph | 21 | Andrew, IA EF-0 75 mph |
| 7 | Urbana, IA EF-U | 22 | Bellevue, IA EF-1 105 mph |
| 8 | Hills, IA EF-2 120 mph | 23 | Geneseo, IL EF-2 135 mph |
| 9 | Rowley, IA EF-U | 24 | Atkinson, IL EF-2 110 mph |
| 10 | Solon-Mt. Vernon, IA EF-2 130 mph | 25 | Hoopole, IL EF-2 120 mph |
| 11 | West Branch, IA EF-0 80 mph | 26 | Kewanee, IL EF-2 120 mph |
| 12 | Tipton-Clarence, IA EF-2 120 mph | 27 | Mt. Carroll, IL EF-1 110 mph |
| 13 | Tipton, IA EF-1 100 mph | 28 | Deer Grove, IL EF-1 110 mph |
| 14 | Bennett, IA EF-2 120 mph | 29 | Lanark-Baileyville, IL EF-1 100 mph |
| 15 | Manchester, IA EF-1 110 mph | | |



U.S. Violent Tornado Climatology (EF4+)

Using a rolling 3 week average from 1950 - 2022



States with the Most Violent Tornadoes (1950-2022): 1. OK 2. TX 3. IA 4. KS 5. AL



NATIONAL WEATHER SERVICE

Honing the Mesoanalysis



Environment: Sig Tor Potential

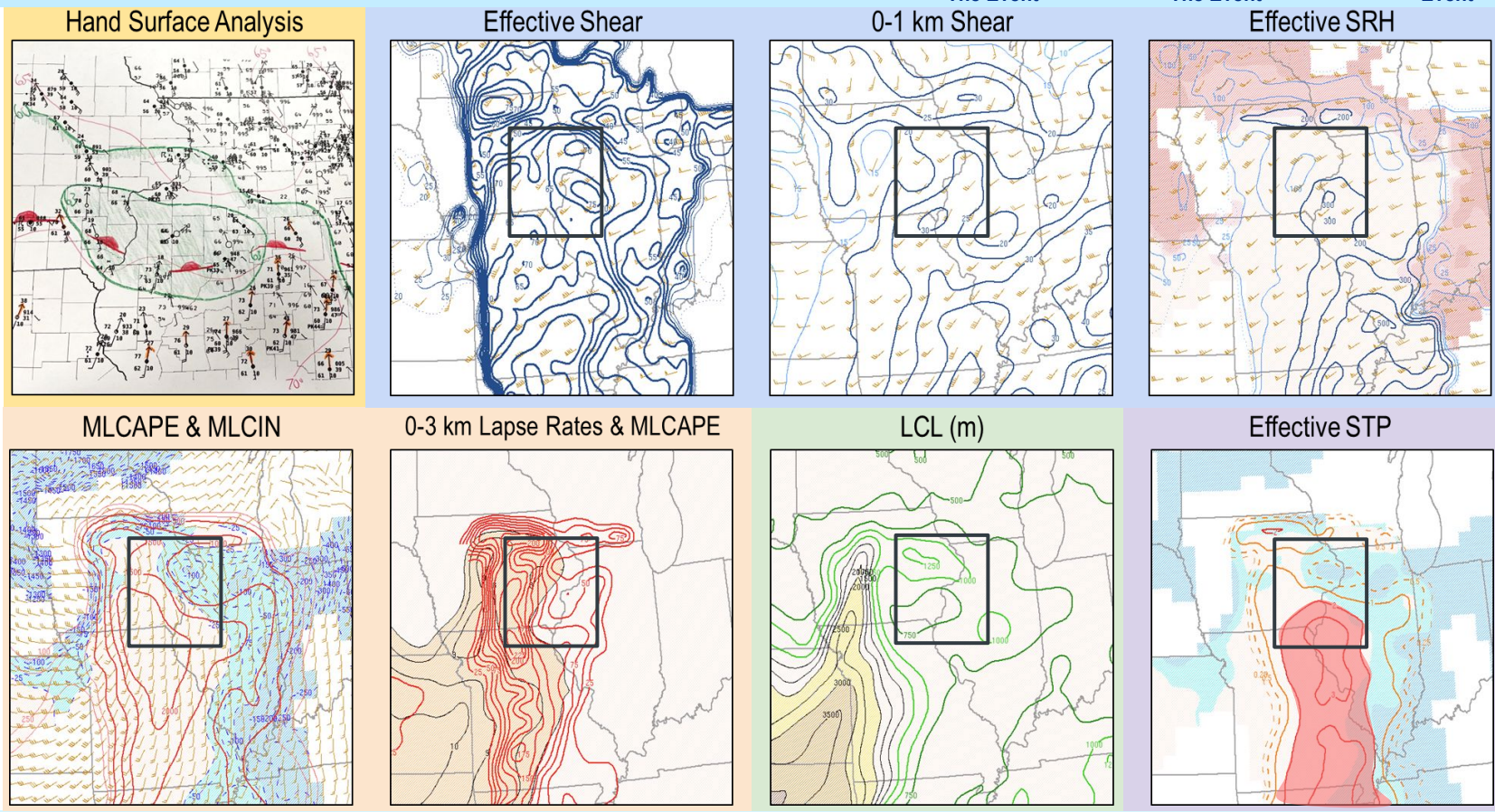
Surface

Kinematics

Instability

**LCL / Warm
RFD Proxy**

Composite



Environment: 4 PM Sfc Wx Map

Before
The Event

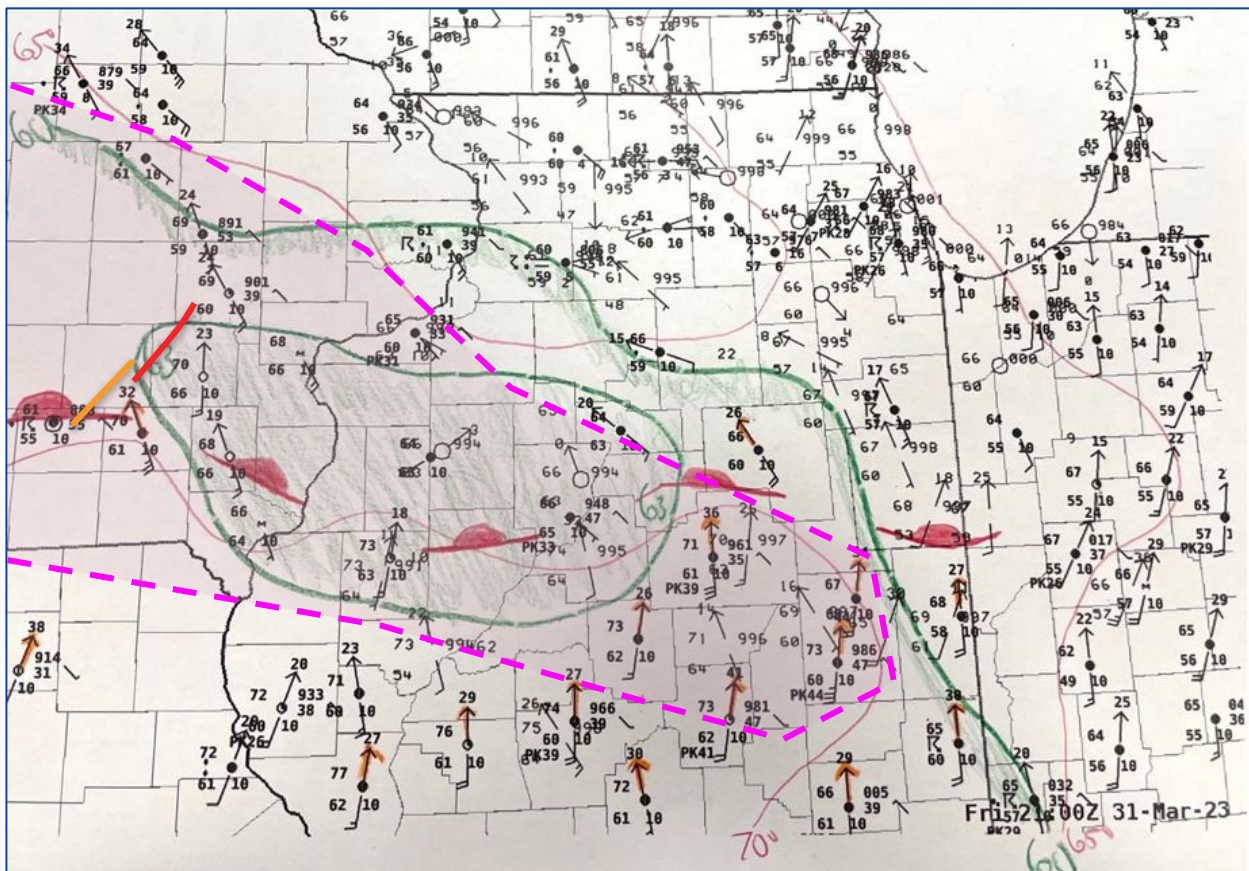
During
The Event

After The
Event

Surface Weather Keys in Tornado Environments

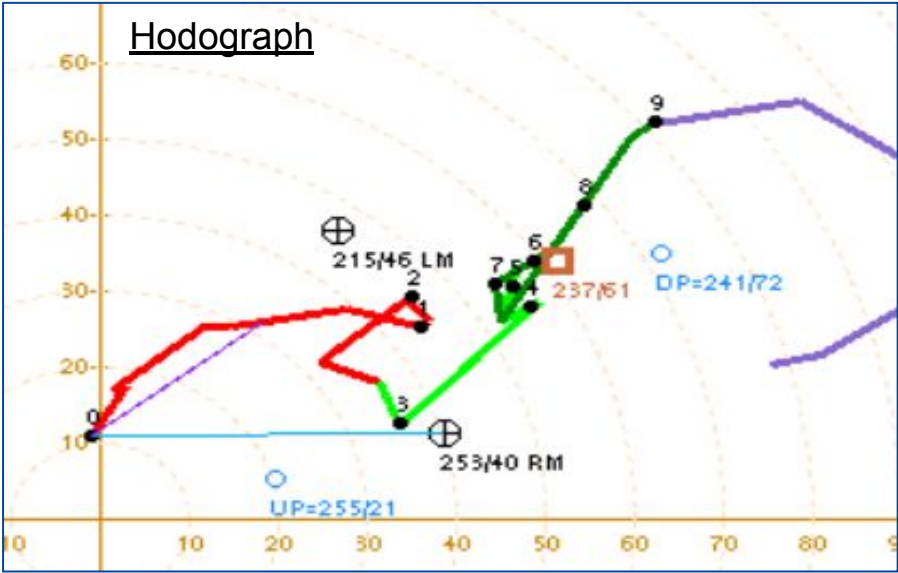
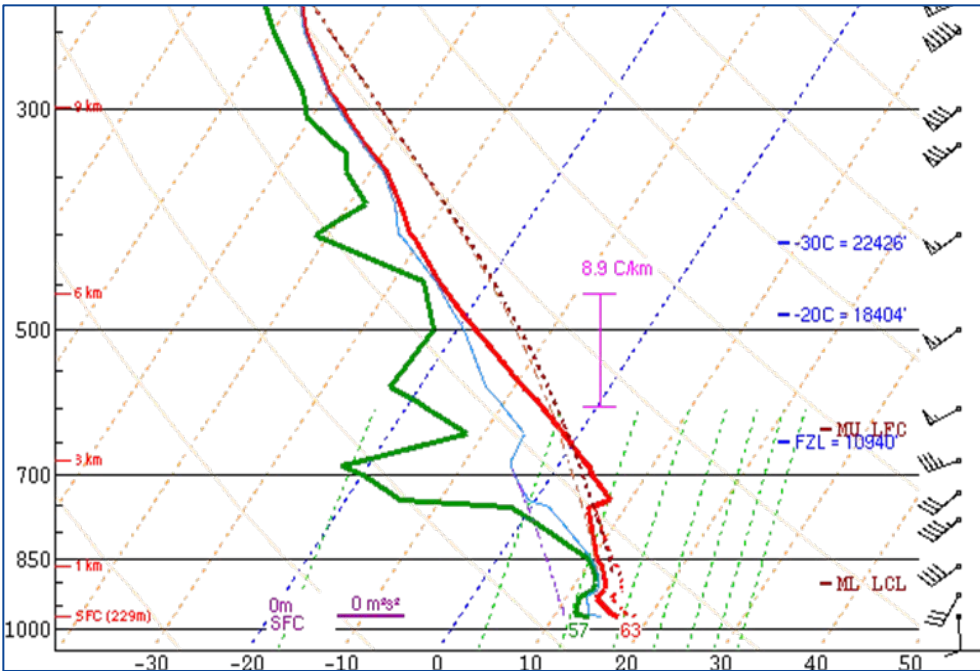
- ❑ Fronts or boundaries, in particular warm frontal-type boundaries
- ❑ Increasing moisture and warmth (theta-e)
- ❑ Sufficiently low T-Td spreads
- ❑ Backed winds from the background environment
- ❑ Gusting south or southeasterly winds advancing northward
- ❑ Pressure falls (proxy to rapid change on the mesoscale)

More favorable all of these are, the greater potential for stronger and longer duration tornadoes



NATIONAL WEATHER SERVICE

DVN Sounding: 18Z 3/31/23



- Modified mICAPE of 1500 - 2000 J/kg

- Effective bulk shear of 70 kts
- 40 kts 0-1 km shear

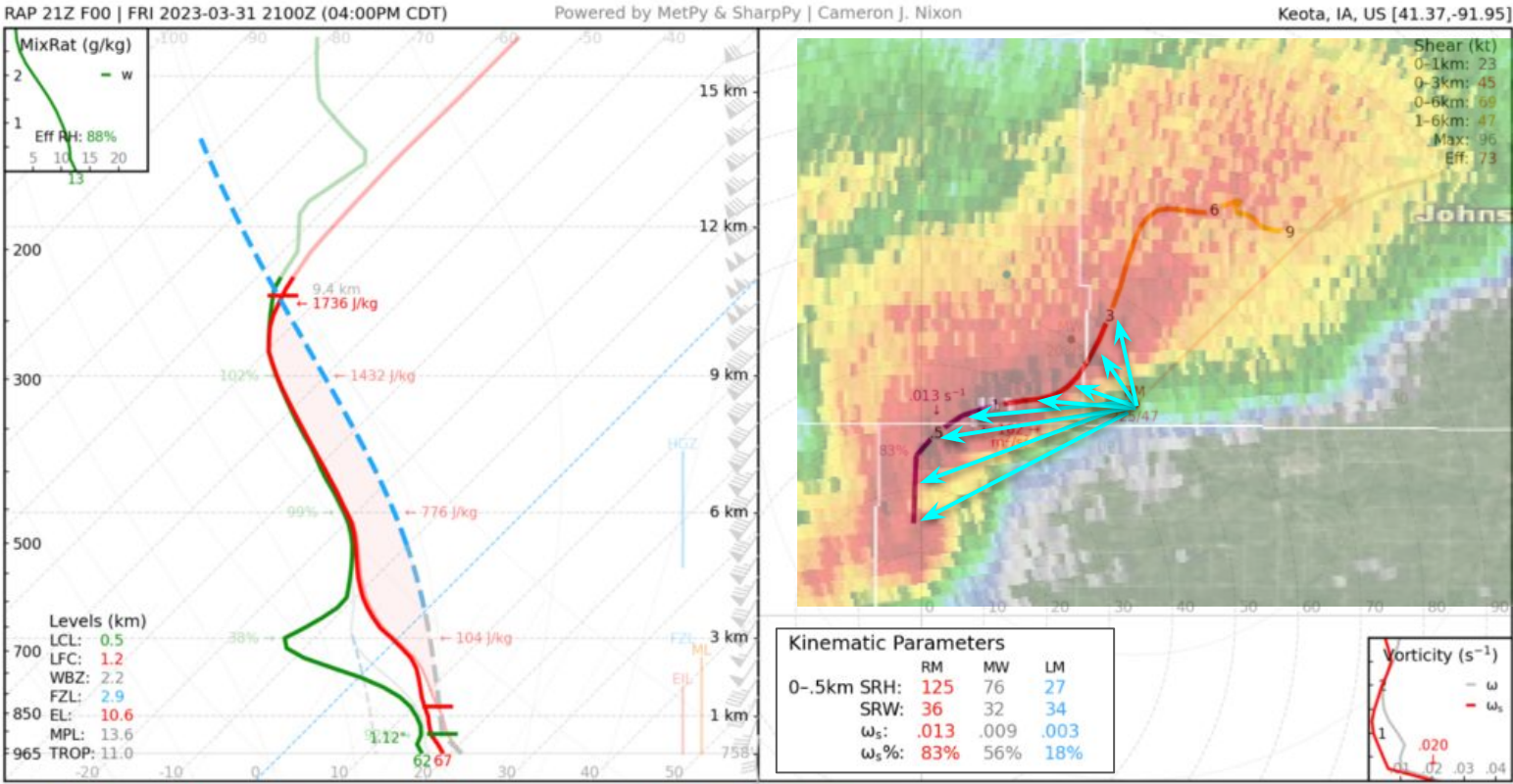


RAP Proximity Data: 21Z 3/31/23

Location: Keota, IA



Plots used
with permission by
Cameron Nixon;
ustornadoes.com

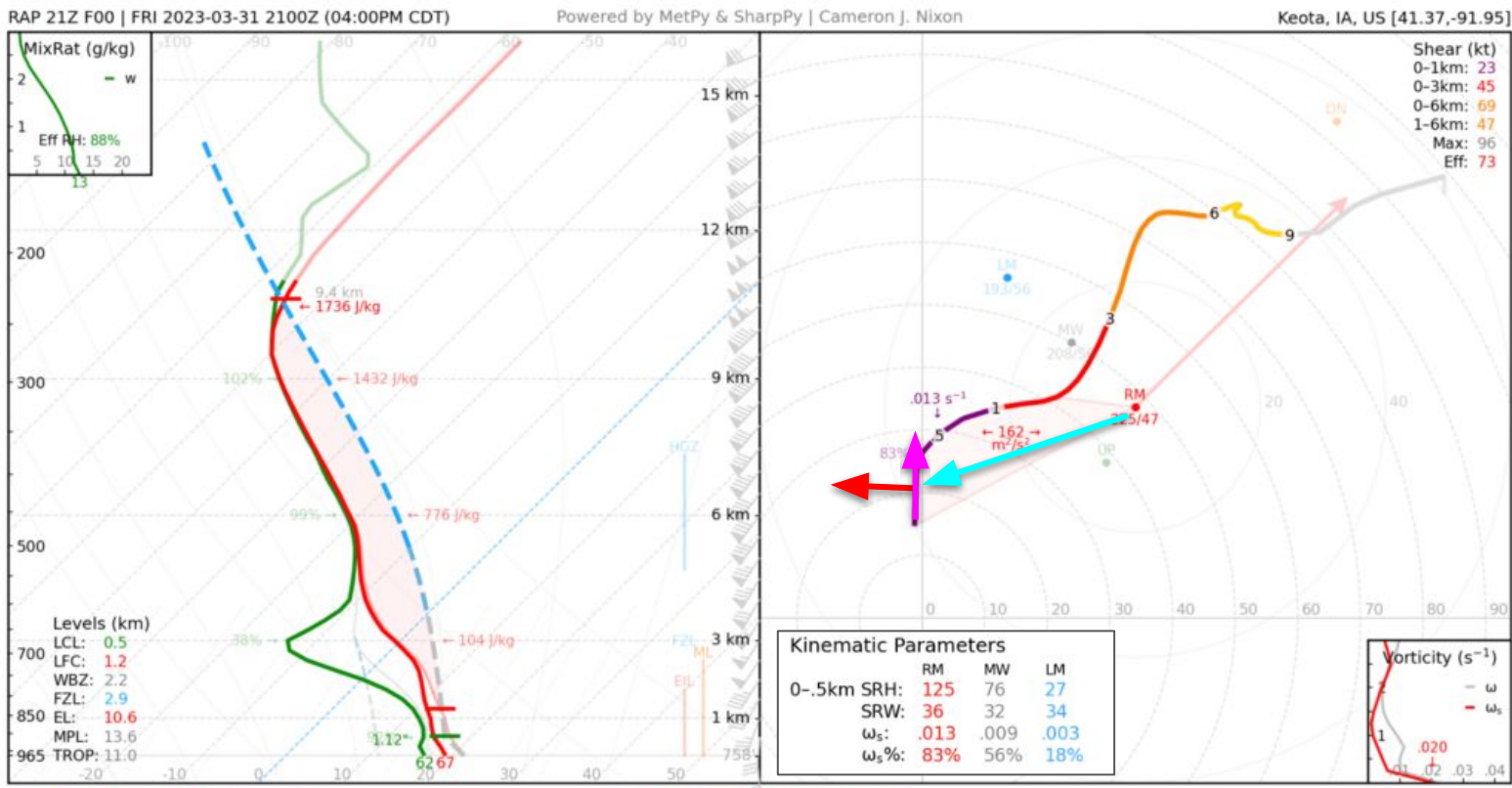


RAP Proximity Data: 21Z 3/31/23

Location: Keota, IA



Plots used
with permission by
Cameron Nixon;
ustornadoes.com



Radar Analysis

with Foundational Environment in Mind

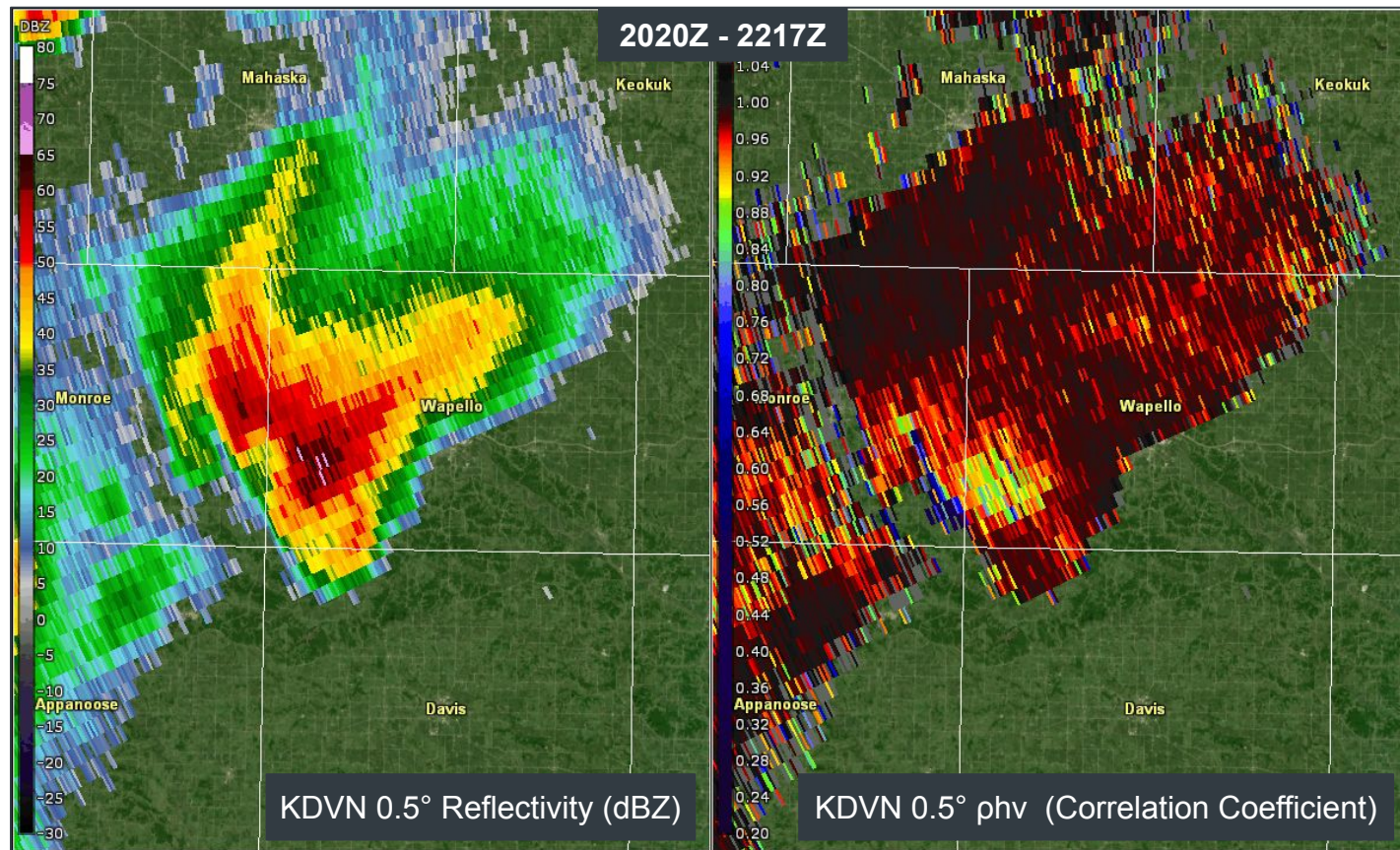


Keota, Iowa Supercell Radar Loop

Before
The Event

During
The Event

After The
Event



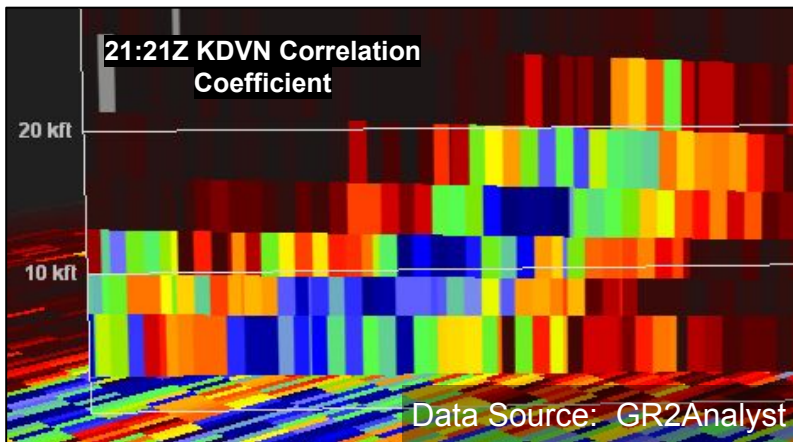
Points of Interest

- 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



NATIONAL WEATHER SERVICE

“The Supercell”



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

← EF3 tornado in
rural Keokuk County, IA;
courtesy Jared Schultz

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



Keota, Iowa EF4 Tornado

○
Before
The Event

●
During
The Event

○
After The
Event

© *Devin Pitts*

March 31, 2023

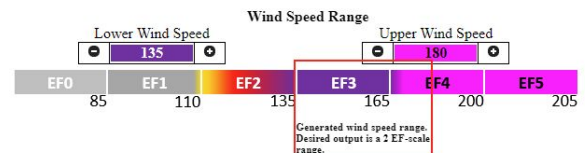
Southwest of Keota, IA



NATIONAL WEATHER SERVICE

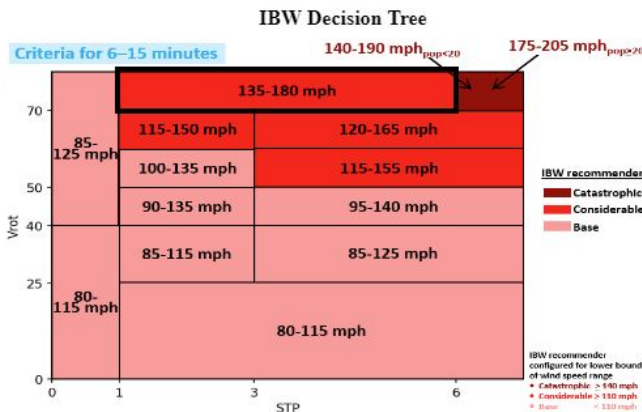
Before The Event During The Event After The Event

Wind Speed Decision Tree

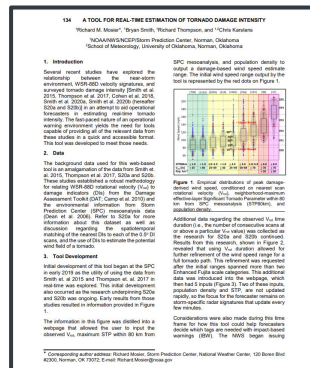


Based on recent radar and environmental data, a strong to potentially violent tornado with potential peak winds of 135 to 180 mph (EF2-EF4) is likely ongoing.

| | |
|------------------------------|--|
| IBW Recommendation: | Considerable |
| Wind Speed Range: | 135 to 180 mph |
| Potential Damage: | Widespread destruction possible; Significant damage likely |
| Typical Storm Mode: | Mature supercell |
| Typical Outlook Probability: | Greater than 10%; Possible sig area |
| Typical Watch Type: | PDS Tornado or Tornado |
| Frequency: | Strongest storm on active day |



Tool Information:
Mosier et al. (2021)
[SPC Publication](#)

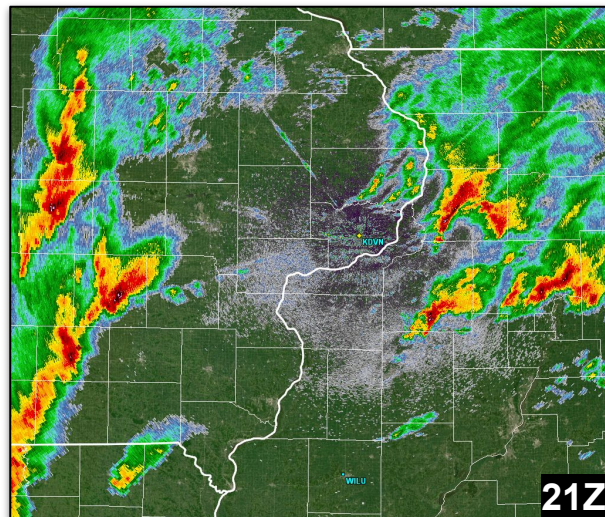


Operational Workflow

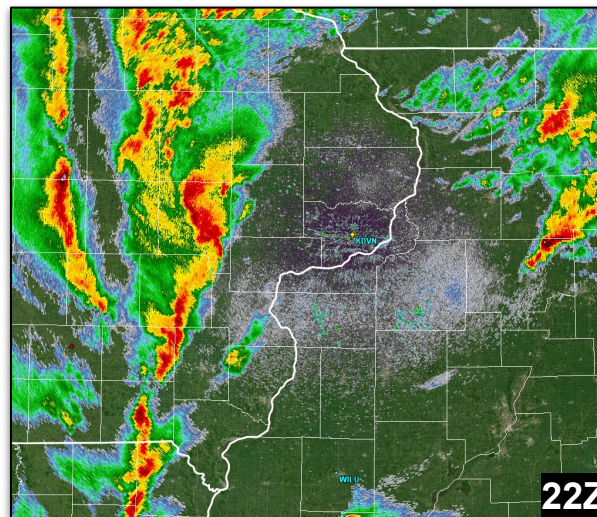


Convective Mode Morphology

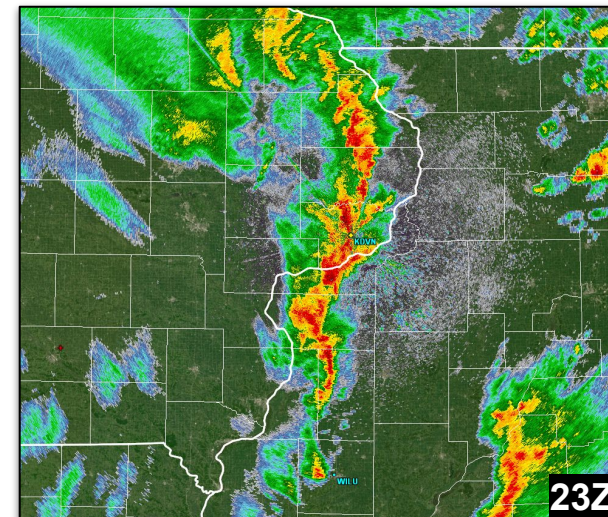
○ ————— ● ————— ○
Before The Event During The Event After The Event



- Discrete to semi-discrete supercells
- All hazards
- Greatest potential for longer duration significant tornadoes



- Supercells absorbed by line; evolving into a QLCS
- Several mesovortices along, with embedded supercell structures
- Most concurrent tornadoes

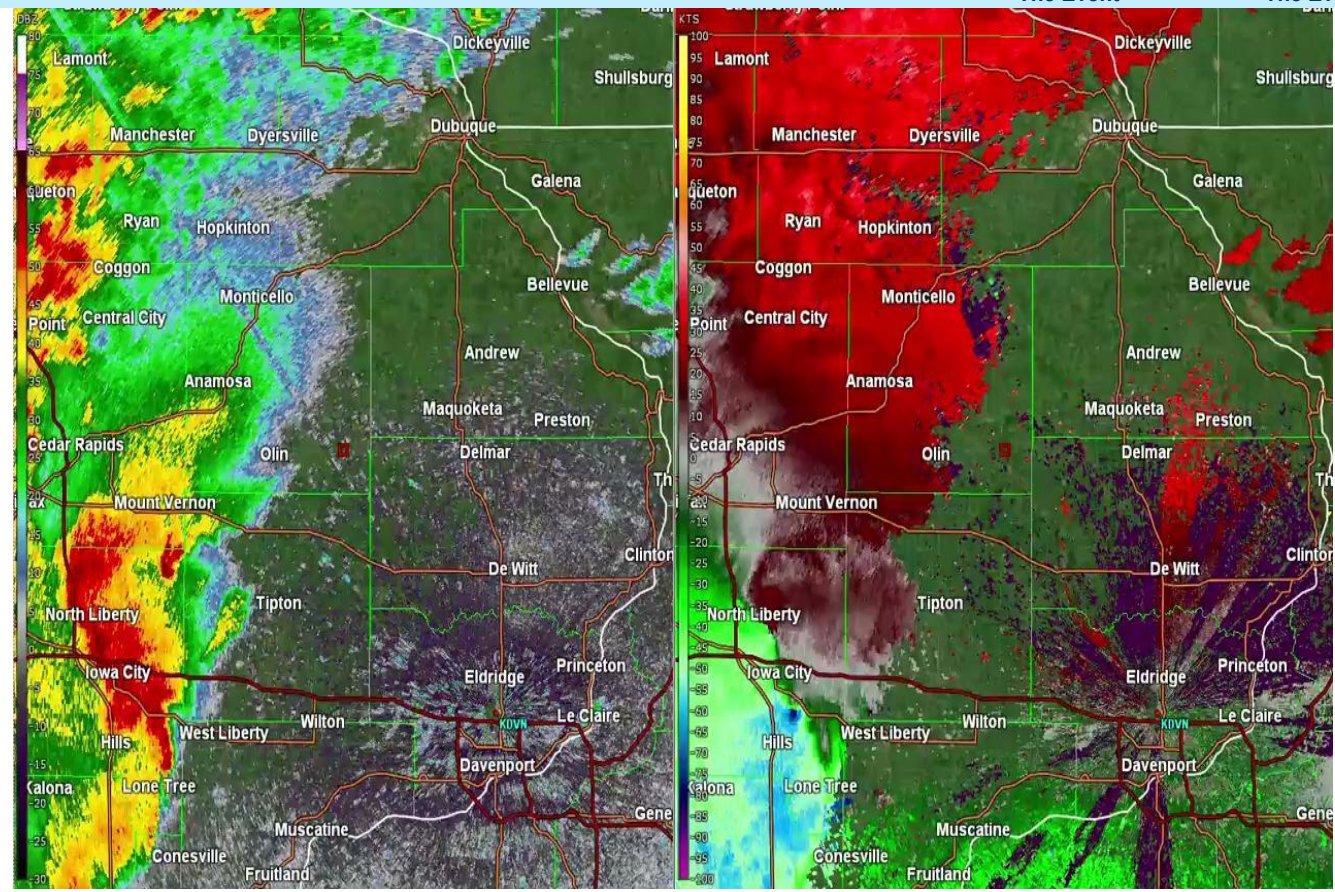


- Mature QLCS (“beast mode”), with primarily a wind and tornado threat with many mesovortices
- Significant wind and still significant tornado threat



NATIONAL WEATHER SERVICE

How Many Mesovorts Can You Count?

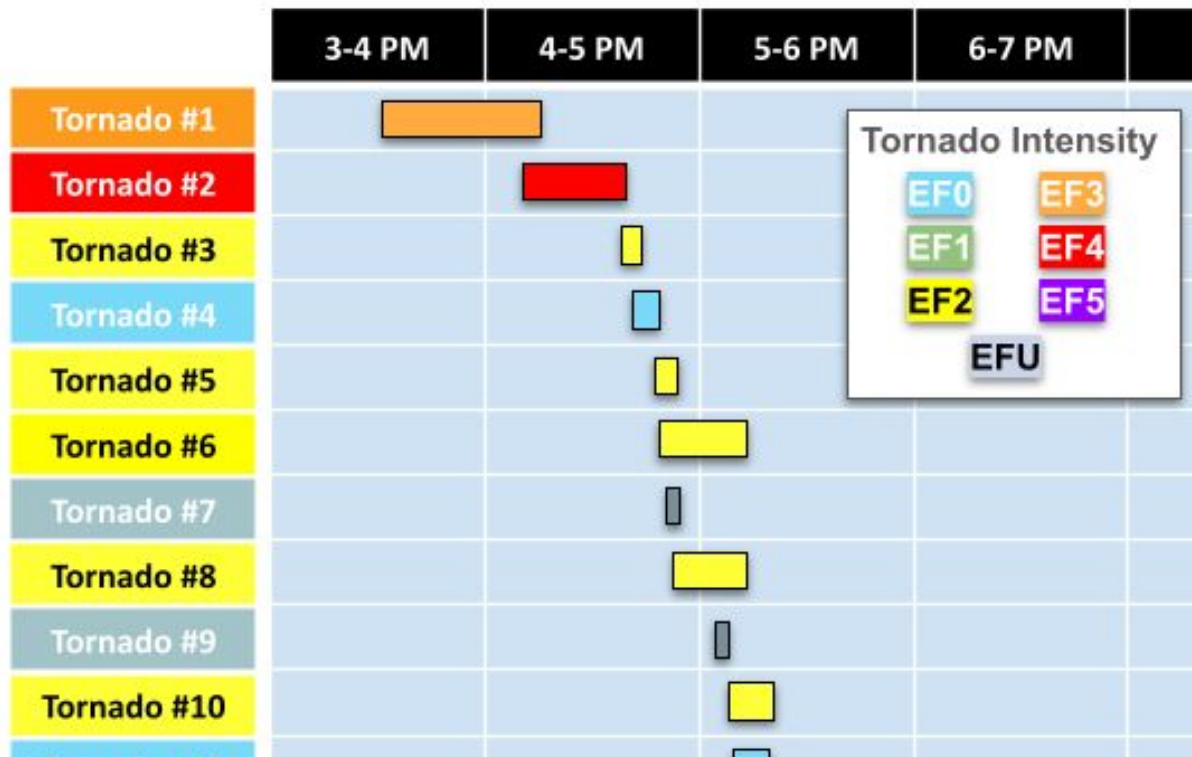


Workload: Concurrent Tornadoes



- NWS Quad Cities CWA Tornado Timeline:
 - 3:49 P.M. - 7:02 P.M.
- Out of the 3 hours & 13 mins:
 - 2 hours & 46 mins with ongoing tornado (86% of time)
 - 38 mins with 3+ concurrent tornadoes
 - 9 mins with 4 concurrent tornadoes
- 15 tornadoes (8 EF2s) between the one hour from 4:51 - 5:50 P.M. CDT

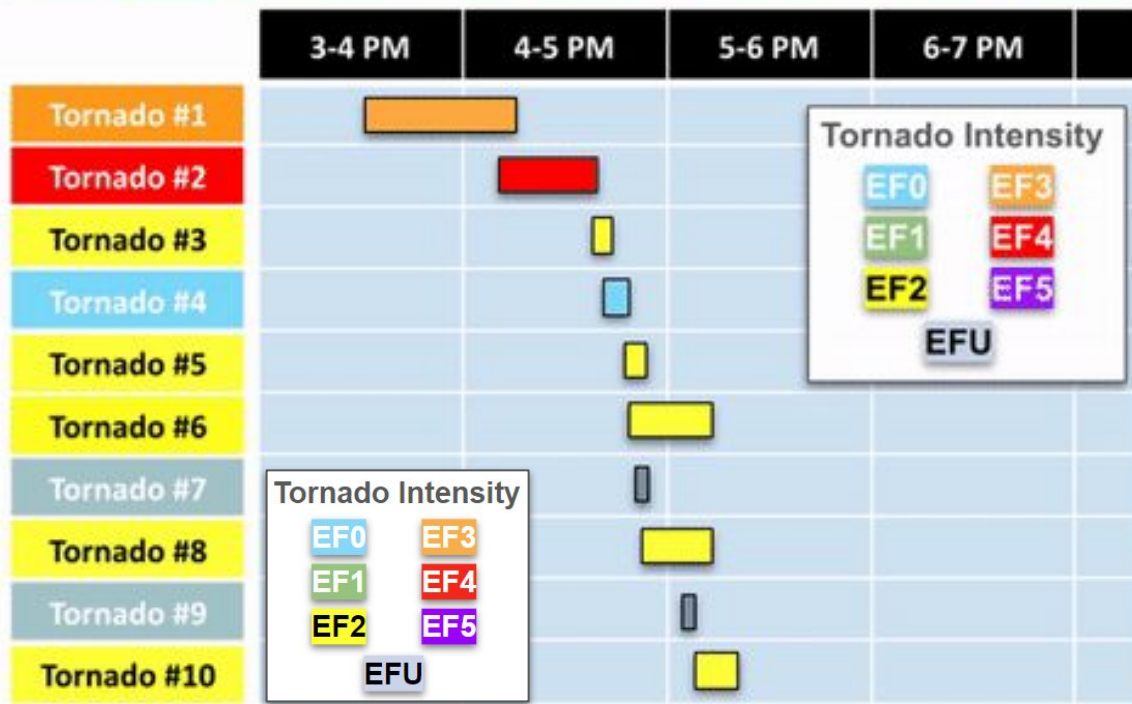
March 31 Tornado Timeline for DVN CWA



Workload: Concurrent Tornadoes

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March 31 Tornado Timeline for DVN CWA



Event Coordinator

Radar

Radar interrogation

Issuing convective warnings

Forecast

Mesoanalysis

Communicating these expectations

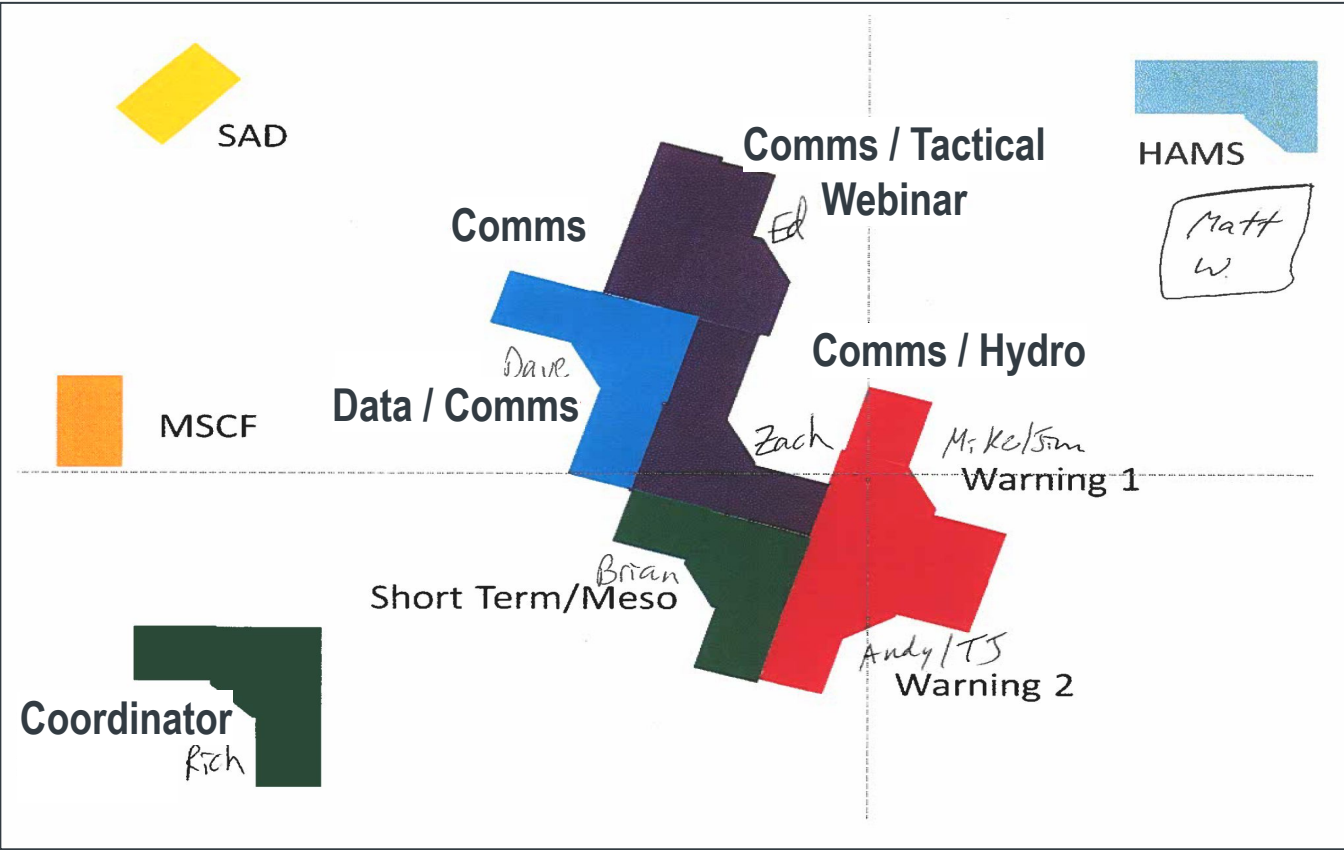
Messaging

Impact-Based
Decision Support
Services (IDSS)

Communications



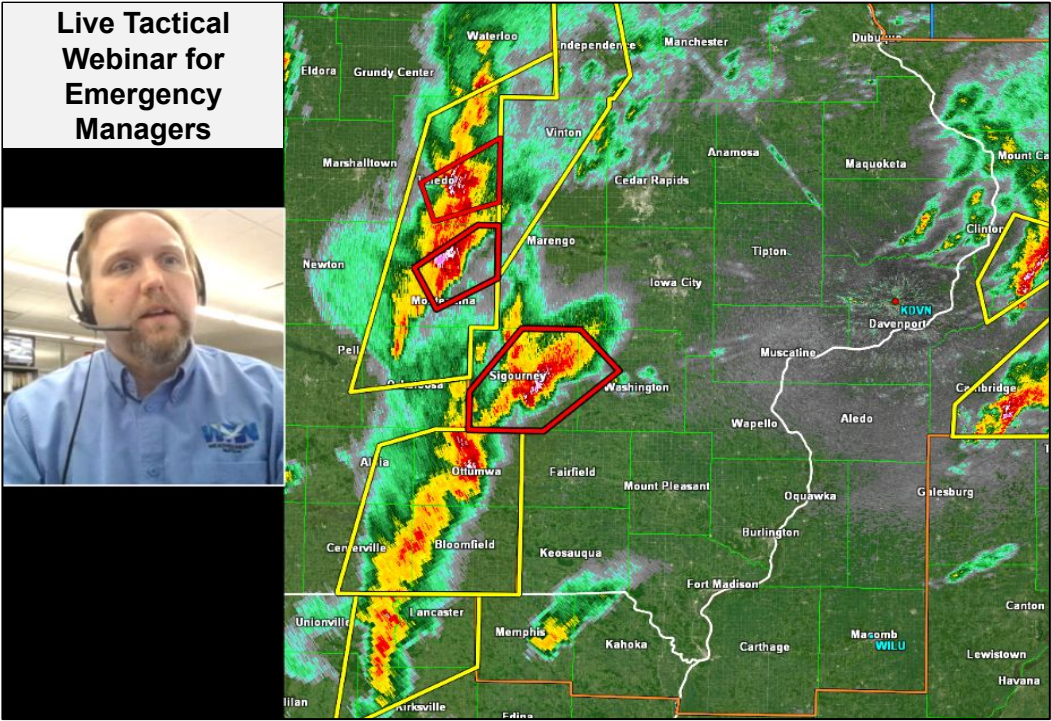
Operations Floor & Sectorization



During Event Briefings



Critical DSS by WFO Quad Cities



➔ 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!”

Mutual Aid



- Remote Mesoanalysis (RMA)
- CWA-Crossing warned convection
- Post-Event service backup
- Storm surveys
 - Satellite assistance
 - Tornadoes crossing CWAs



High Post Event Workflow

Before
The Event

During
The Event

After The
Event

- Having post event playbooks and practicing them via training is essential
- Keeping track of hundreds of reports of damage within dozens of mesovortex paths requires planned, organized methods for these higher end events, and often mutual aid in multiple formats

March 31, 2023: NWS Quad Cities Tornado Tracking Spreadsheet

| Federal Tornado Path | TEST | Damage Reported | Spotted For | Bottomed Out | Surveyed | Rating | Path Sent | LSR Sent | DAT | WEB | STORMDATA | Notes |
|---------------------------------|------|-----------------|-------------|--------------|----------|--------|-----------|----------|-----|------------------|-----------|-------|
| Other Quad | Yes | Yes | 1 | Yes | LOT | EF-1 | X by LOT | X | X | X (Tornado #1) | X-Andy | |
| Macgregor | Yes | Yes | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #2) | X-Andy | |
| Adrian to Washington Irving Tor | Yes | Yes | Yes | Yes | X | EF-1 | X | X | X | X (Tornado #3) | X-Andy | |
| Carleton to Dorcas | Yes | Yes | Yes | Yes | X | EF-1 | X | X | X | X (Tornado #4) | X-Andy | |
| Scott #1 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #5) | X-Andy | |
| Scott #2 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #6) | X-Andy | |
| Scott #3 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #7) | X-Andy | |
| Scott #4 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #8) | X-Andy | |
| Scott #5 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #9) | X-Andy | |
| Scott #6 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #10) | X-Andy | |
| Scott #7 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #11) | X-Andy | |
| Scott #8 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #12) | X-Andy | |
| Scott #9 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #13) | X-Andy | |
| Scott #10 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #14) | X-Andy | |
| Scott #11 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #15) | X-Andy | |
| Scott #12 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #16) | X-Andy | |
| Scott #13 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #17) | X-Andy | |
| Scott #14 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #18) | X-Andy | |
| Scott #15 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #19) | X-Andy | |
| Scott #16 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #20) | X-Andy | |
| Scott #17 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #21) | X-Andy | |
| Scott #18 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #22) | X-Andy | |
| Scott #19 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #23) | X-Andy | |
| Scott #20 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #24) | X-Andy | |
| Scott #21 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #25) | X-Andy | |
| Scott #22 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #26) | X-Andy | |
| Scott #23 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #27) | X-Andy | |
| Scott #24 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #28) | X-Andy | |
| Scott #25 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #29) | X-Andy | |
| Scott #26 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #30) | X-Andy | |
| Scott #27 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #31) | X-Andy | |
| Scott #28 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #32) | X-Andy | |
| Scott #29 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #33) | X-Andy | |
| Scott #30 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #34) | X-Andy | |
| Scott #31 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #35) | X-Andy | |
| Scott #32 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #36) | X-Andy | |
| Scott #33 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #37) | X-Andy | |
| Scott #34 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #38) | X-Andy | |
| Scott #35 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #39) | X-Andy | |
| Scott #36 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #40) | X-Andy | |
| Scott #37 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #41) | X-Andy | |
| Scott #38 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #42) | X-Andy | |
| Scott #39 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #43) | X-Andy | |
| Scott #40 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #44) | X-Andy | |
| Scott #41 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #45) | X-Andy | |
| Scott #42 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #46) | X-Andy | |
| Scott #43 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #47) | X-Andy | |
| Scott #44 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #48) | X-Andy | |
| Scott #45 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #49) | X-Andy | |
| Scott #46 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #50) | X-Andy | |
| Scott #47 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #51) | X-Andy | |
| Scott #48 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #52) | X-Andy | |
| Scott #49 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #53) | X-Andy | |
| Scott #50 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #54) | X-Andy | |
| Scott #51 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #55) | X-Andy | |
| Scott #52 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #56) | X-Andy | |
| Scott #53 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #57) | X-Andy | |
| Scott #54 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #58) | X-Andy | |
| Scott #55 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #59) | X-Andy | |
| Scott #56 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #60) | X-Andy | |
| Scott #57 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #61) | X-Andy | |
| Scott #58 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #62) | X-Andy | |
| Scott #59 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #63) | X-Andy | |
| Scott #60 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #64) | X-Andy | |
| Scott #61 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #65) | X-Andy | |
| Scott #62 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #66) | X-Andy | |
| Scott #63 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #67) | X-Andy | |
| Scott #64 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #68) | X-Andy | |
| Scott #65 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #69) | X-Andy | |
| Scott #66 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #70) | X-Andy | |
| Scott #67 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #71) | X-Andy | |
| Scott #68 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #72) | X-Andy | |
| Scott #69 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #73) | X-Andy | |
| Scott #70 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #74) | X-Andy | |
| Scott #71 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #75) | X-Andy | |
| Scott #72 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #76) | X-Andy | |
| Scott #73 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #77) | X-Andy | |
| Scott #74 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #78) | X-Andy | |
| Scott #75 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #79) | X-Andy | |
| Scott #76 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #80) | X-Andy | |
| Scott #77 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #81) | X-Andy | |
| Scott #78 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #82) | X-Andy | |
| Scott #79 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #83) | X-Andy | |
| Scott #80 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #84) | X-Andy | |
| Scott #81 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #85) | X-Andy | |
| Scott #82 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #86) | X-Andy | |
| Scott #83 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #87) | X-Andy | |
| Scott #84 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #88) | X-Andy | |
| Scott #85 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #89) | X-Andy | |
| Scott #86 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #90) | X-Andy | |
| Scott #87 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #91) | X-Andy | |
| Scott #88 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #92) | X-Andy | |
| Scott #89 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #93) | X-Andy | |
| Scott #90 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #94) | X-Andy | |
| Scott #91 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #95) | X-Andy | |
| Scott #92 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #96) | X-Andy | |
| Scott #93 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #97) | X-Andy | |
| Scott #94 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #98) | X-Andy | |
| Scott #95 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #99) | X-Andy | |
| Scott #96 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #100) | X-Andy | |
| Scott #97 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #101) | X-Andy | |
| Scott #98 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #102) | X-Andy | |
| Scott #99 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #103) | X-Andy | |
| Scott #100 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #104) | X-Andy | |
| Scott #101 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #105) | X-Andy | |
| Scott #102 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #106) | X-Andy | |
| Scott #103 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #107) | X-Andy | |
| Scott #104 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #108) | X-Andy | |
| Scott #105 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #109) | X-Andy | |
| Scott #106 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #110) | X-Andy | |
| Scott #107 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #111) | X-Andy | |
| Scott #108 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #112) | X-Andy | |
| Scott #109 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #113) | X-Andy | |
| Scott #110 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #114) | X-Andy | |
| Scott #111 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #115) | X-Andy | |
| Scott #112 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #116) | X-Andy | |
| Scott #113 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #117) | X-Andy | |
| Scott #114 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #118) | X-Andy | |
| Scott #115 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #119) | X-Andy | |
| Scott #116 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #120) | X-Andy | |
| Scott #117 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #121) | X-Andy | |
| Scott #118 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #122) | X-Andy | |
| Scott #119 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #123) | X-Andy | |
| Scott #120 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #124) | X-Andy | |
| Scott #121 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #125) | X-Andy | |
| Scott #122 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #126) | X-Andy | |
| Scott #123 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #127) | X-Andy | |
| Scott #124 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #128) | X-Andy | |
| Scott #125 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #129) | X-Andy | |
| Scott #126 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #130) | X-Andy | |
| Scott #127 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #131) | X-Andy | |
| Scott #128 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #132) | X-Andy | |
| Scott #129 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #133) | X-Andy | |
| Scott #130 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #134) | X-Andy | |
| Scott #131 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #135) | X-Andy | |
| Scott #132 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #136) | X-Andy | |
| Scott #133 | Yes | 1 | 1 | Yes | X | EF-1 | X | X | X | X (Tornado #137) | X-Andy | |

Summary & Lessons Learned



- Exceptional national level forecasts were honed to the local scale with **pattern recognition adding confidence** to what was messaged and how strongly it was messaged
- Evaluating the environment is equally as important as interrogating storms on radar, as it **serves the foundation for how we expect storms to evolve**
- 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**
- **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!

Questions?

NWS DMX Event Webpage



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NWS DVN Event Webpage



*Also look for the NWS Quad Cities
Story Map for the 1-year anniversary of
this event to be shared his weekend*



NATIONAL WEATHER SERVICE