

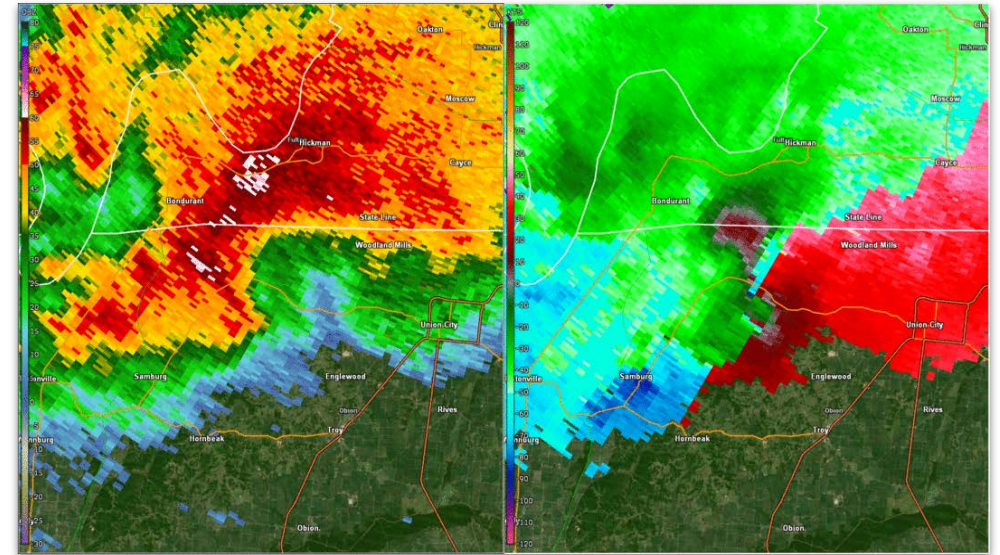
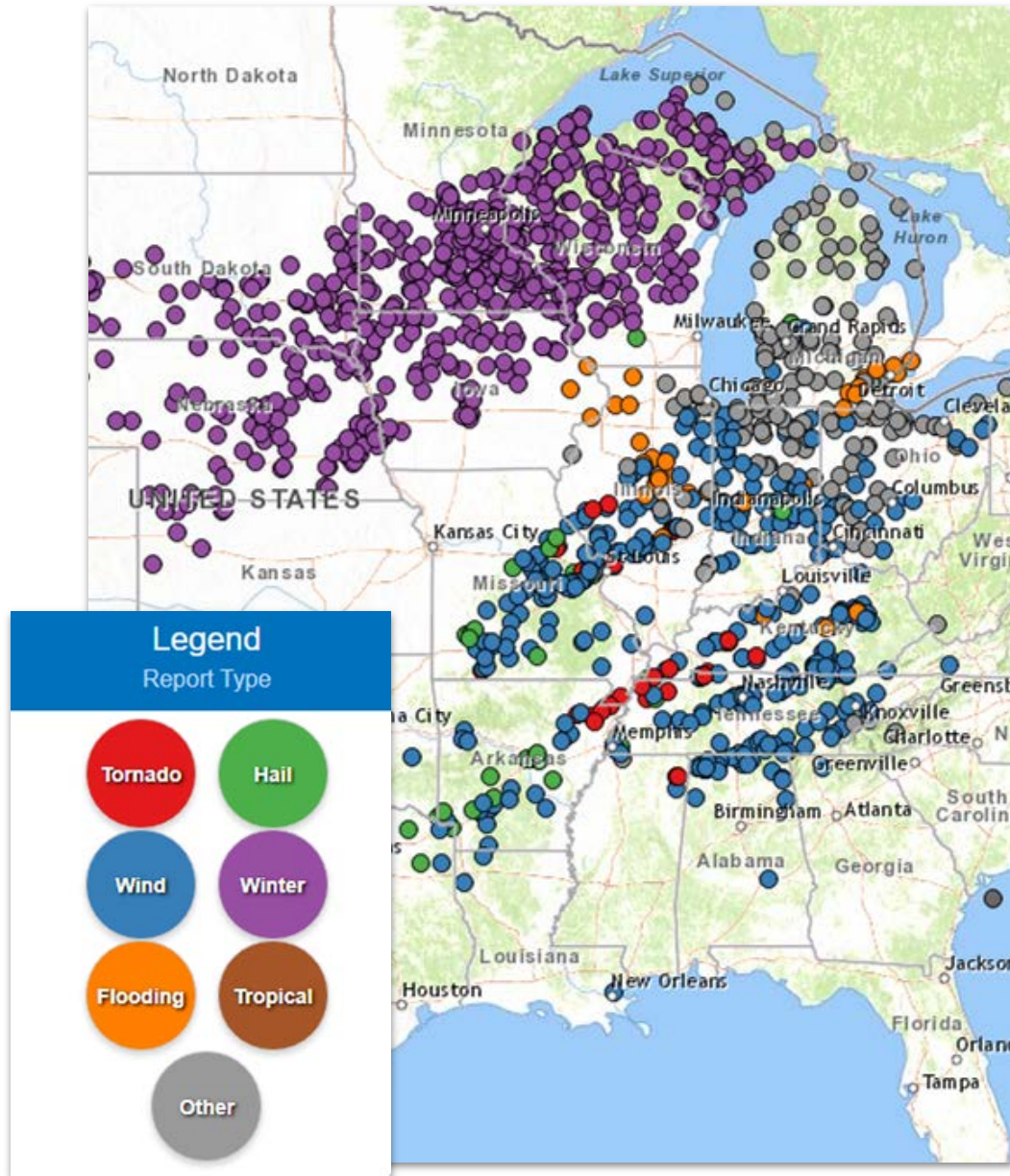
Decision Support Messaging of Rare Weather/Climate Events: A Retrospective of the December 15-16, 2021 Record Warmth & Severe Weather in the Midwest



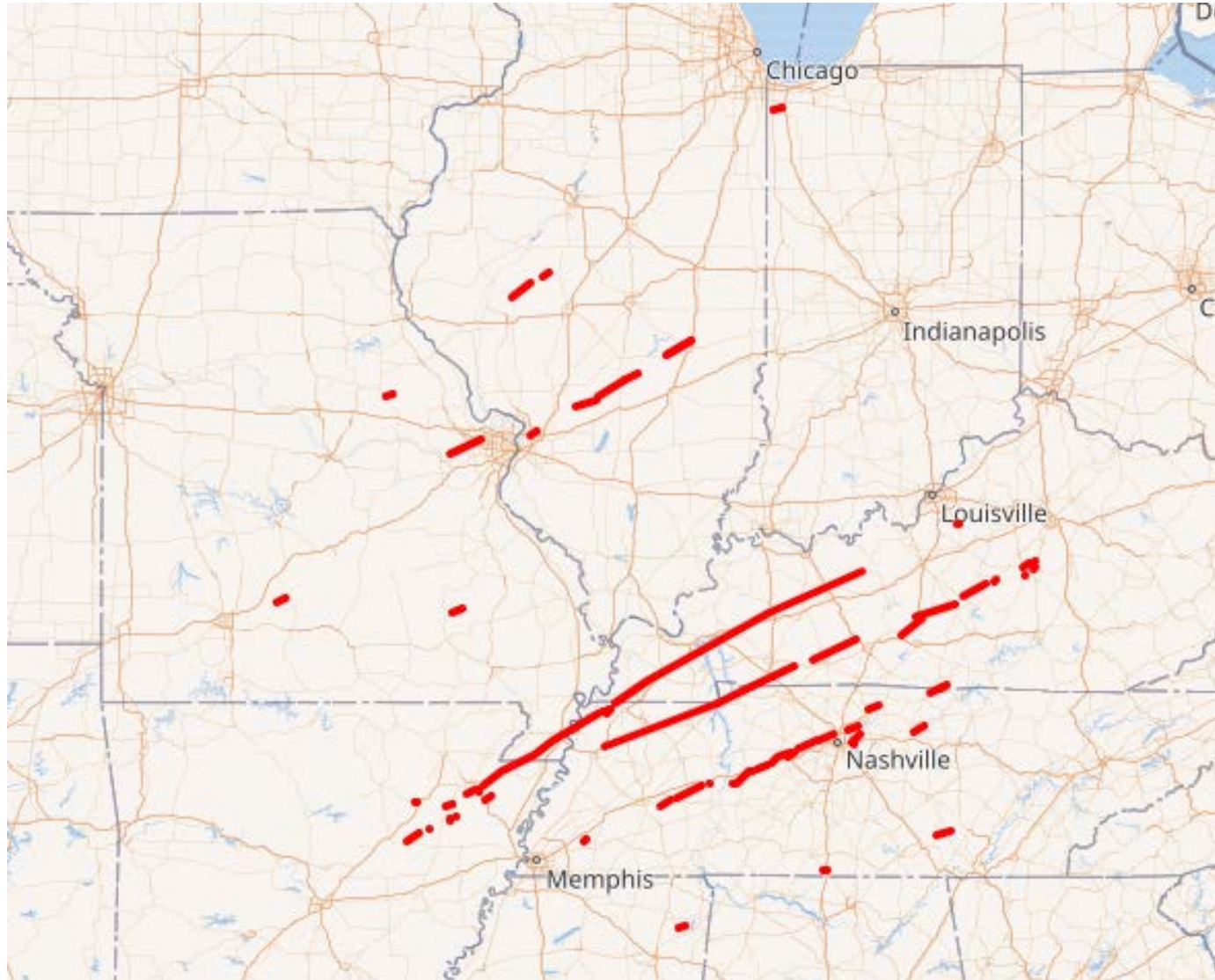
19th Annual Climate Prediction Applications Science Workshop (CPASW)
May 24-26, 2022
East Lansing, Michigan



Dec 10-11, 2021 Severe Weather



Dec 10-11, 2021 Tornadoes



149 Tornado Warnings Issued

71 confirmed tornadoes in just over 24 hours (24 hours 11 minutes)

Confirmed tornadoes by Enhanced Fujita rating

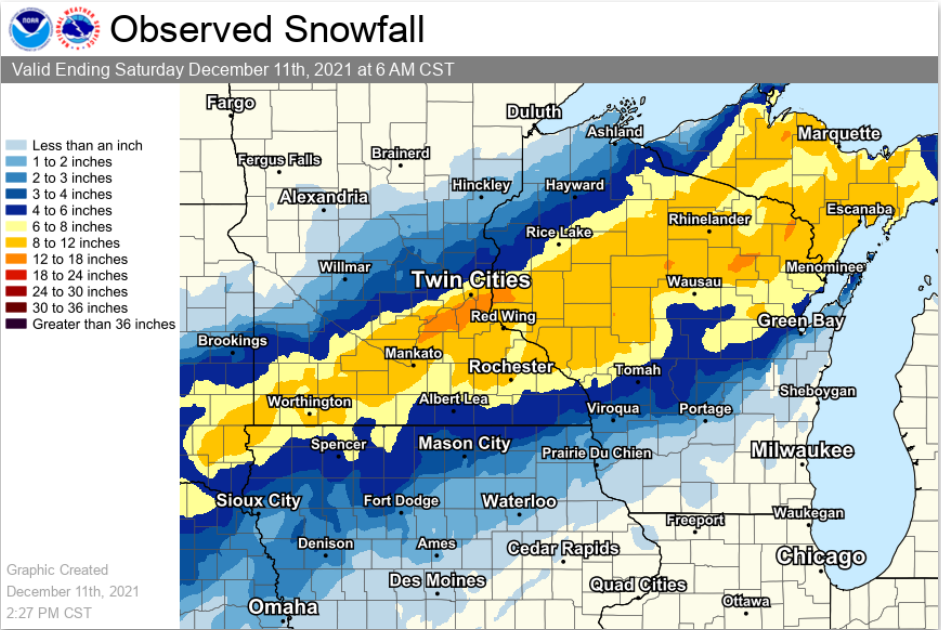
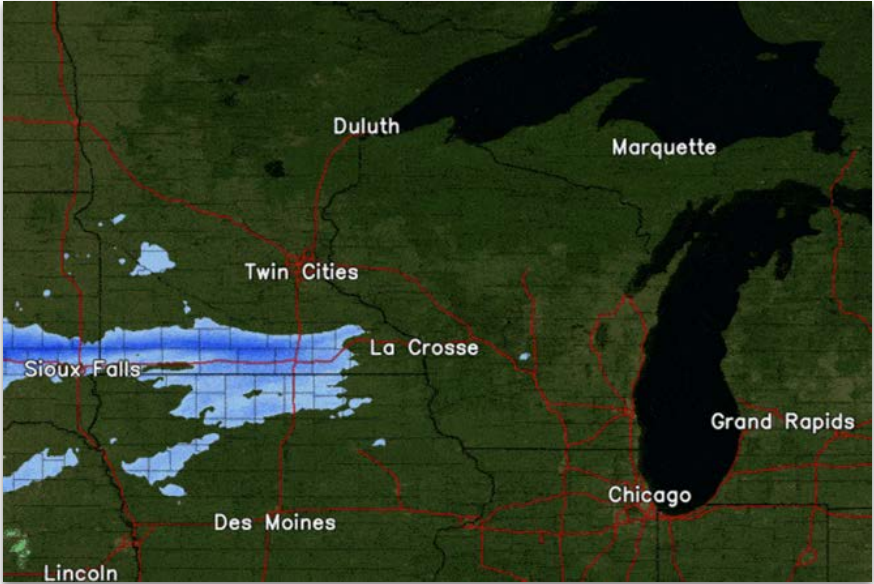
EFU	EF0	EF1	EF2	EF3	EF4	EF5	Total
1	17	30	15	6	2	0	71

As of this date, the outbreak set a new record for confirmed tornadoes in the month of December.

89 confirmed tornadic fatalities (+6 non-tornadic) & 672 injuries

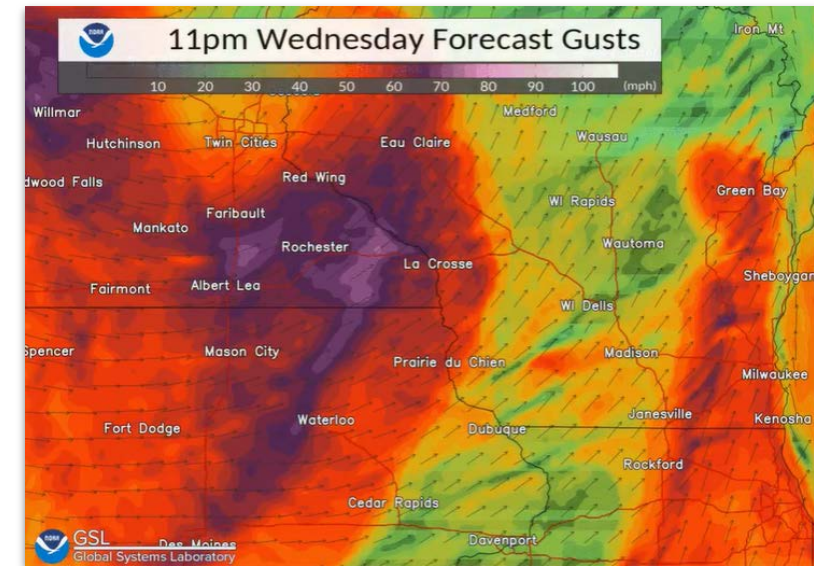
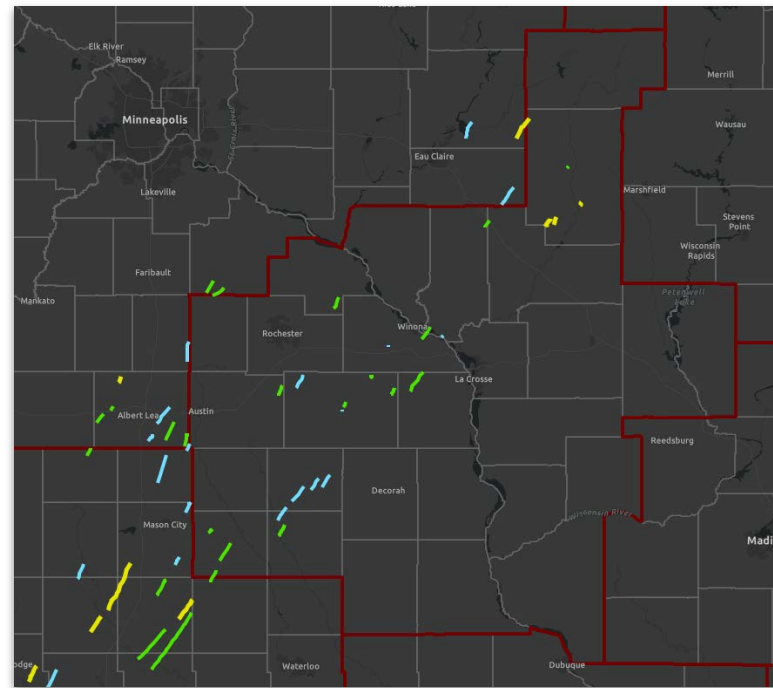
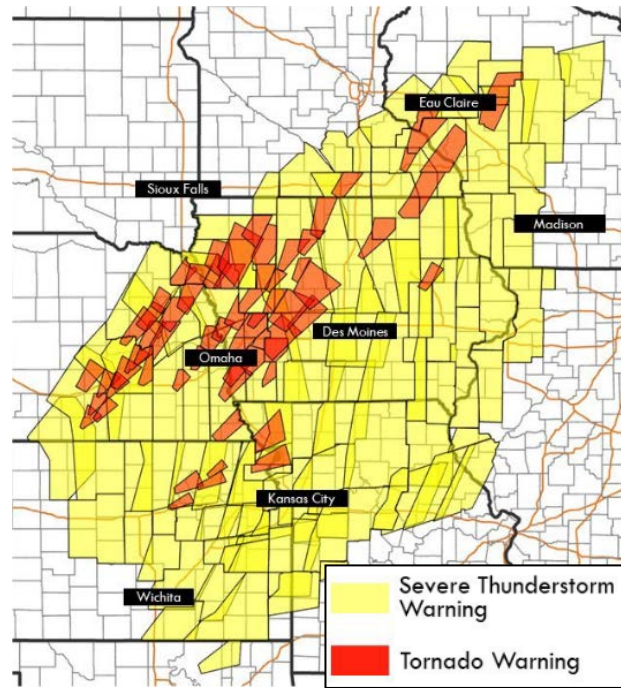
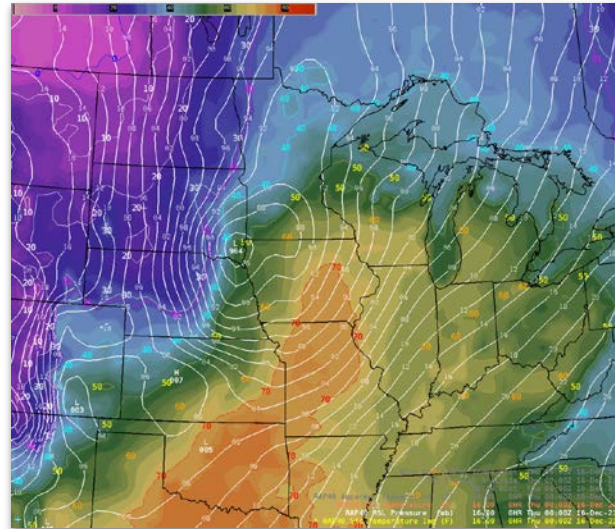
\$3.9 billion (2021 USD)

Dec 10-11, 2021 Snowstorm



This system produced a very narrow band of intense snow from south of the Twin Cities into northwest Wisconsin where amounts ranged from 15 to locally 21 inches!

Everything, but the Kitchen Sink



Multifaceted System: High Winds



High Wind Watches are Rare in Our Area

The High Wind Watch for Wednesday Afternoon & Night is only the 4th issued by NWS La Crosse since 2005.

For every High Wind Watch issued by NWS La Crosse, WI, we have issued 26 Wind Advisories.

High Wind Watch is issued for the potential of:

- Sustained winds of ≥ 40 mph
- Gusts of 58 mph or greater
- 4 issued since 2005

High Wind Warning is issued for Sustained winds of ≥ 40 mph

- Gusts of 58 mph or greater
- 10 issued since 2005

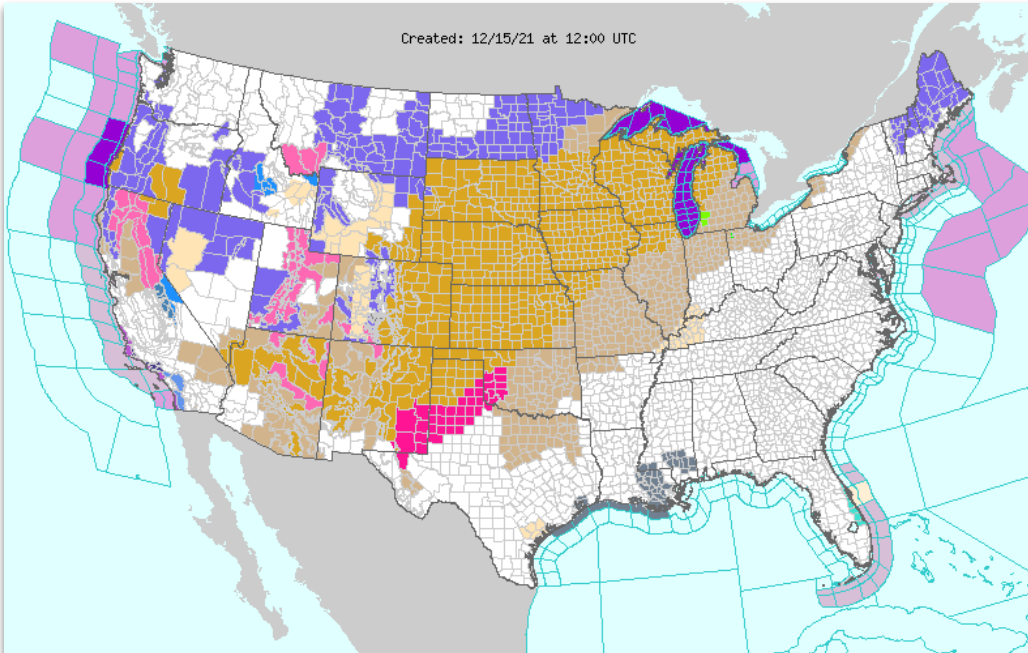
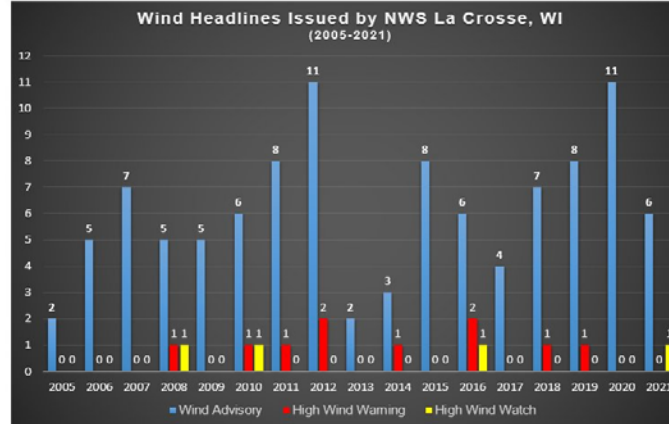
Wind Advisory is issued for

- Sustained wind of ≥ 30 mph
- Gusts of 45 mph or greater
- 104 issued since 2005

Note: These are non-thunderstorm winds.



NWS LA CROSSE



12HR Peak Winds (mph)

Rochester International Airport

Olmsted 1298ft

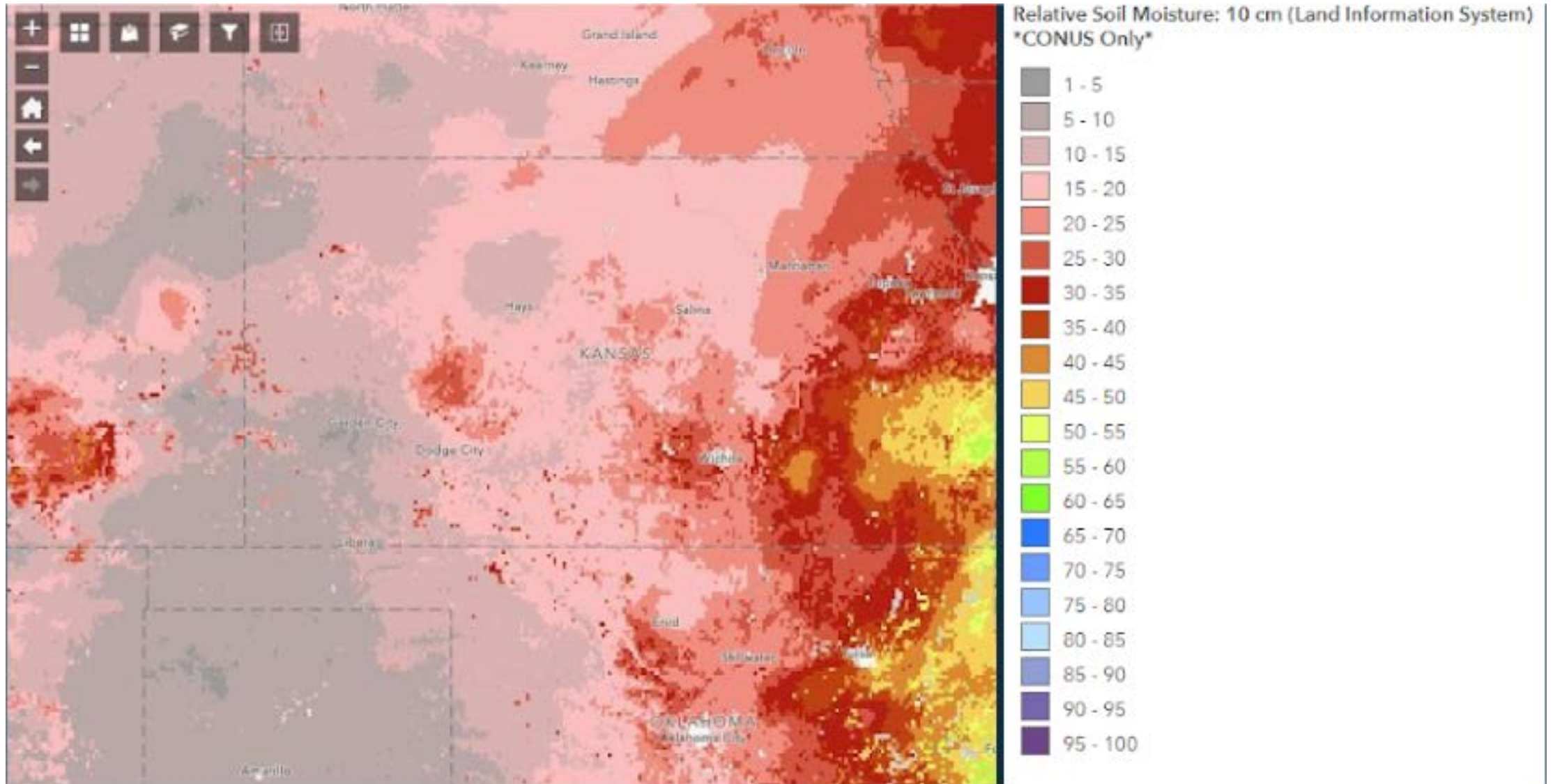
77

Jct CR 7 I-90 Mile Post 226	74	1 ENE Dexter	73
2 E Kasson	72	Viroqua Municipal Airport	69
Platteville Municipal Airport	68	La Crosse Regional Airport	68
3 N Stewartville	65	Trempealeau	65
2 N Ionia	63	1 SSE Kellogg	63
Charles City Airport	61	Mayo Helipad	61
Oelwein Municipal Airport	60	Preston Airport	60
Lake City	60	5 NW Frankville	58
Dodge Center Airport	58	Boscobel Airport	58
Austin Municipal Airport	58	Mauston Airport	58
Lancaster	57	Wabasha	57
Rochester	57	Sparta/Fort McCoy Airport	56
Lancaster	55	Onalaska	55
Necedah	53	Medford Airport	53
Decorah Municipal Airport	51	Gilman	51

valid as of Thu Dec 16th 04:54 am - NWS La Crosse

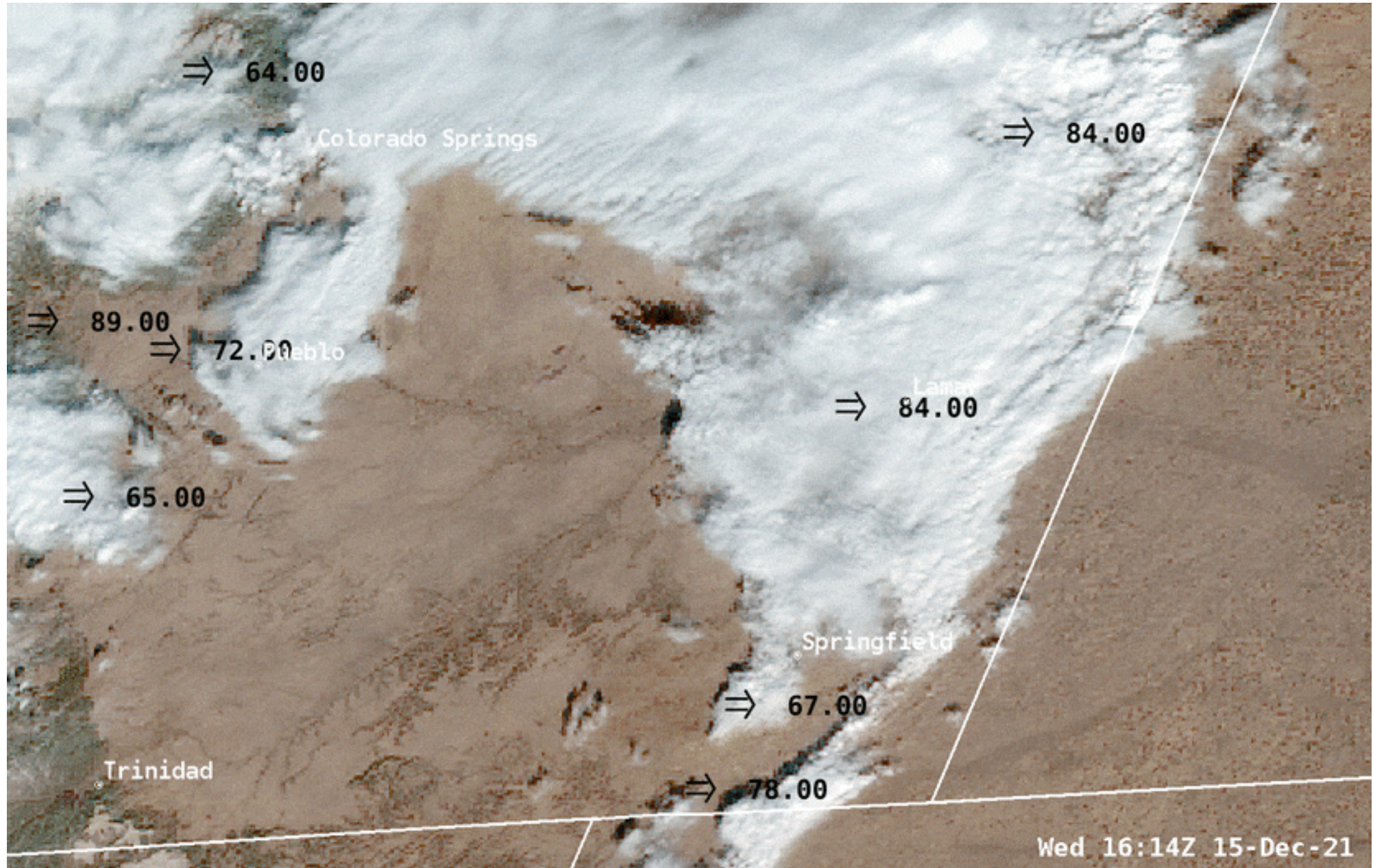
- 2nd highest gusts on record at RST and LSE
- RST hit 77 mph twice (storms & high winds)

Very Dry across Western US (December 10)



4" Soil Moisture from Dec 14 - saved off from NASA's [Land Information System](#)

Multifaceted System: Blowing Dust



Multifaceted System: Blowing Dust



Damaging West Winds Increasing Next 2-3 hours. Gusts up to 90 mph



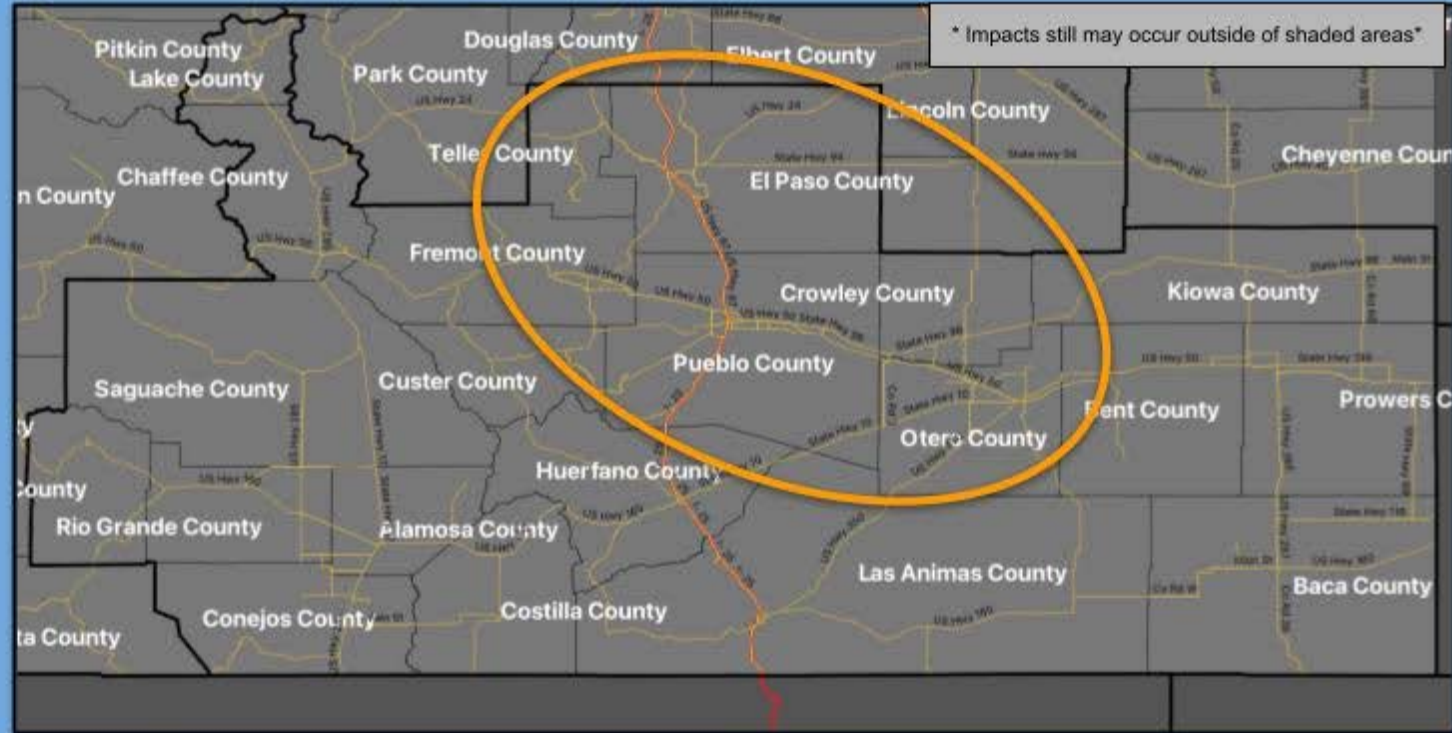
What:

- Strong West Winds gusting to **90 mph**
- Blowing dust with visibility of a quarter mile or less

Where (highest confidence):

- North I-25 and Plains

High profile vehicles on I-25 should use extreme caution!



**NATIONAL WEATHER SERVICE
PUEBLO, COLORADO**
Issued: Dec 15, 2021 at 9:20AM

Winds will continue to increase this afternoon. Secure loose objects and travel with caution.

Multifaceted System: Blowing Dust



US National Weather Service La
Crosse Wisconsin

Published by John Halbach ·
December 16, 2021 ·

Who else has smelled smoke or noticed a coating of dust on things outside? Smoke from wildfires and a dust storm over Kansas/eastern Colorado earlier Wednesday managed to make it all the way up into our neck of the woods! Incredible.



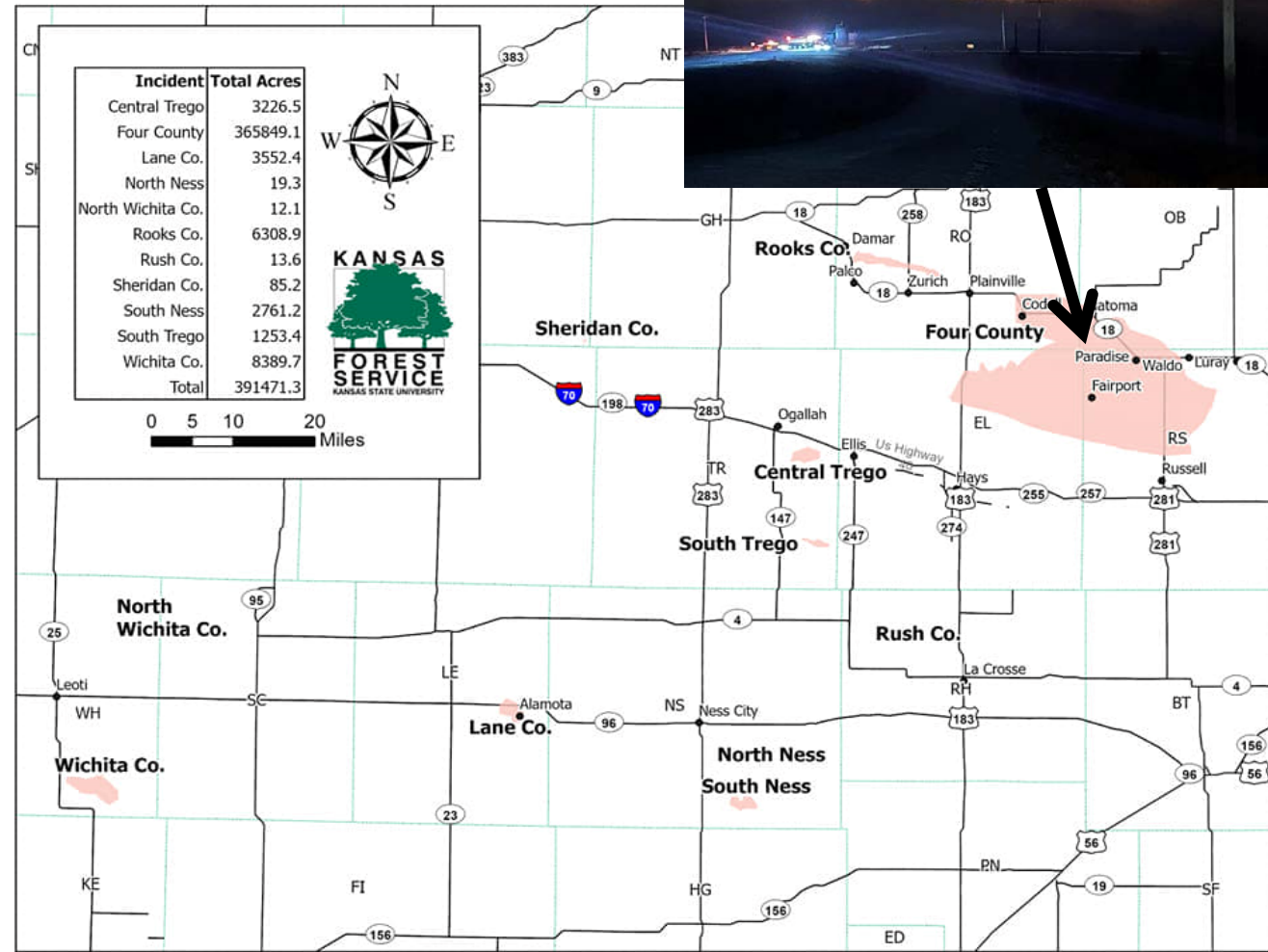
Multifaceted System: Wild Fires



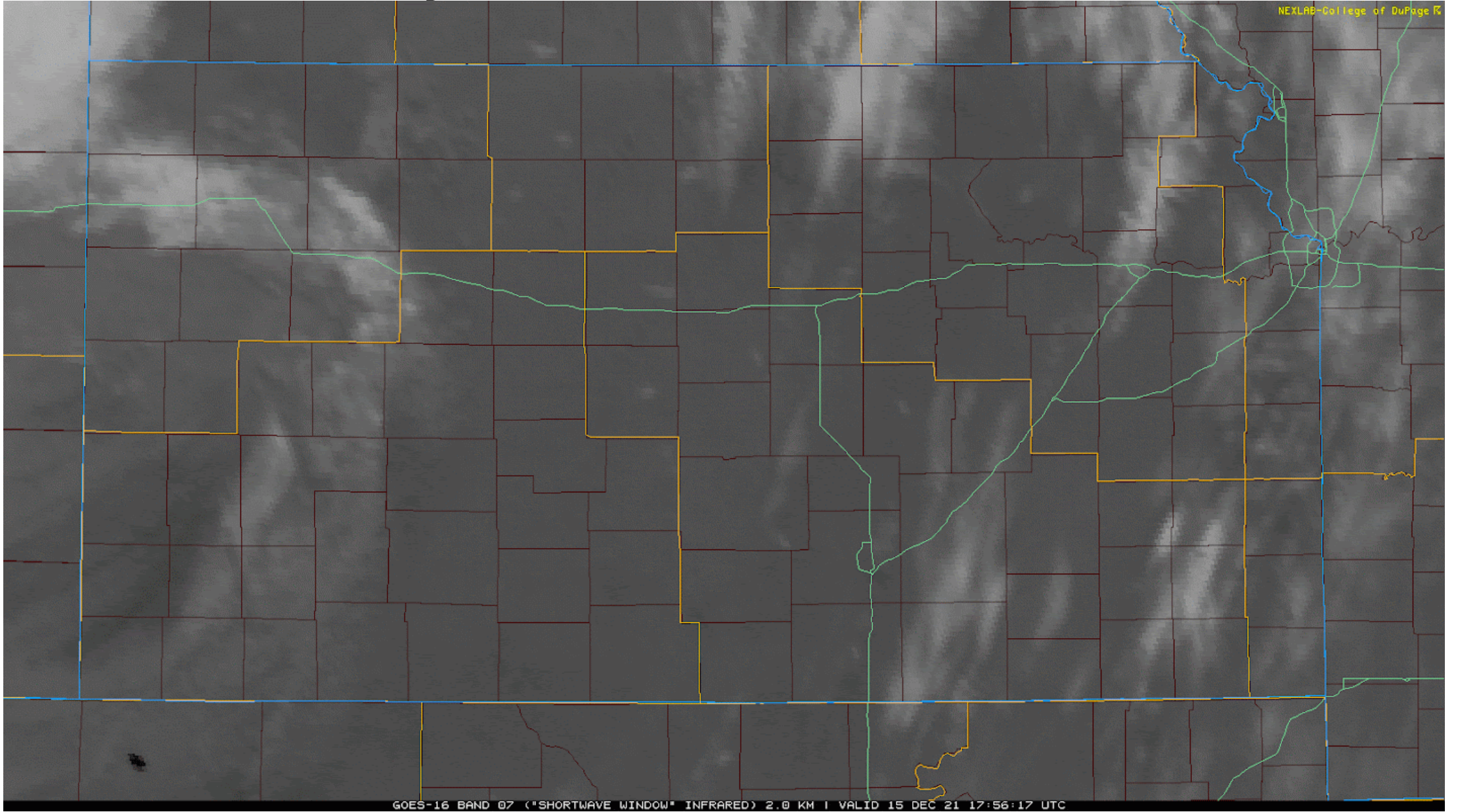
Kansas Forest Service

December 16, 2021 · 🌐

Nearly 400,000 acres have been impacted by wildfire, so far, due to yesterday's historic high winds combined with the drought or near drought conditions across Kansas. Wind gusts exceeding 80 miles per hour were detected in the four county region of Ellis, Russell, Osborne and Rooks, where the largest fire occurred. The fire referred to below as the Four County Fire is approximately 365,850 acres. The smoke from this fire impacted most of the eastern portion of the state on Wednesday evening.



Multifaceted System: Wild Fires

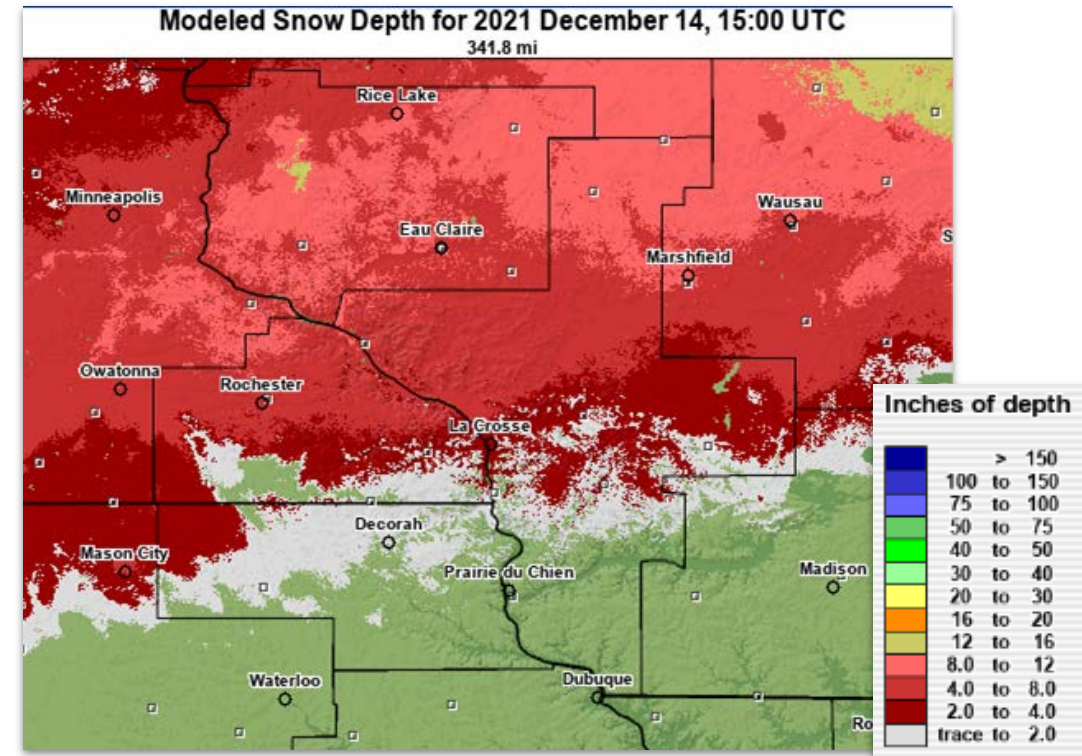
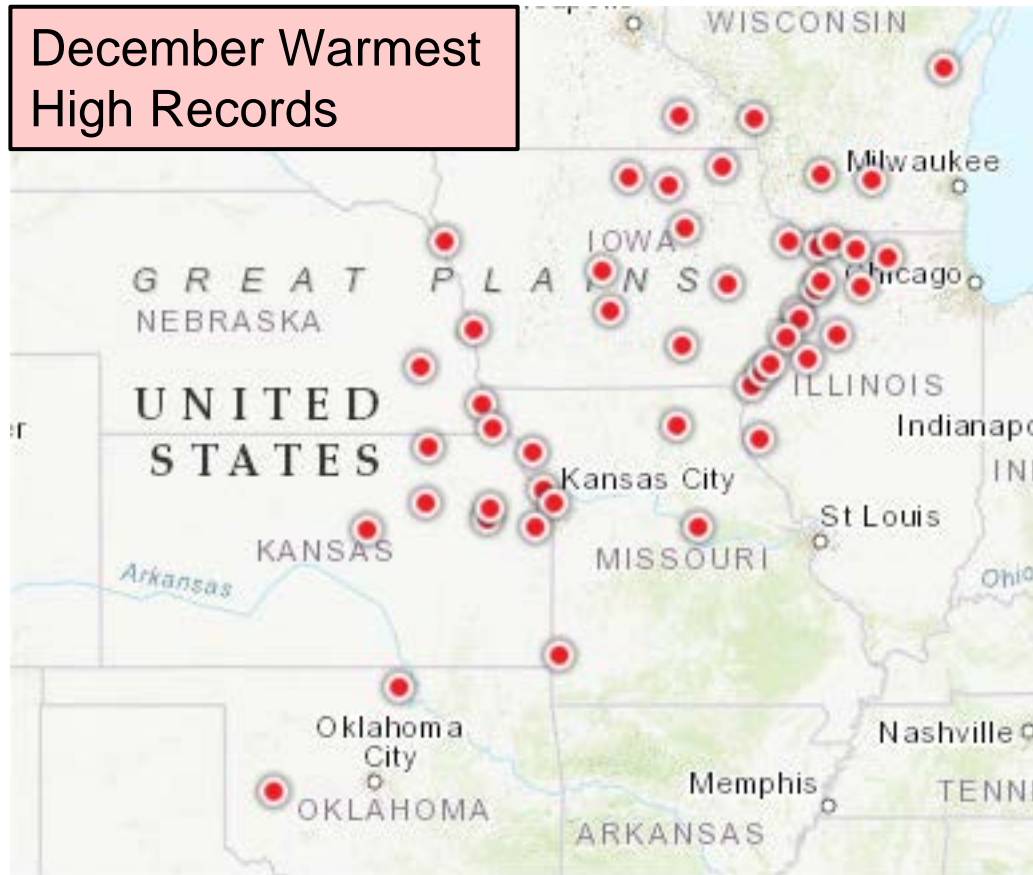


GOES-16 BAND 07 ("SHORTWAVE WINDOW" INFRARED) 2.0 KM 1 VALID 15 DEC 21 17:56:17 UTC

Multifaceted System: Record Warmth



December Warmest High Records



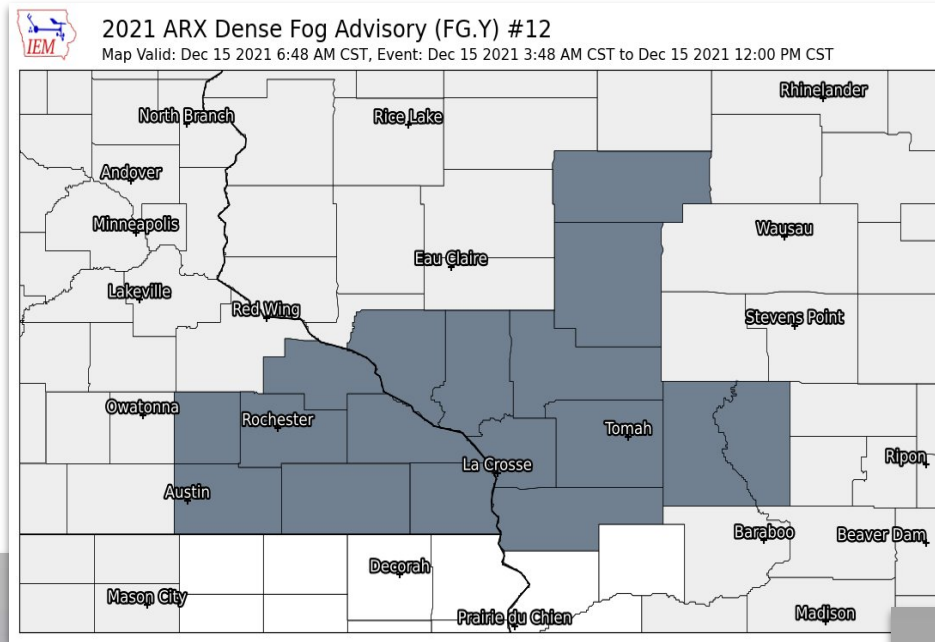
Melted 8+” snow within 36 hrs

		Broken	Tied	Total
Daily	Record Highs	793	127	920
	Warms Lows	557	105	662
Monthly	Record Highs	141	48	189
	Warms Lows	26	14	40

Boscobel, WI had a high of 72°F. Previous record was 71°F at Wautoma on 12/1/2016.

Several IA sites 75°F. Previous record 74°F at Thurman on 12/6/1939.

Multifaceted System: Dense Fog



KTTV 56°
Rochester, MN

Watch LIVE On Demand News Weather Sports

One dead in multiple vehicle crash along Highway 52 north of Oronoco

Published: Dec. 15, 2021 at 4:00 PM CST | Updated: Dec. 15, 2021 at 4:07 PM CST

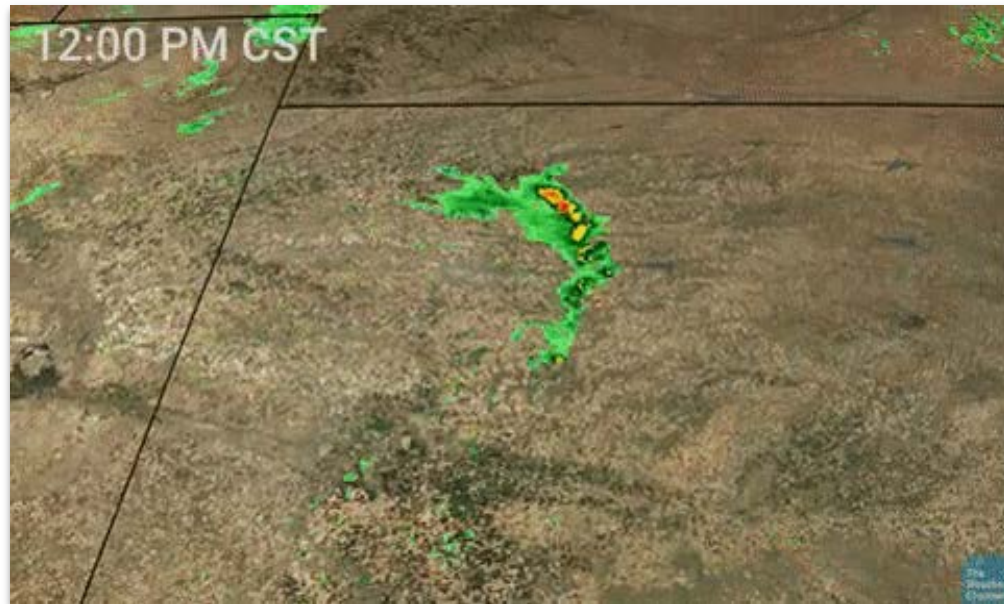
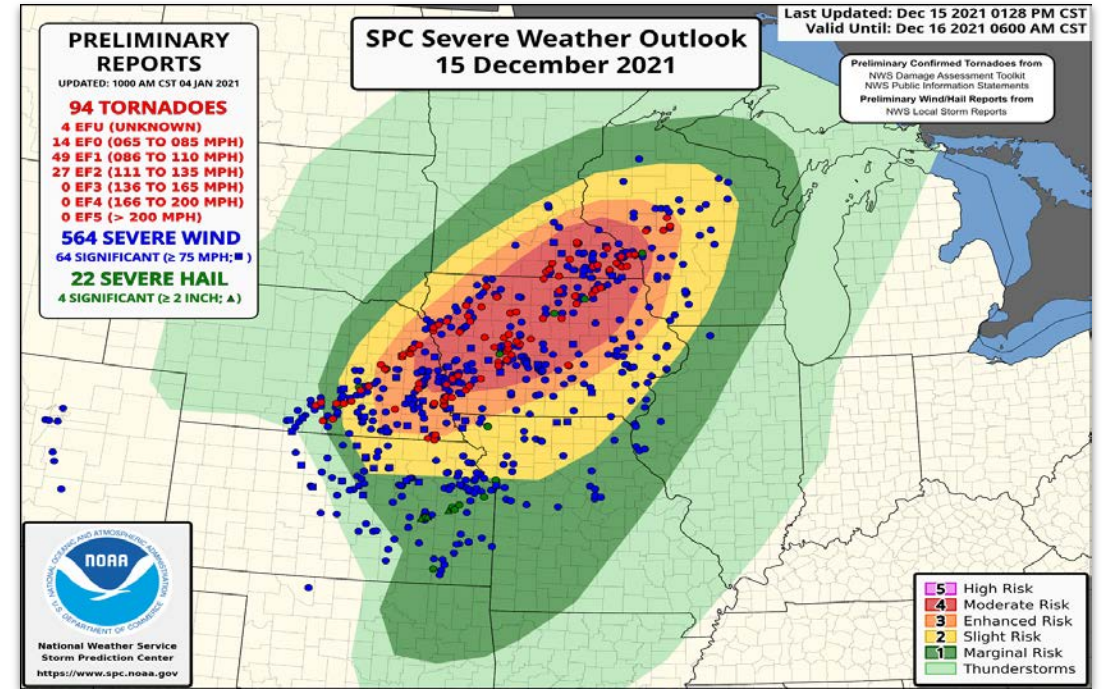
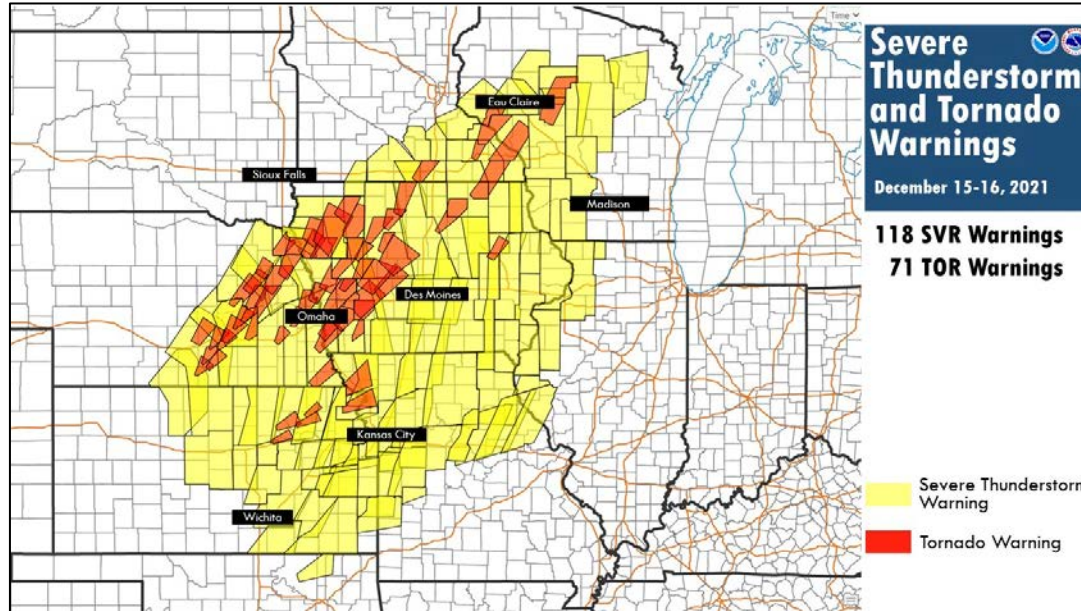
Facebook Email Twitter Pinterest LinkedIn

BREAKING NEWS
HWY 52 Northbound Crash
Near Pine Island

KTTV
12:44 | 59°



Multifaceted System: Derecho & Tornado Outbreak



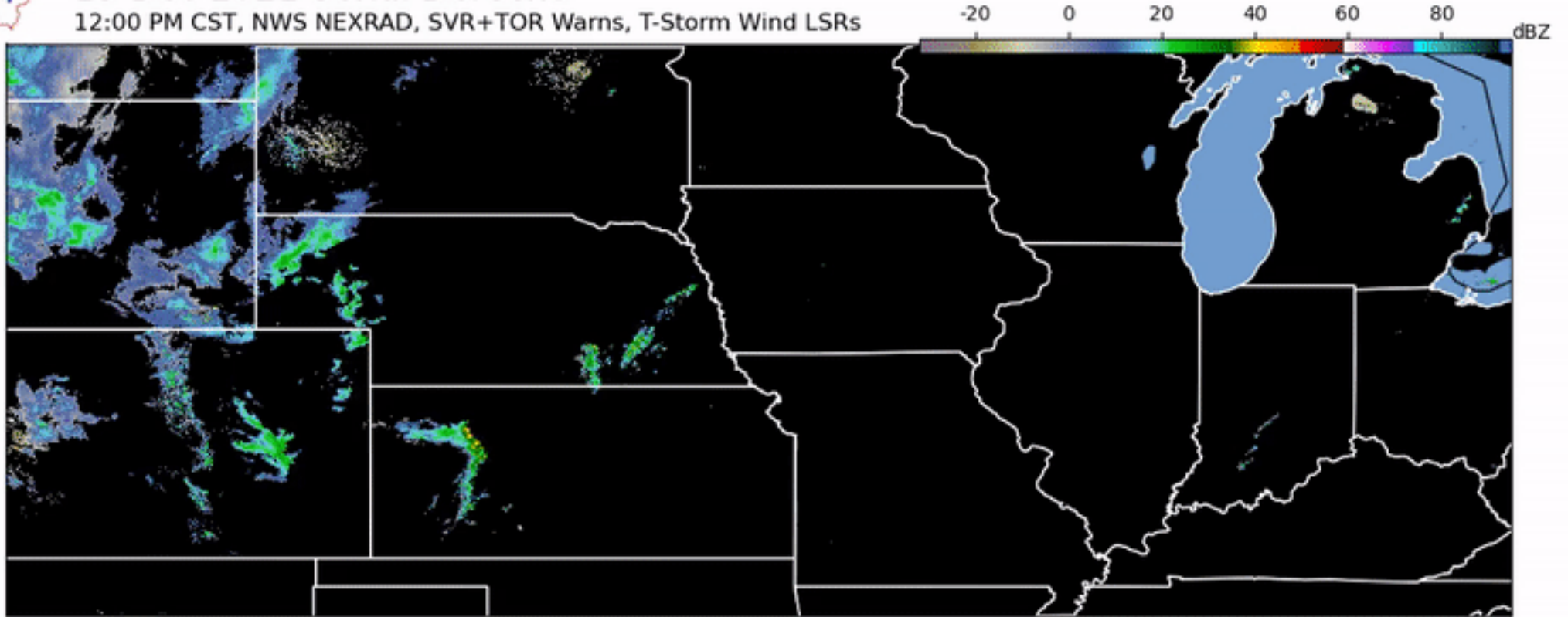
- 121 Tornadoes in NE, SD, IA, MN, & WI
- ***Largest December Tornado Outbreak surpassing the December 10-11, 2022 Outbreak***
- First December tornado on record in MN
- Derecho winds
 - 93 reports of 70-79 mph gusts
 - 48 reports of 80-89 mph gusts
 - 18 reports of 90-99 mph gusts
 - 4 reports of 100-107 mph gusts
 - Highest wind gust 107 mph @ Lamar, CO (8:44 AM)

Multifaceted System: Derecho & Tornado Outbreak

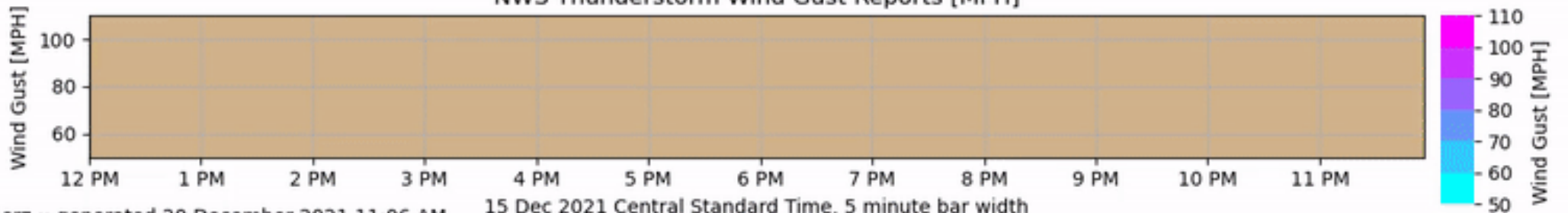


15 Dec 2021 Serial Derecho

12:00 PM CST, NWS NEXRAD, SVR+TOR Warns, T-Storm Wind LSRs



NWS Thunderstorm Wind Gust Reports [MPH]



@akrherz :: generated 20 December 2021 11:06 AM

15 Dec 2021 Central Standard Time, 5 minute bar width

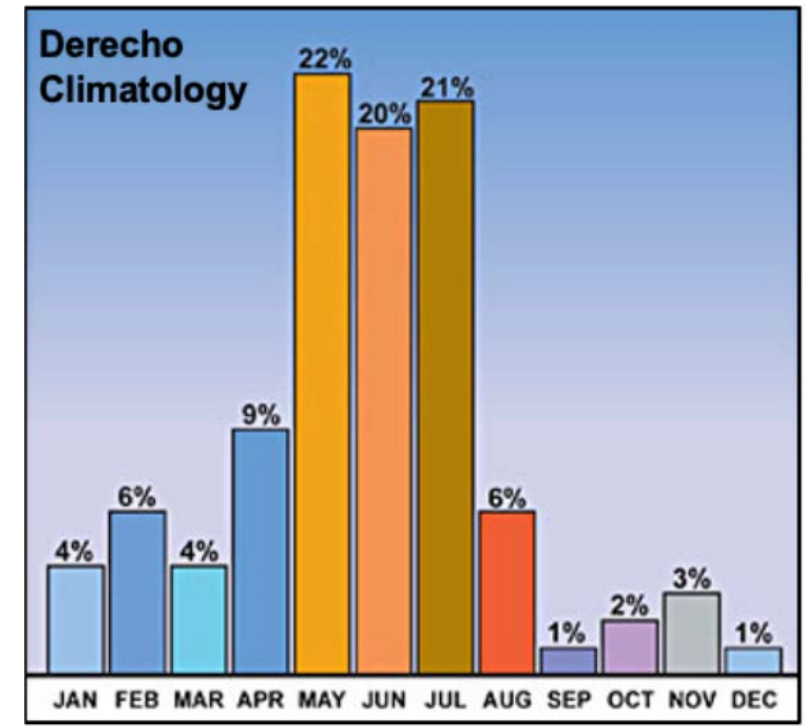
Source: IEM Feature of the Day (<https://mesonet.agron.iastate.edu/onsite/features/cat.php?day=2021-12-21>)

Multifaceted System: Derecho & Tornado Outbreak



Top 8 Days by Number of Preliminary Significant (75+ mph) Wind Gusts		
Date	# of 75+ mph wind gusts	Event
12/15/2021	64	Central Plains to Upper Mississippi Valley Derecho
8/10/2020	53	Midwest (Iowa) Derecho
6/6/2020	47	Rockies to Northern Plains Derecho
6/29/2012	37	Midwest to Mid-Atlantic Derecho
6/14/2014	31	Central Plains to Midwest Severe
6/16/17	24	Central Plains Severe
6/30/14	23	Midwest Derecho
6/10/21	23	Northern Plains Severe

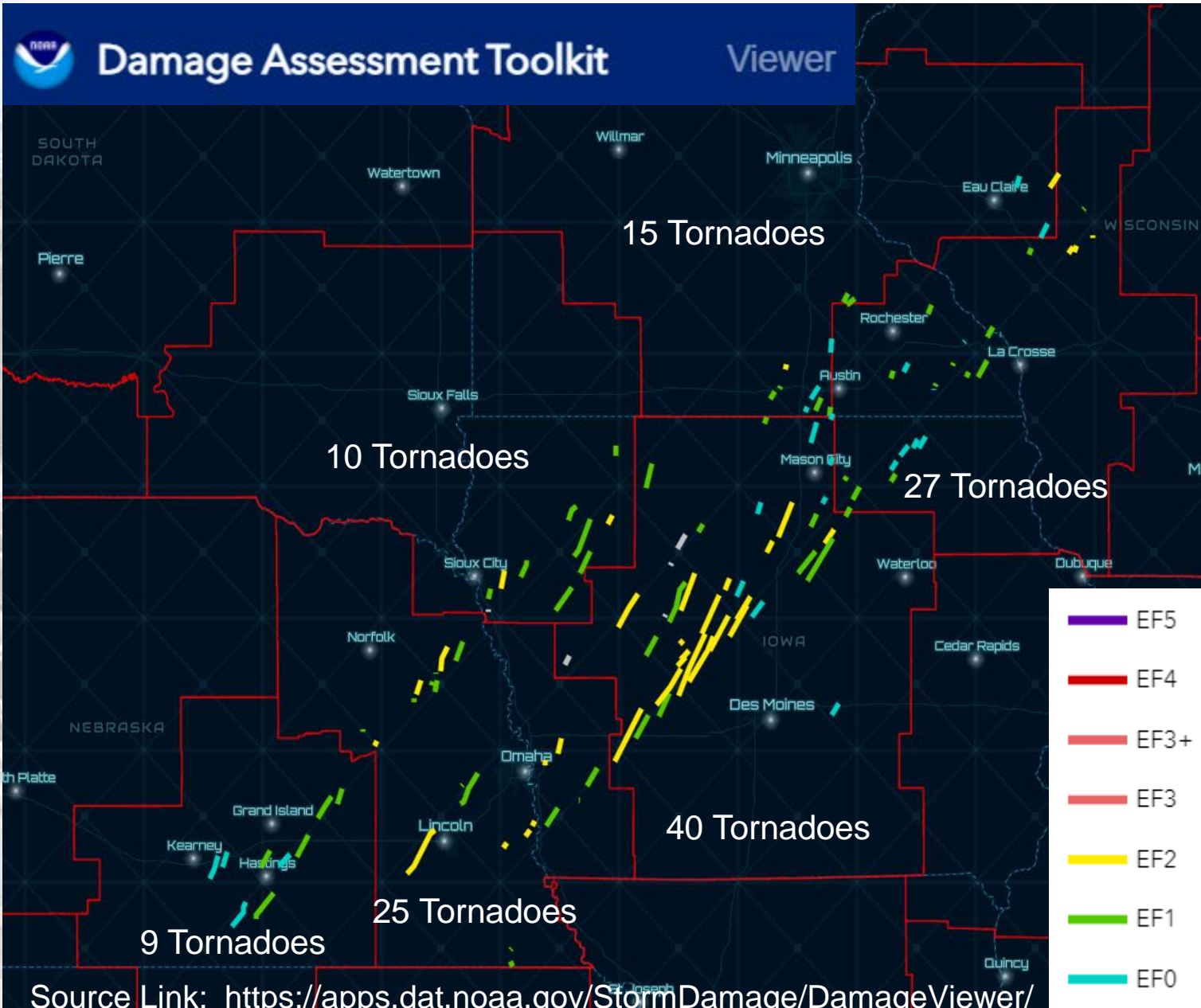
*Data from 2004 to present. 2021 data is preliminary and subject to change before final storm data publication.



1% (or less) of all derechos occur in the month of December

Derecho Climatology Illustration by Dennis Cain. Located at SPC Derecho FAQ page.

Multifaceted System: Derecho & Tornado Outbreak



State Breakdown of Tornadoes					
	Unranked	EF0	EF1	EF2	Totals
NE	0	5	16	7	28
IA	6	13	24	21	64
MN	0	7	14	1	22
WI	0	3	3	4	10
Totals	6	28	58	34	124

County Warning Area Breakdown of Tornadoes					
	Unranked	EF0	EF1	EF2	Totals
GID	0	4	5	0	9
FSD	1	0	7	2	10
OAX	0	2	14	9	25
DMX	5	7	11	17	40
MPX	0	6	7	2	15
ARX	0	9	14	4	27
Totals	6	28	58	34	126

Multifaceted System: Derecho & Tornado Outbreak



US National Weather Service Des Moines Iowa

February 6 · 🌐

Iowa Record for number of EF2+ tornadoes for a single day was set on December 15, 2021. Note all 21 tornadoes listed as EF2+ for December 15th were EF2 with zero EF3 or greater tornadoes.



NATIONAL WEATHER SERVICE
OCEANIC AND ATMOSPHERIC ADMINISTRATION



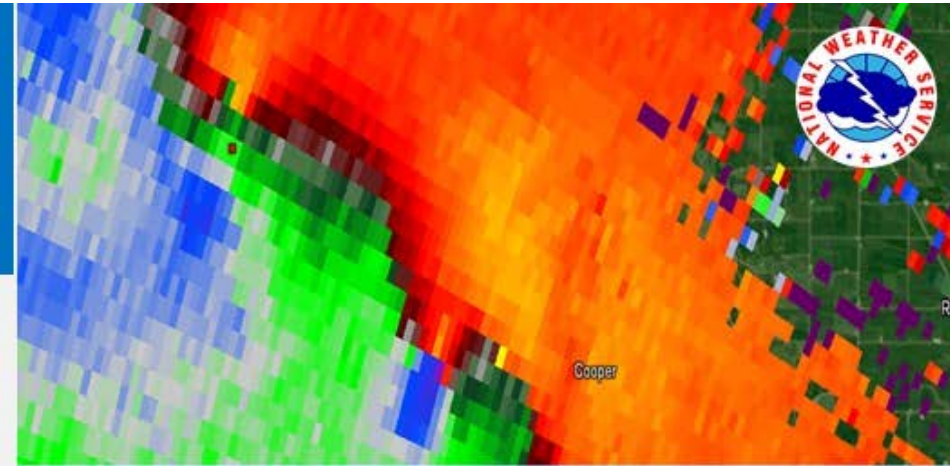
December 15, 2021 Iowa Tornado Facts

Iowa Record Number of EF2+ Tornadoes For a single day

1. 21 - December 15, 2021 (63)
2. 16 - June 7, 1984 (21)
3. 8 - April 9, 2011 (20)
4. 6 - May 8, 1988 (22)
6 - March 22, 1991 (12)
6 - March 6, 2017 (18)

() = Total Number of Iowa Tornadoes for Date

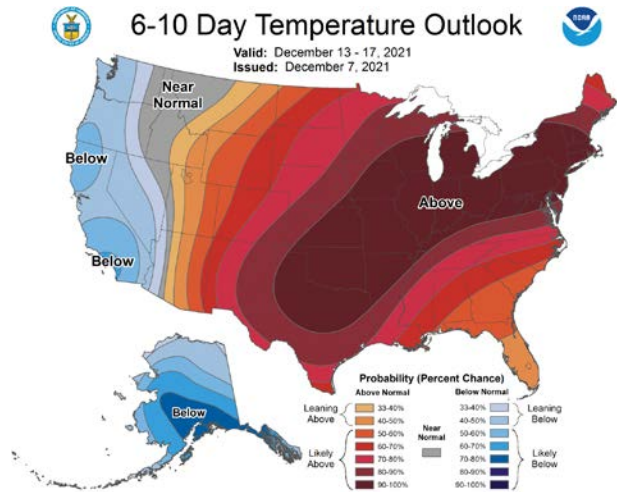
Did you know that the Iowa Record for Tornadoes In a single month was May 2004 with 57? Iowa had 63 Tornadoes on Dec 15, 2021.



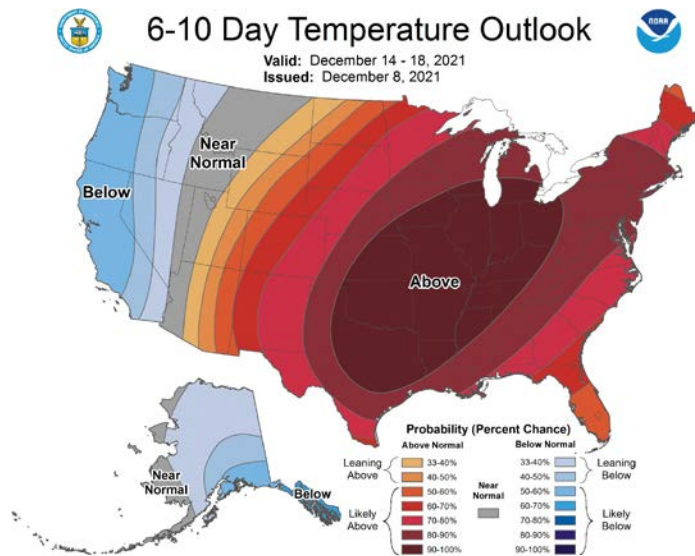
Enhanced Fujita Scale

EF-0	65-85 mph
EF-1	86-110 mph
EF-2	111-135 mph
EF-3	136-165 mph
EF-4	166-200 mph
EF-5	> 200 mph

CPC 6-10 Day Outlooks from December 7-8, 2021



December 7 - The National Blend of Models indicates the *potential for record high temperatures* across portions of the Great Plains and Midwest on days 7 and 8, with *maximum temperature anomalies exceeding +20°F in some places.*

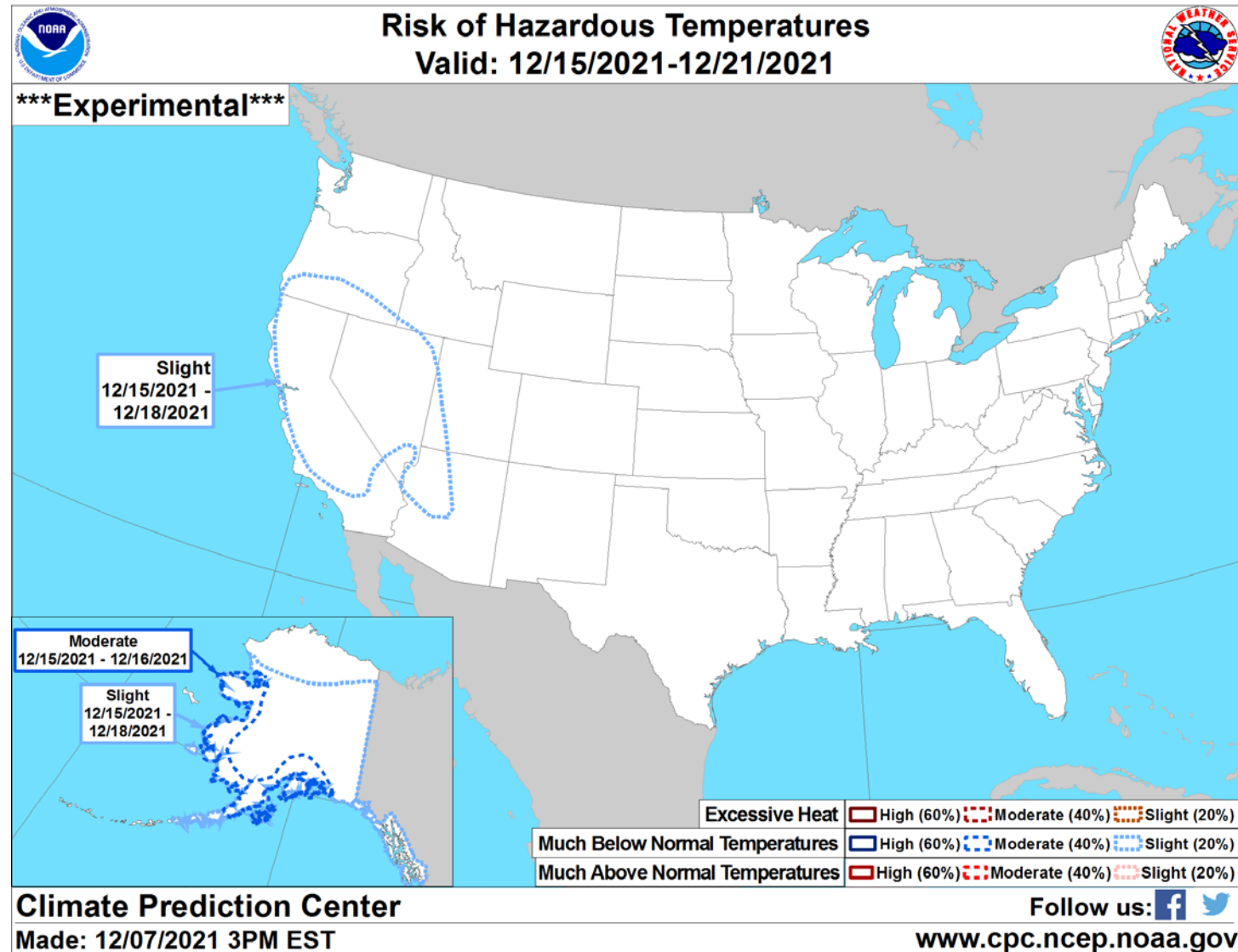


December 8 - The highest probabilities (>90 percent) are located over parts of the Great Plains, Mississippi Valley, Great Lakes, and Ohio Valley, corresponding with large positive 500-hPa height anomalies and enhanced southerly flow. *Maximum temperatures near 30°F above normal are possible for parts of this region early in the period.*

Climate Prediction Center: <https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

CPC 6-10 & 8-14 Day Data & Graphics Archive: https://www.cpc.ncep.noaa.gov/products/archives/short_range/srarc.ind.php

CPC Outlooks from December 7, 2021



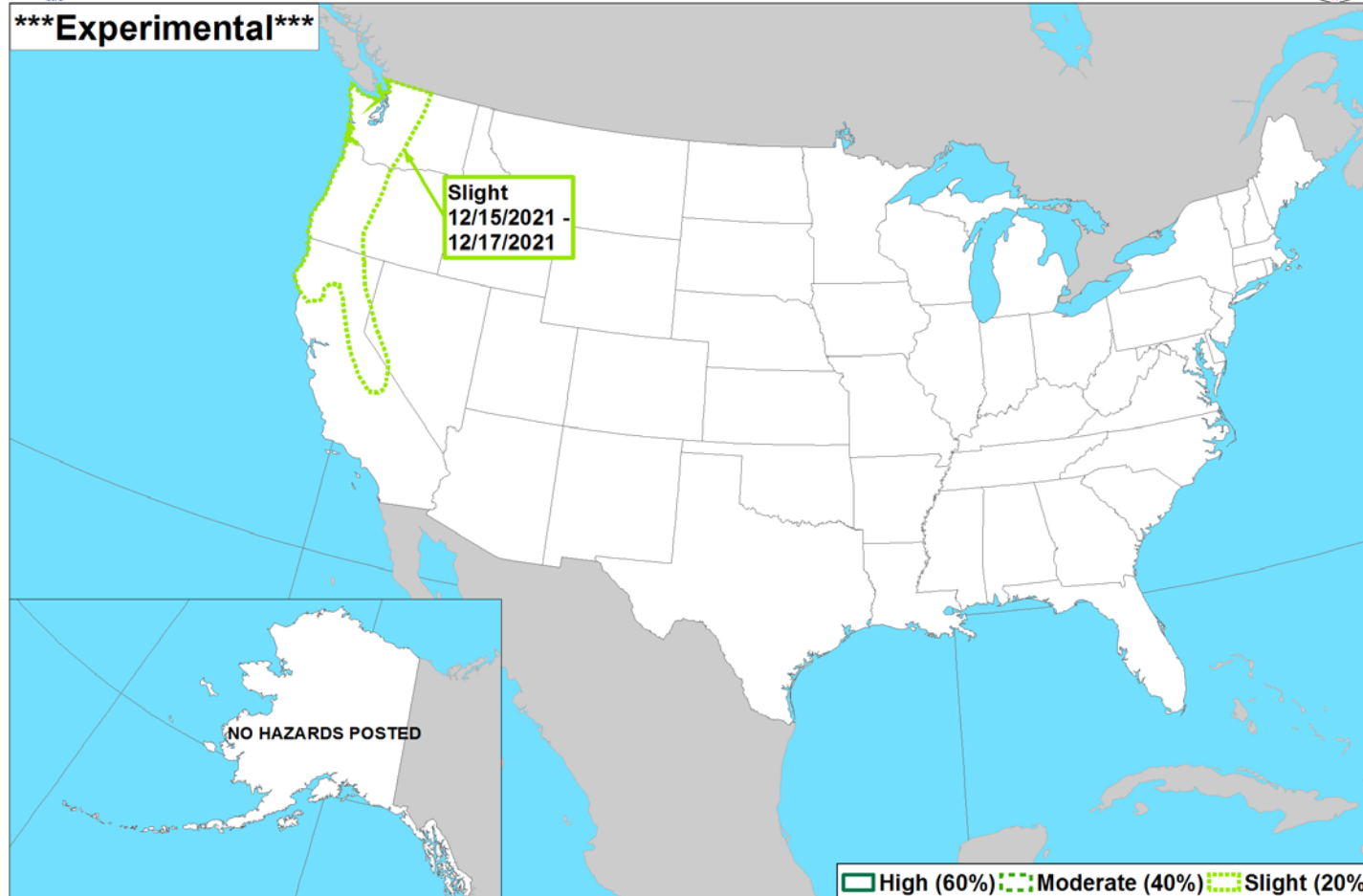
CPC Day 8-14 U.S. Hazards: <https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

CPC's Day 8-14 U.S. Hazards Archive: <https://www.cpc.ncep.noaa.gov/products/archives/hazards/gethazards.php>

CPC Outlooks from December 7, 2021



Risk of Heavy Precipitation
Valid: 12/15/2021-12/21/2021



Climate Prediction Center

Made: 12/07/2021 3PM EST

Follow us:  

www.cpc.ncep.noaa.gov

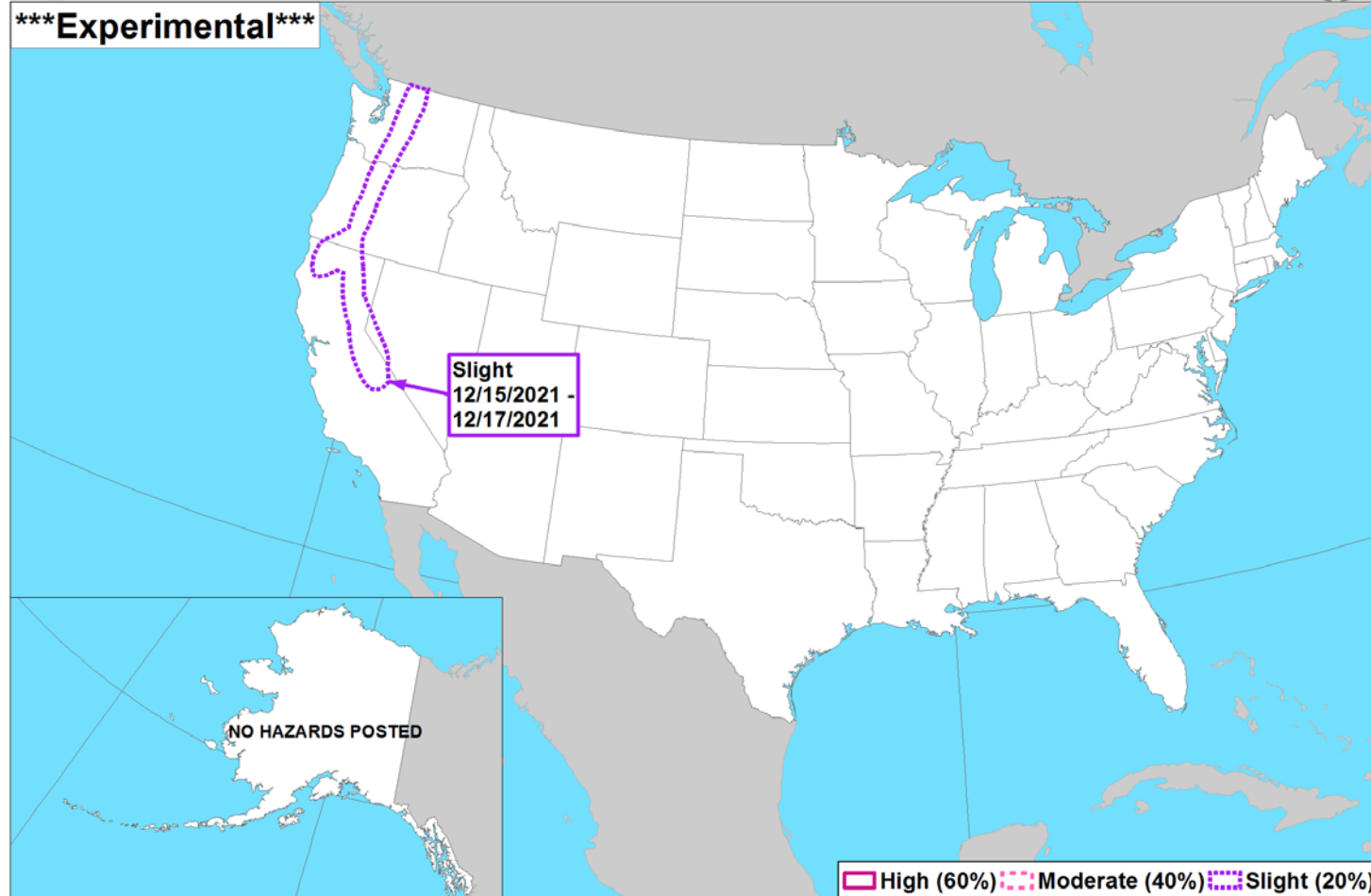
CPC Day 8-14 U.S. Hazards: <https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

CPC's Day 8-14 U.S. Hazards Archive: <https://www.cpc.ncep.noaa.gov/products/archives/hazards/gethazards.php>

CPC Outlooks from December 7, 2021



Risk of Heavy Snow
Valid: 12/15/2021-12/21/2021



Climate Prediction Center

Made: 12/07/2021 3PM EST

Follow us:  

www.cpc.ncep.noaa.gov

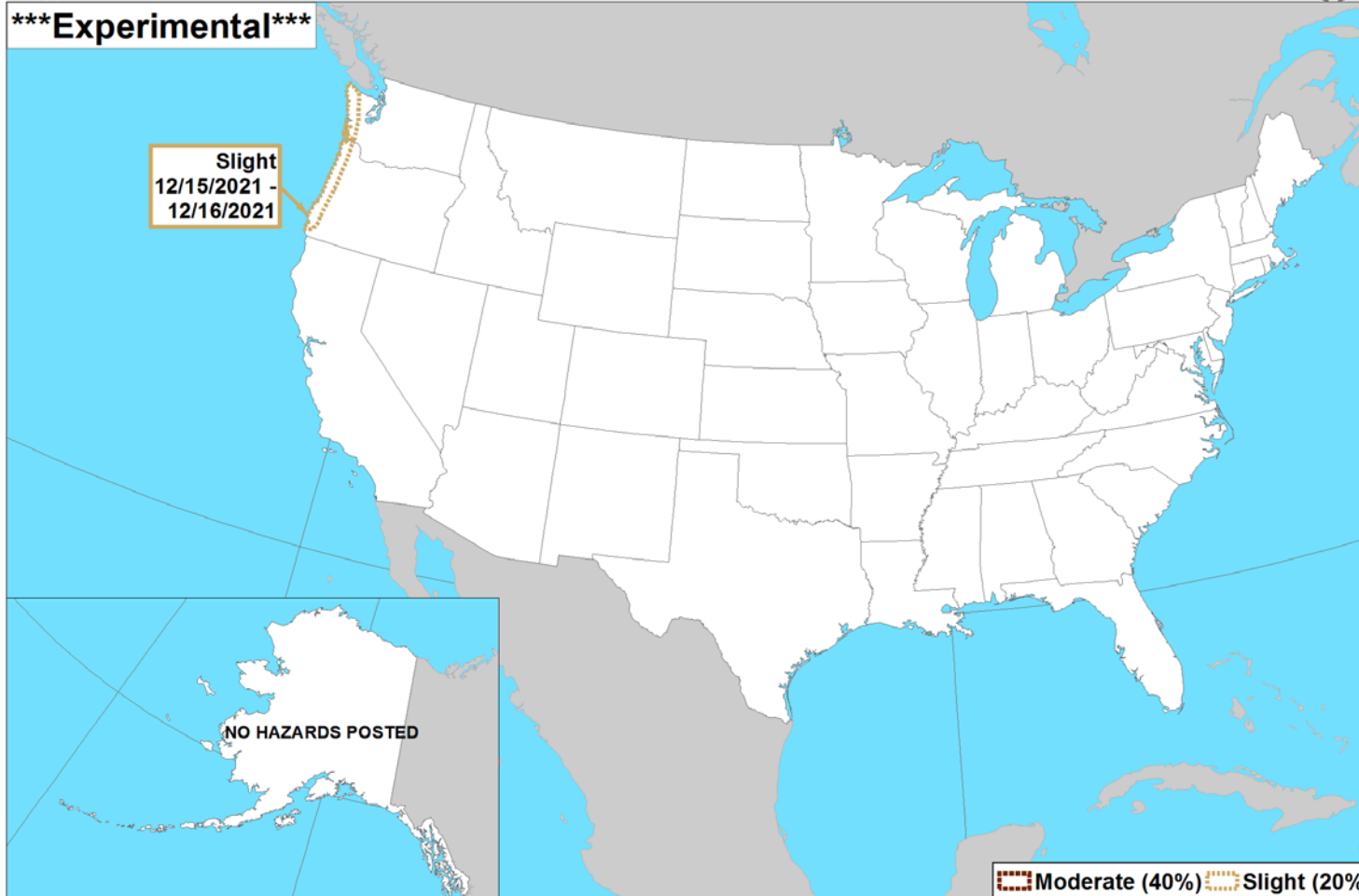
CPC Day 8-14 U.S. Hazards: <https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

CPC's Day 8-14 U.S. Hazards Archive: <https://www.cpc.ncep.noaa.gov/products/archives/hazards/gethazards.php>

CPC Outlooks from December 7, 2021





Risk of High Winds
Valid: 12/15/2021-12/21/2021



Climate Prediction Center

Made: 12/07/2021 3PM EST

Follow us:  

www.cpc.ncep.noaa.gov

CPC Day 8-14 U.S. Hazards: <https://www.cpc.ncep.noaa.gov/products/predictions/threats/threats.php>

CPC's Day 8-14 U.S. Hazards Archive: <https://www.cpc.ncep.noaa.gov/products/archives/hazards/gethazards.php>

Dec 8 – Models Indicating Record Warmth

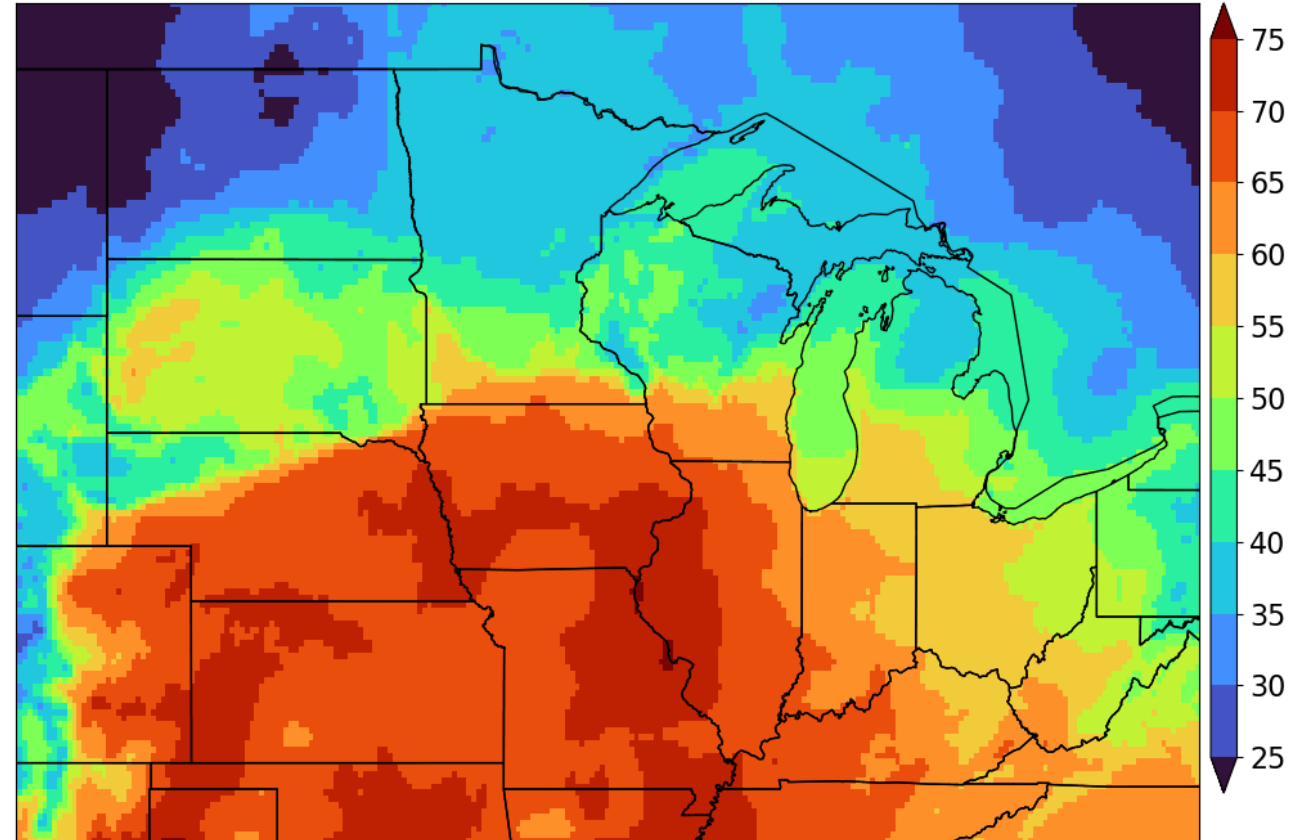
Weather Model Fantasy Land?

08 Dec 2021 05:32 AM

After an expected winter storm that will bring accumulating snowfall over northwestern Iowa later this week, a major temperature warm up is expected next week. Weather forecasters are already buzzing with how warm temperatures are predicted by models like the NWS Global Forecast System (GFS). The featured map is a forecast for *next* Wednesday afternoon with much of Iowa in the 65 to 75°F range. ***If this would verify, it would represent a number of new month of December records for high temperature over Iowa!*** Of course, many consider maps like these "model fantasy land" as it is a 189 hour forecast!



NCEP Global Forecast System (GFS) 2m Air Temp valid 3 PM 15 December 2021
189 Hour Forecast from 00 UTC run on 8 December 2021



Iowa Environmental Mesonet :: generated 07 December 2021 11:22 PM

data units :: F

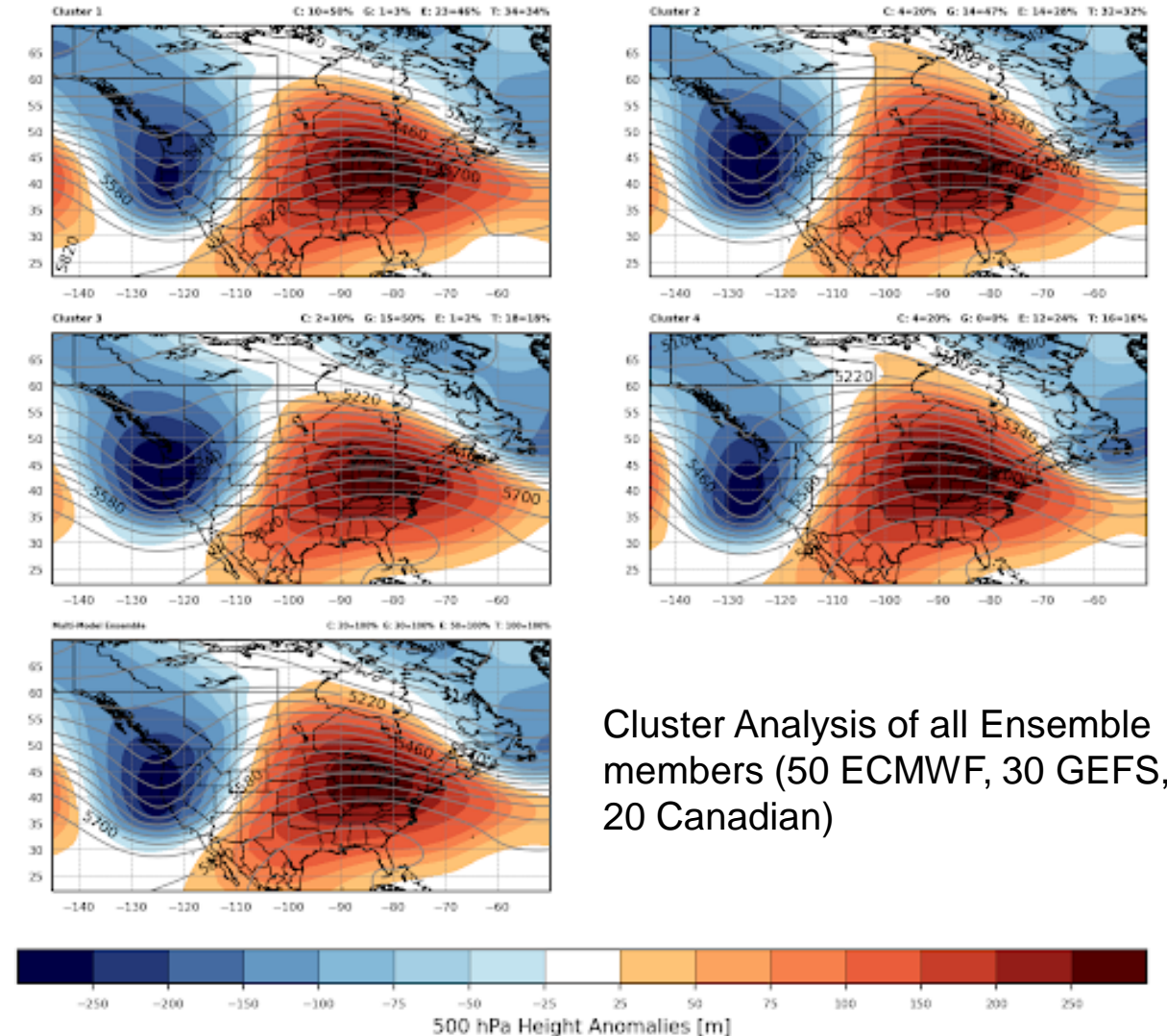
<https://mesonet.agron.iastate.edu/onsite/features/past.php?year=2021&month=12>

Forecast Trends: Notable Signals 6 Days Prior

Cluster Analysis depicted this very anomalous ridge/trough pattern with anomalies +/- 200 m respectively leading up to the event.

While there are some fine details to consider, all ensembles agree on the same pattern setup with similar anomalies.

Cluster Mean 24-hour Mean 500-hPa Heights and Anomalies [meters]
Init: 00Z Fri Dec 10 2021 --> Valid: 24-hours Ending 00Z Wed Dec 15 2021

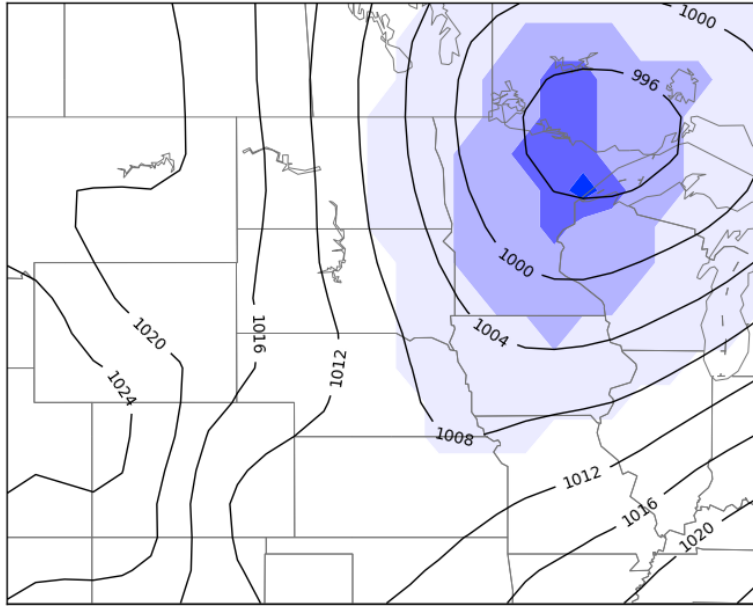


Cluster Analysis of all Ensemble members (50 ECMWF, 30 GEFS, 20 Canadian)

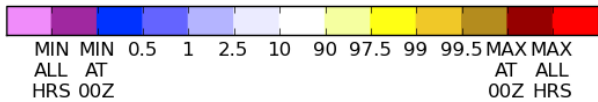
Forecast Trends: Notable Signals 6 Days Prior



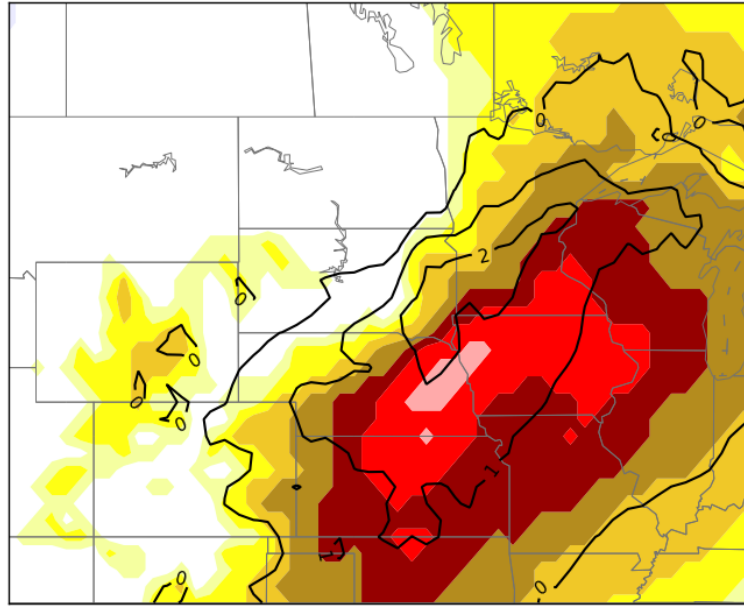
NAEFS Mean MSLP (hPa) and Climatological Percentile
 HOUR 144 - VALID 00:00 UTC Thu Dec 16 2021



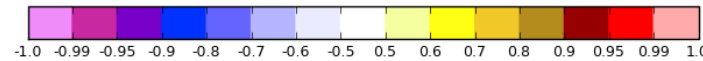
Relative to the 05-Dec to 26-Dec 1979-2009 CFSR climatology



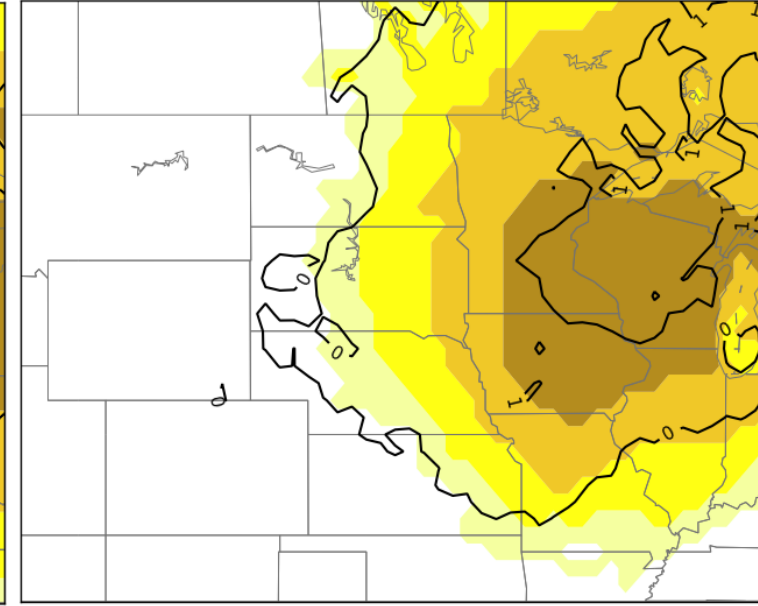
ECMWF Extreme Forecast Index (shaded)
 and Shift of Tails (black contours) for Max-Temp
 120-144-h forecast valid
 00Z Wed Dec 15 2021 to 00Z Thu Dec 16 2021



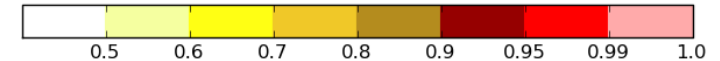
Relative to the ECMWF reforecasts from a 5 week period (2000 - 2021)
 centered on the week this forecast was initialized



ECMWF Extreme Forecast Index (shaded)
 and Shift of Tails (black contours) for Wind-Gust
 144-168-h forecast valid
 00Z Thu Dec 16 2021 to 00Z Fri Dec 17 2021



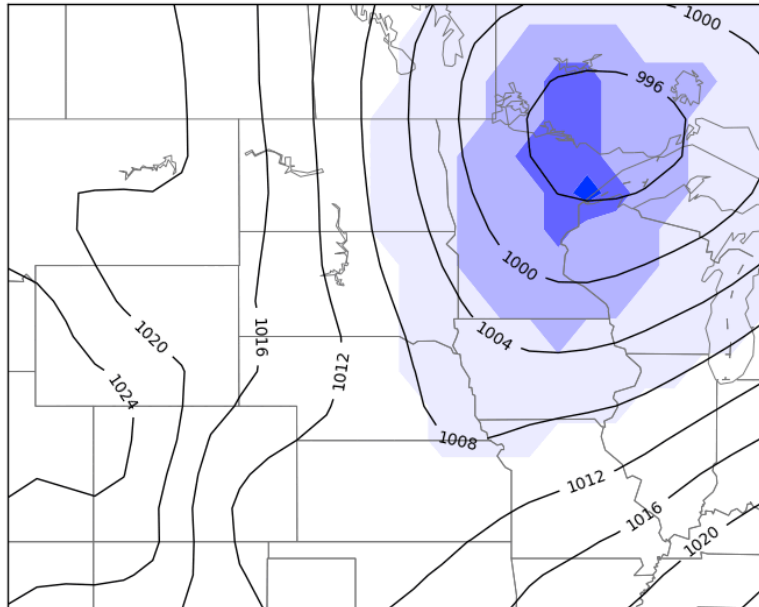
Relative to the ECMWF reforecasts from a 5 week period (2000 - 2021)
 centered on the week this forecast was initialized



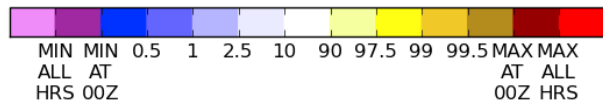
With such an anomalous ridge/trough pattern in December, one can expect surface fields to reflect extremes. Sure enough that was the case. NAEFS Mean Sea Level Pressure & ECMWF Ensemble Extreme Forecast Index and Shift of Tails plots for Max T, and wind gusts.

Forecast Trends: 6 Days To 1 Day Prior

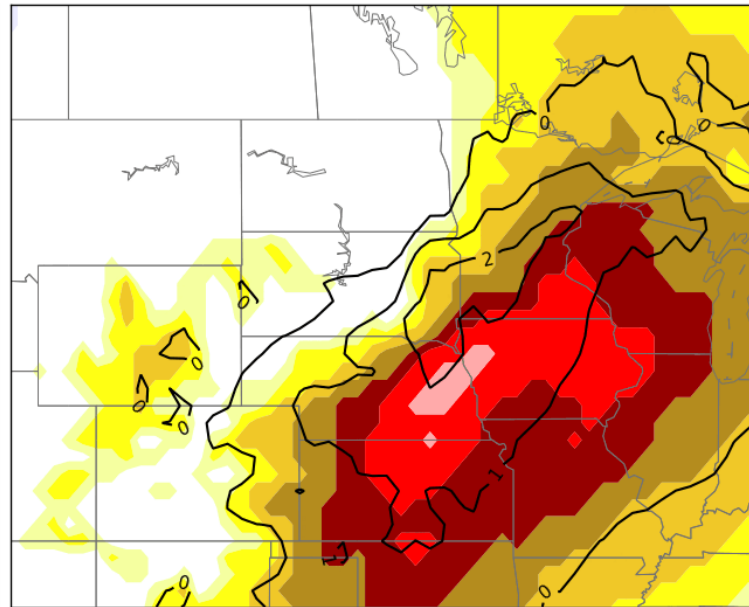
NAEFS Mean MSLP (hPa) and Climatological Percentile
 HOUR 144 - VALID 00:00 UTC Thu Dec 16 2021



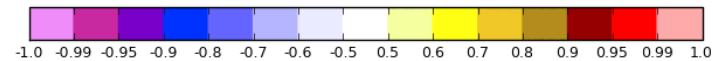
Relative to the 05-Dec to 26-Dec 1979-2009 CFSR climatology



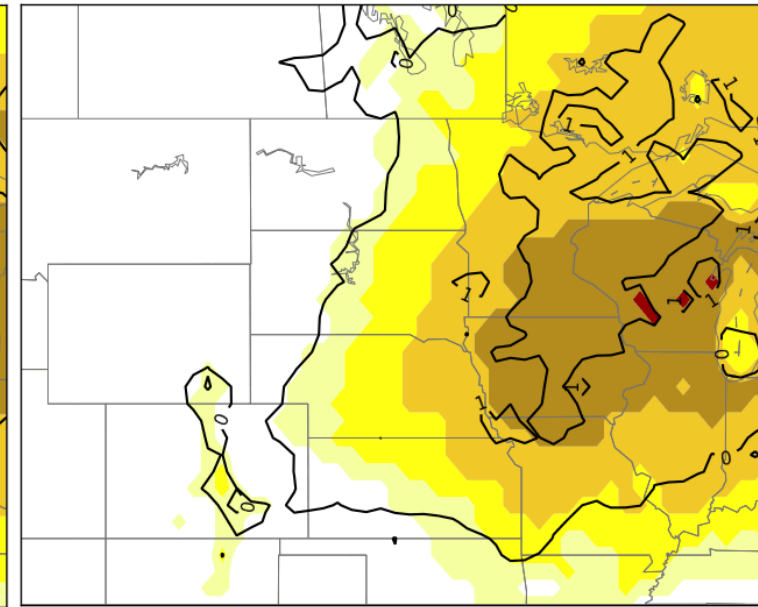
ECMWF Extreme Forecast Index (shaded)
 and Shift of Tails (black contours) for Max-Temp
 120-144-h forecast valid
 00Z Wed Dec 15 2021 to 00Z Thu Dec 16 2021



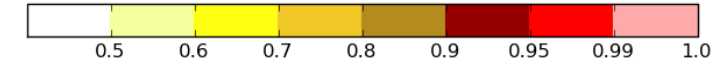
Relative to the ECMWF reforecasts from a 5 week period (2000 - 2021)
 centered on the week this forecast was initialized



ECMWF Extreme Forecast Index (shaded)
 and Shift of Tails (black contours) for Wind-Gust
 120-144-h forecast valid
 00Z Thu Dec 16 2021 to 00Z Fri Dec 17 2021



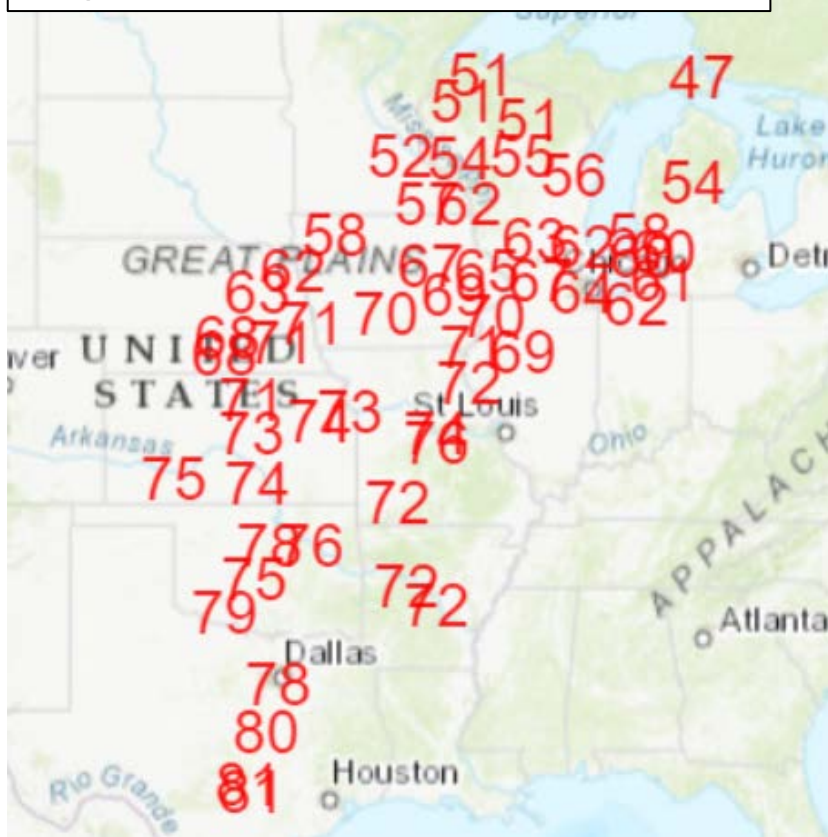
Relative to the ECMWF reforecasts from a 5 week period (2000 - 2021)
 centered on the week this forecast was initialized



Increasing signals for unprecedented mid-Dec system!

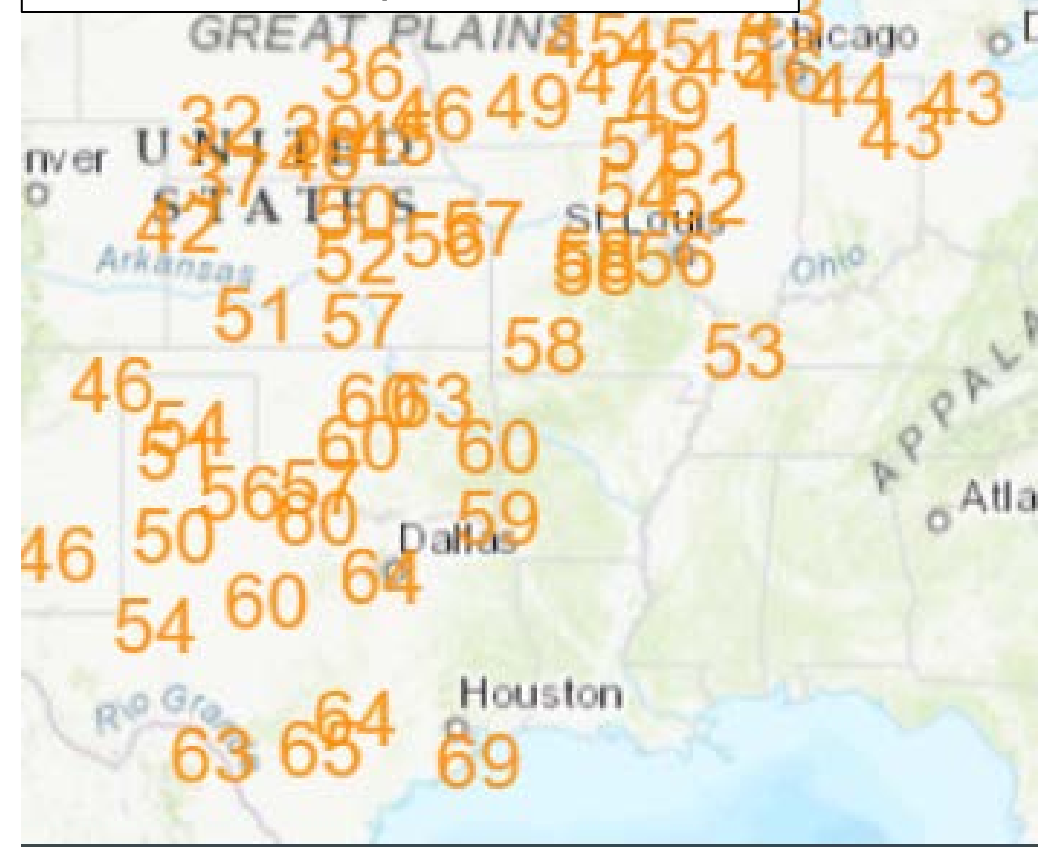
WPC's NBM Forecast Records (December 10)

High Max Temperature Records



The NBM is already forecasting 43 sites to reach record high MaxT values & another 12 near (within 1°F) on December 15.

Warm Min Temperature Records



MinT values are also forecast to reach record high minimums at over 50 sites for December 15.

Forecast Trends: Thunderstorm Potential

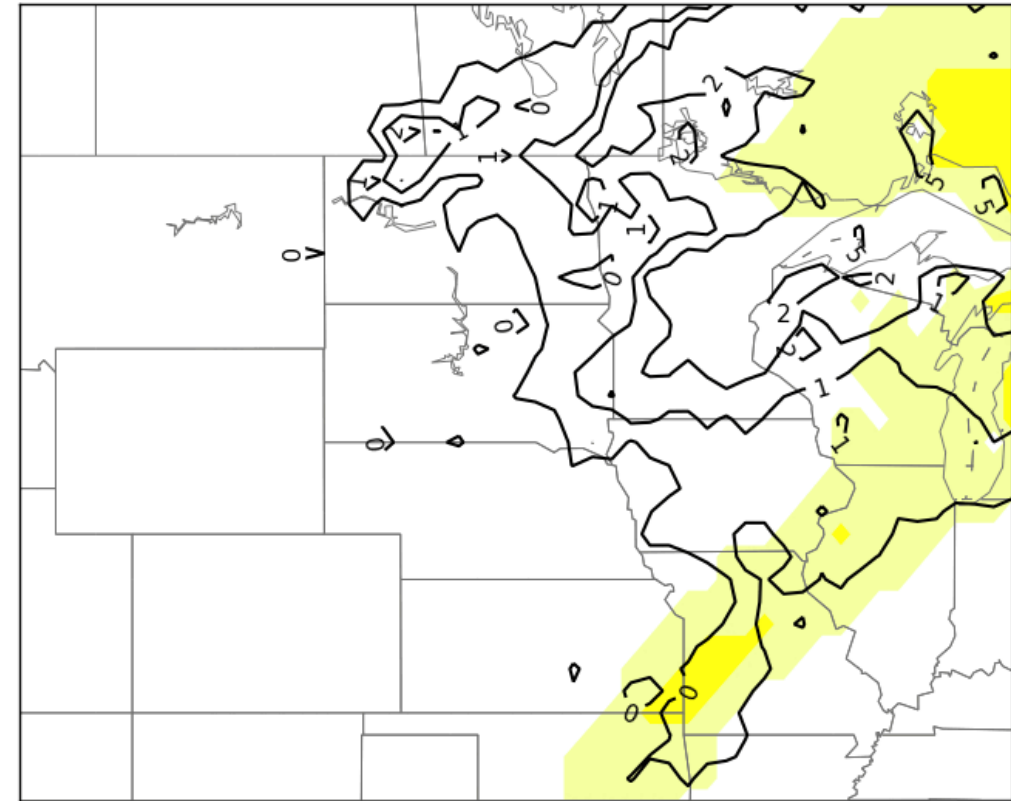
“Due to this instability, there are chances for thunder in the forecast.”

“Certainly strong dynamics in play, so will have to monitor potential for severe storms.”

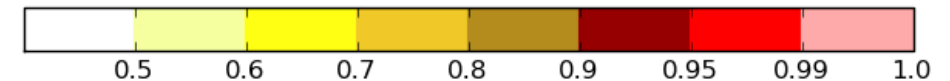
“Given the very fast storm motions and reservoir of strong winds aloft, any convection could produce severe wind gusts...and a conditional risk for a tornado.”

“For mid-December, seeing dewpoints climbing to around 60 with the aforementioned dynamics in place is **EXTREMELY** concerning. ...The line of storms will quickly race eastward at forward speeds perhaps exceeding 70 kts.

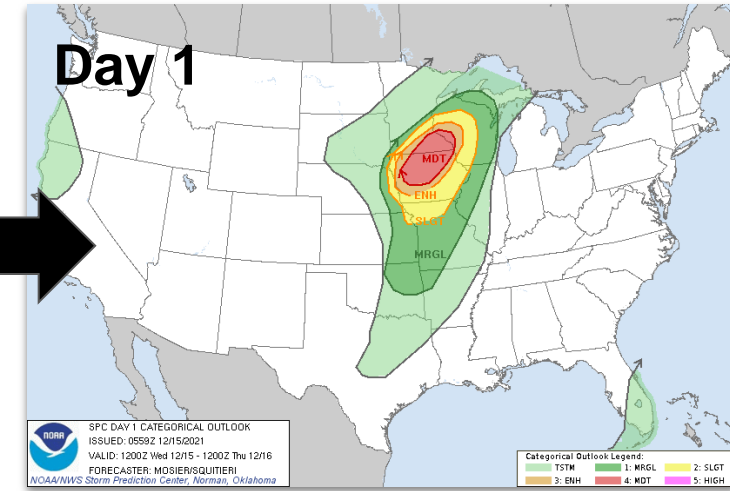
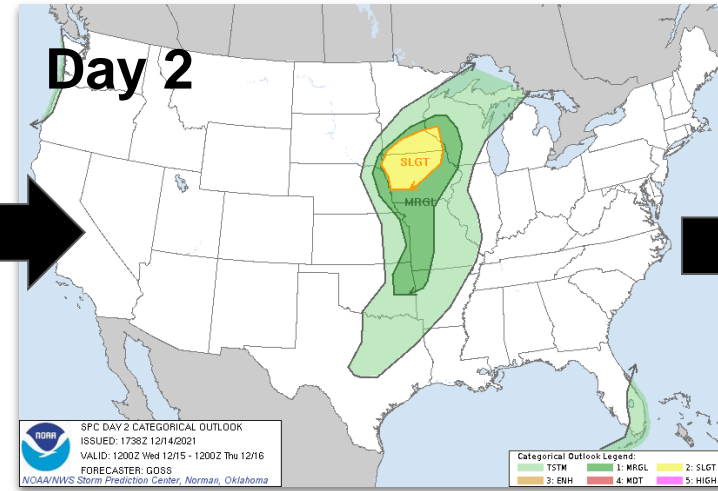
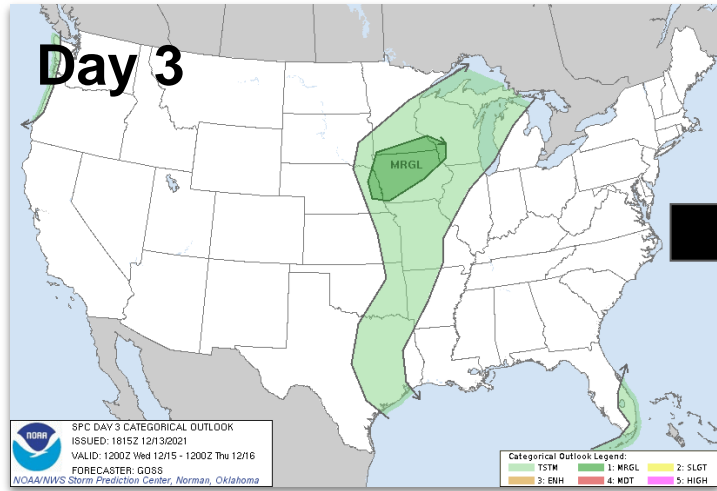
ECMWF Extreme Forecast Index (shaded)
and Shift of Tails (black contours) for CAPE
156-180-h forecast valid
00Z Thu Dec 16 2021 to 00Z Fri Dec 17 2021



Relative to the ECMWF reforecasts from a 5 week period (2000 - 2021)
centered on the week this forecast was initialized



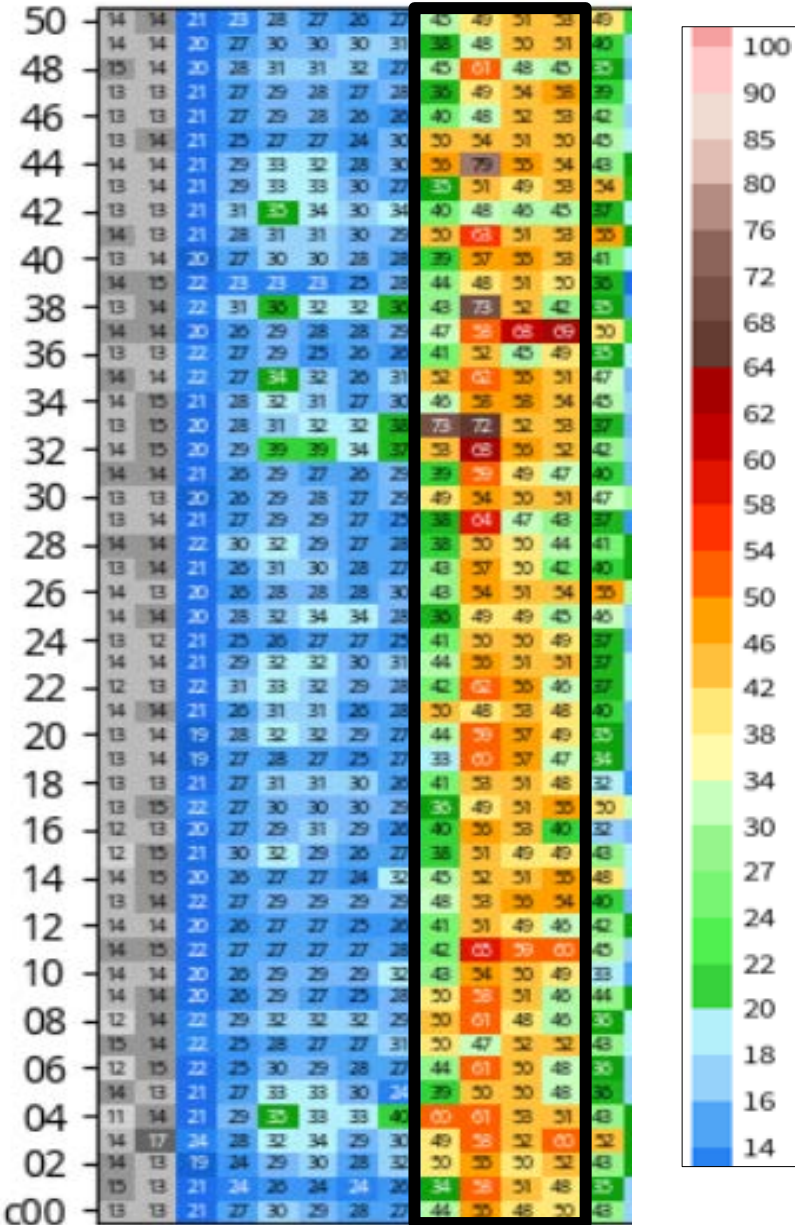
Forecast Trends: Thunderstorm Potential



Dec 15-16

ECMWF Ensemble Wind Gust Plots

- ECMWF Ensemble consistently showed high wind gusts for about a week ahead of December 15-16
- Wind gusts were in high end Wind Advisory or High Wind Warning criteria



ECMWF ECE Wind Gusts (mph)
Gaylord, MI from December 13

WeatherBELL: <https://maps.weatherbell.com/>

WEATHERMODELS.COM: <https://weathermodels.com/>

Forecast Trends: 1 Day Prior



ENSEMBLE SITUATIONAL AWARENESS

NOAA / NATIONAL WEATHER SERVICE


Model Run: Dec 14, 2021 12Z ▾ Table Region: Northcentral U.S. ▾ Plot Region: Northcentral U.S.

WFO Northcentral U.S. Table Dec 14, 2021 12Z Run											
		Z	I	U	V	WSP	SLP	Q	PW	IVT	
0	Tue 14th	12Z	MAX	MAX	MAX	MAX	99.5	97.5	MAX	97.5	99.5
6		18Z	MAX	MAX	MAX	MAX	MAX	99	MAX	99	MAX
12	Wed 15th	00Z	MAX	MAX	99.5	MAX	MAX	1	MAX	99.5	MAX
18		06Z	MAX	MAX	99.5	MAX	MAX	MIN	MAX	99.5	MAX
24		12Z	99.5	MAX	MAX	MAX	MAX	0.5	MAX	99.5	MAX
30		18Z	99.5	MAX	MAX	MAX	MAX	MIN	MAX	99.5	MAX
36	Thu 16th	00Z	MIN	MAX	MAX	MAX	MAX	MIN	MAX	MAX	MAX
42		06Z	MIN	MAX	MAX	MAX	MAX	MIN	MAX	MAX	MAX
48		12Z	MIN	MAX	MAX	99.5	MAX	MIN	MAX	99.5	99.5
54		18Z	0.5	99.5	MAX	97.5	99.5	MIN	99.5	99	97.5

WPC Ensemble Situational Awareness Tables: <https://satable.ncep.noaa.gov/>

Challenges Faced: Communicating Threats

- Wide variety of impacts
- Time of year
- Intense storms
- Nighttime storms (ARX CWA)
- Fast-moving storms
 - Limited warning lead time
 - Limited heads-up calls to dispatch centers
- “Lull” between storms and high winds
- How to express seriousness of situation and potential severity of impacts









Rare Storm Considerations December 15, 2021 1:20 PM
Non-traditional things to think about

- **SCHOOLS** - Avoid gyms, cafeterias, theaters, etc. with larger span roofs
- **SHOPPERS** - Have a plan when in big box stores with larger span roofs
- **HIGHWAYS / STREETS** - Are you prepped for debris / trees / branch removals?
- **HOLIDAY DECORATIONS** - Are they secure? Can they withstand these levels of winds?
- **STORM SPEEDS** - People need to take action IMMEDIATELY upon warnings. Fast storm speed will make for less action or response times.
- **POST STORMS** - Will not just be storms and done. Strong, long lasting winds will follow storms and likely last most of the night.

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

National Weather Service
La Crosse, Wisconsin

Preparing for Power Outages in Winter

-  Fully charge cell phones and other devices in advance.
-  Flashlights are safer than candles. Have extra batteries on hand.
-  Only use portable generator outdoors (not even in garage) with adequate ventilation. NEVER heat home with gas stove/oven.
-  Close off unneeded rooms and cover windows to conserve heat. Stuff towels under doors. Have extra blankets handy.
-  Have ample supply of nonperishable food, drinking water, and medications for each person and pet.
-  On a well? Fill extra buckets of water for washing up and flushing toilets.

NATIONAL WEATHER SERVICE • LA CROSSE, WI

Messaging: 3-4 Days Prior (December 11-12)

December 11

December 12

December Thaw
Above-Normal Temperatures through Thursday

Day	Weather	High	Low
Sunday	Sunny	45	35
Monday	Mostly Sunny	45	35
Tuesday	Partly Sunny	50	35
Wednesday	Record Warmth Possible	65	50
Thursday	Very Windy	40	30

National Weather Service • La Crosse, WI
weather.gov/lacrosse

**Mild... Warm...
Record Breaking?**

Day	Weather	High	Low
TODAY	Sunny	43	32
MONDAY	Partly Sunny	45	32
TUESDAY	Partly Sunny	48	35
WEDNESDAY	Record Warmth Possible	65	50
THURSDAY	Partly Sunny	40	30

National Weather Service • La Crosse, WI
weather.gov/lacrosse

First mentions of possible record warmth and windy conditions

Messaging: 3-4 Days Prior (December 11-12)



US National Weather Service La Crosse Wisconsin
 Published by John Halbach · December 12, 2021 ·

Record warmth continues to look likely for many locations on Wednesday. This table provides the record high temperature along with the probabilities for various temperatures and records occurring. [See less](#)



Record Warmth Looking Likely Wednesday

Location	Record High for December 15	Probabilities of the December 15 High Temperature					Chance of Record
		>=50°F	>=55°F	>=60°F	>=65°F	>=70°F	
Austin, MN	52°F in 1939	67%	64%	60%	45%	8%	65%
Charles City, IA	53°F in 1939	99%	86%	77%	59%	26%	98%
Decorah, IA	52°F in 1998	99%	88%	79%	52%	10%	99%
La Crosse, WI	52°F in 1923	99%	84%	79%	41%	5%	99%
Mauston, WI	55°F in 1998	99%	98%	80%	48%	7%	98%
Medford, WI	48°F in 1998	81%	68%	33%	2%	0%	82%
Oelwein, IA	57°F in 1968	100%	99%	98%	78%	33%	99%
Prairie du Chien, WI	54°F in 2006	100%	99%	99%	85%	30%	100%
Preston, MN	54°F in 1998	84%	67%	59%	40%	7%	72%
Rochester, MN	52°F in 1910	73%	63%	58%	39%	6%	66%
Sparta, WI	55°F in 1998	99%	86%	81%	50%	8%	86%
Viroqua, WI	54°F in 1998	99%	98%	86%	41%	4%	99%
Winona, MN	56°F in 1998	86%	82%	72%	46%	9%	81%



NATIONAL WEATHER SERVICE • LA CROSSE, WI



NBM 1D Viewer

Element Browser | NBM 4.0 | 2021 | 04 | undefined | 13 UTC |

Statistical Tool



Messaging: 3-4 Days Prior (December 11-12)



US National Weather Service La Crosse Wisconsin

Published by John Halbach
December 13, 2021

The High Wind Watch for Wednesday afternoon & night is only the 4th issued by NWS La Crosse since 2005. The other 3 were issued October 26-27, 2008; October 26-27, 2010; and March 15, 2016. The reason for this is that these winds (which are for non-thunderstorms) are rare for our area.

At La Crosse Regional Airport, both the sustained wind criteria (≥ 40 mph) and the wind gust criteria (≥ 58 mph) were only reached 1 hour since 2005.

At Rochester International Airport, the sustained high wind (≥ 40 mph) criteria were reached 6 hours and the wind gust criteria (≥ 58 mph) was reached 9 hours since 2005. [See less](#)

IOWA STATE UNIVERSITY
Iowa Environmental Mesonet



<https://mesonet.agron.iastate.edu/plotting/auto/?q=73>

High Wind Watches are Rare in Our Area

The High Wind Watch for Wednesday Afternoon & Night is only the 4th issued by NWS La Crosse since 2005.

For every High Wind Watch issued by NWS La Crosse, WI, we have issued 26 Wind Advisories.

High Wind Watch is issued for the potential of:

- Sustained winds of ≥ 40 mph
- Gusts of 58 mph or greater
- 4 issued since 2005

High Wind Warning is issued for Sustained winds of ≥ 40 mph

- Gusts of 58 mph or greater
- 10 issued since 2005

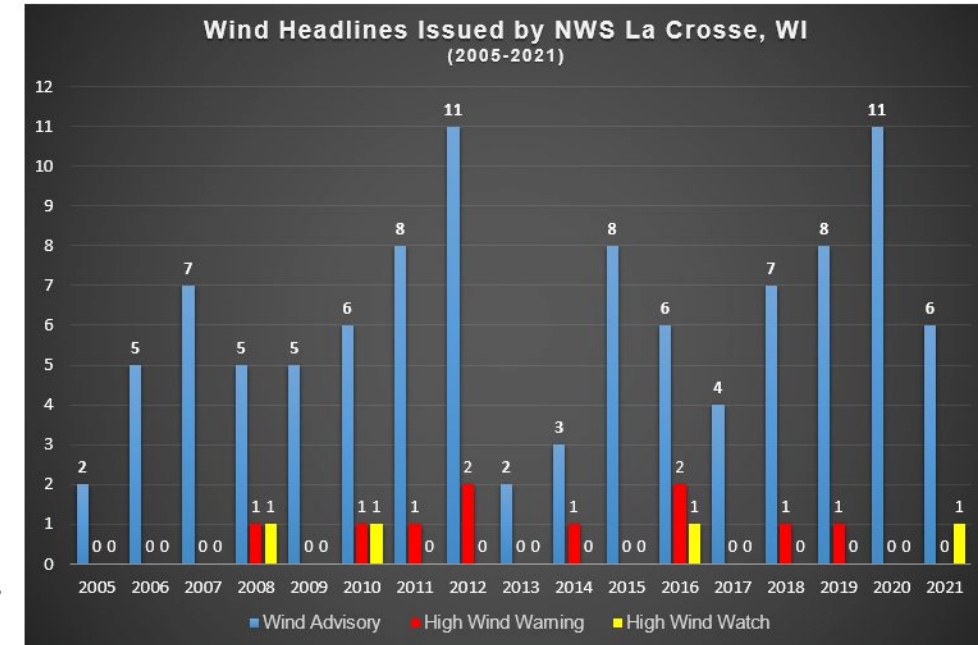
Wind Advisory is issued for

- Sustained wind of ≥ 30 mph
- Gusts of 45 mph or greater
- 104 issued since 2005

Note: These are non-thunderstorm winds.



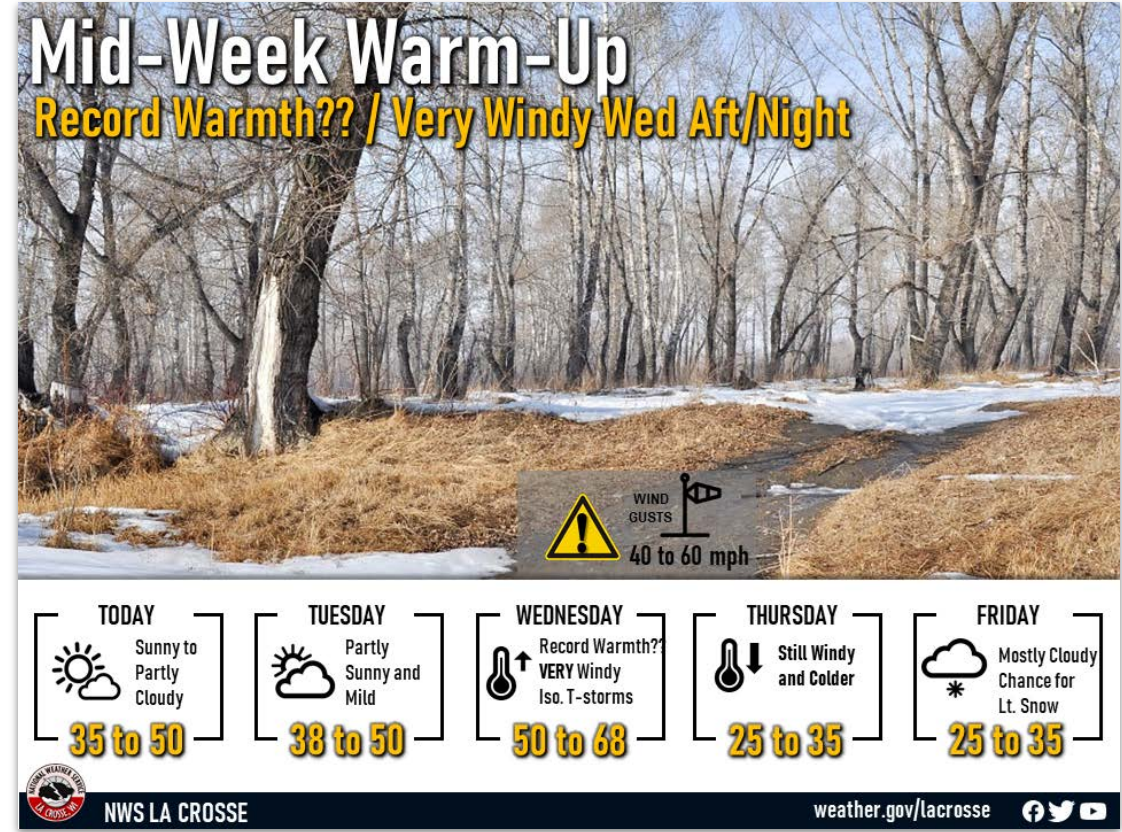
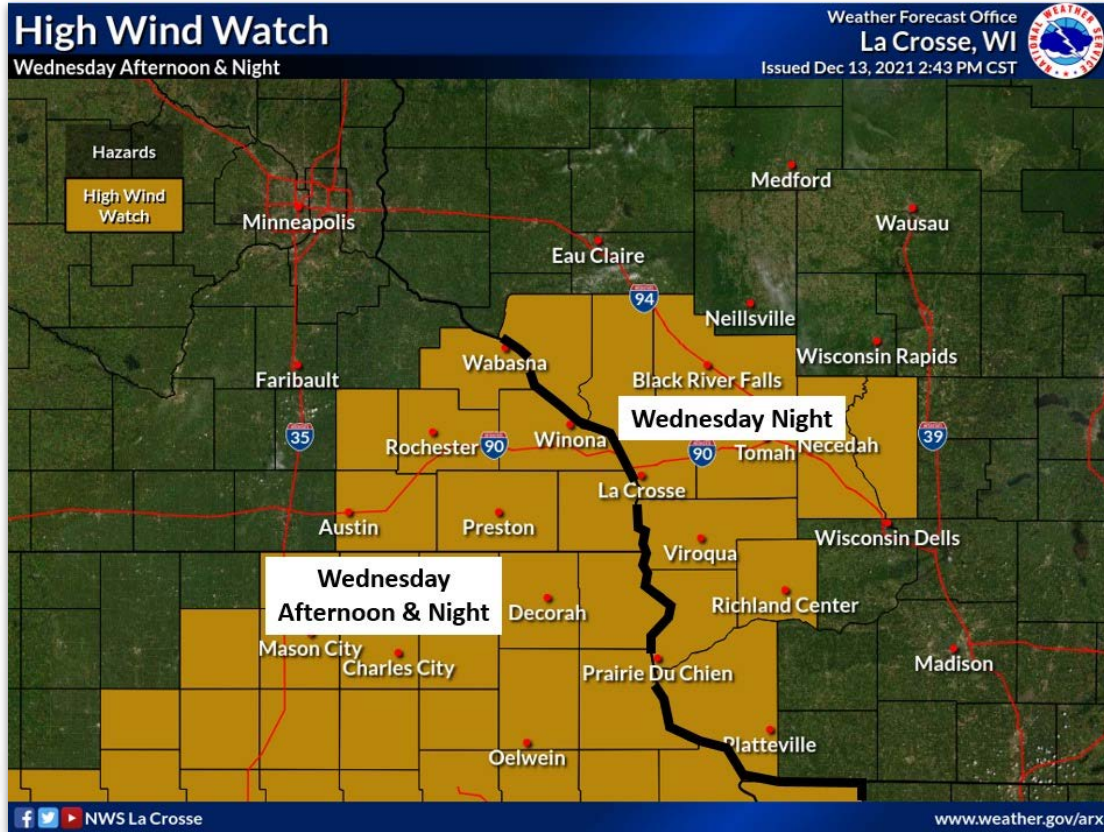
NWS LA CROSSE



weather.gov/lacrosse



Messaging: 2 Days Prior (December 13)

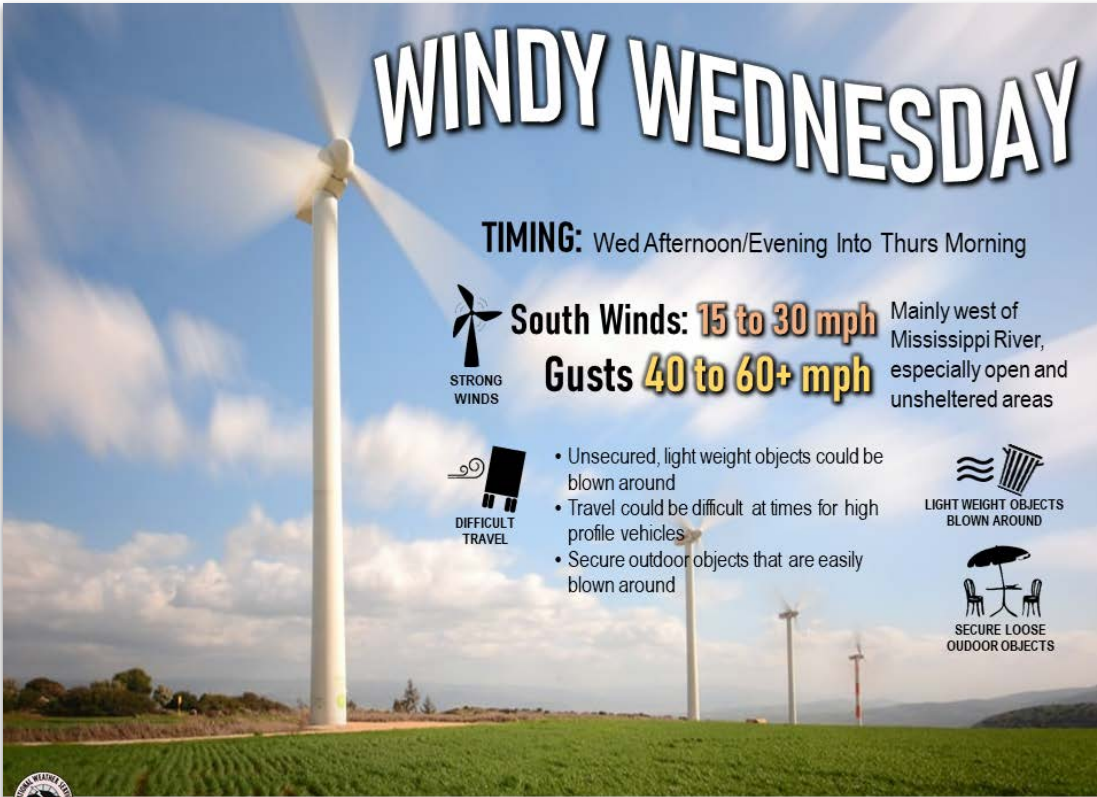


First mentions of possible high winds and thunderstorms

Messaging: 1-2 Days Prior (December 13-14)

December 13

December 14



WINDY WEDNESDAY

TIMING: Wed Afternoon/Evening Into Thurs Morning

South Winds: 15 to 30 mph Mainly west of Mississippi River, especially open and unsheltered areas
Gusts 40 to 60+ mph

STRONG WINDS

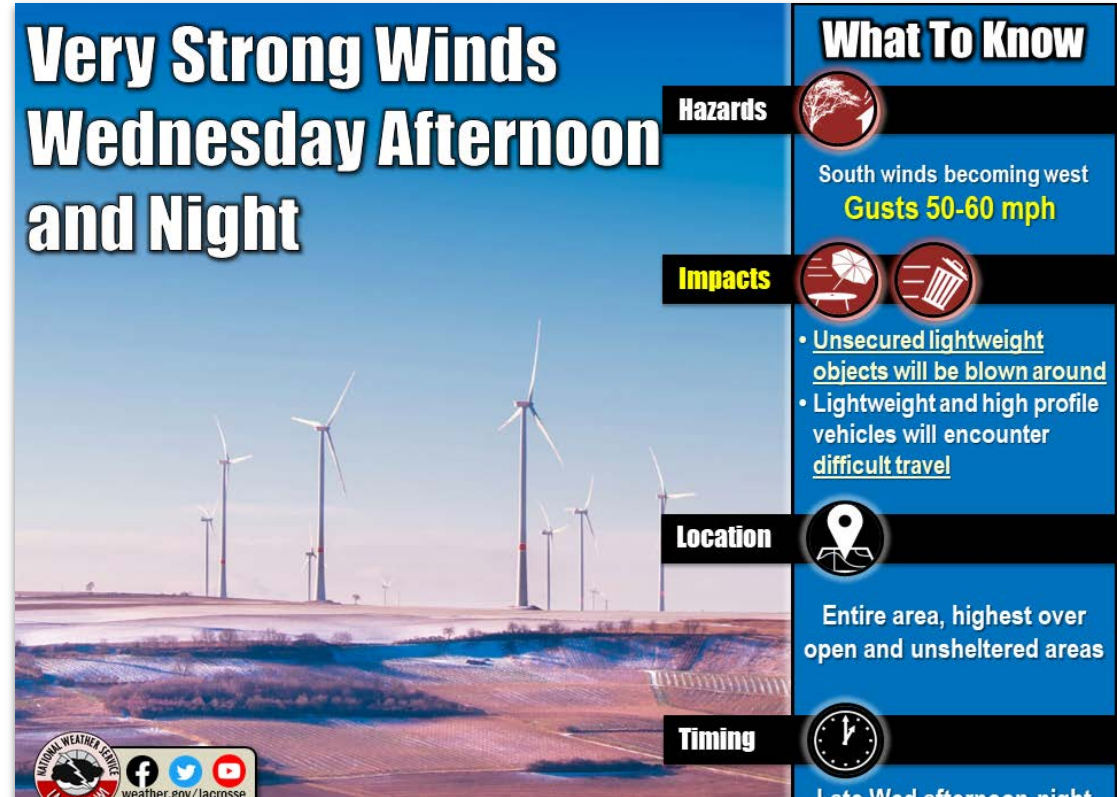
DIFFICULT TRAVEL

- Unsecured, light weight objects could be blown around
- Travel could be difficult at times for high profile vehicles
- Secure outdoor objects that are easily blown around

LIGHT WEIGHT OBJECTS BLOWN AROUND

SECURE LOOSE OUTDOOR OBJECTS

NWS LA CROSSE weather.gov/lacrosse



Very Strong Winds Wednesday Afternoon and Night

What To Know

Hazards South winds becoming west
Gusts 50-60 mph

Impacts

- Unsecured lightweight objects will be blown around
- Lightweight and high profile vehicles will encounter difficult travel

Location Entire area, highest over open and unsheltered areas

Timing Late Wed afternoon-night

NATIONAL WEATHER SERVICE LA CROSSE, WI weather.gov/lacrosse

First heightened wording for high winds and expected impacts

Messaging: 1-2 Days Prior (December 13-14)



Peak Wind Gusts Late Wednesday

December 13, 2021
3:00 PM

What

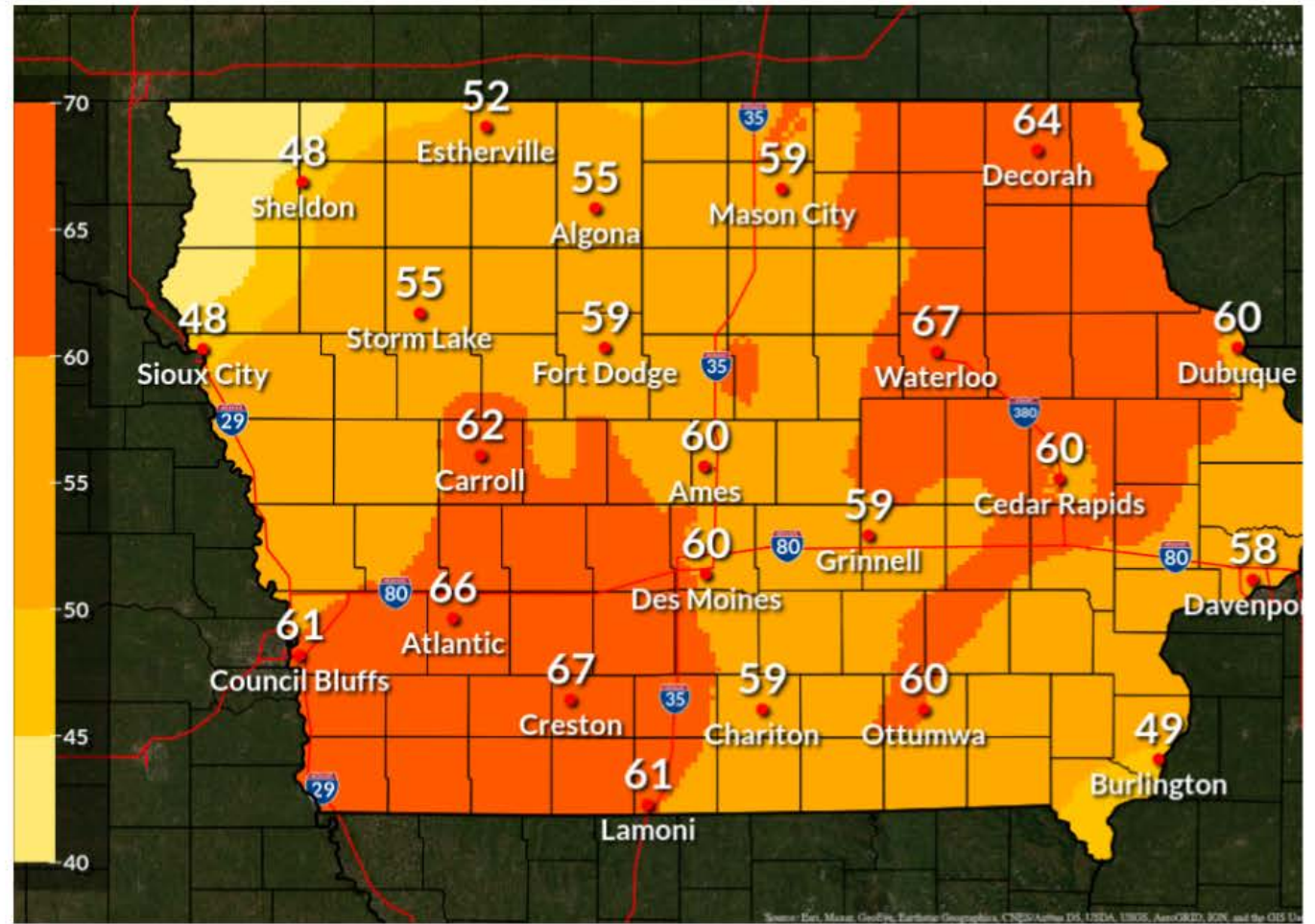
- Strong S-SW winds with sustained wind speeds of 25 to 40 mph, and gusts of 55 to 70 mph.
- Very strong winds could produce tree damage and fallen power lines with outages. Blowing dust is also possible. Travel will be especially difficult for high-profile vehicles on area interstates and highways.

Where

- Much of central Iowa

When

- Winds will be strong Wednesday, but increase sharply during the late afternoon to evening hours before diminishing toward daybreak Thursday.



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

National Weather Service
Des Moines, Iowa

Messaging: 1 Day Prior (December 14)



Strong To Severe Storms Possible Wednesday Evening

SEVERE STORM THREAT

WHAT TO KNOW

HAZARDS
Thunderstorms, some strong to severe.
Main Threat: strong, damaging winds.
Secondary Threat: isolated tornadoes

DAMAGING WIND

ISOLATED TORNADOES POSSIBLE

TIMING
6 to 10 p.m. Wed

ACTIONS

- Stay weather aware!
- Seek indoor shelter when storms approach

NWS LA CROSSE
weather.gov/lacrosse

High Wind Warning Issued

Weather Forecast Office
La Crosse, WI
Issued Dec 14, 2021 3:09 PM CST

Jason Elsing
A tad hyped up.

www.weather.gov/ax

When the Wind Blows

weather.gov/wind

First mention of severe weather possibility, high wind warning, and wind safety considerations

Messaging: 1 Day Prior (December 14)



Wind Gust Speed & Timing Wed

December 14, 2021
3:16 PM

Central Iowa Forecast: Strongest Winds in the Evening But Windy All Day

Key Points

- Windy all day Wednesday. Significant gusts increase in the afternoon and through the evening.
- Travel will become extremely difficult in the afternoon and evening, especially for high profile vehicles (extreme danger to semis, buses, etc)
- Any thunderstorms will enhance wind gusts and could approach 80+ mph

Maximum Wind Gust Forecast

	12/15 Wed											12/16 Thu										
	8am	9am	10am	11am	12pm	1pm	2pm	3pm	4pm	5pm	6pm	7pm	8pm	9pm	10pm	11pm	12am	1am	2am	3am	4am	5am
Ames	25	30	33	38	39	39	43	43	47	52	58	64	66	63	60	54	49	47	44	41	37	32
Atlantic	29	31	35	39	40	44	46	49	55	59	63	64	60	54	48	44	40	37	33	31	29	28
Creston	32	36	40	40	41	46	49	53	56	61	66	69	67	62	56	49	44	37	35	33	31	28
Des Moines	26	30	32	37	37	39	41	45	49	54	58	63	63	60	59	53	48	44	39	36	33	31
Estherville	23	26	30	33	36	38	39	41	43	46	53	58	55	58	54	54	52	49	44	40	38	36
Fort Dodge	26	30	33	37	38	38	40	41	46	54	59	61	60	59	56	53	49	46	43	40	36	32
Marshalltown	28	33	36	39	39	41	43	43	46	49	56	64	66	63	61	56	51	47	43	40	37	33
Mason City	24	29	32	36	37	37	39	40	43	44	48	58	58	56	58	56	54	51	48	46	43	38
Ottumwa	28	32	36	39	39	39	41	43	43	45	51	56	59	55	53	51	46	44	38	33	30	26
Waterloo	26	31	33	38	38	39	40	41	43	44	47	54	60	61	61	60	56	51	45	41	38	35

Current Forecast Peak Wind Gusts in mph



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

National Weather Service
Des Moines, Iowa

Source: Forecast Sampler (DLH)

Messaging: Morning Prior (December 15)



Dense Fog This Morning

EXPECT:

- **Visibility 1/4 mile or less**
- Mainly in southeast Minnesota through central and north-central Wisconsin and along ridge tops. Visibility gradually improving mid to late morning from the south.

IMPACTS:

- Motorists...
 - Use low beam headlights
 - **Slow down**
 - Leave extra distance between you and vehicle in front of you
 - Anticipate rapid reductions in visibilities

NATIONAL WEATHER SERVICE
LA CROSSE, WI



HISTORIC DANGEROUS WINDS

This Evening - Overnight

South Becoming West: 25 to 40 mph
⇒ **Gusts: 50 to 65 mph**

IMPACTS

- **DIFFICULT TRAVEL**
- **TREE DAMAGE**
- **POWER OUTAGES LIKELY**
- **UNSECURED OBJECTS BLOWN AROUND**

IMPACTS

- Unsecured, lightweight objects (including holiday decorations) **will be blown around.**
- **Difficult to hazardous travel**, especially for high profile vehicles.
- Tree damage and **power outages likely.**

WHAT TO DO

- **PREPARE FOR POWER OUTAGES!** Could be prolonged!
- Bring unsecured objects inside.
- **Traveling?** Be ready for difficult to hazardous conditions!

weather.gov/lacrosse

National Weather Service • La Crosse, WI

- Historic event
- Dec SVR warnings are **rare**
- Line of **fast-moving** strong to severe storms
- Damaging winds to 70 mph, isolated tornadoes
- **Exceedingly rare** December moderate risk
- **Enhanced damaging winds 70-80+ mph**
- **Cannot emphasize enough the unusual nature of this event**
- **Strong tornadoes possible**

Safety Messaging: Morning/Afternoon Prior

Preparing for Power Outages in Winter

- Fully charge cell phones and other devices in advance.
- Flashlights are safer than candles. Have extra batteries on hand.
- Only use portable generator outdoors (not even in garage) with adequate ventilation. NEVER heat home with gas stove/oven.
- Close off unneeded rooms and cover windows to conserve heat. Stuff towels under doors. Have extra blankets handy.
- Have ample supply of nonperishable food, drinking water, and medications for each person and pet.
- On a well? Fill extra buckets of water for washing up and flushing toilets.

NATIONAL WEATHER SERVICE • LA CROSSE, WI

Have multiple ways to get warnings
weather.gov

Preparing an Emergency Kit

Keep this kit in your safe room.

MUST Have Supplies

- First Aid Kit
- Phone/Charger
- NOAA Weather Radio
- Water
- Non-Perishable Food
- Flashlight
- Batteries
- Whistle (to signal help)

Additional Supplies

- Extra Infant Food
- Pet Supplies
- Books/Games
- Extra Cash
- Fire Extinguisher
- Important Records
- Change of Clothes

High Wind Safety Tips

- Provide plenty of space between you and other vehicles, especially high profile vehicles such as semis and school buses
- Secure loose outdoor objects like lawn furniture, trash cans, holiday decorations
- Avoid power lines and tall trees or any potential falling hazard
- Use two hands on the steering wheel! That means put the phone down!
- Head inside and stay away from windows



NATIONAL WEATHER SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Severe Weather can escalate quickly.

While the possibility of tornadoes can be forecast ahead of time, they can form in minutes, day or night. Will you be prepared?

- Set up a way to get weather warnings any time of day
- When alerted to a tornado, quickly get to a storm shelter or basement
- If underground shelter isn't available, get to an interior hall away from windows



weather.gov

Tornado Sheltering Guidelines

Seek the best available refuge area **immediately** when a Tornado Warning is issued. Your chance of surviving a tornado is excellent if you follow these guidelines.

WORST OPTIONS	BAD OPTIONS	GOOD OPTIONS	BEST OPTIONS
Mobile homes Vehicles Underneath a highway overpass	Large open rooms like gymnasiums Manufactured housing	Interior room of a well-constructed home or building Basement	Above or below ground Tornado Storm Shelter (NNSA/ICC 500 compliant)* Specifically-designed FEMA Safe Room*

Find another option → Stay in place until all clear

PHOTO: U.S. Air Force Tech Sgt. Wesley C. Chertel *Recommended by FEMA

Messaging: As Event Unfolds



US National Weather Service La Crosse Wisconsin

Published by Hootsuite · December 15, 2021 ·

We cannot emphasize enough the unusual nature of this event. A risk this high for severe weather in December has never occurred before this far north. Storms will have the potential to produce 70 mph wind gusts with isolated gusts of 80 mph or higher possible. Tornadoes will be possible and a strong tornado could occur. If warnings are issued for your location, DO NOT take time to validate that a storm is occurring. Instead, take shelter immediately! The storms will likely be moving at 60 to 70 mph and if you delay seeking shelter, the storms could hit your location before you are safe. See less

SEVERE STORMS EXPECTED THIS EVENING

TIMING: 6 to 11 pm

What

- Very fast moving line of strong to severe storms will race eastward at 60-70 mph through the area this evening
- Enhanced damaging wind gusts to 70 mph likely
 - *Isolated gusts of 80 mph or higher possible*
- Tornadoes will be possible
 - *A strong tornado could occur*

What To Do?

- ✓ Stay Weather Aware!
- ✓ Take shelter immediately if a warning is issued for your location!
- ✓ Have multiple ways to receive warnings
- ✓ Be prepared for power outages
- ✓ Seek shelter in interior room on lowest level away from windows



DAMAGING WINDS



ISOLATED TORNADOES



PLAN NOW!



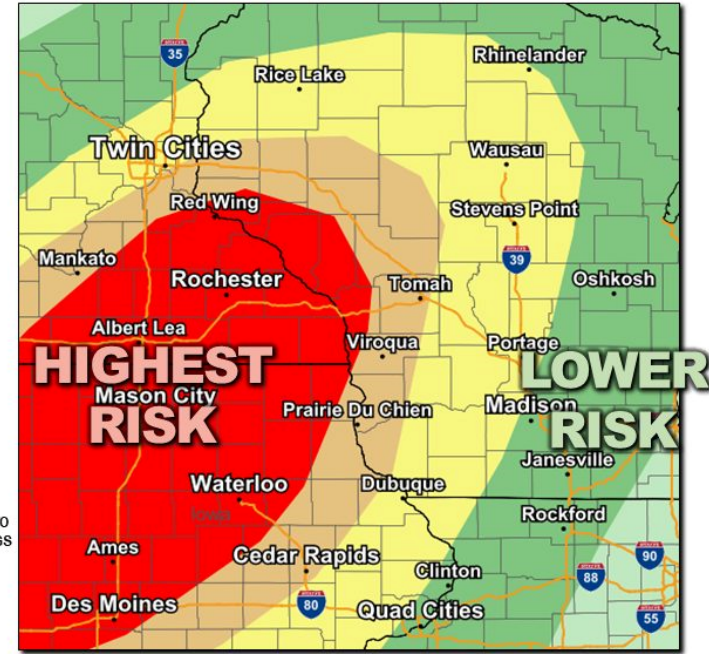
MULTIPLE WAYS TO RECEIVE WARNINGS



TREE DAMAGE



POWER OUTAGES

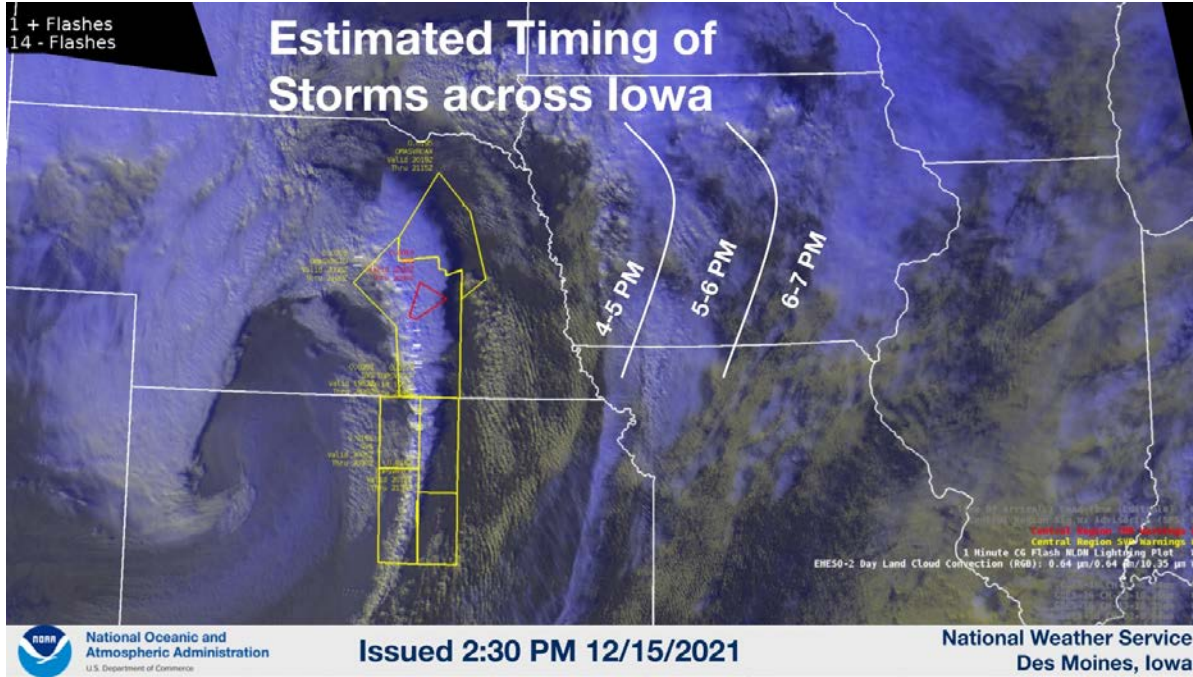


National Weather Service • La Crosse, WI

weather.gov/lacrosse



Messaging: As Event Unfolds



Severe Thunderstorm Risk/Timing
December 15, 2021 2:08 PM

Overview
Storms racing east/northeast at 60-70 mph through the region. Storms will affect a given location for only 20 minutes.

Actions
Be weather aware and ready to act. Have multiple ways to receive warning information!

Severe Threats

- Tornado: Lo, Med, HI
- Hail: Lo, Med, HI
- Wind: Lo, Med, HI
- Flooding: Lo, Med, HI

Severe Weather Outlook Wednesday, December 15, 2021

7 pm, 9 pm, 11 pm

High Risk, Moderate Risk, Enhanced Risk, Slight Risk, Marginal Risk, Thunderstorms

National Weather Service
La Crosse, Wisconsin

SEVERE STORMS EXPECTED
Weather Update - through 8 pm

What to Expect

- Very fast moving line of SEVERE storms producing 60 to 80 mph wind gusts
- Tornadoes possible
- Storms impact a given location for less than 1/2 hour

What To Do?

- Stay Weather Aware!
- Take immediate shelter when storms near your location

INDOOR SHELTER

AREA OF CONCERN

Twin Cities, Rochester, La Crosse, Madison, etc.

DAMAGING WIND GUSTS TO 80 MPH

TORNADOES POSSIBLE

NWS LA CROSSE
weather.gov/lacrosse

SEVERE STORMS MOVING THROUGH AREA

Radar at 8:09 PM

What to Expect Through 10pm

- Very fast moving line of SEVERE storms producing 60 to 80 mph wind gusts
- Tornadoes possible
- Storms impact a given location for less than 1/2 hour

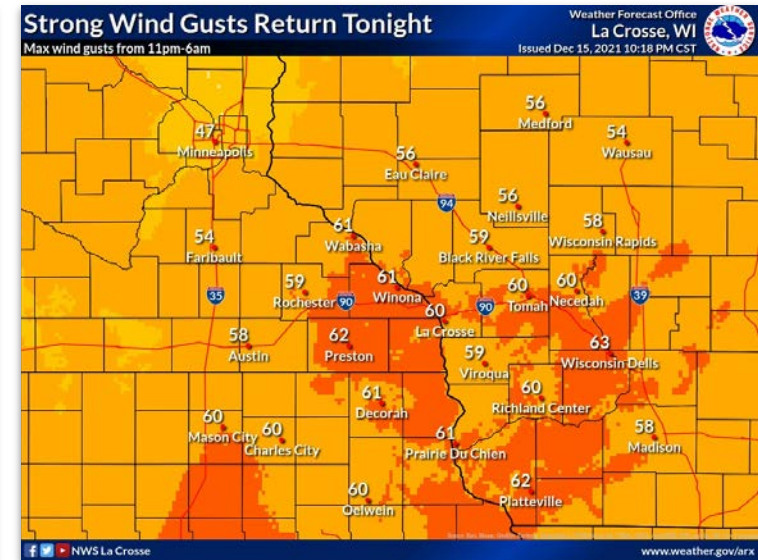
Threats?

SMALL HAIL, DAMAGING WIND GUSTS TO 80 MPH, TORNADOES POSSIBLE

What to Do?

- Stay weather aware!
- Seek shelter in your safe place as storms approach.

National Weather Service - La Crosse, WI
weather.gov/lacrosse



References

Climate Prediction Center

- [6 to 10 Day Outlooks](#)
- [8 to 14 Day Outlooks](#)
- [6-10 & 8-14 Day Data & Graphics Archive](#)
- [U.S. Week 2 Hazards Outlook](#)
- [U.S. Hazards Archive](#)

[Damage Assessment Toolkit](#)

[Day 3-7 Cluster Prototype Page](#)

ECMWF Ensemble Wind Gust Plots

- [WeatherBELL](#)
- [WEATHERMODELS.COM](#)

Forecast Sampler (DLH)

- [Web Site](#)
- [Documentation](#)

Iowa Environmental Mesonet

- [Main Page](#)
- [Daily Past Features](#)
- Automated Data Plotter
 - Number of Watch/Warnings/Advisories Issued per Year ([#73](#))

Midwestern RCC

- [cli-MATE Sub-Daily Threshold Search](#)
- [Tornado Tracks Tool](#)

[NBM 1D Viewer](#)

NWS Central Region Presentations

- [Dec 15-16, 2021 Megastorm](#) (Andrew Just)
- [Dec 15-16, 2021 Storm](#) (Andrew Just)

Storm Prediction Center

- [Hourly Mesoscale Analysis Archive](#)
- [High Resolution Ensemble Forecast version 2 \(HREFv2\)](#)
- [Severe Weather Climatology \(1982-2011\)](#)
- [Severe Weather Event Archive](#)

Weather Prediction Center

- [NBM Forecast Records](#)
- [Ensemble Situational Awareness Tables](#)
- [Ensemble Situational Awareness Table NAEFS Percentile](#)
- [ECMWF Extremes Forecast Index & Shift of Tails](#)
- [Weather in Context Prototype](#)