Extreme Weather and Resilience Workshop

CITY OF SHREVEPORT
UNION • JUSTICE
CONFIDENCE
LOUISIANA

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Workshop Goals

- Identify weather-related risks for the City of Shreveport
- Identify ways to prepare for and respond to extreme temperatures, damaging wind events, flooding, and other hazardous weather conditions
- Explore mitigation options and funding opportunities that can help the city reduce future risks

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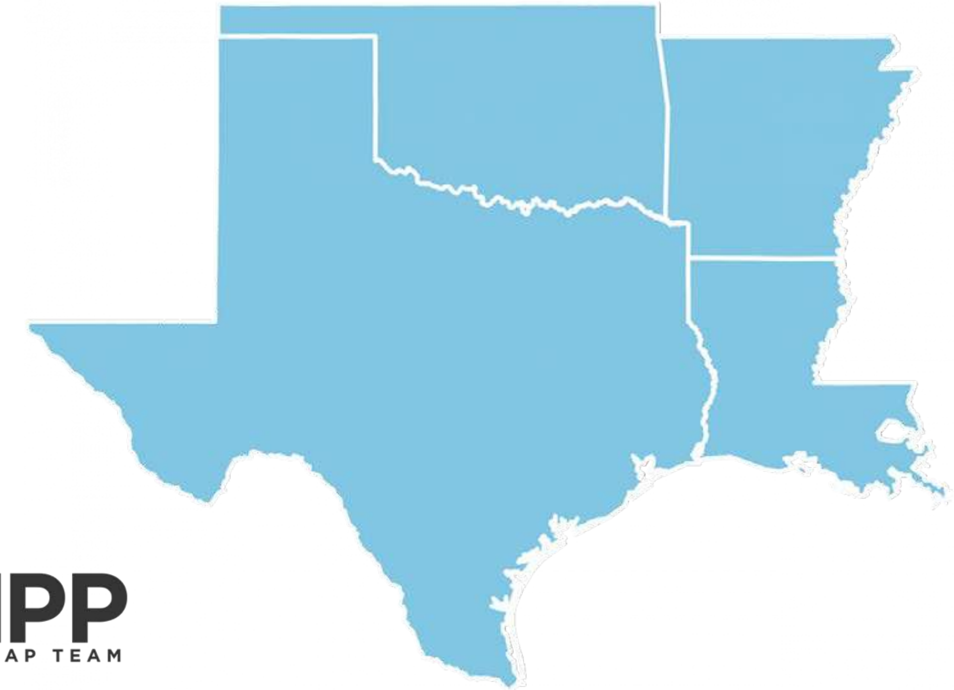
About SCIPP

- Mission: To assist organizations with decision-making that builds resilience by collaboratively producing research, tools, and knowledge that reduces weather and climate risks and impacts across the South-Central United States



LSU

adaptation international

Sea Grant Texas

AT TEXAS A&M UNIVERSITY

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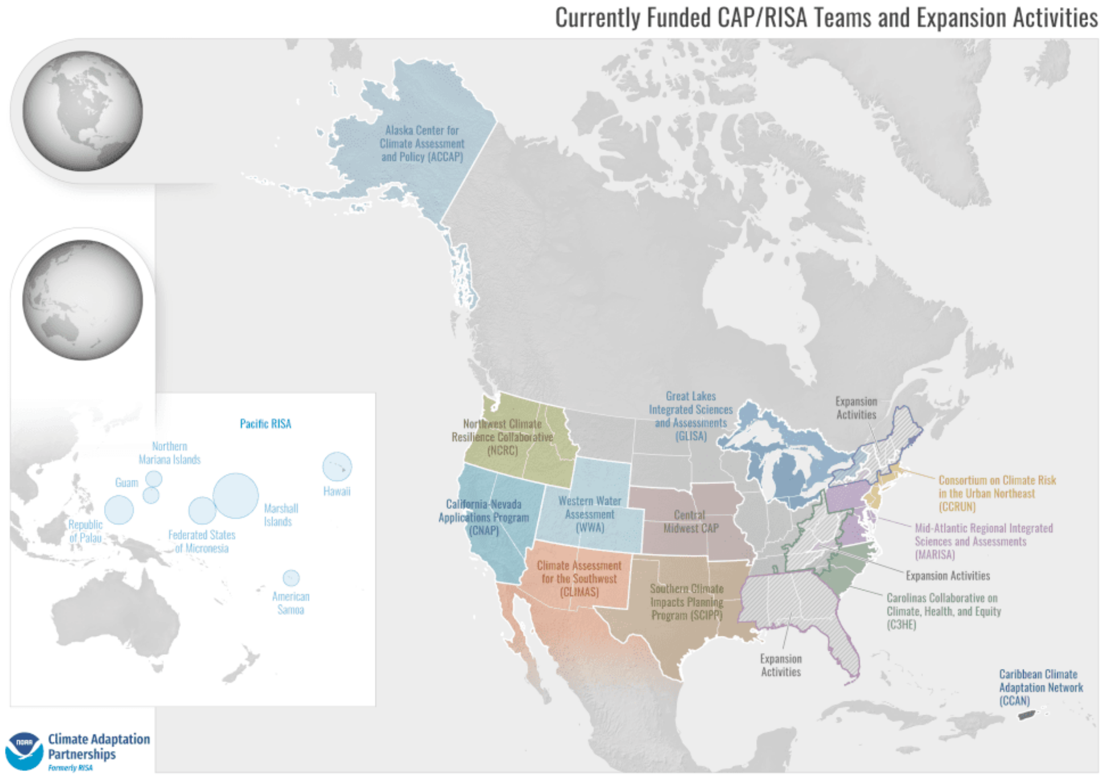
Climate Adaptation Partnerships (CAP)

Formerly RISA

- One of 13 regional teams funded by NOAA
- Address local needs by providing relevant scientific expertise and resources
- Each team partners with multiple private and public sector organizations across their regions



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Agenda

- Day 1: How does extreme weather impact Shreveport?
  - Flooding & Rainfall
  - Extreme Temperatures
  - Damaging Wind Events

- Day 2: What can we do about it?
  - Hazard Planning
  - Homes & Businesses
  - Protecting People

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Extreme Weather and Resilience Workshop Agenda

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Day 1
March 17th

Location
Sci-Port Discovery Center
Shreveport, LA

Workshop Begins
8:30 AM

Workshop Ends
1:00 PM

TIME	TOPIC
8:30 - 9:00	Light Breakfast
9:00 - 9:10	Welcome & Introductions
9:10 - 10:00	Flooding & Rainfall
10:00 - 10:10	Break
10:10 - 11:00	Extreme Temperatures
11:00 - 11:10	Break
11:10 AM - 12:00 PM	Damaging Wind Events
12:00 - 1:00	Working Lunch (Provided)

Day 2
March 18th

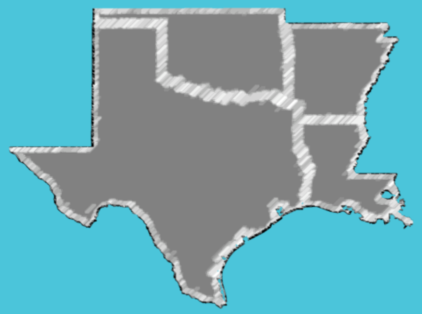
Location
Sci-Port Discovery Center
Shreveport, LA

Workshop Begins
8:30 AM

Workshop Ends
1:00 PM

TIME	TOPIC
8:30 - 9:00	Light Breakfast
9:00 - 9:10	Welcome & Introductions
9:10 - 10:00	Hazard Planning
10:00 - 10:10	Break
10:10 - 11:00	Protecting Homes & Businesses
11:00 - 11:10	Break
11:10 AM - 12:00 PM	Protecting People
12:00 - 1:00	Working Lunch (Provided)

SCIPP Phase IV: Planning for Long Term Change in a Short-Term World



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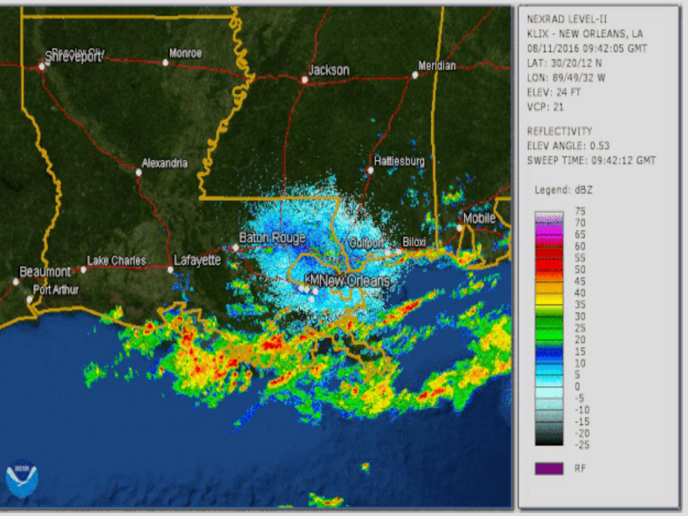

Precipitation Characteristics of Shreveport, LA

by:
Dr. Vincent M. Brown

LSU

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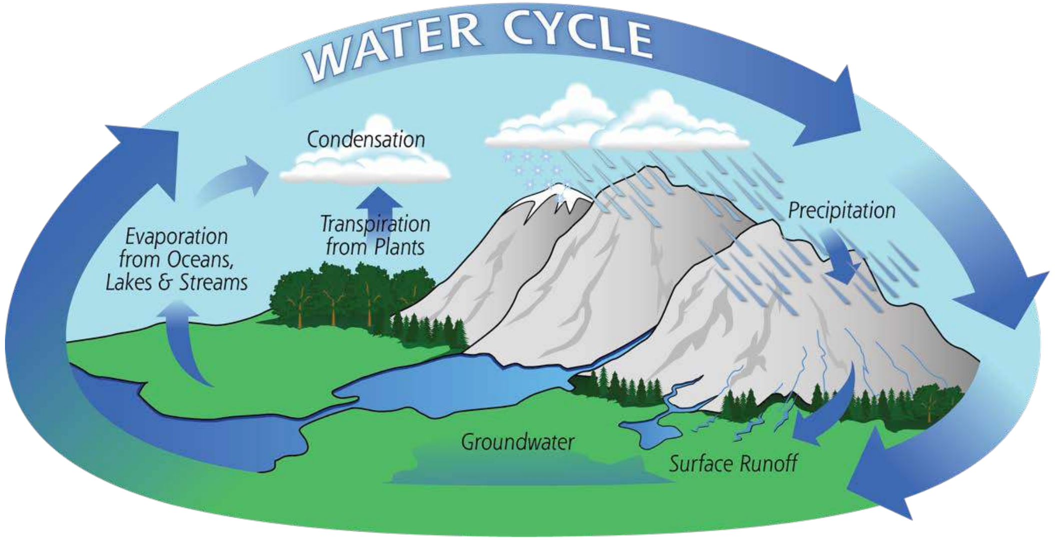
Agenda

Precipitation Characteristics

1. Annual Accumulation, Days, and Hours
2. Contribution of Heaviest Events
3. Intensity
    1. Daily + Hourly
4. Consecutive Dry Days
    1. Drought Severity
5. Potential Future Changes
6. Applications



Goal:
Spark discussion on challenges with precipitation (or lack of precipitation) and see if we can help!

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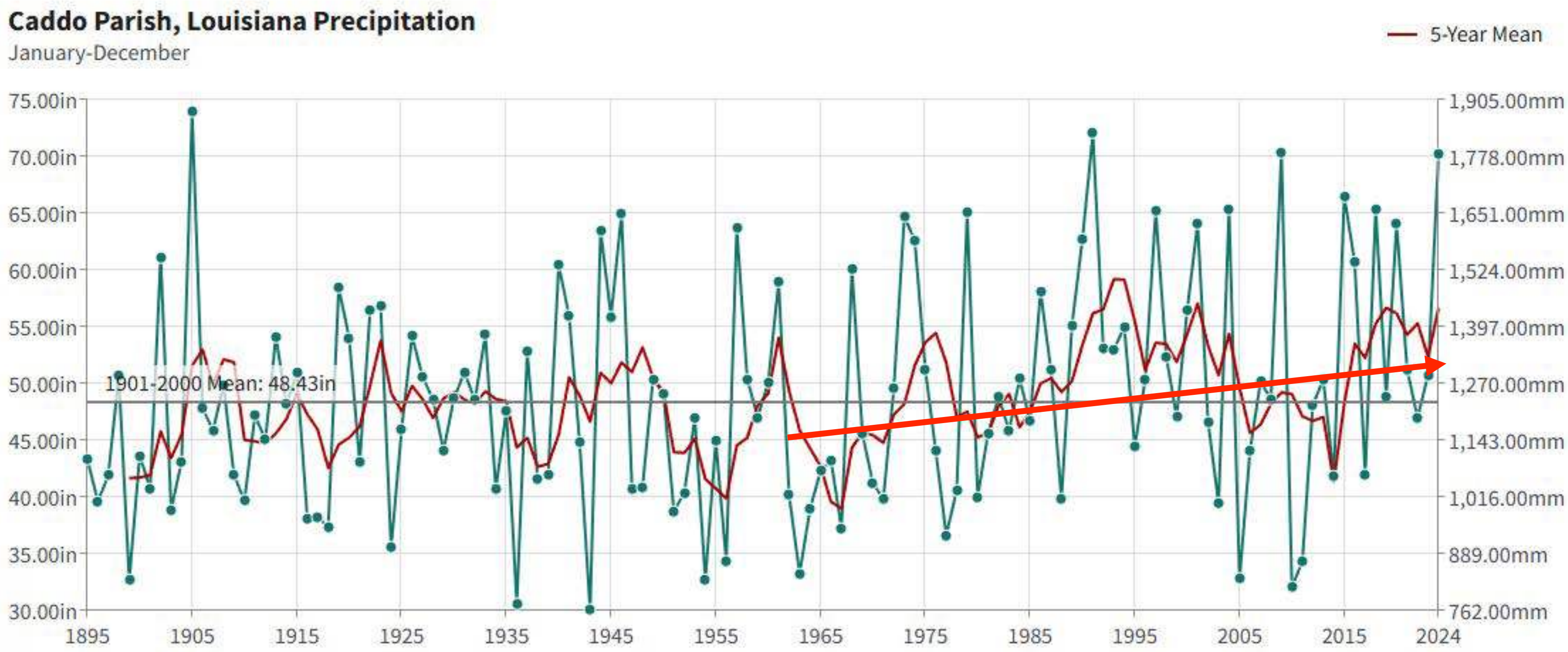
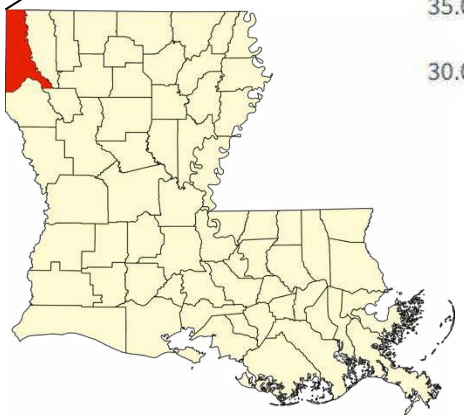
Annual Accumulation, 1895-2024

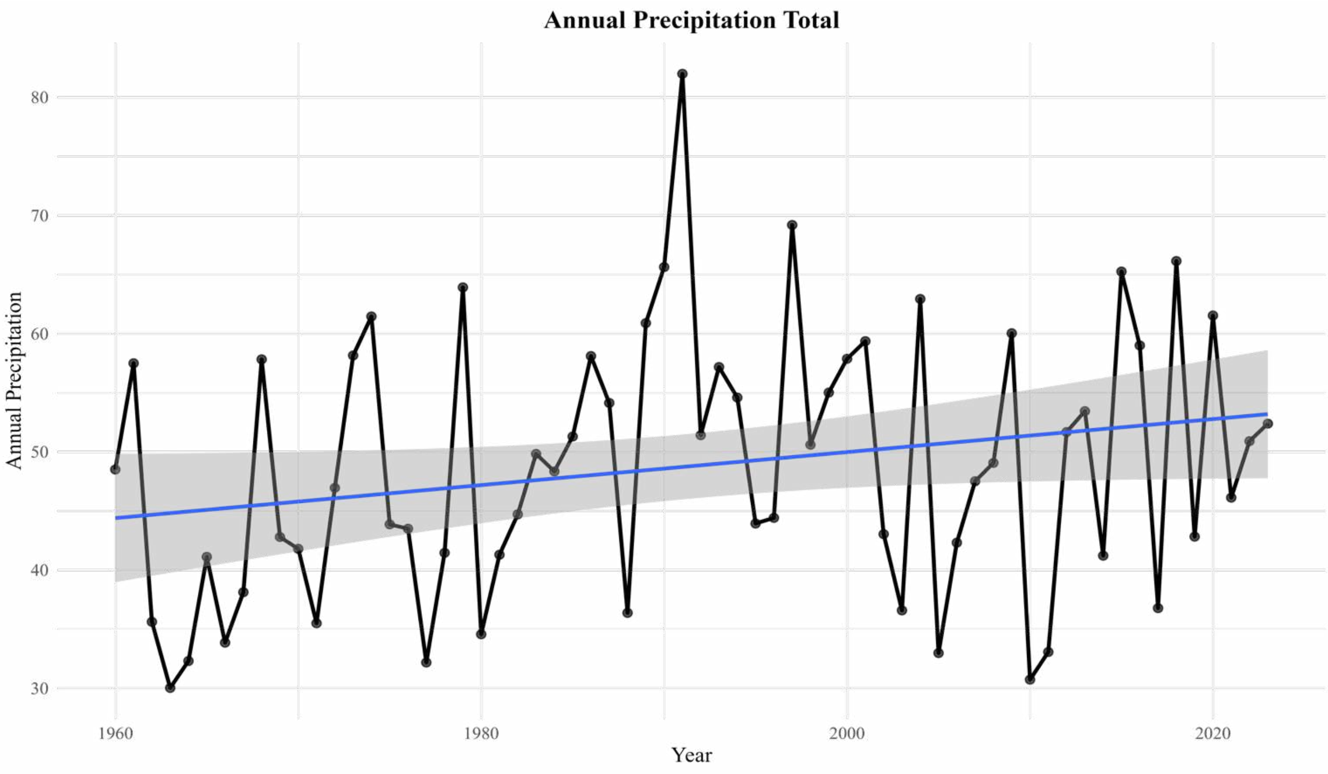


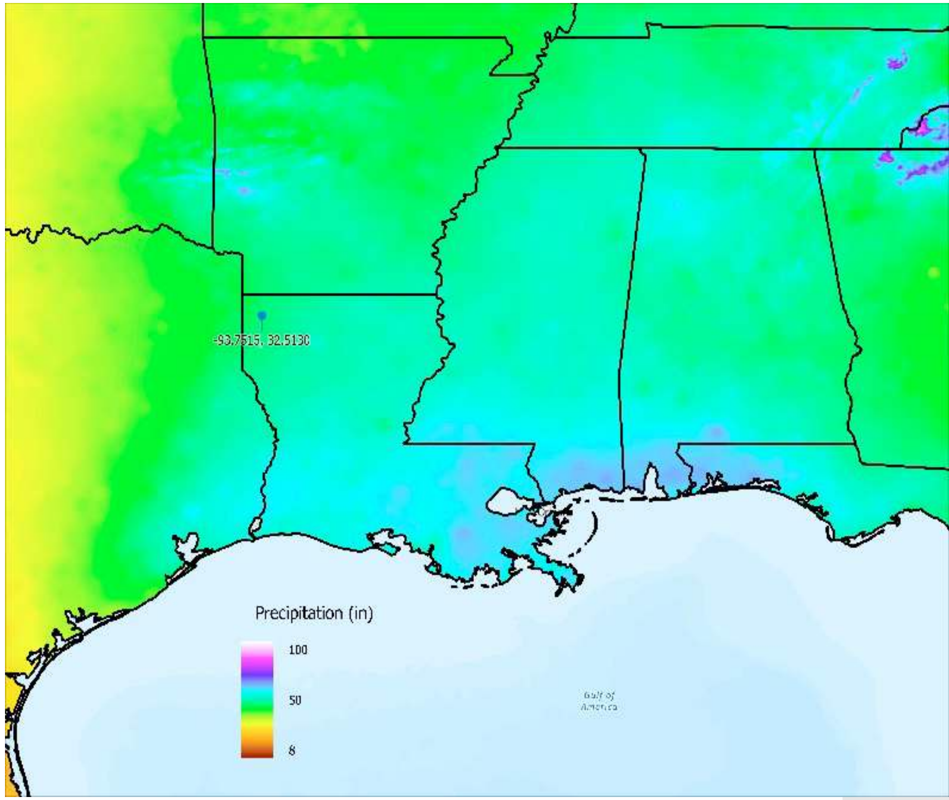


Top Five Wettest = 73.93 (1905), 72.05 (1991), 70.39 (2009), 70.20 (2024), 66.51 (2015)

Top Five Driest = 30.04 (1943), 30.66 (1936), 32.05 (2010), 32.72 (1899), 32.73 (1954)

Annual Accumulation, 1960–2023





Since 1960, slight increase in annual accumulation (~6 in last 64 years).

In the driest area of the wettest state!

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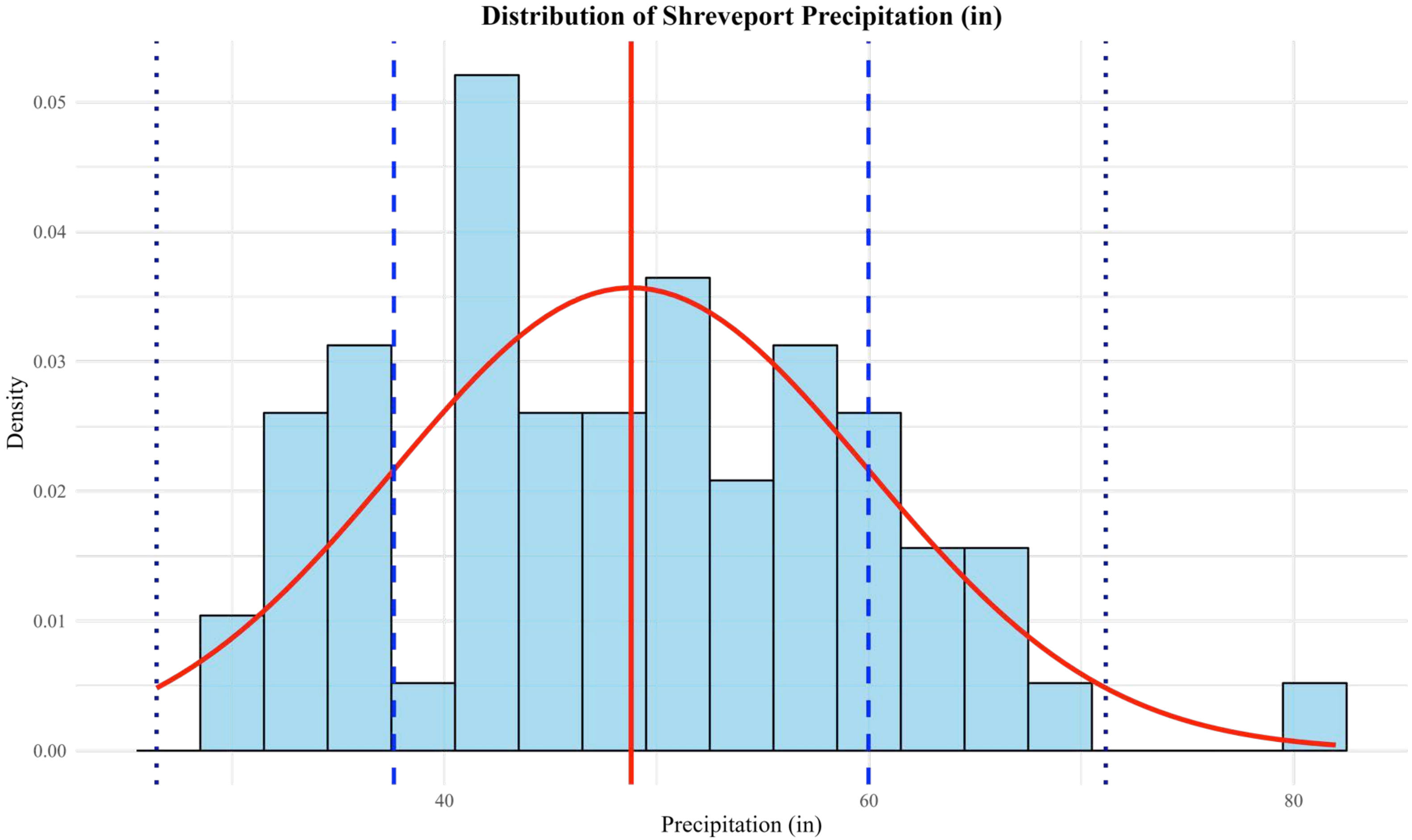
Annual Accumulation



Average Annual = 48.69″, std = 11.18″,
68% of years between: 37.61–59.95,
95% of years between: 26.33–71.05,
*recent notable years: 1991 (81.99″), 2024 (72.46″)

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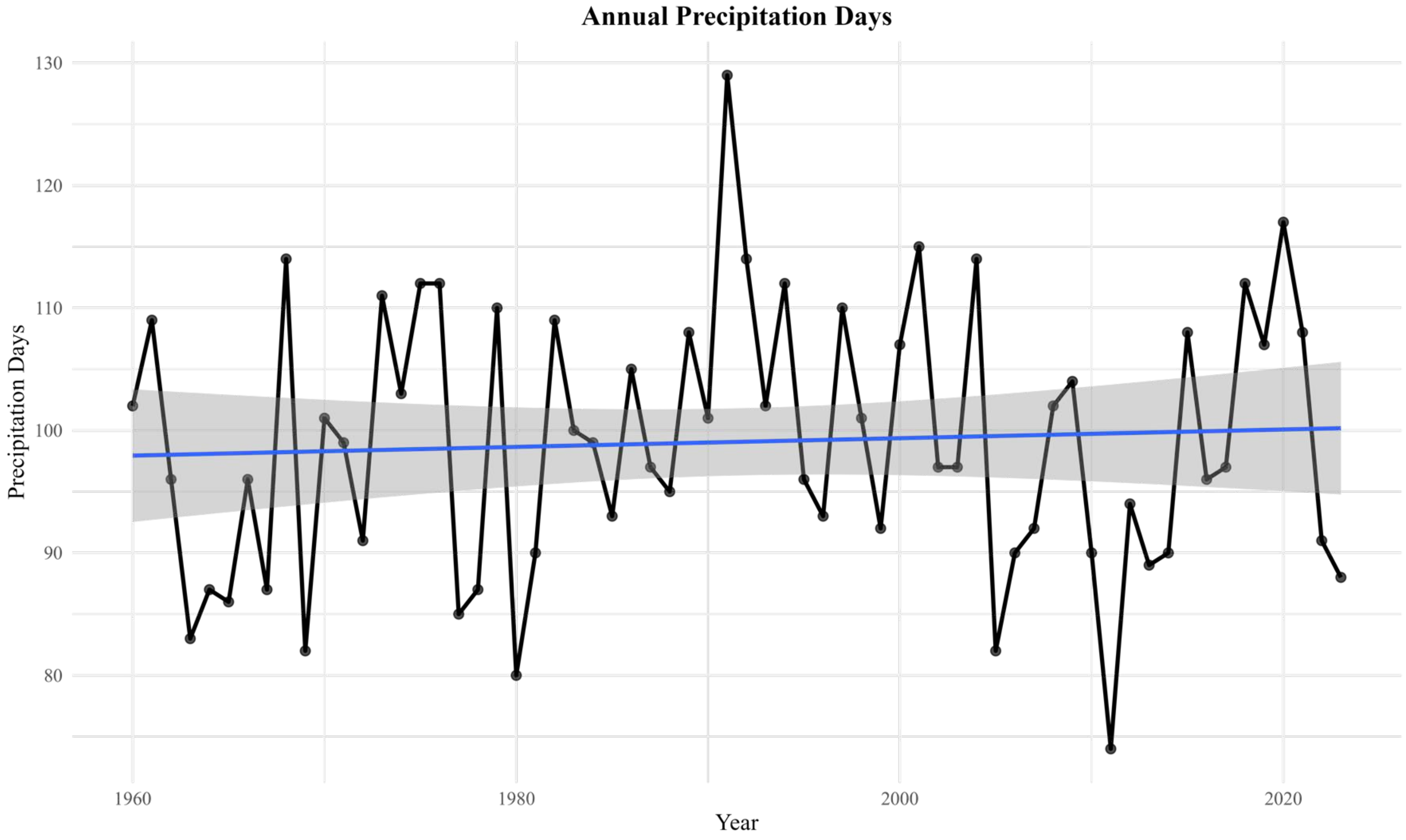
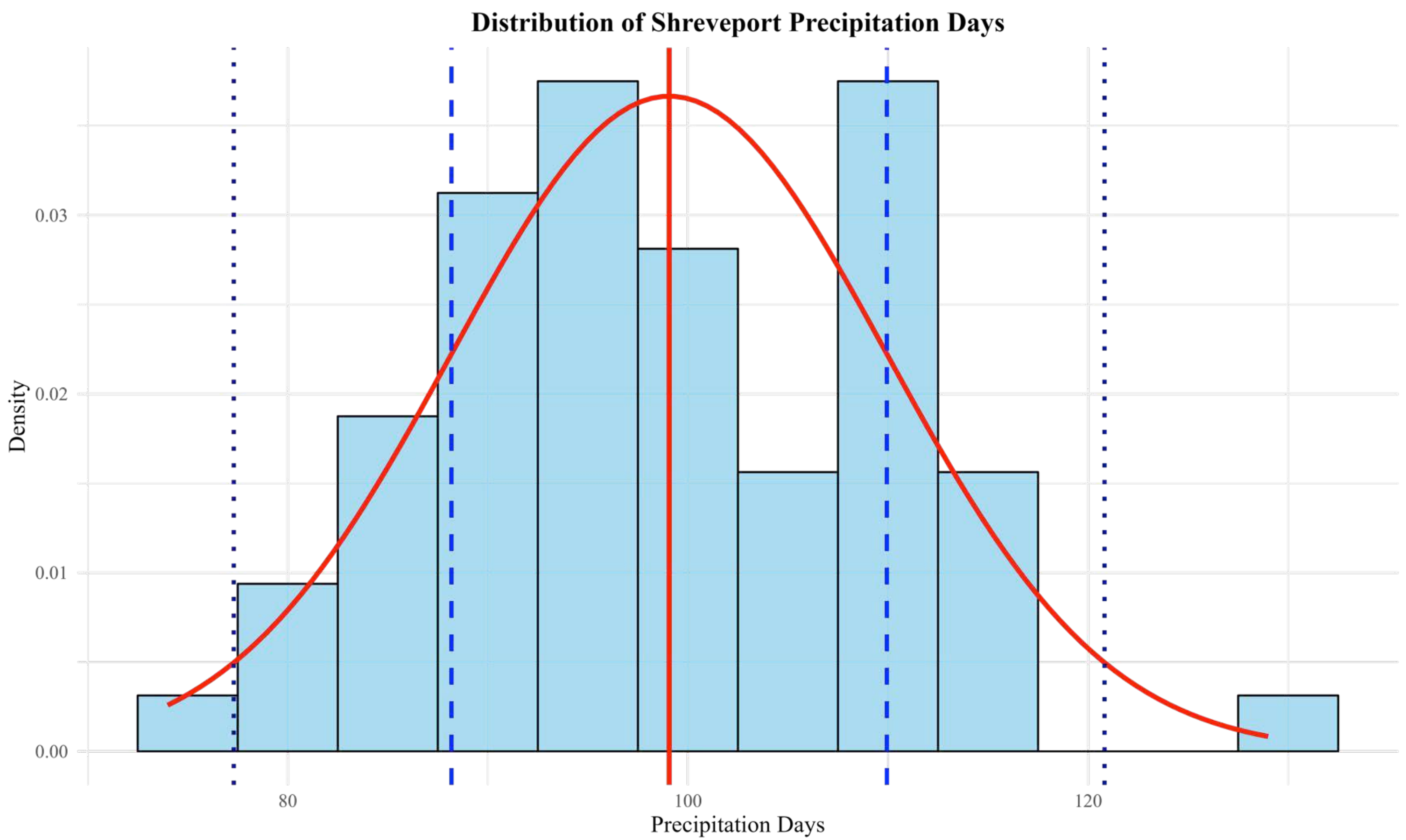
Annual Precipitation Days



No observable trend in the number of days it precipitates per year (1960–2023).

Annual Precipitation Days, 1960–2023



Precipitation Days = 99 y, std = 11,
68% of years between 88–110,
95% of years between 77–121,
Max = 129 (1991), Min = 74 (2011).

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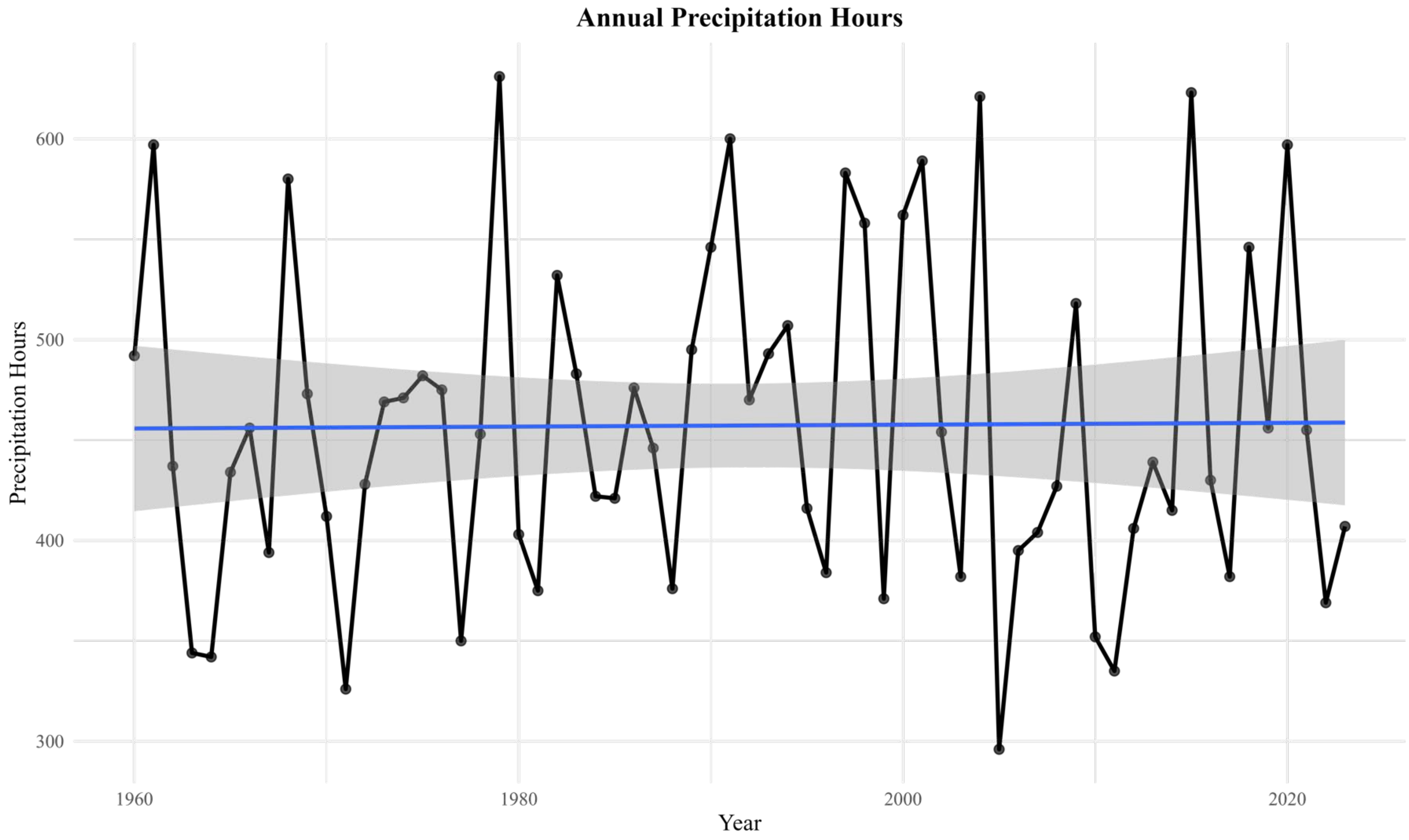
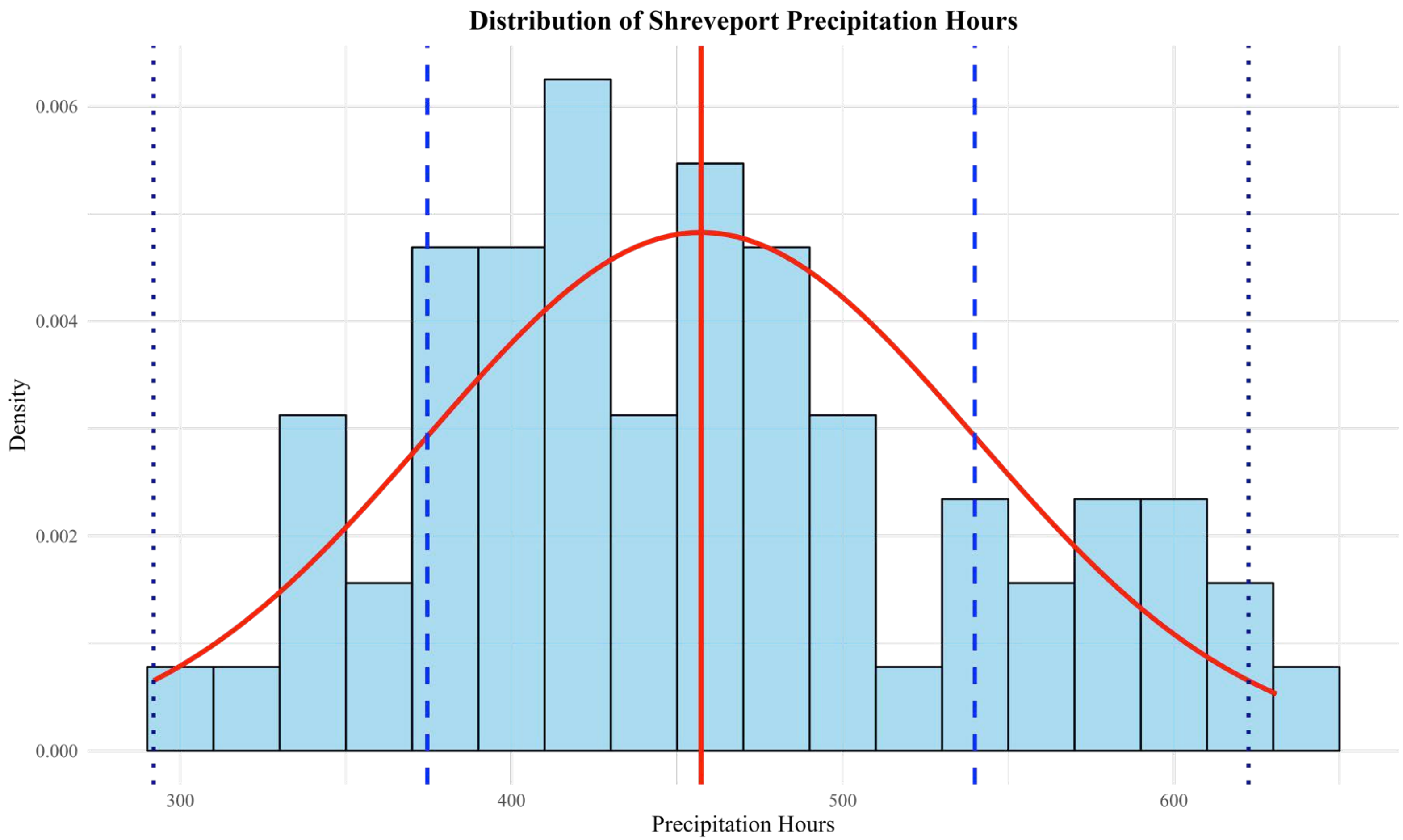
Annual Precipitation Hours



No statistically significant trend in precipitation hours per year (1960–2023).

Annual Precipitation Hours



Precipitation Hours = 457 y, std = 82.65,
68% of years between 374–540,
95% of years between 209–622,
Max = 631 (1979) , Min = 296 (2005)

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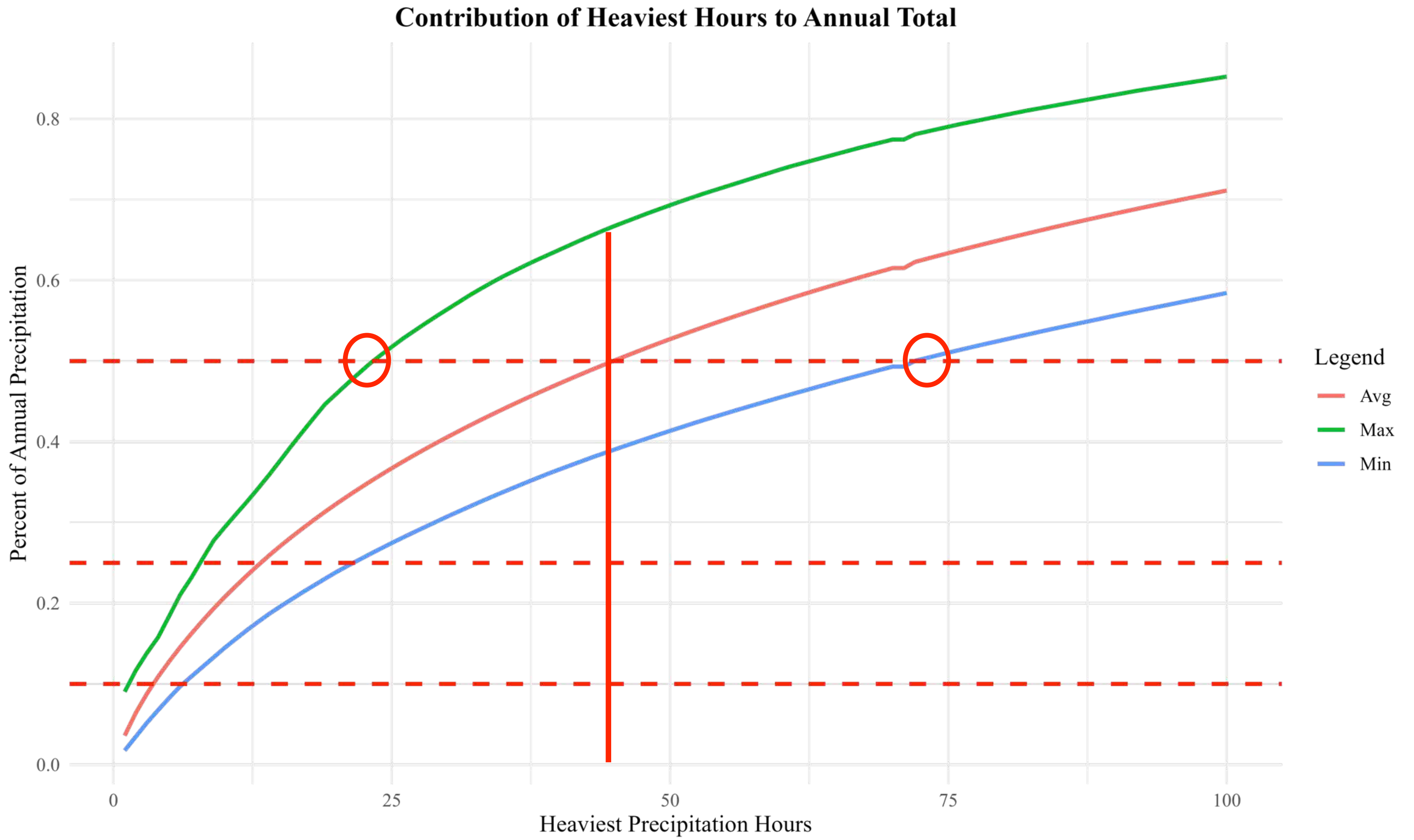
Contribution of Heaviest Precipitation



10% of annual total in heaviest 4 hours (1–6)

25% of annual total in heaviest 13 hours (8–22)

50% of annual total in heaviest 44 hours (23–70) → 0.5% of annual time!

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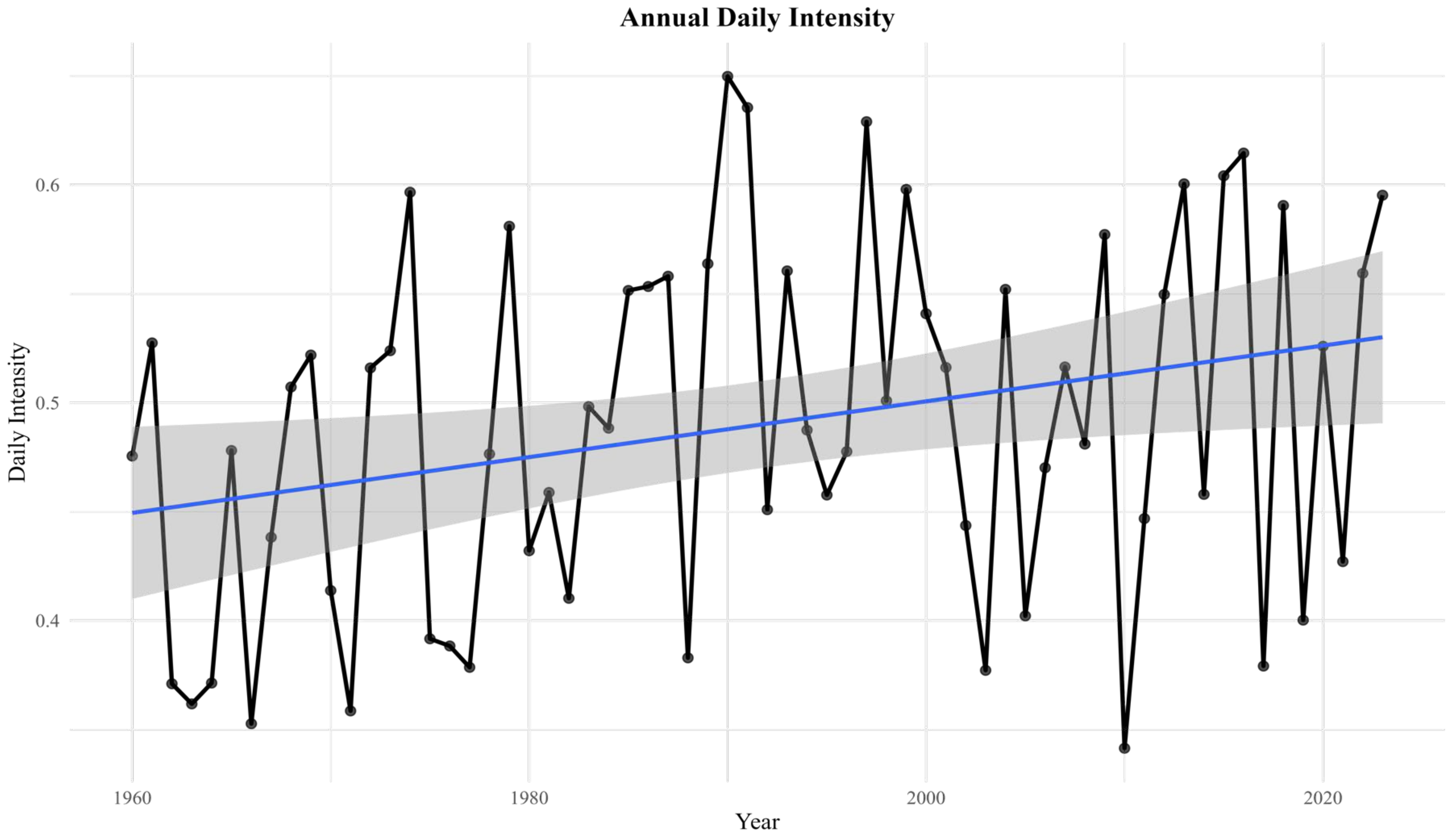
Daily Precipitation Intensity



Volume of Precipitation on rainfall days has significantly increased.
Makes sense, given upward trend in accumulation and no trend in rain days.

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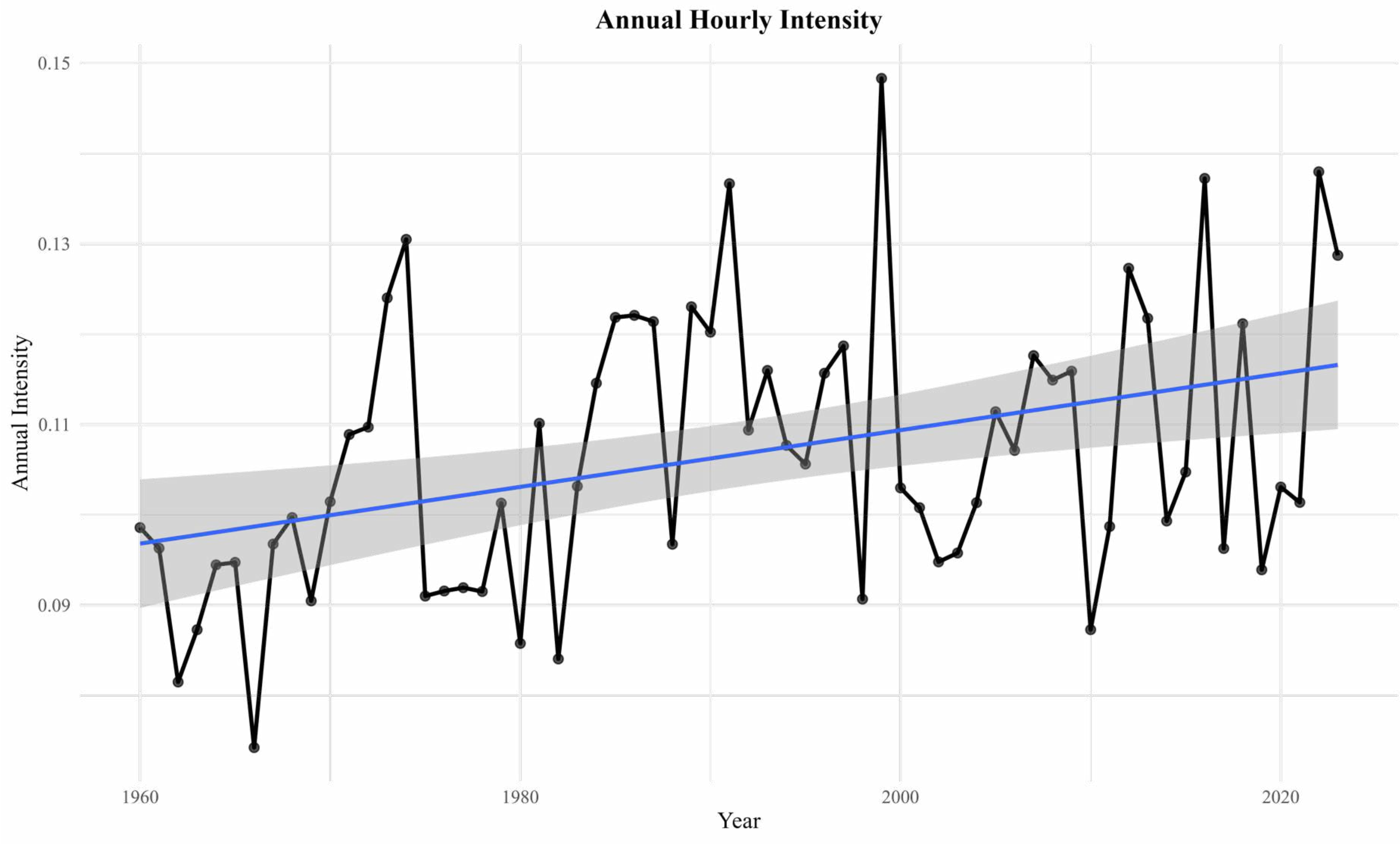
Hourly Precipitation Intensity



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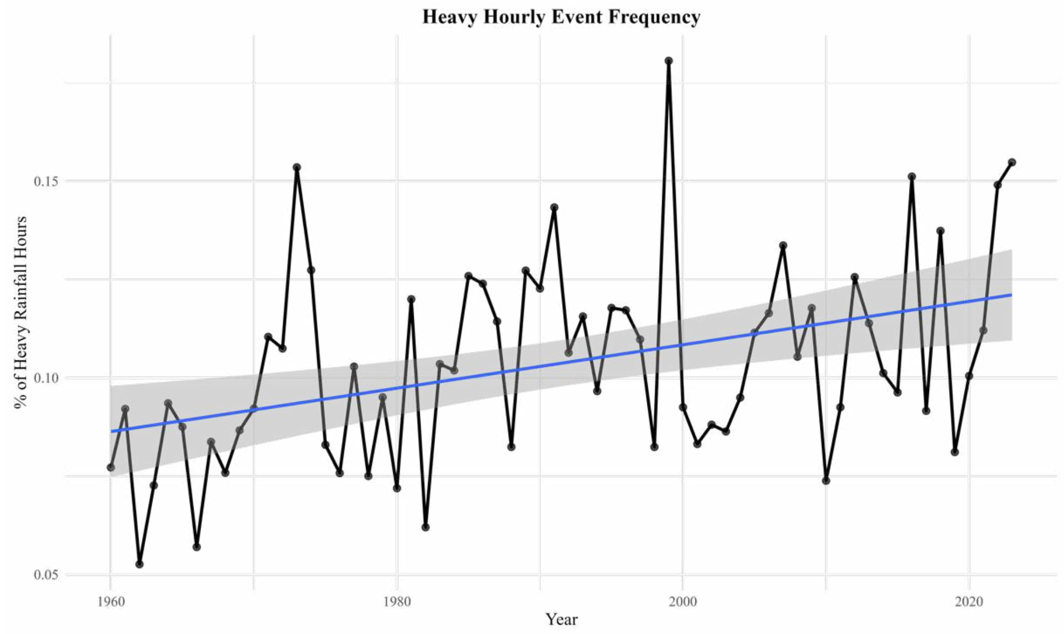
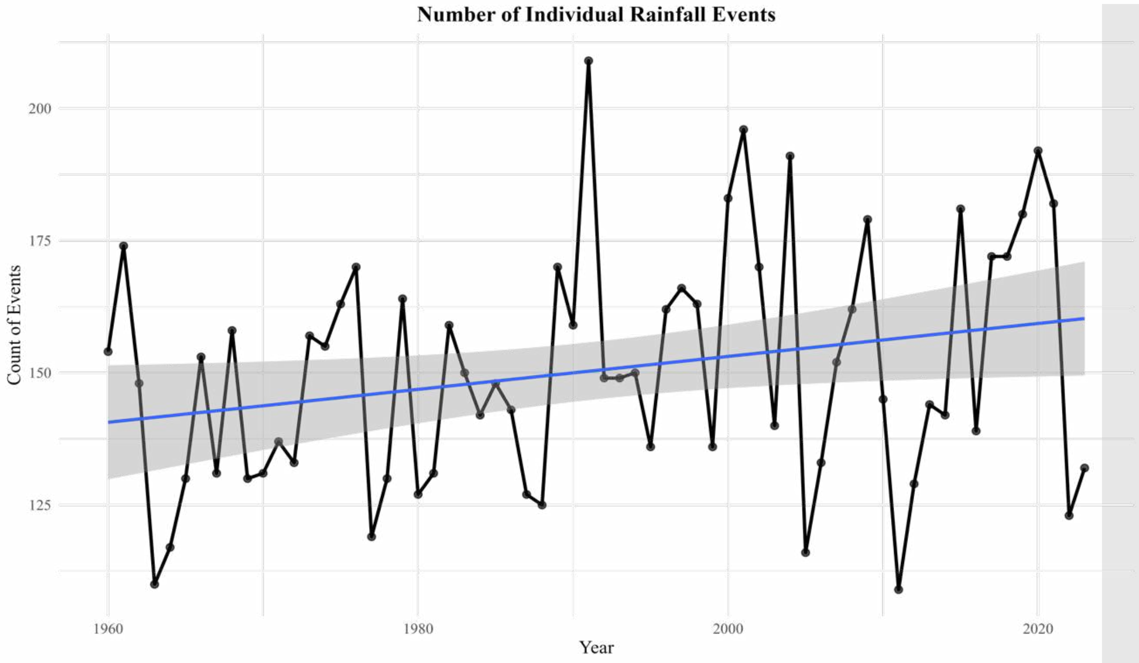
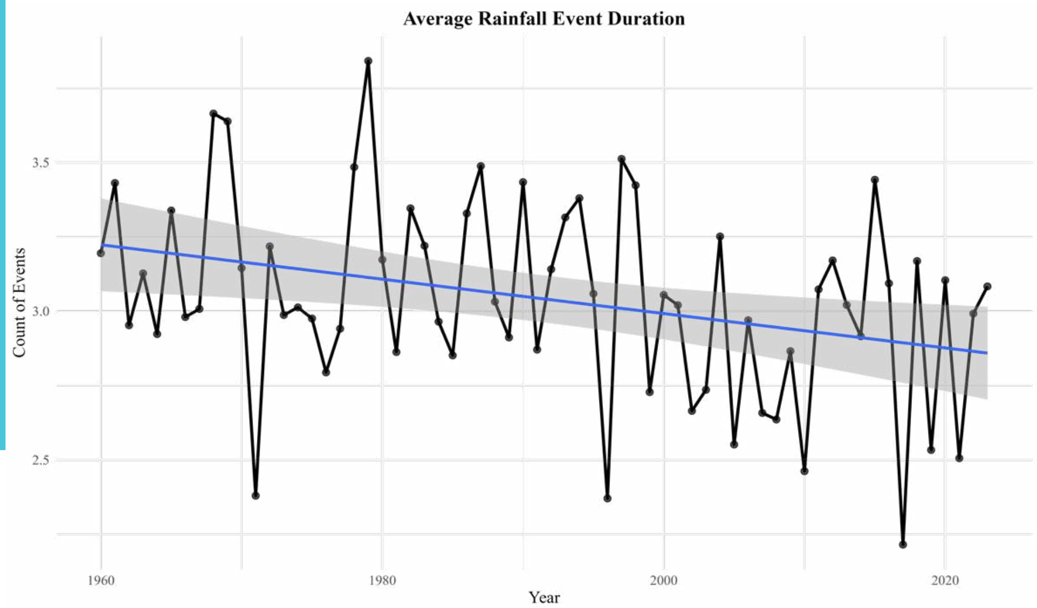
Driving Hourly Intensity?





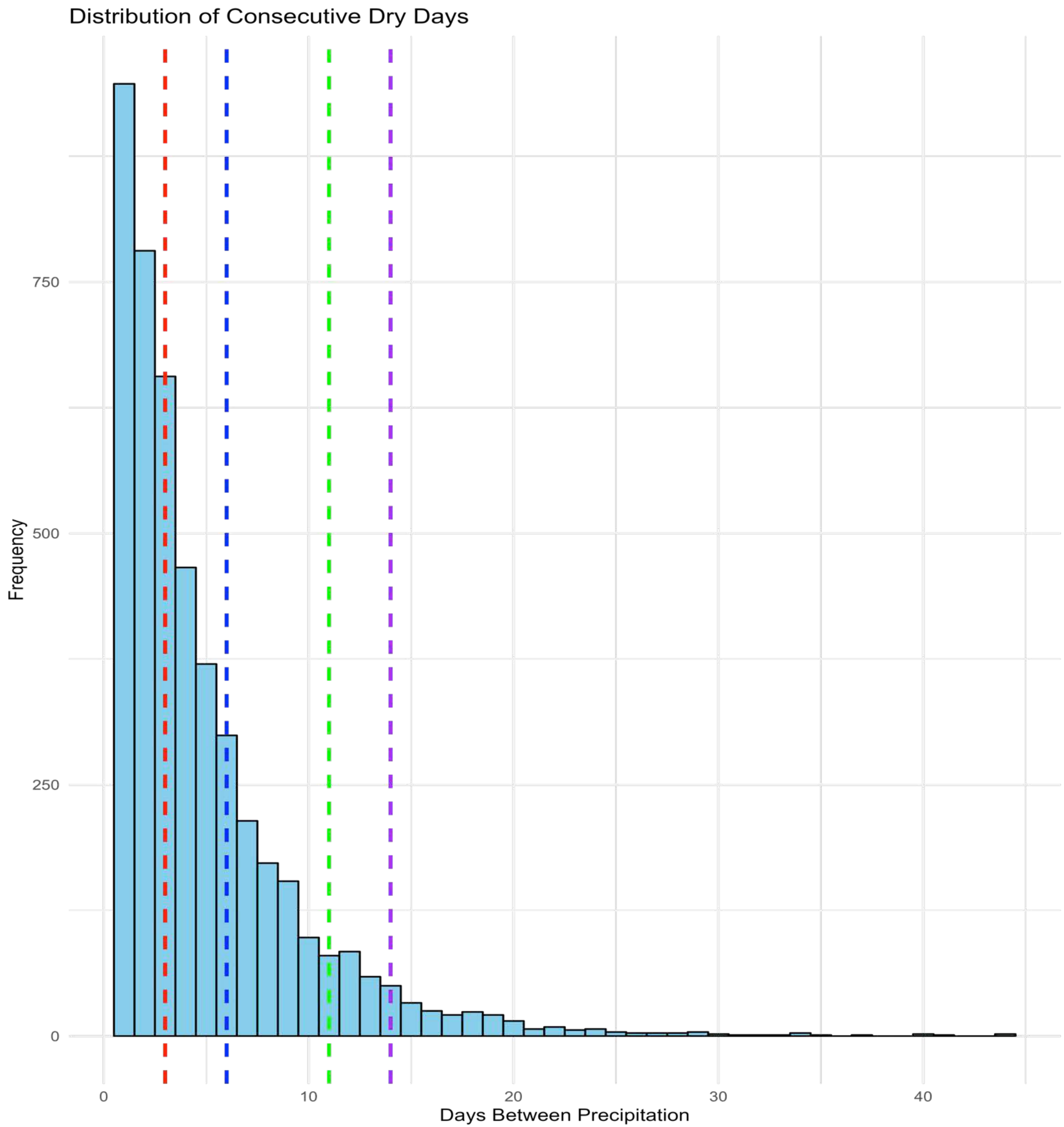


Increase in “heavy” hourly events +
Increase in individual hourly events (unch. Hours) =
Decrease in event duration +
Increase in annual accumulation =
Increase in average hourly intensity.

Consecutive Dry Days

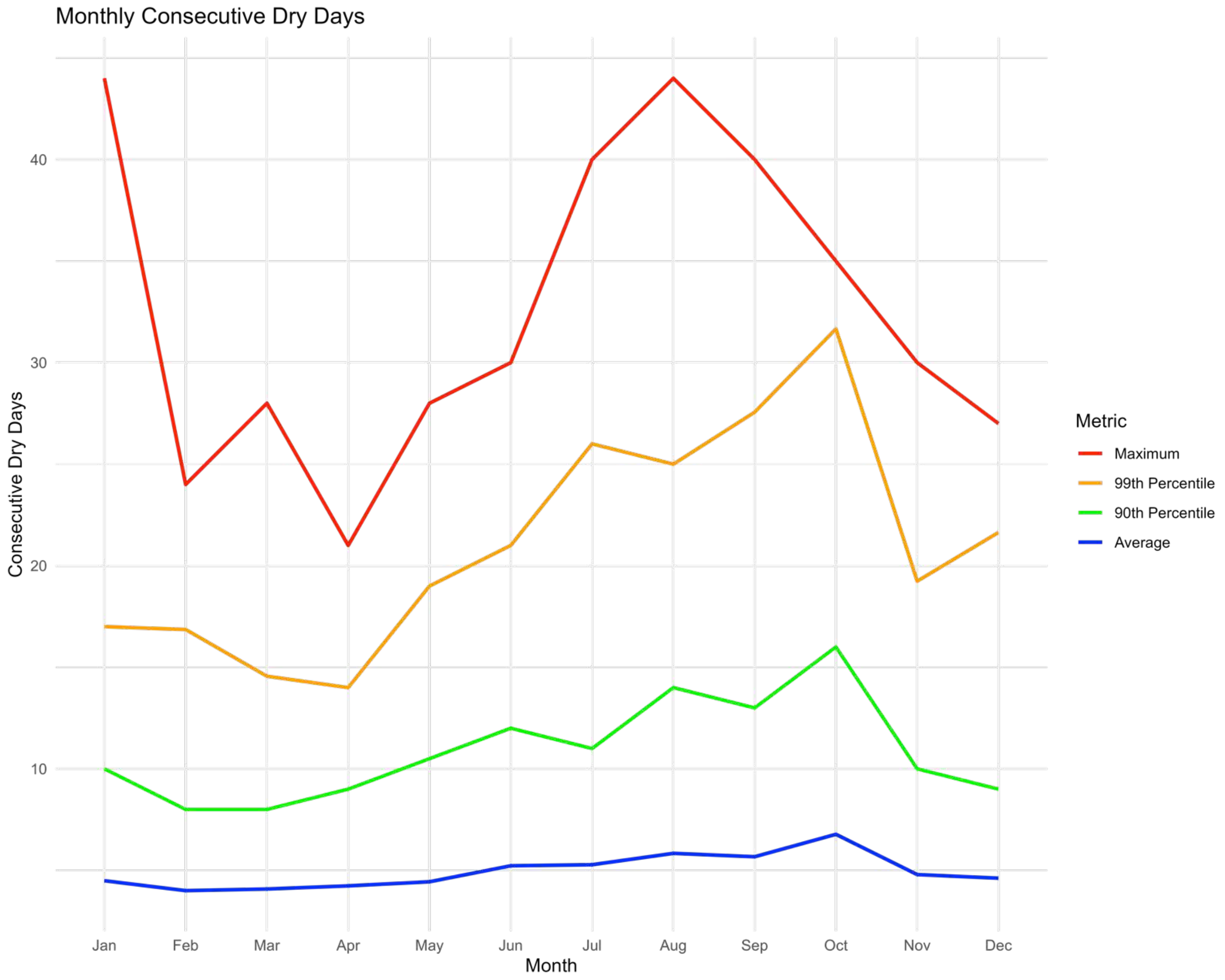
How many days between rainfall events (1940–2024)?

Median = 3
$75^{th} = 6$
$90^{th} = 11$
$95^{th} = 14$

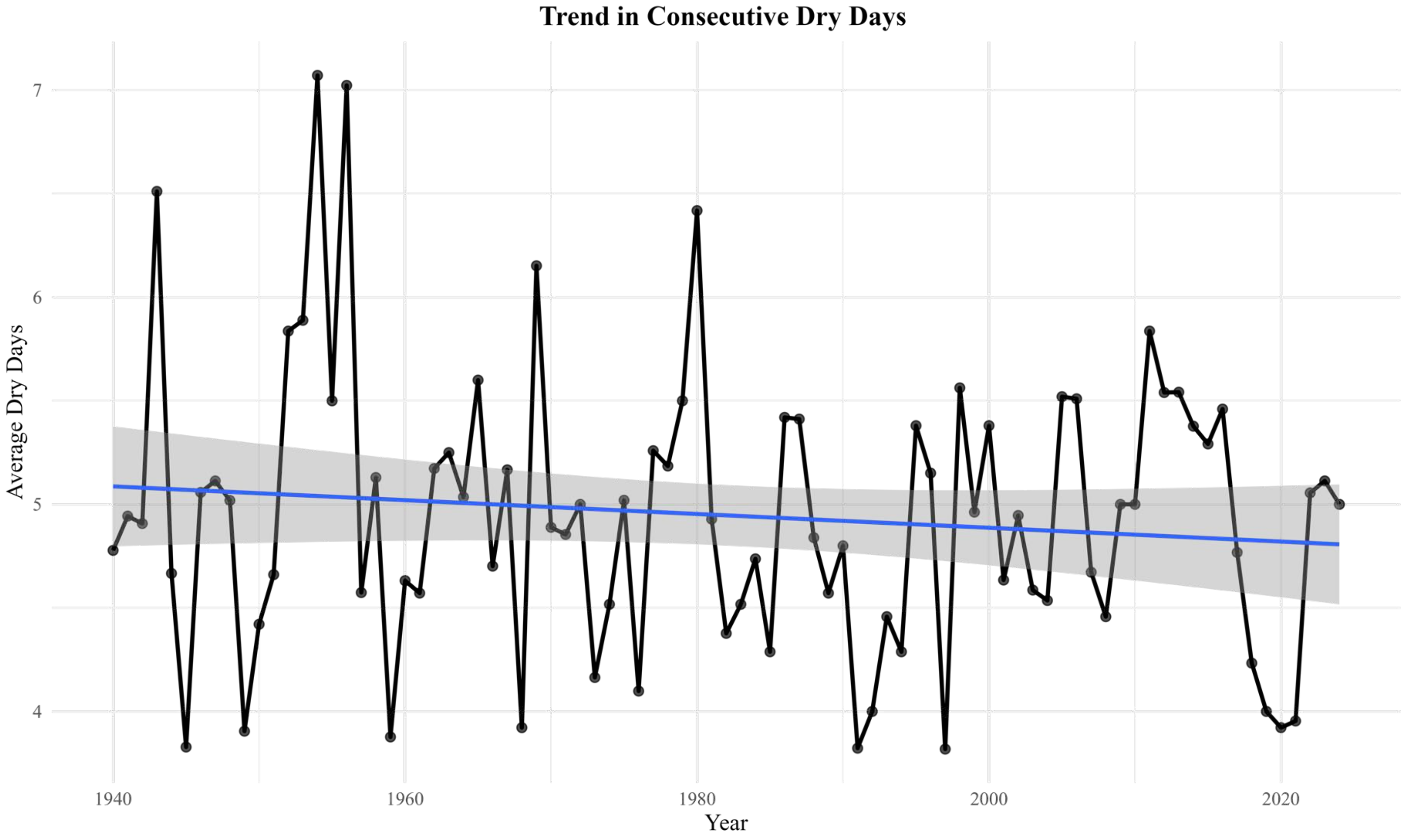


Monthly Distribution

What month do we experience the longest period between rainfall events (1940–2024)?

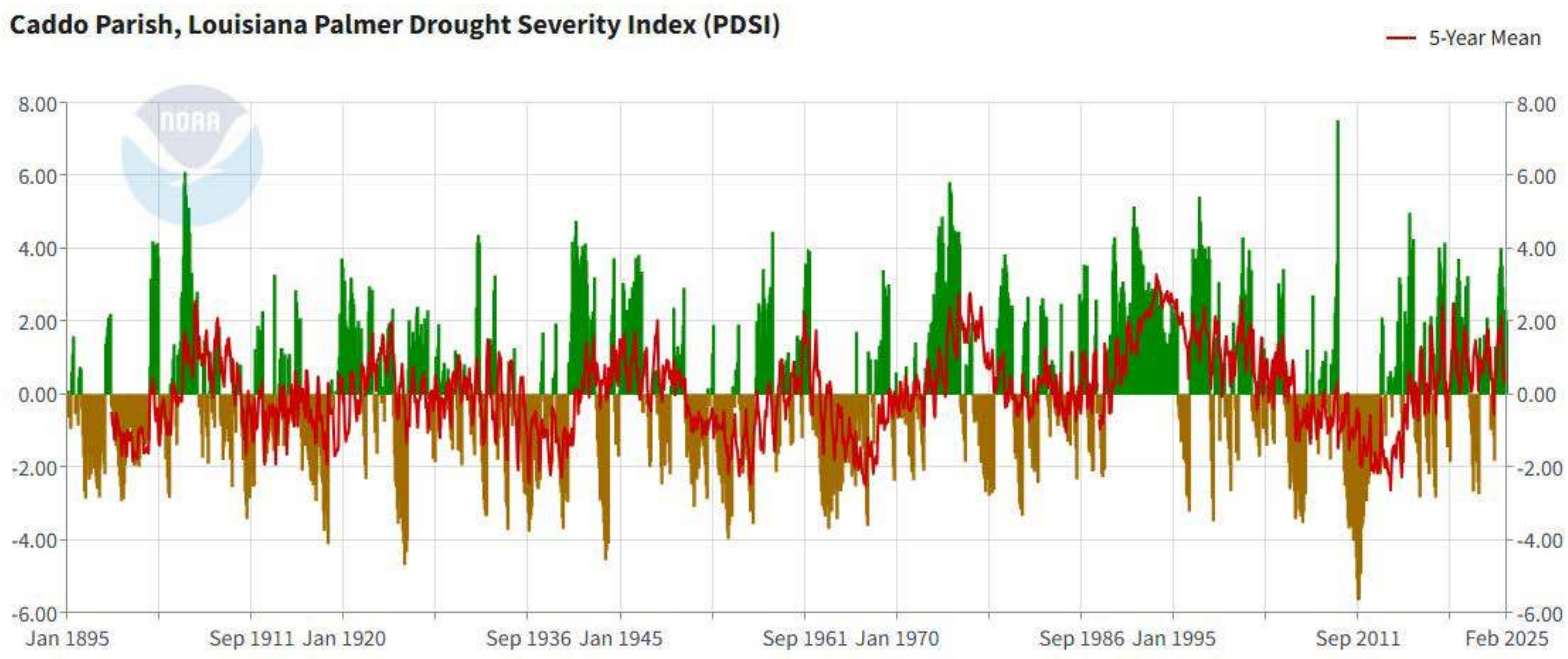


Dry Day Trends



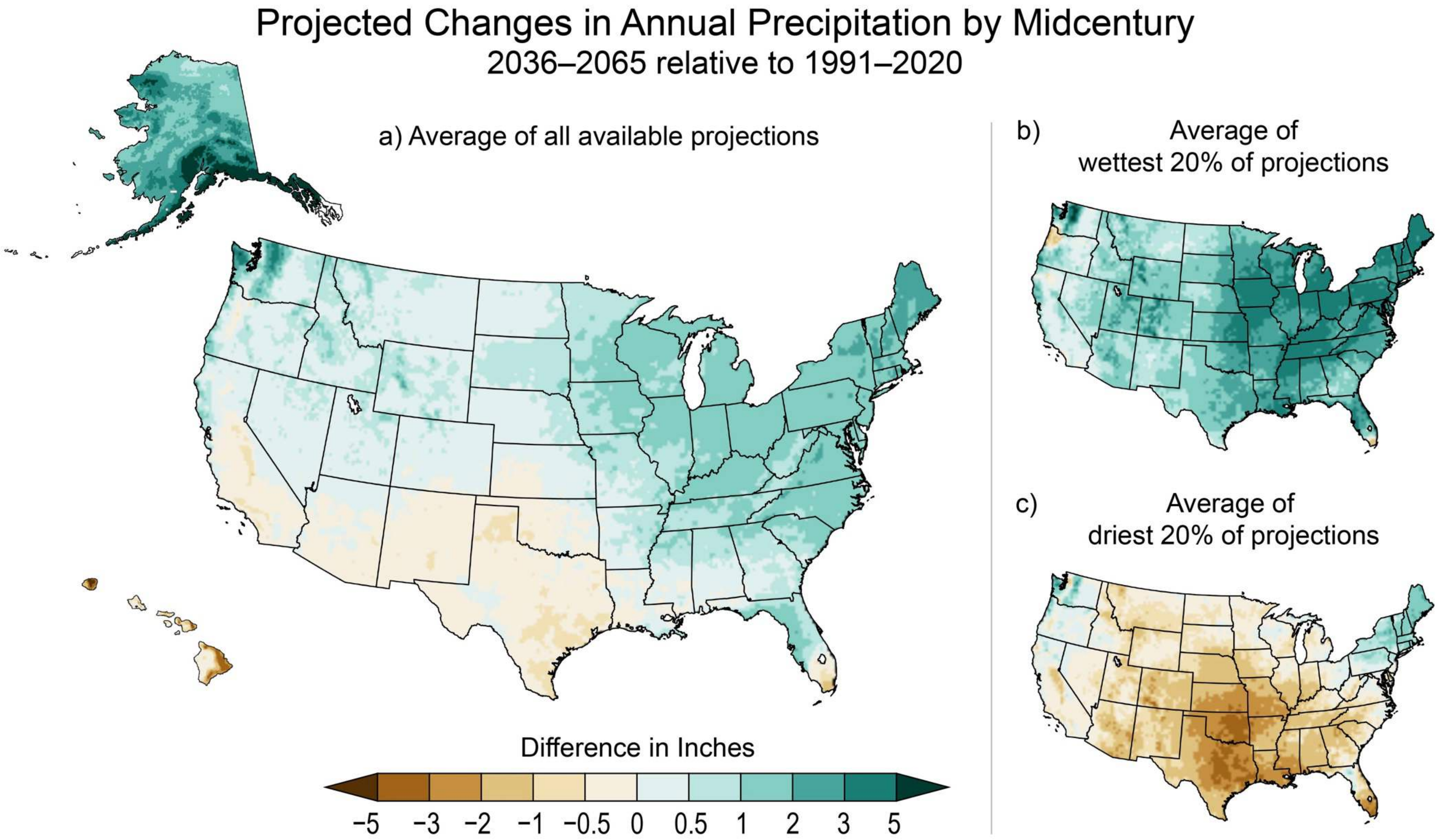
No significant trends in any month or season, but decreases were attributed to April-July. Improved approach would be to include low precipitation totals in (e.g., 0.01–0.10) dry periods. Rain days are not changing but timing might be (or increase in hourly events).

Monthly Drought Severity Index



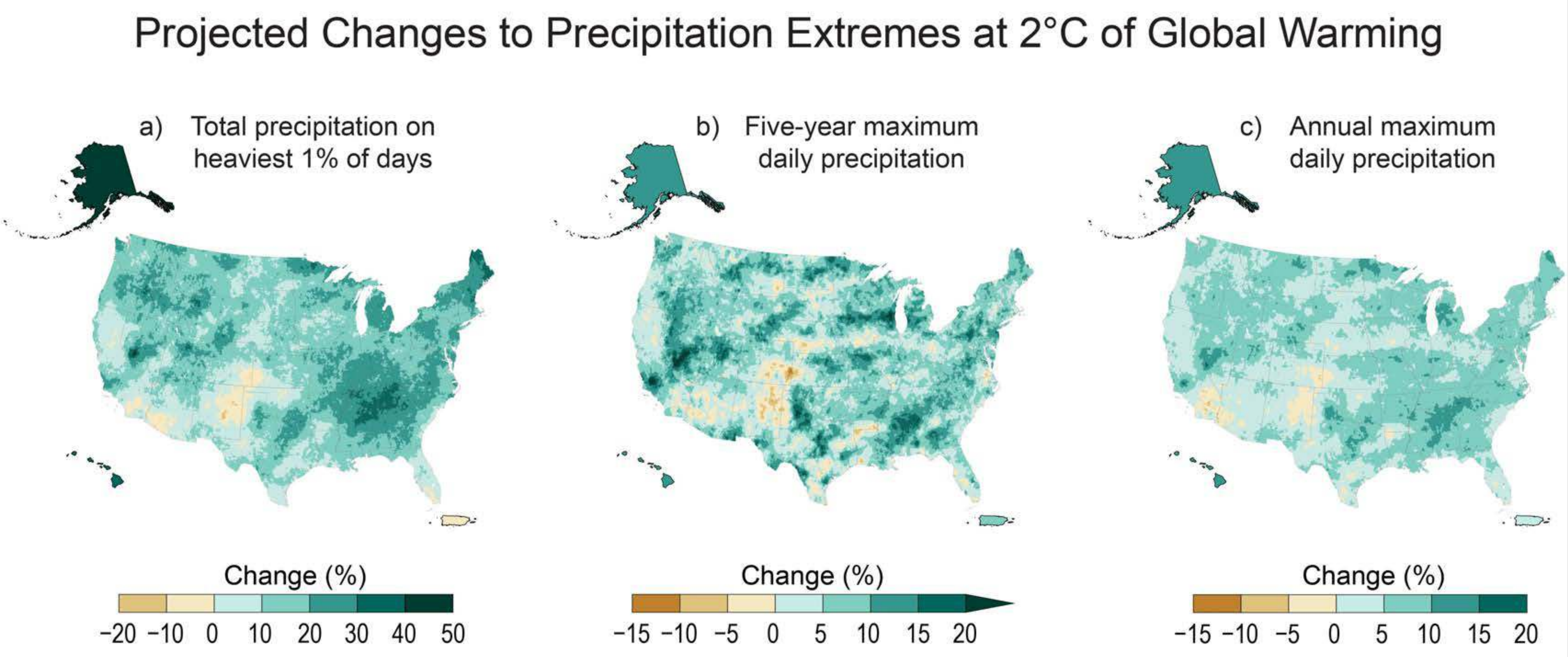
Drought from November 2009–September 2013.
Peaked in August 2011.

Potential Future Changes in Precipitation

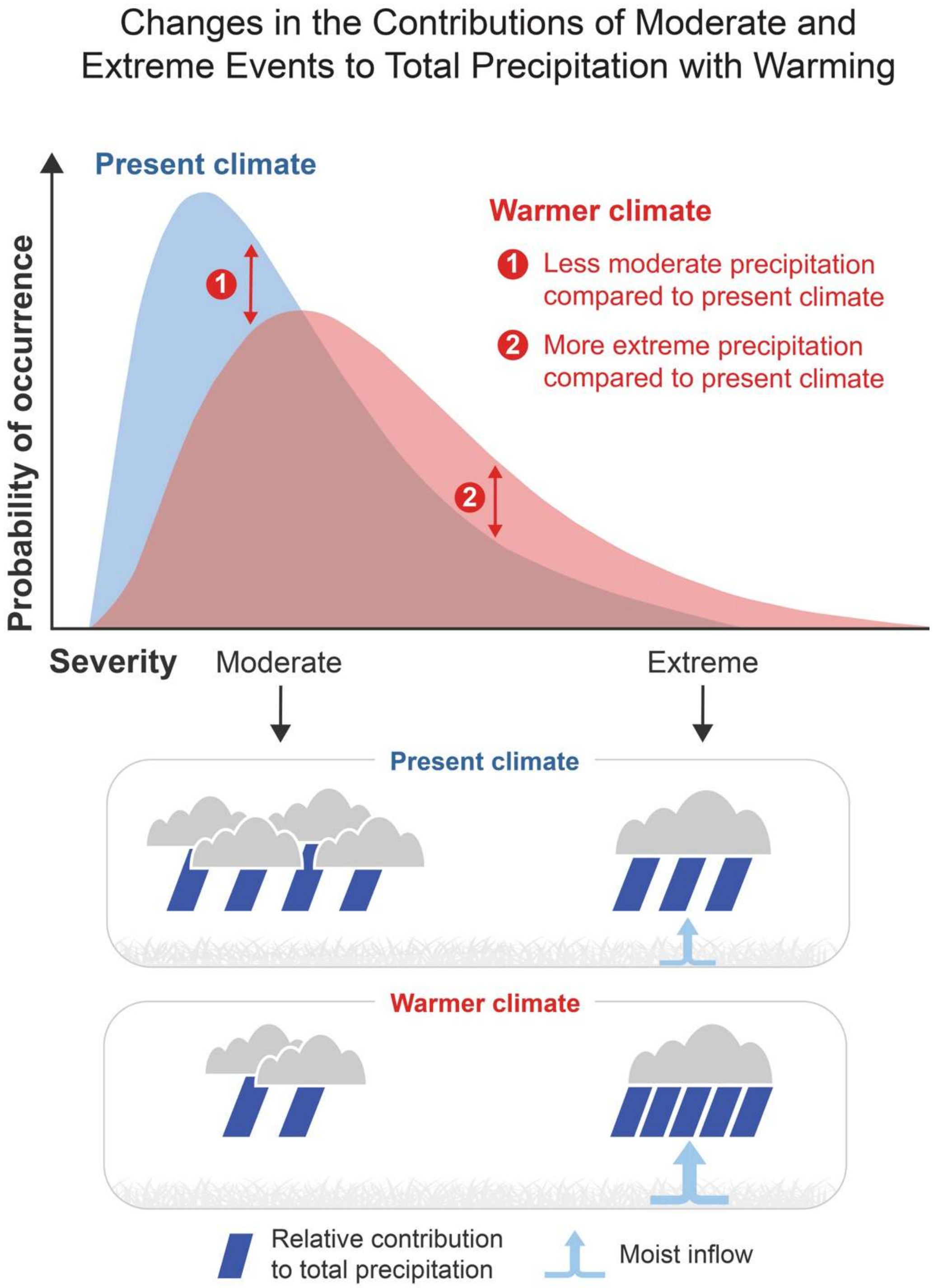


Very little anticipated change in annual precipitation for northern Louisiana

Potential Future Changes in Precipitation

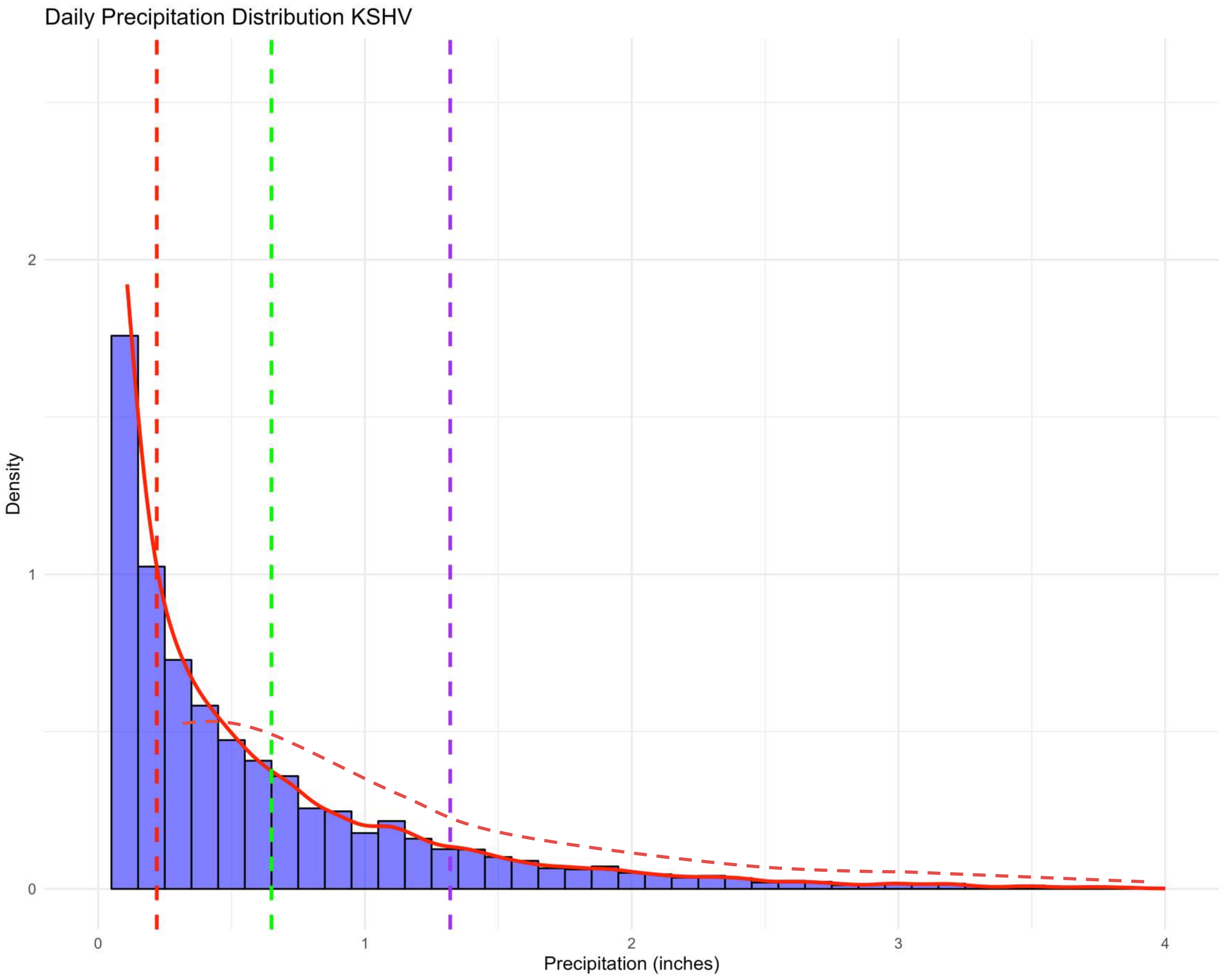


Potentially more rainfall on the heaviest days each year.



Changes in the Contributions of Moderate and Extreme Events to Total Precipitation with Warming
Present climate
Warmer climate
1 Less moderate precipitation compared to present climate
2 More extreme precipitation compared to present climate
Probability of occurrence
Severity
Moderate
Extreme
Present climate
Warmer climate
Relative contribution to total precipitation
Moist inflow

Why?



Daily Precipitation Distribution KSHV
Density
Precipitation (inches)
0
1
2
3
4

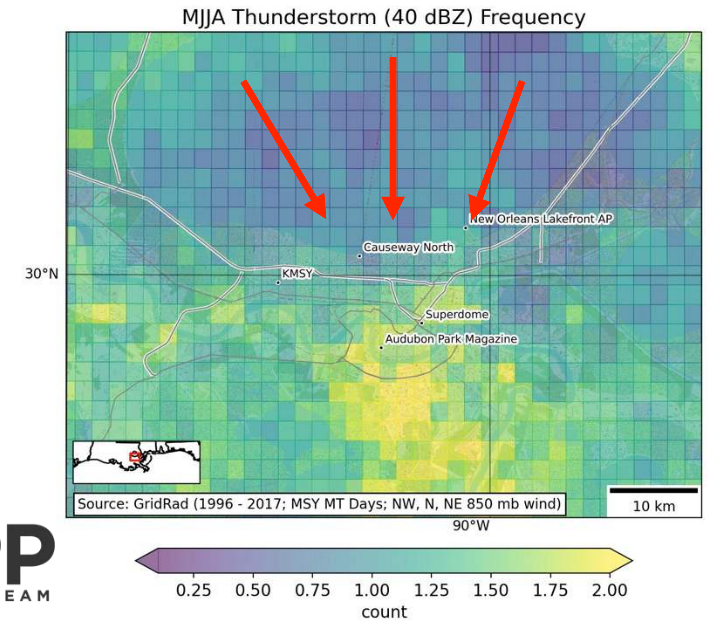
Real World Application of Our Work

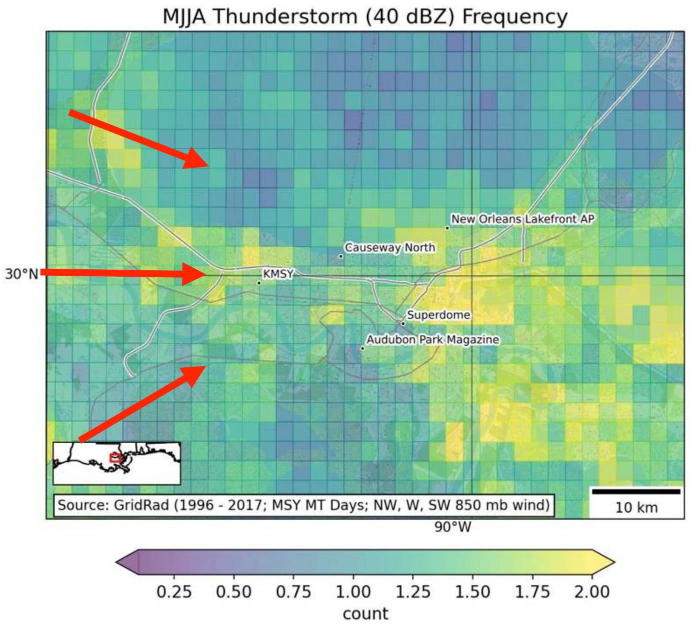
Historical Event Reconstruction/Transposition.
May 1995, Hurricane Harvey, etc.

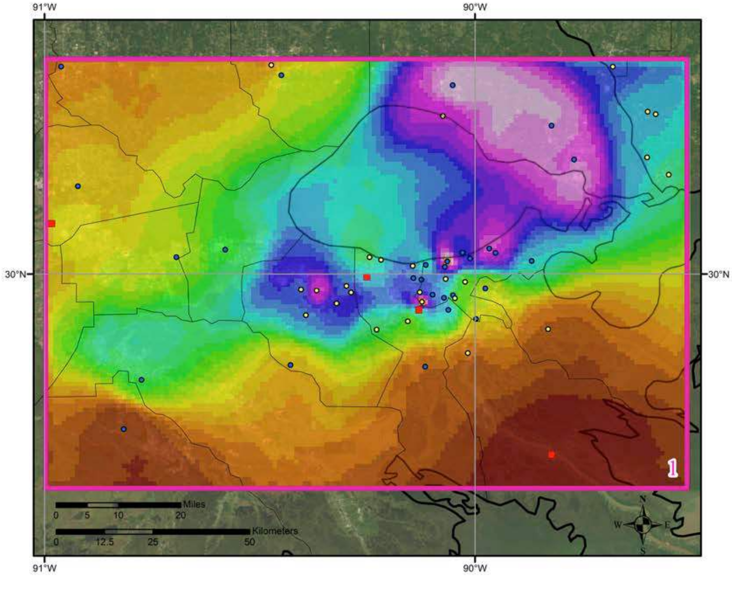
Forcing Mechanisms of Heavy Rainfall.
Where to expect heavy precipitation based on wind?

Decision Making.
Neutral Ground Parking.

Survey of Perceptions of Climate Change Planning.







Total Storm (72-hours) Precipitation (inches)
May 8-11, 1995
SPAS 1856 - New Orleans, LA

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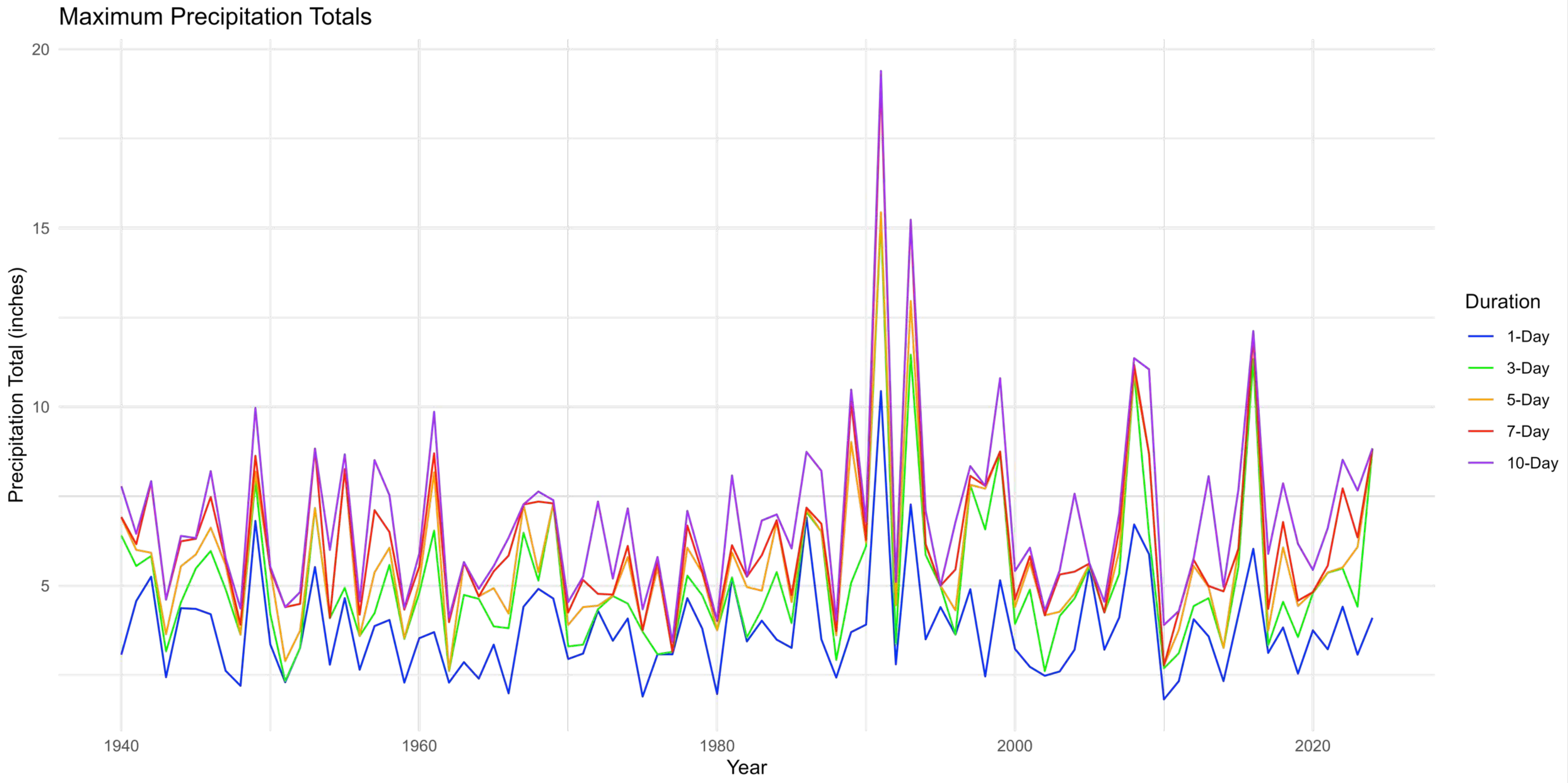
Honorable Mention



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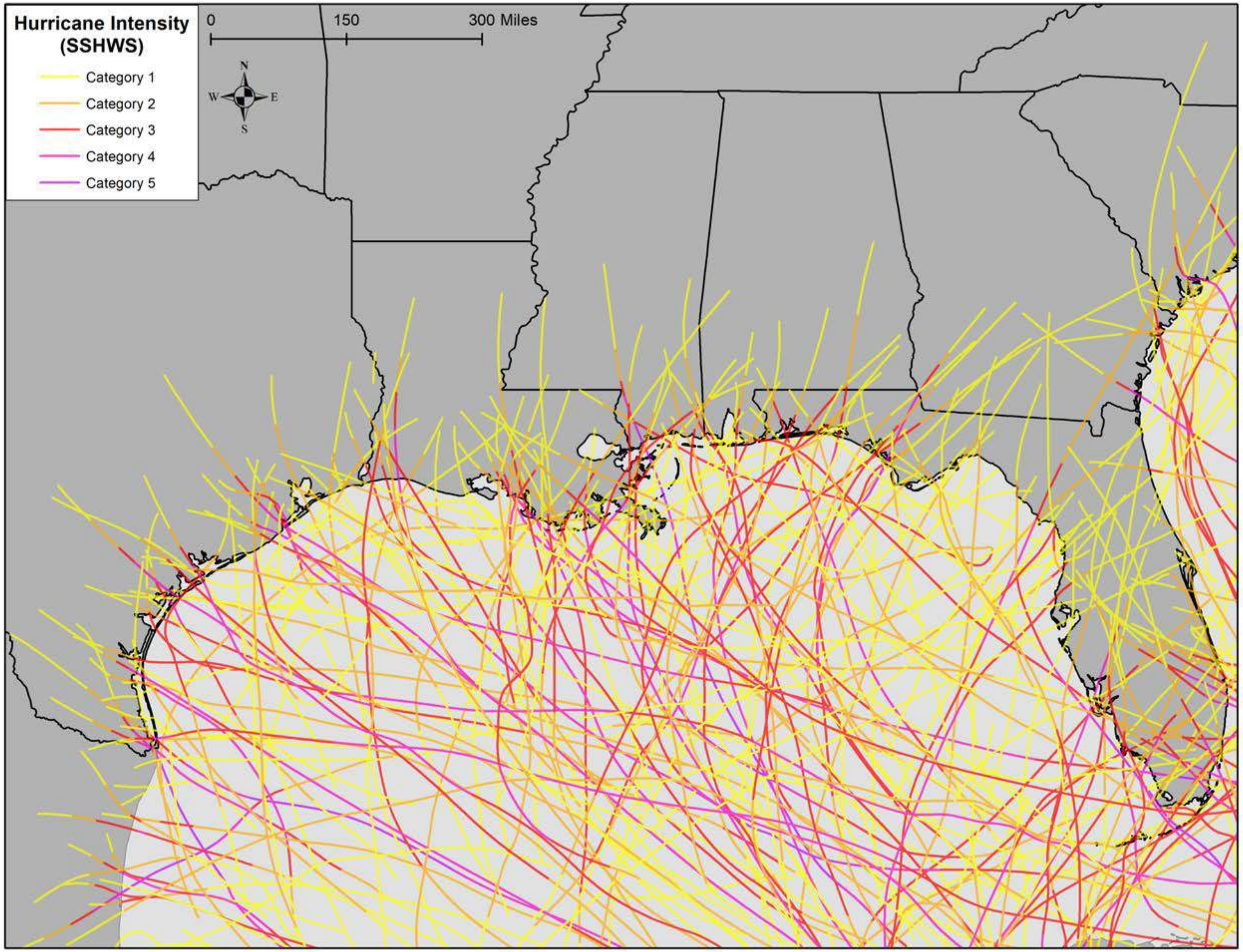

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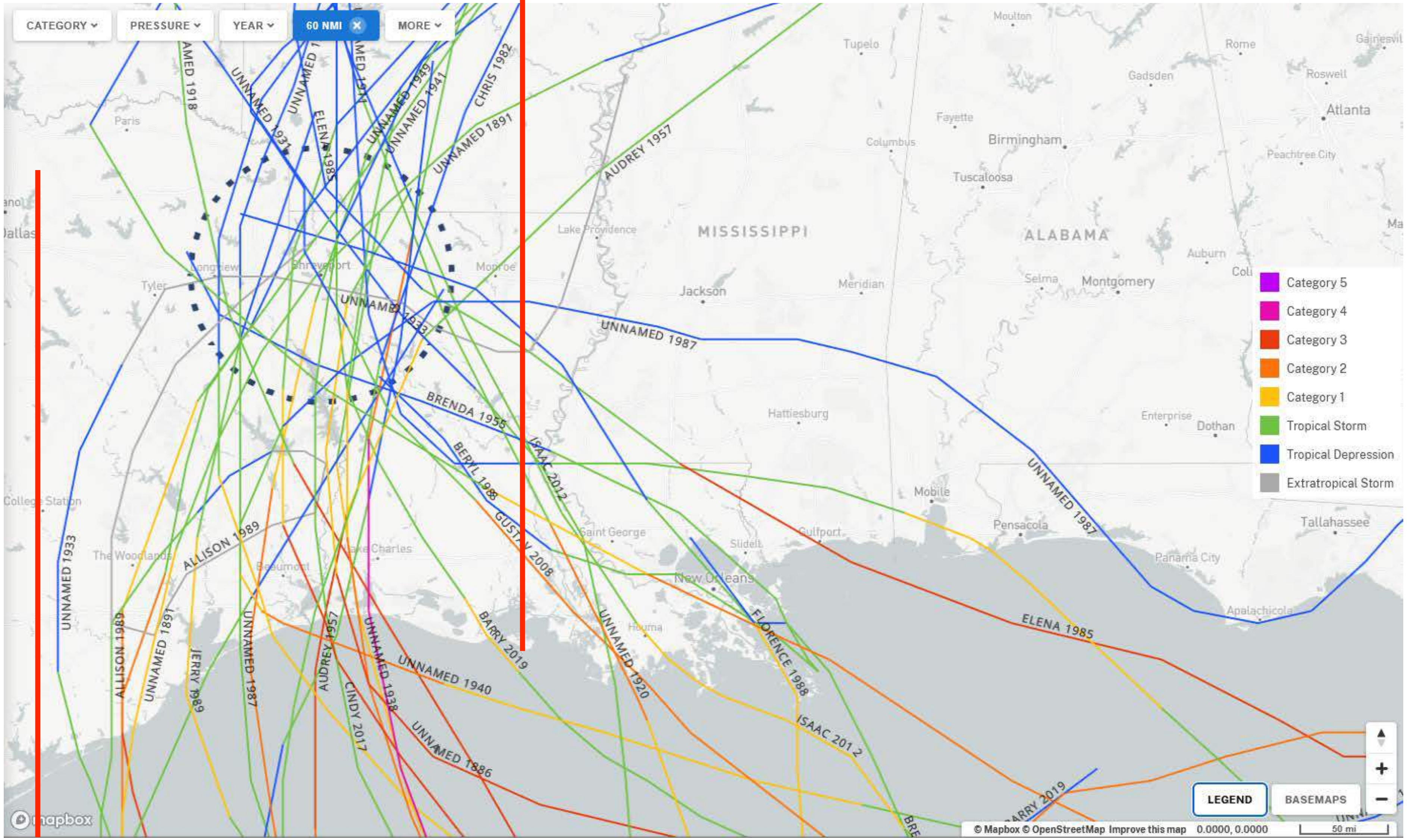

32 storms within 60 nm of Shreveport.

22 between Matagorda Bay and western Vermillion Bay / 10 east of Vermillion Bay

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Thank You

Reminder

SCIPP is a resource available to you!

We are experts at obtaining quality and accurate weather/climate data and are here to help!

Dr. Vincent Brown

Research Director, SCIPP

vbrow31@lsu.edu

I also have slides on tropical cyclones if you would like to discuss those hazards

Extreme Weather and Resilience Workshop: Extreme Temperatures

Derek T. Thompson
Research Associate – SCIPP
Monday, March 17, 2025

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Outline

- Minimum Temperatures
- Maximum Temperatures
- Heat (Heat Index and WBGT)
- Future
- Application

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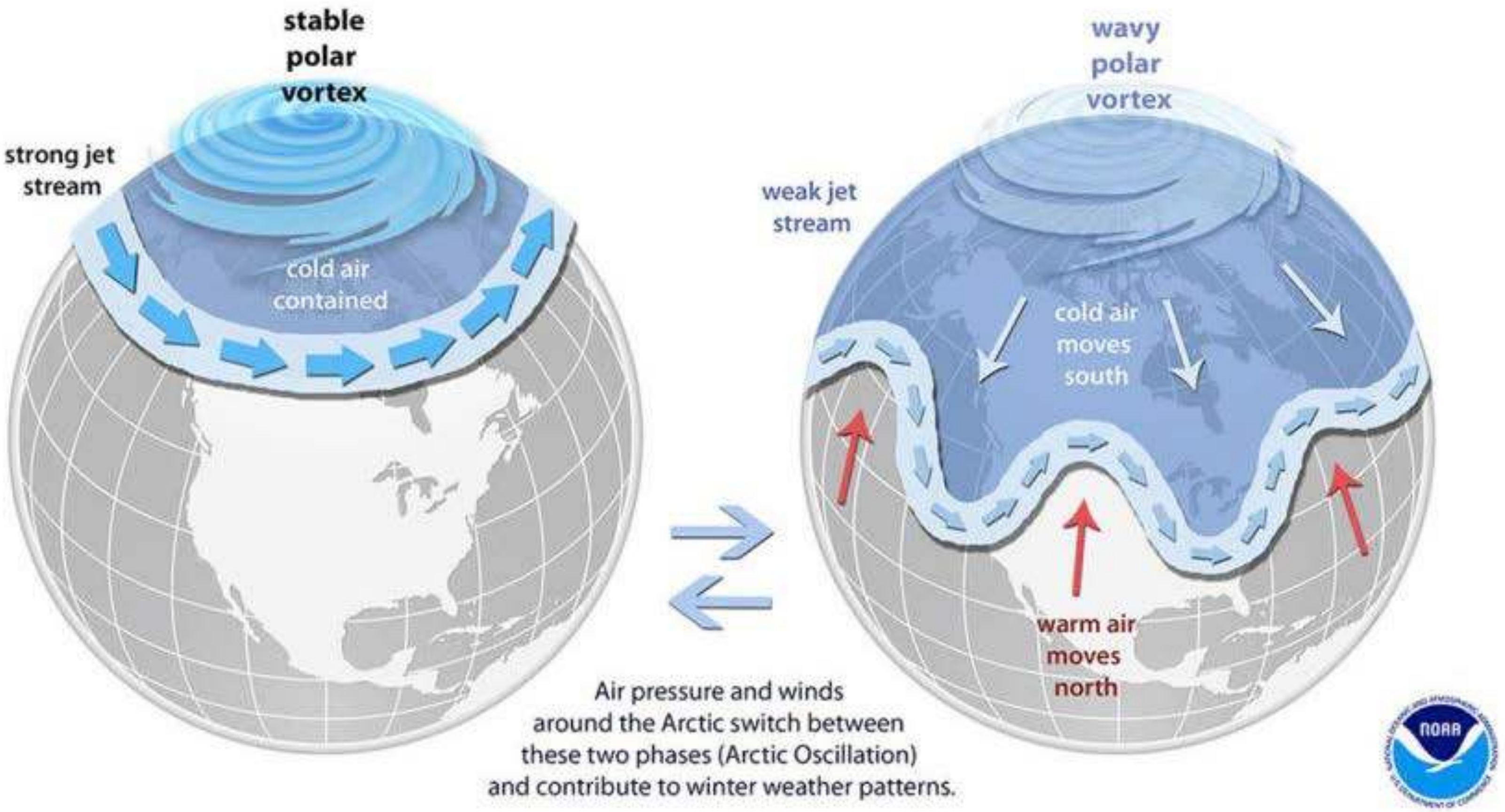
Minimum Temperatures - Cold

- Arctic air outbreaks from Canada – Polar Vortex and Jet Stream.



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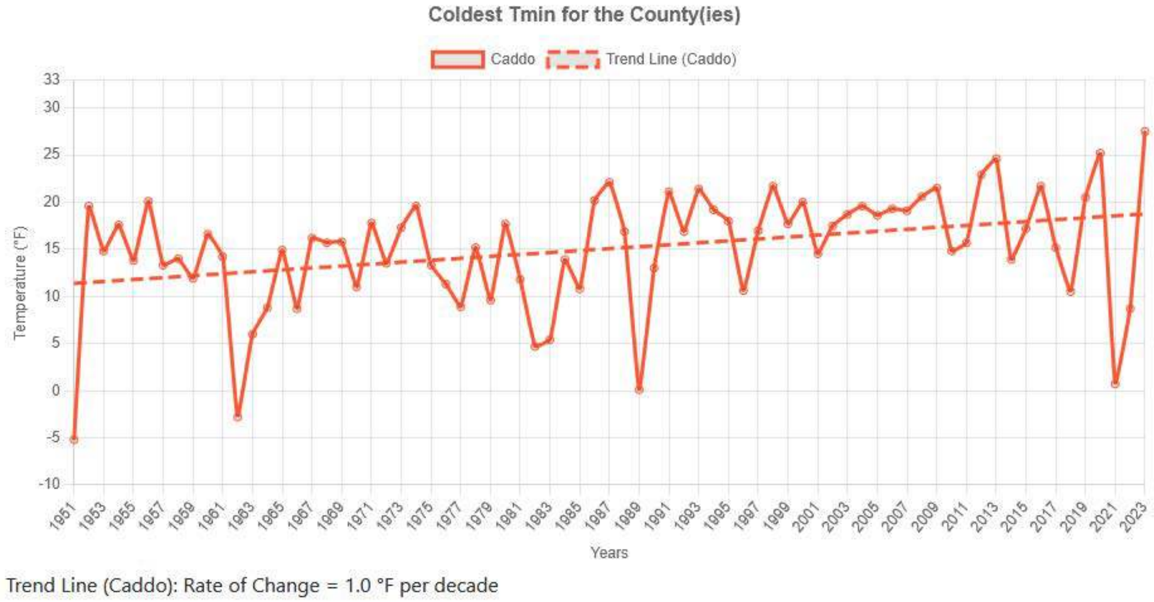
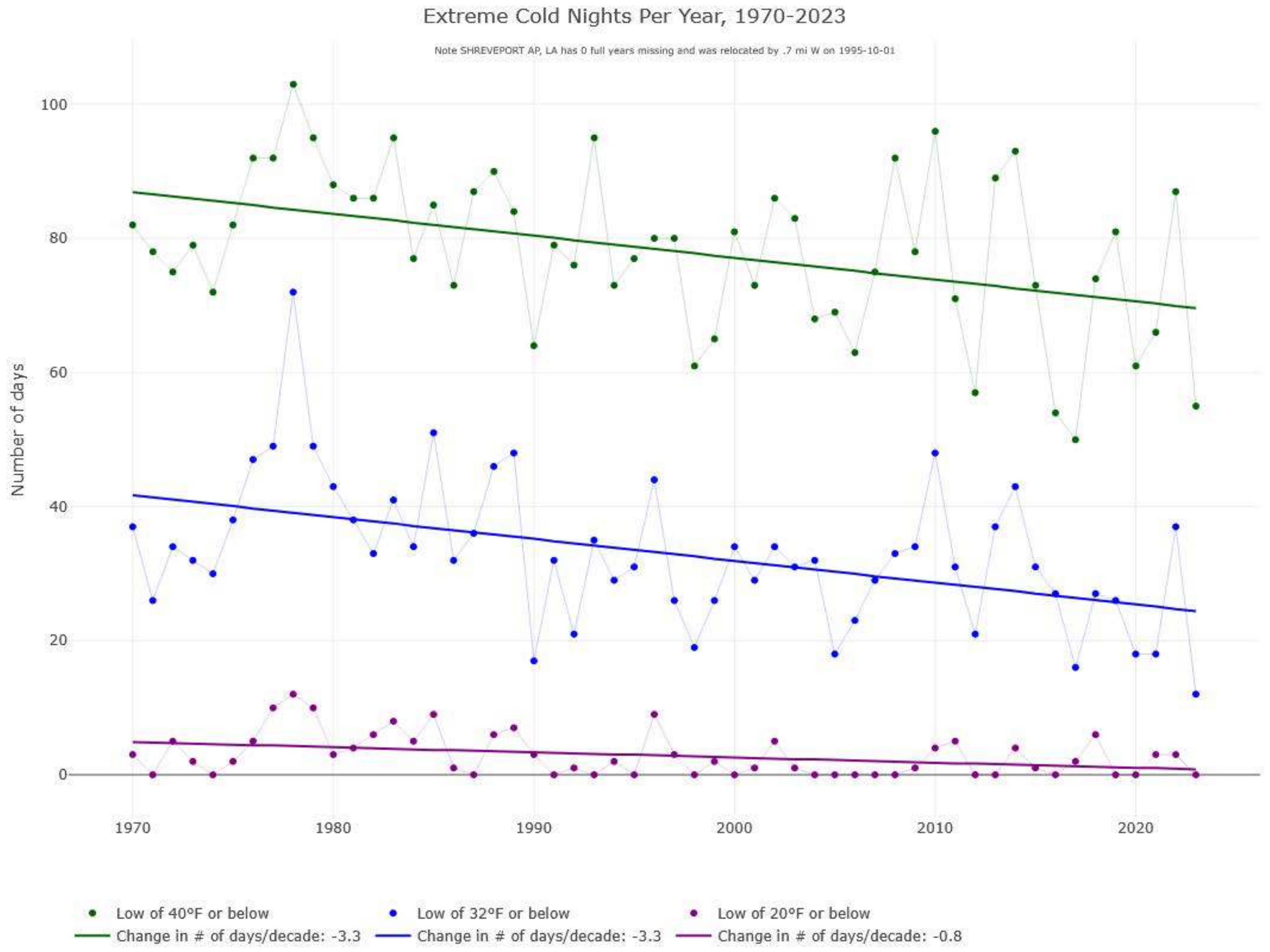
Minimum Temperatures - Cold

- Decrease in cold nights

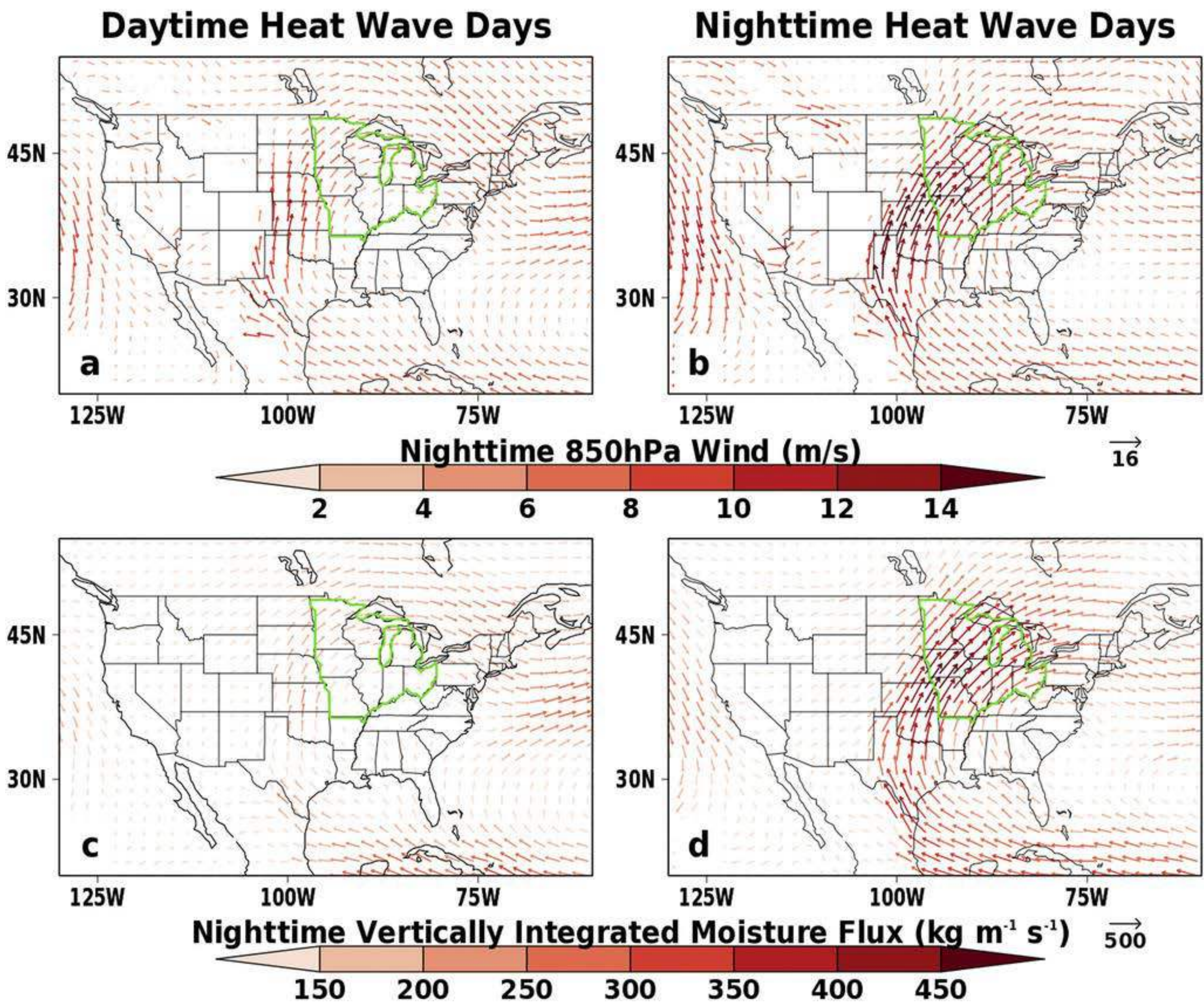
- Increase in coldest min. temperature





Minimum Temperatures - Warm

- Warm + moist air.
- Increasing faster than daytime max. temperatures.
- Critical for human health.



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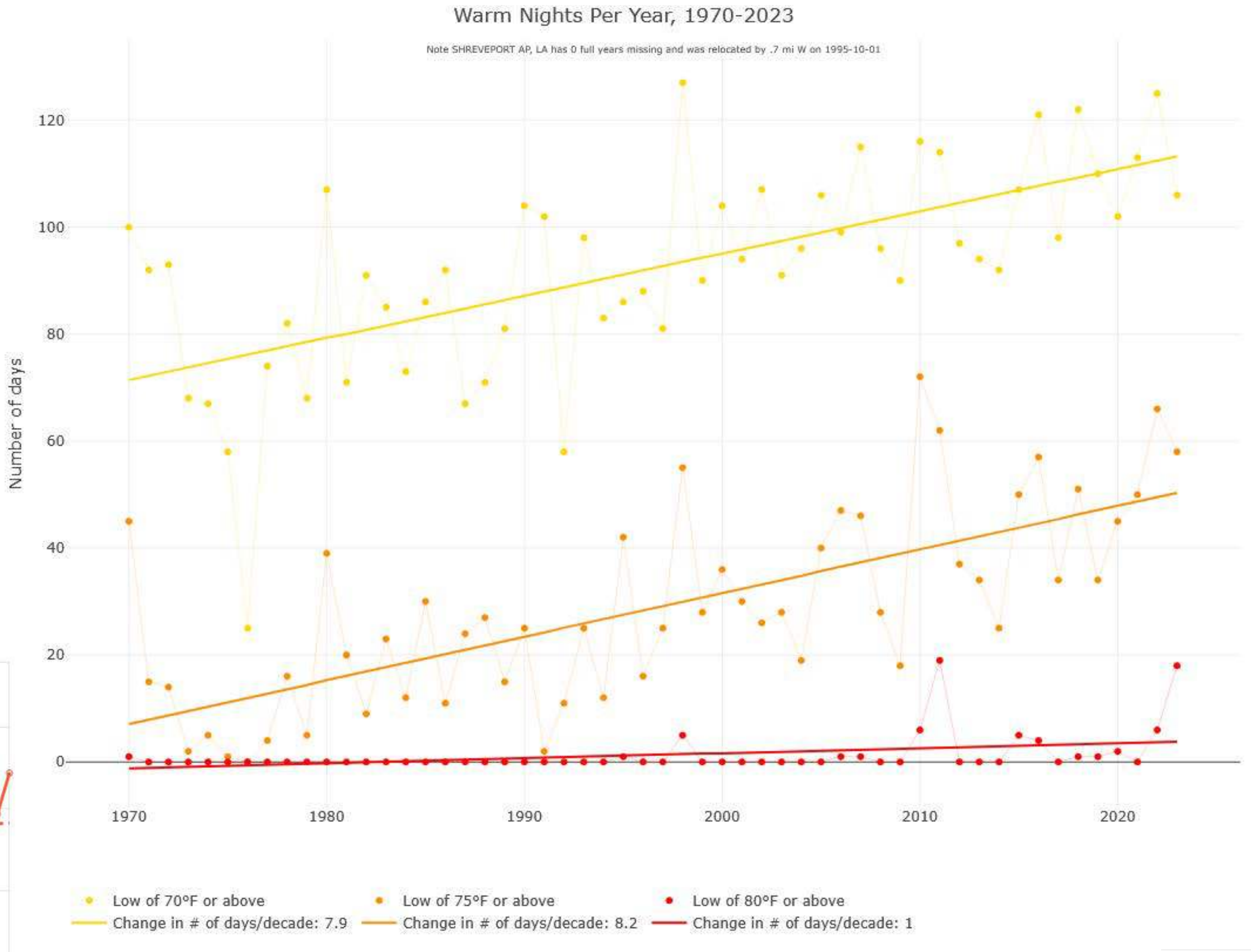
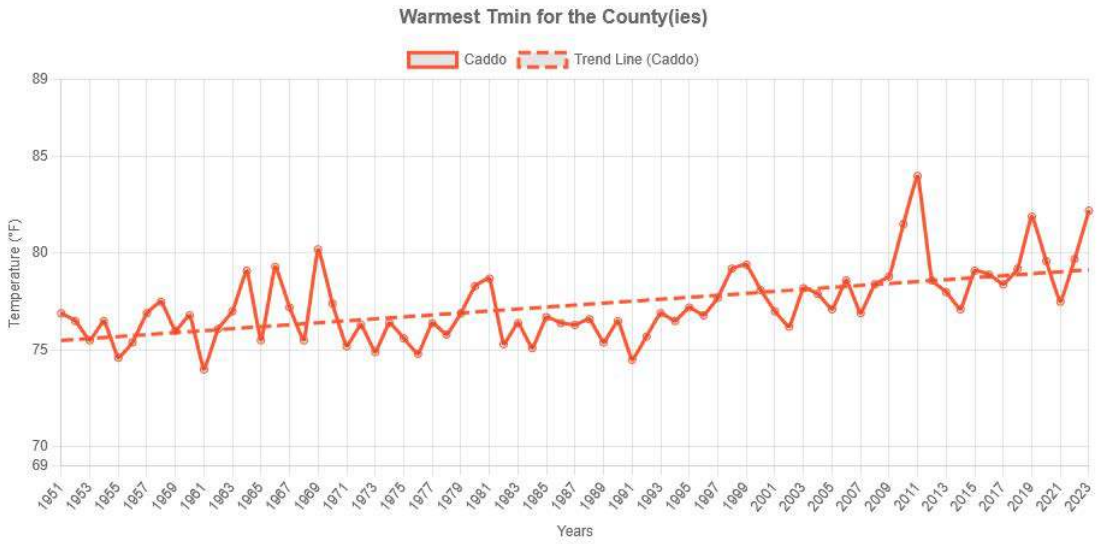
Minimum Temperatures - Warm

- More warm nights
- Warmest min. temperature increasing

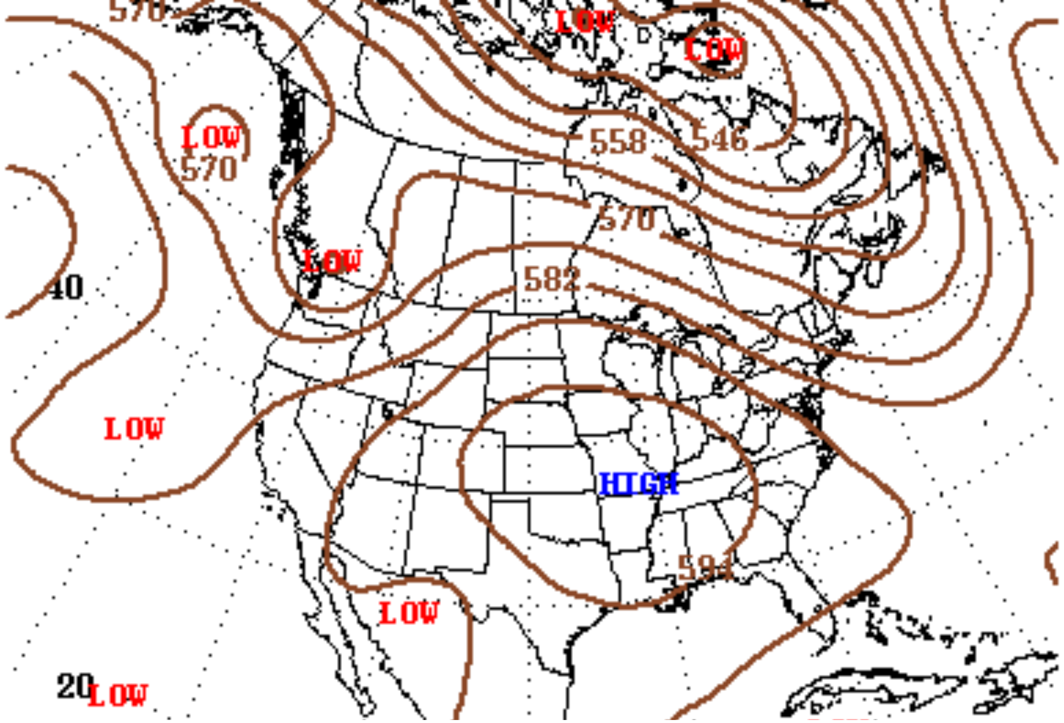


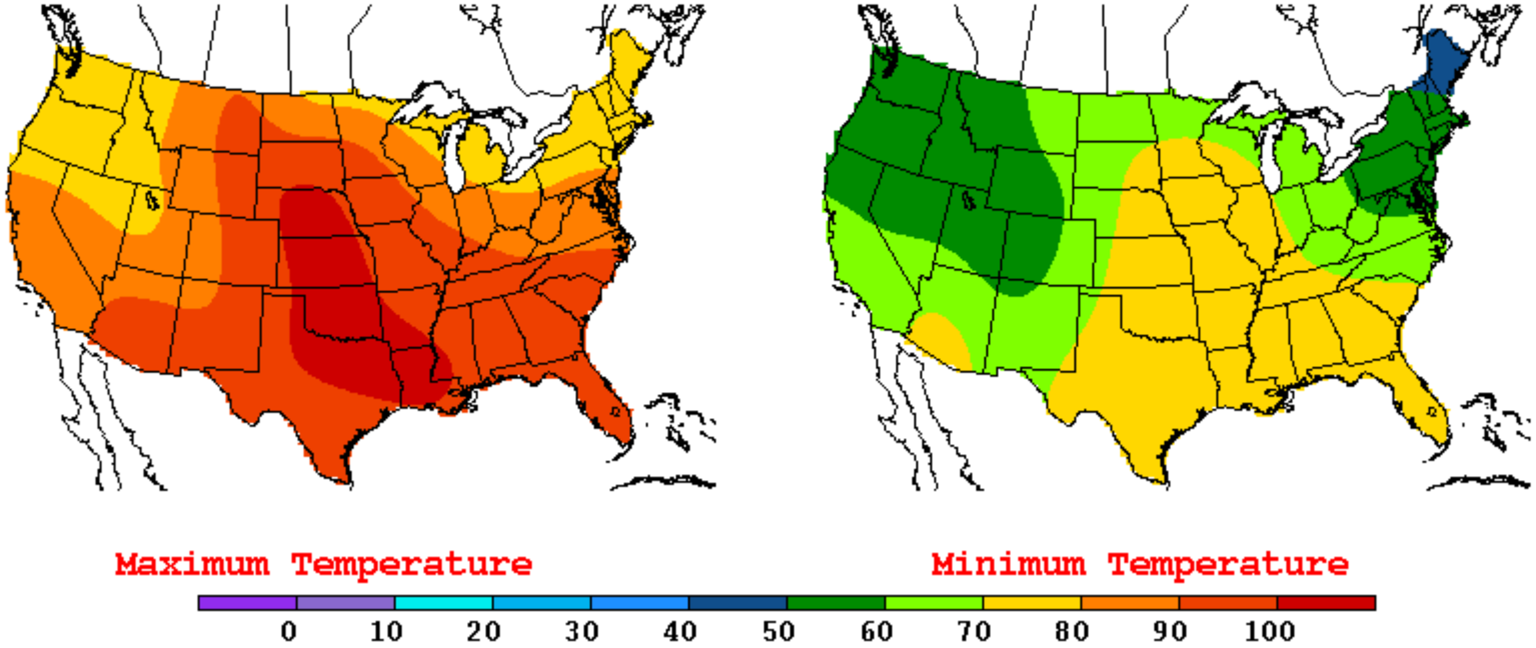


Trend Line (Caddo): Rate of Change = 0.5 °F per decade

Maximum Temperatures

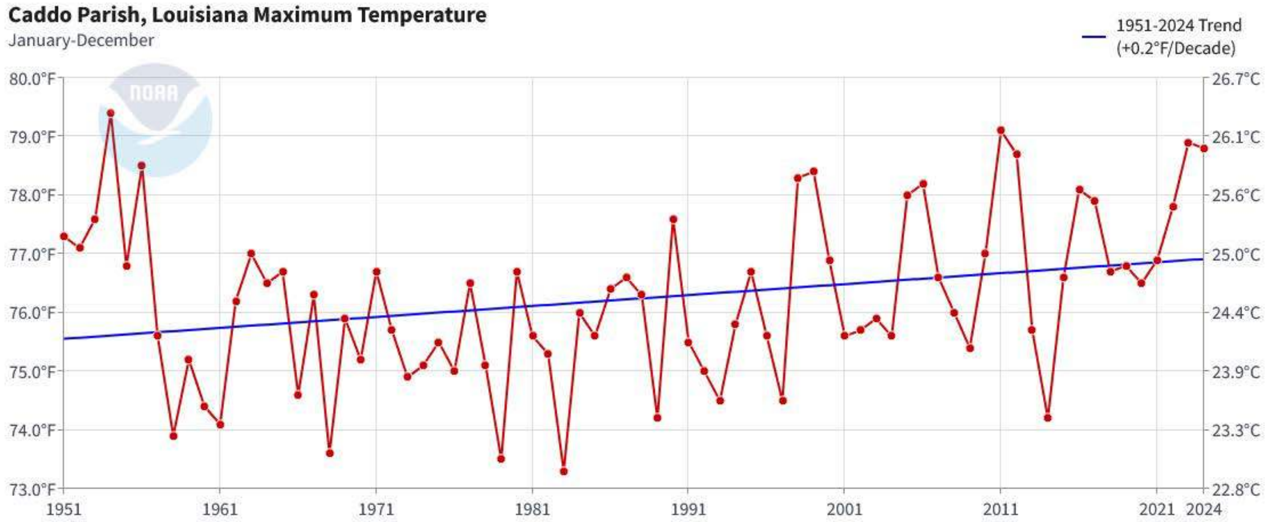
- Primarily driven by persistent high pressure.

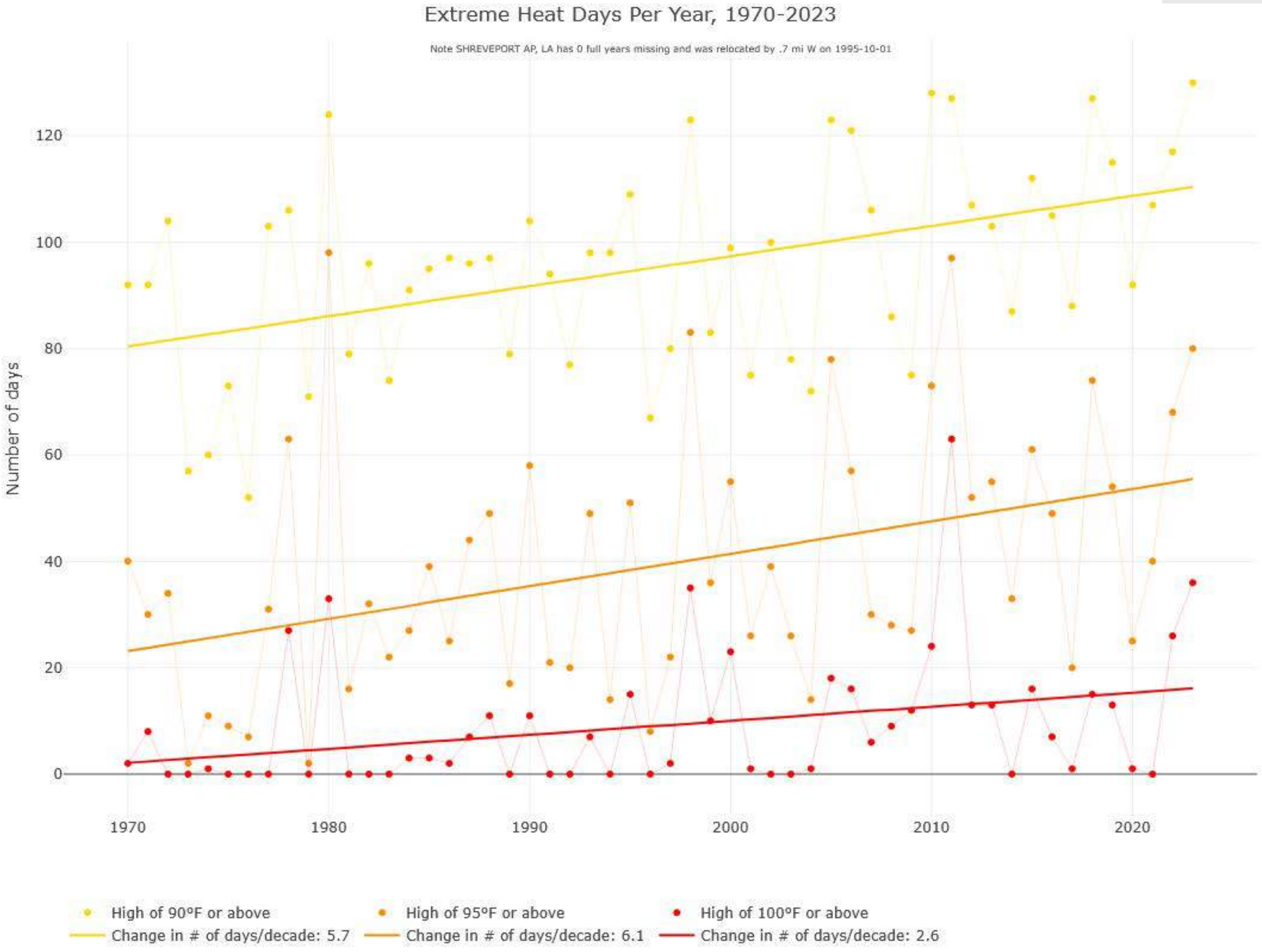




Maximum Temperatures

- More hot days
- Increasing max. temperature
  BUT not like
  min. temperature





Heat Index

- Combination of temperature and humidity.
- NWS Guidelines
  - Heat Advisory - 105°F
  - Heat Warning - 110°F

Temperature (°F)

Relative Humidity (%)

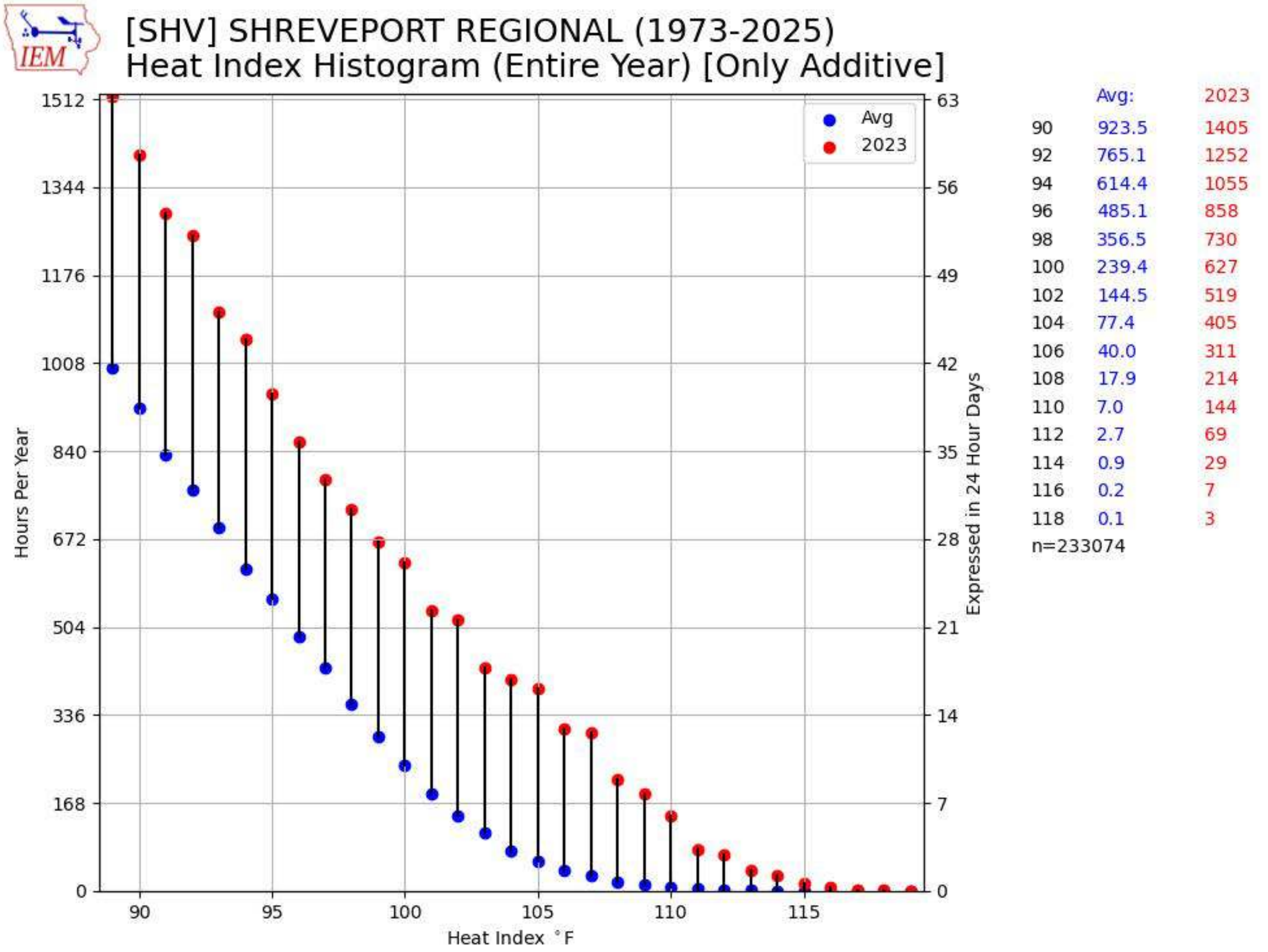
RH (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure and/or Strenuous Activity

Caution · Extreme Caution · Danger · Extreme Danger

Heat Index

- ~ 173 hrs/yr ≥ 105°F
- ~ 17 hrs/yr ≥ 110°F
- 2023
  - 1,792 hrs ≥ 105°F
  - 391 hrs ≥ 110°F



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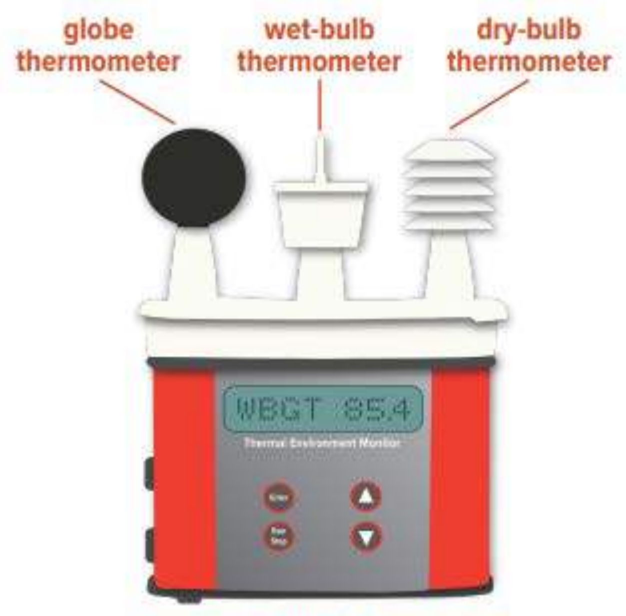
Wet-Bulb Globe Temperature (WBGT)

- Combination of temperature, humidity, wind, and solar radiation.
  - More complete measure of heat.

- Recommended for athlete and worker safety.

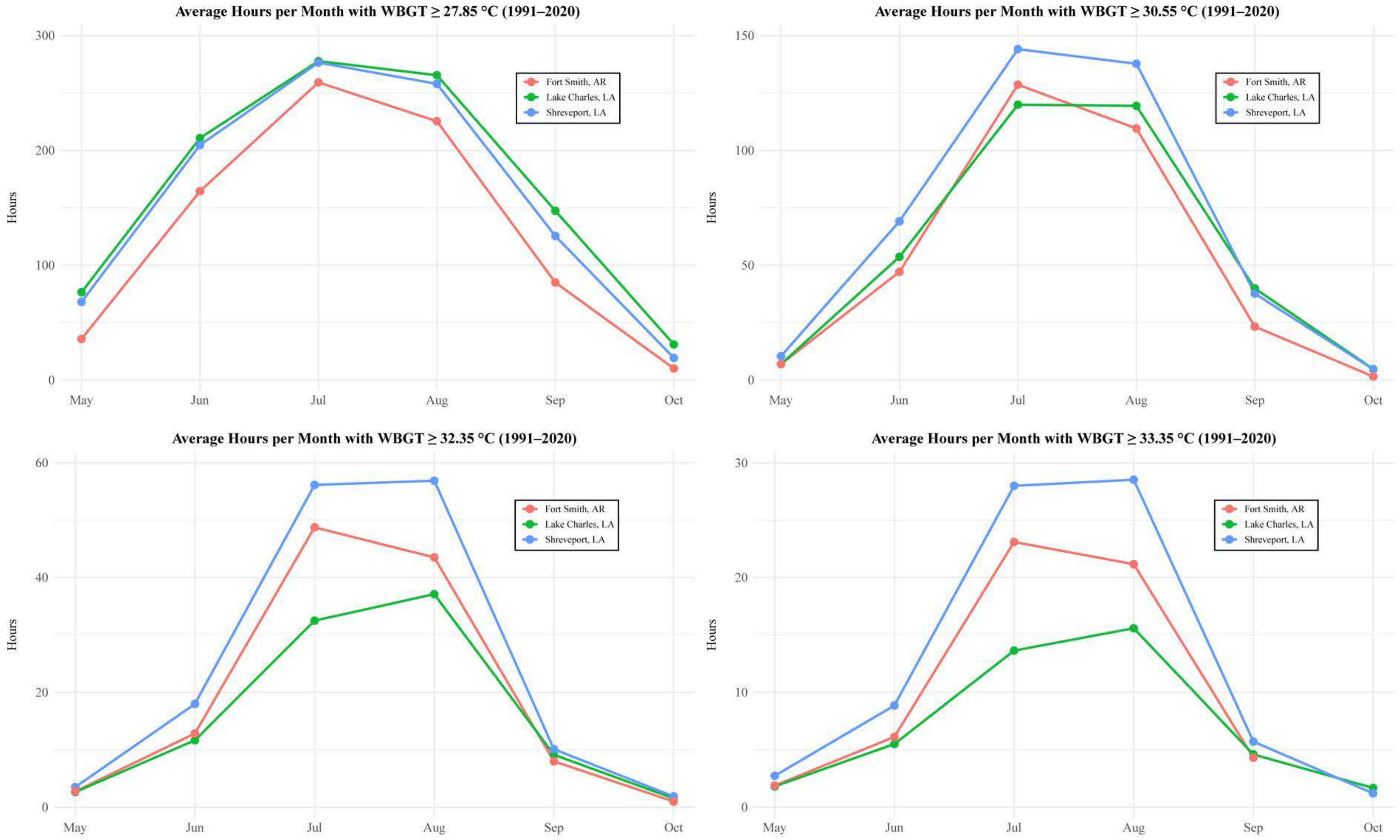
- DRAWBACKS
  - Not commonly measured
  - Hard to communicate ("90 vs. 115")



Example of WBGT Equipment

Wet-Bulb Globe Temperature (WBGT)

- Average WBGT: 74.61°F
- Average Max. WBGT: 95.88°F
- Single hottest hour: 107.53°F (1997)
- Hottest year: 1998



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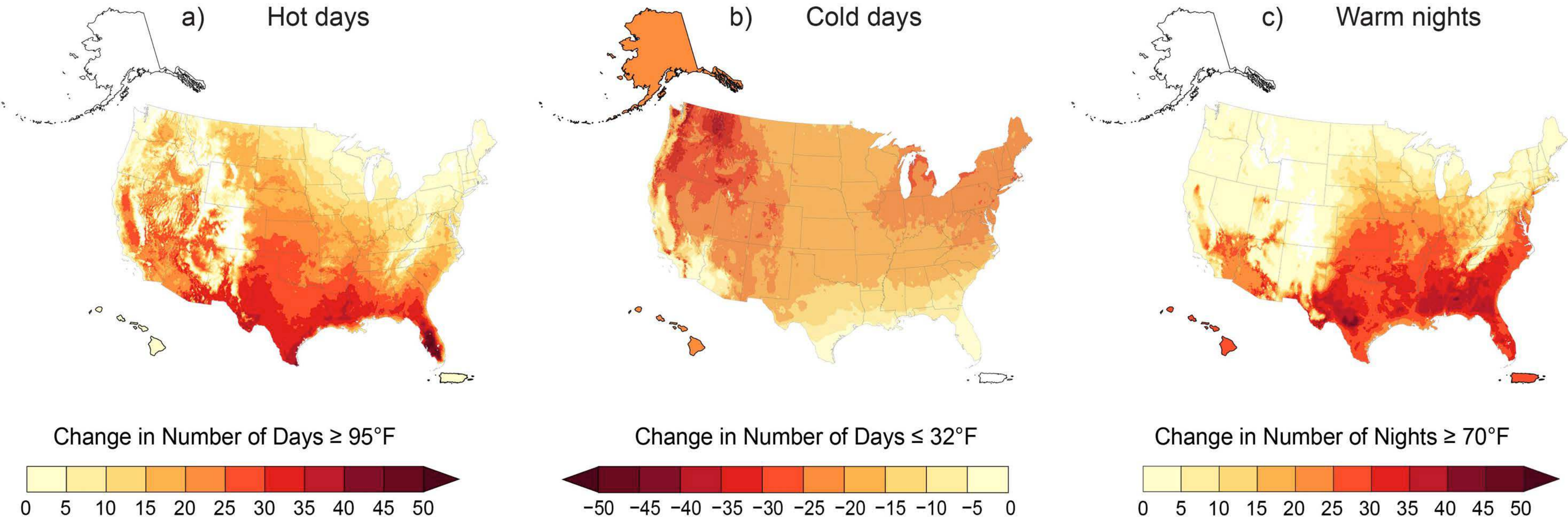
Future

Projected Changes to Hot and Cold Extremes at 2°C of Global Warming



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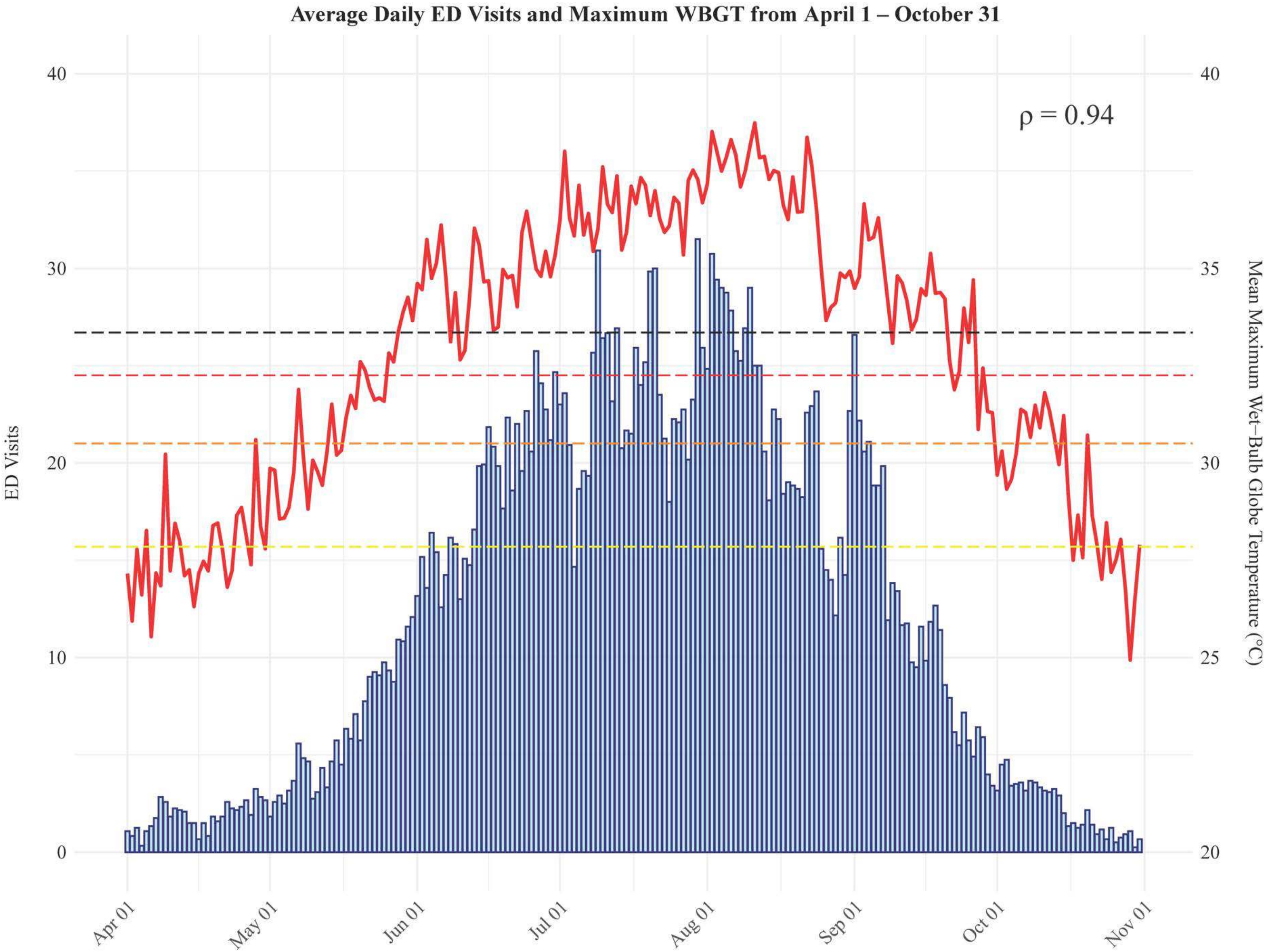
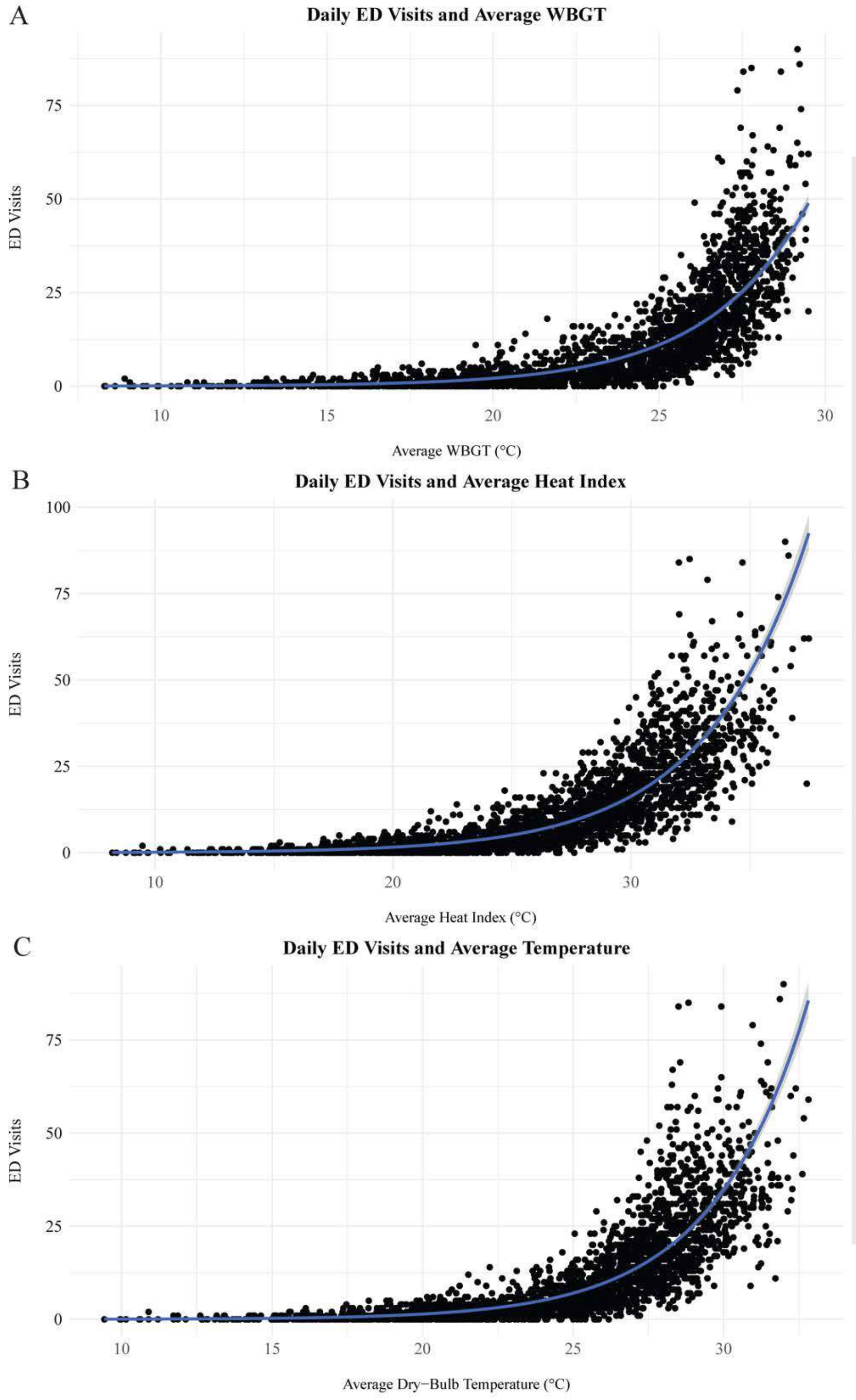
Application





Thank you!

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Damaging Wind: When It Doesn't Just Blow Over

Trey Bell
Engagement Associate
Southern Climate Impacts Planning Program

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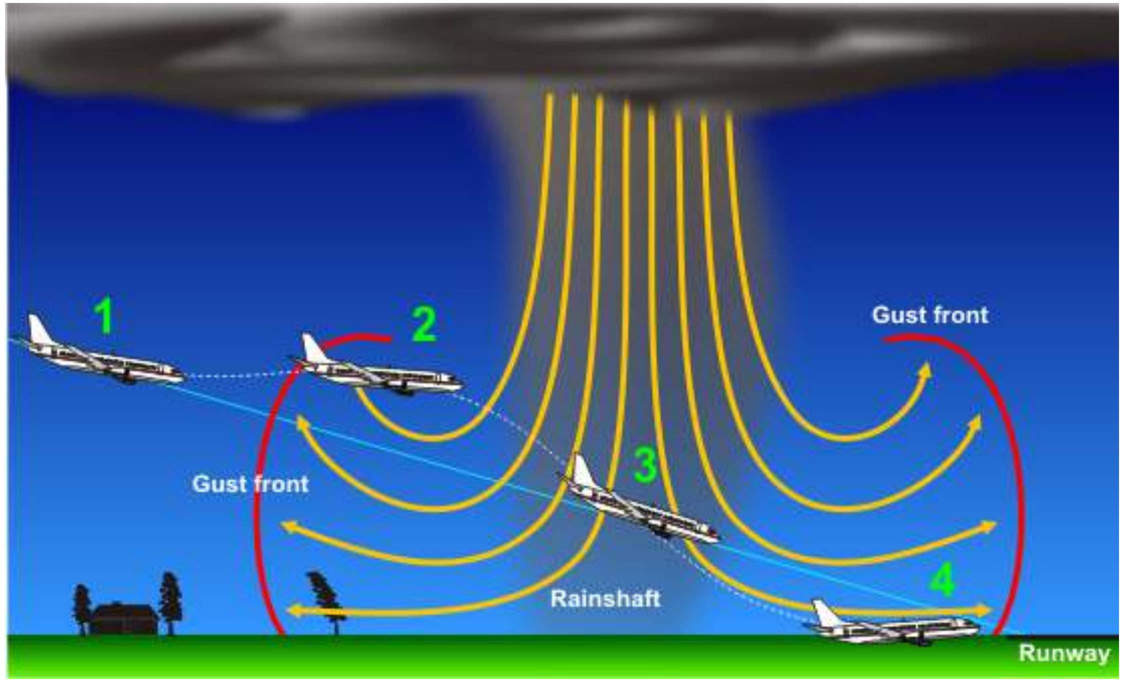
Where can we see severe winds?

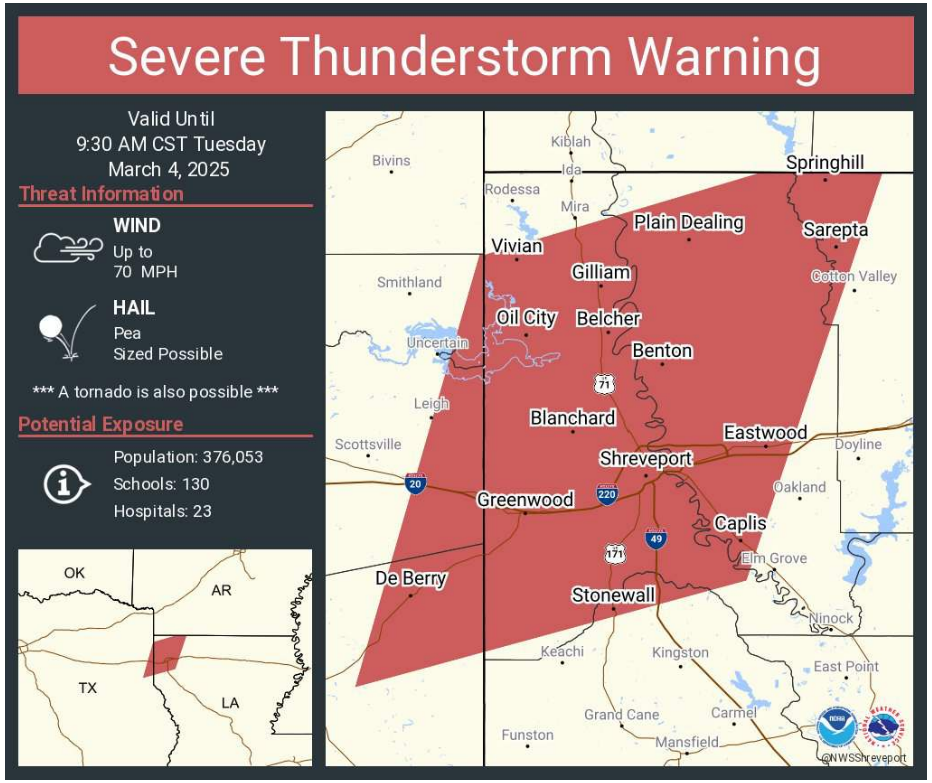
- Severe Thunderstorms
- Tornadoes
- Tropical Cyclones

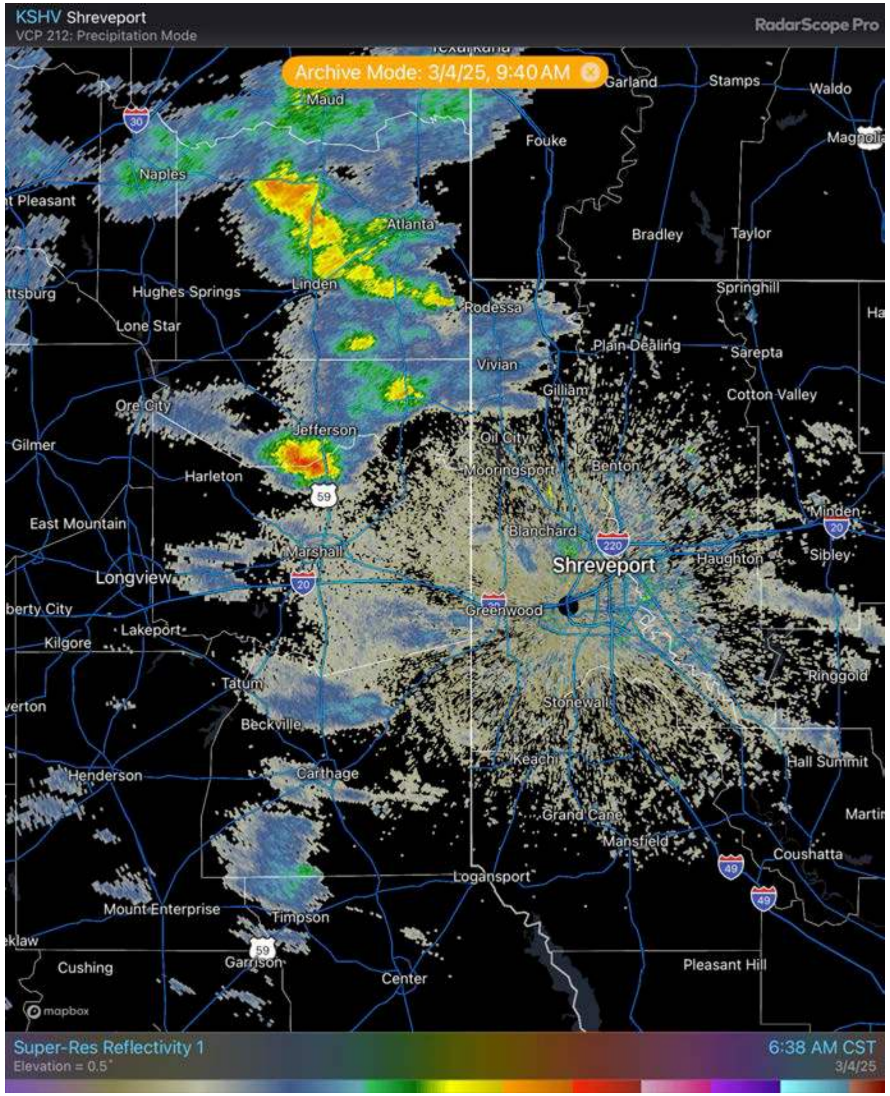
Severe Winds

- Responsible for most thunderstorm damage
- Much larger area affected than tornado paths
- Can exceed 100 mph
- Average 47 fatalities annually in the US
- Most often associated with supercells or squall lines, like in the next slide.



Severe Thunderstorms





Severe Thunderstorms

Photo: Natchitoches Parish Sheriff's Office

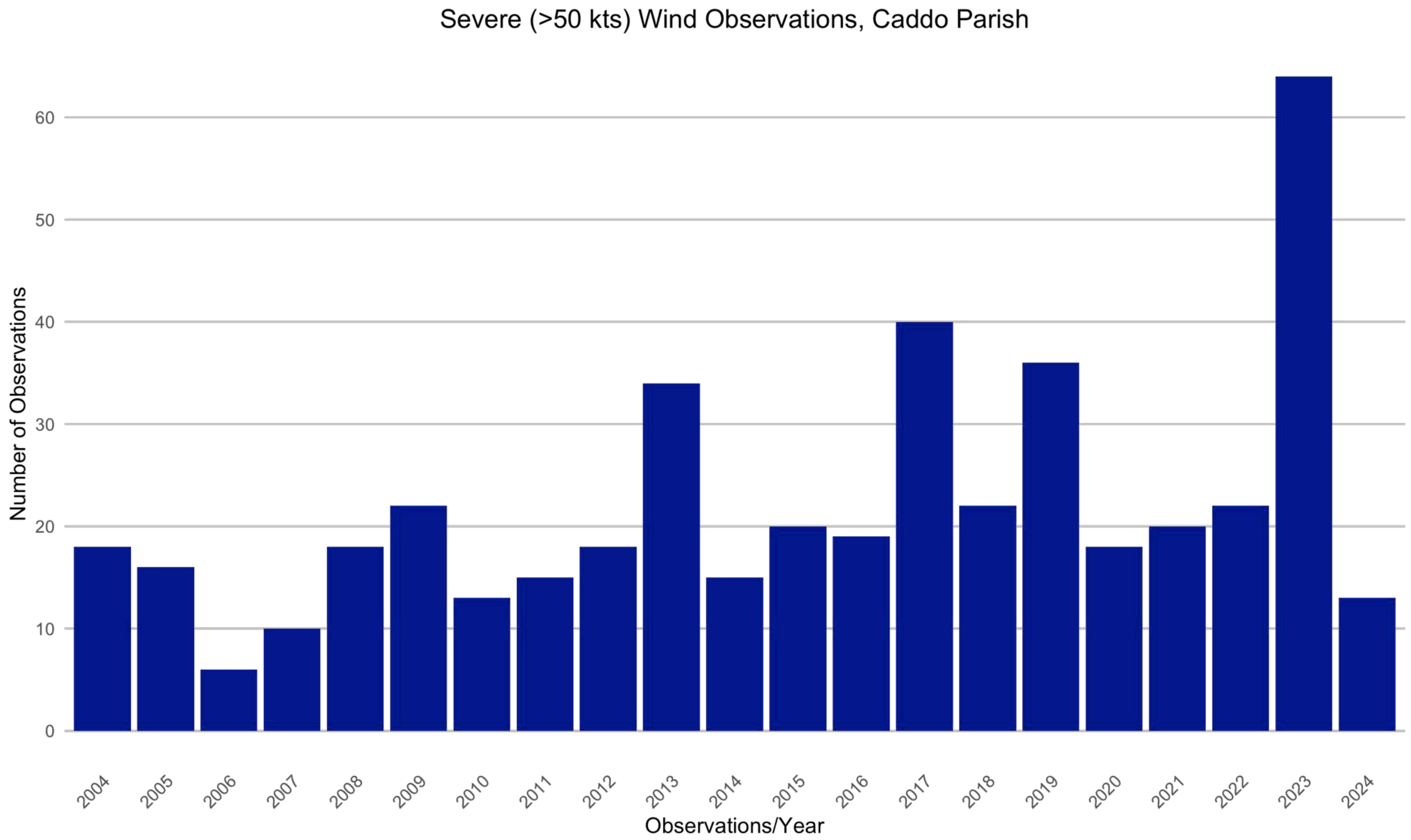
Photo: KSLA, Blanchard, LA

Photo: SWEPCO

What can severe wind do?

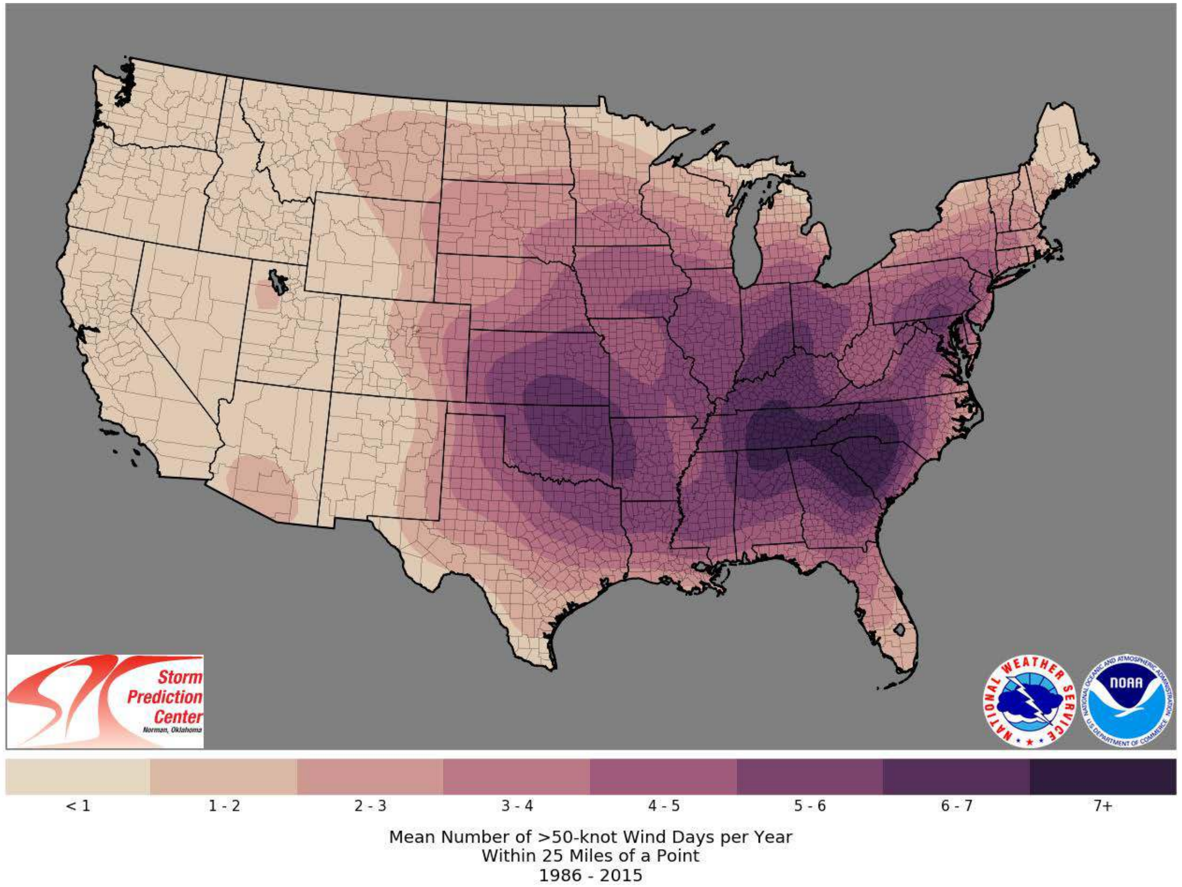
- Damage buildings
- Uproot trees
- Negatively impact power infrastructure

How often does it happen?



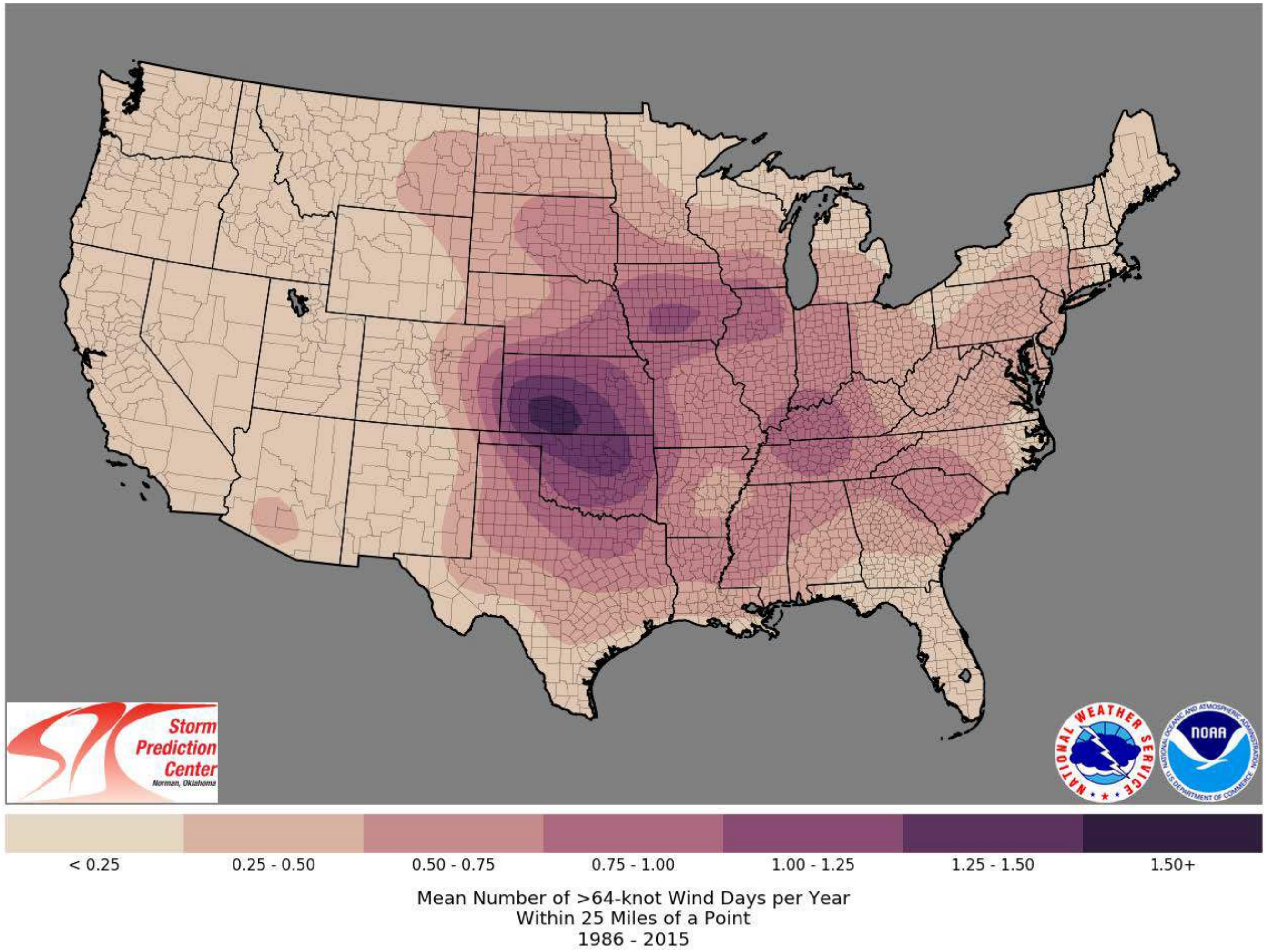
- Likely happens more frequently, these are only observations taken at particular locations across the parish.

Where do we see severe winds across the US?



Winds > 58 mph within 25 miles of a point

Winds > 74 mph within 25 miles of a point



Tornadoes

- Building destruction
- Uprooting trees
- Landscape scarring

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Tornadoes

- Measured using the Enhanced Fujita Scale
- Damage-based indicator
- Expected damage to 28 different types of structures

The Enhanced Fujita Scale

EF rating	Wind Velocity (km/h)	Wind velocity (mph)	Typical Damage
EF0	105–137	65–85	*Minor damage:* Peels of some shingles; breaks branches; topples weak trees
EF1	138–177	86–110	*Moderate damage:* Strips roofs of shingles; overturns mobile homes, breaks windows
EF2	178–217	111–135	*Considerable damage:* Tears off roofs; shifts houses off foundations; destroys mobile homes; uproots large trees; flings debris and lifts cars
EF3	218–266	136–165	*Severe damage:* Destroys upper stories of well-built houses; severely damages large buildings; overturns trains; throws cars; debarks trees
EF4	267–322	166–200	*Extreme damage:* Completely levels well-built houses; throws cars and trucks
EF5	>322	>200	*Catastrophic damage:* Collapses tall buildings; severely damages structures made of reinforced concrete; carries cars and trucks more than a kilometer

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Tornado Strength

- Only one-third of all tornadoes are strong and just 2% violent
- This equates to about 25 EF4-EF5 tornadoes per year
- These violent tornadoes cause 70% of fatalities

EF Number		Wind Speed (mph)
EF0	Weak	65-85
EF1	Weak	86-109
EF2	Significant/ Strong	110-137
EF3	Significant/ Strong	138-167
EF4	Significant/ Violent	168-199
EF5	Significant/ Violent	200-234

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Shreveport/Bossier City Tornado – 04/03/1999

- Seven lives lost in Bossier Parish
  - All but one were in mobile homes
- $1.26M (1999) in damages in Caddo Parish
- $6.68M (1999) in damages in Bossier Parish
- Nearly 20-mile path, 200 yards at the widest

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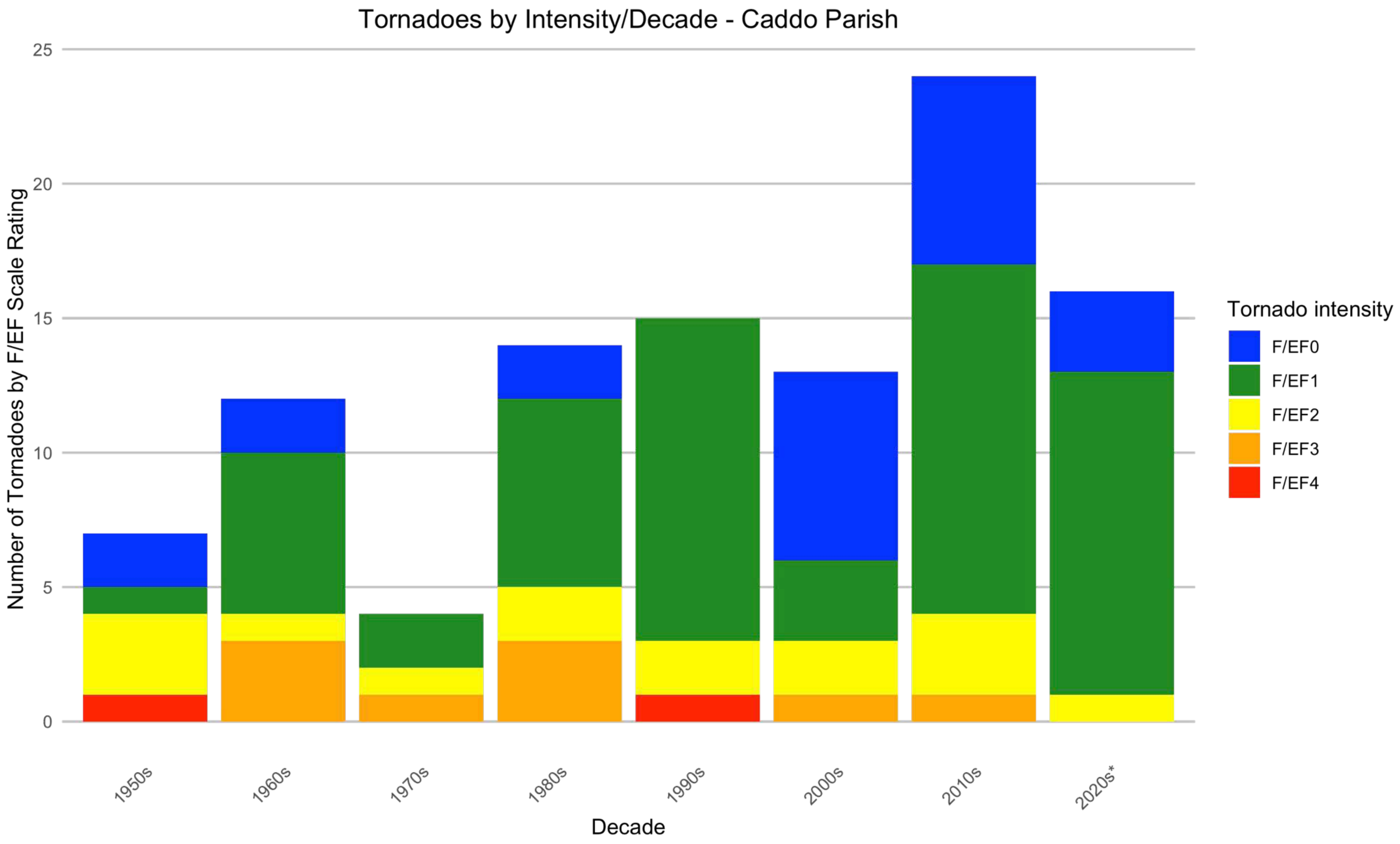
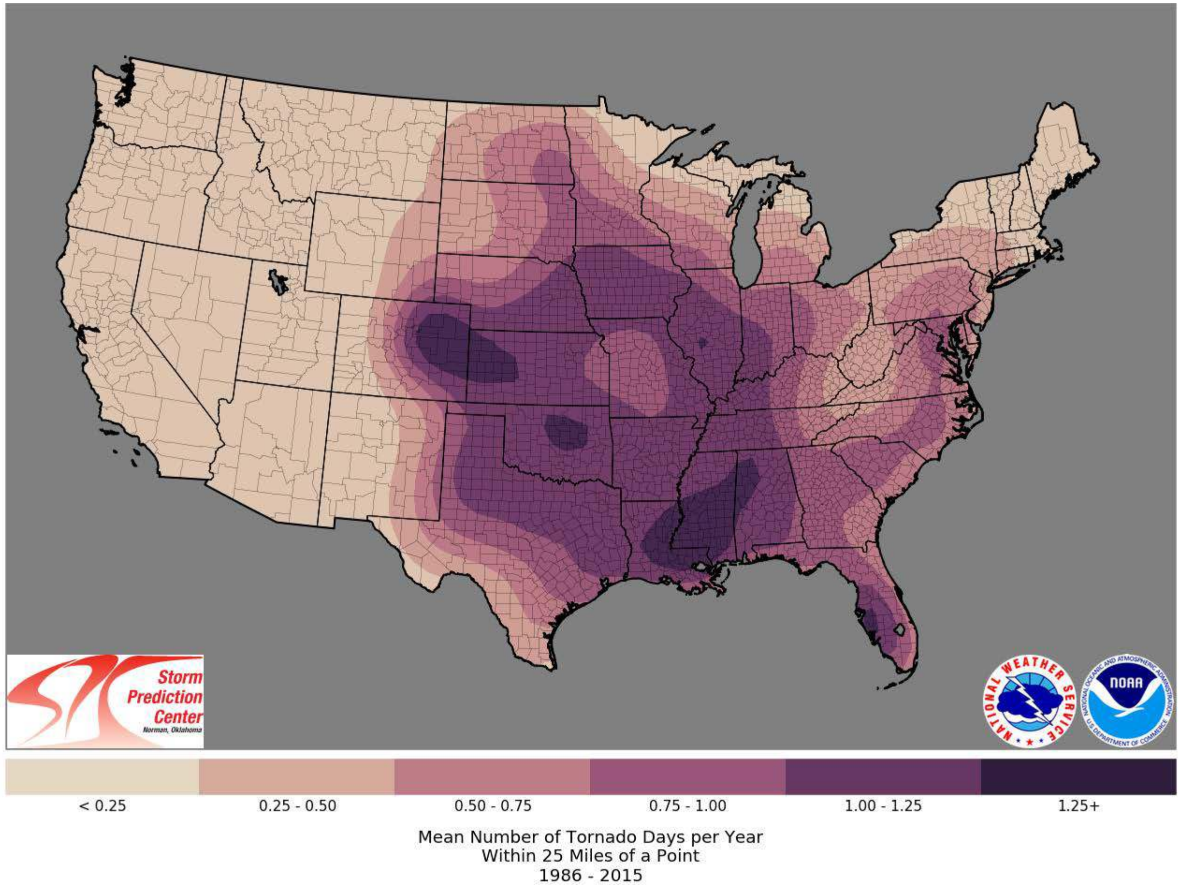
Tornadoes



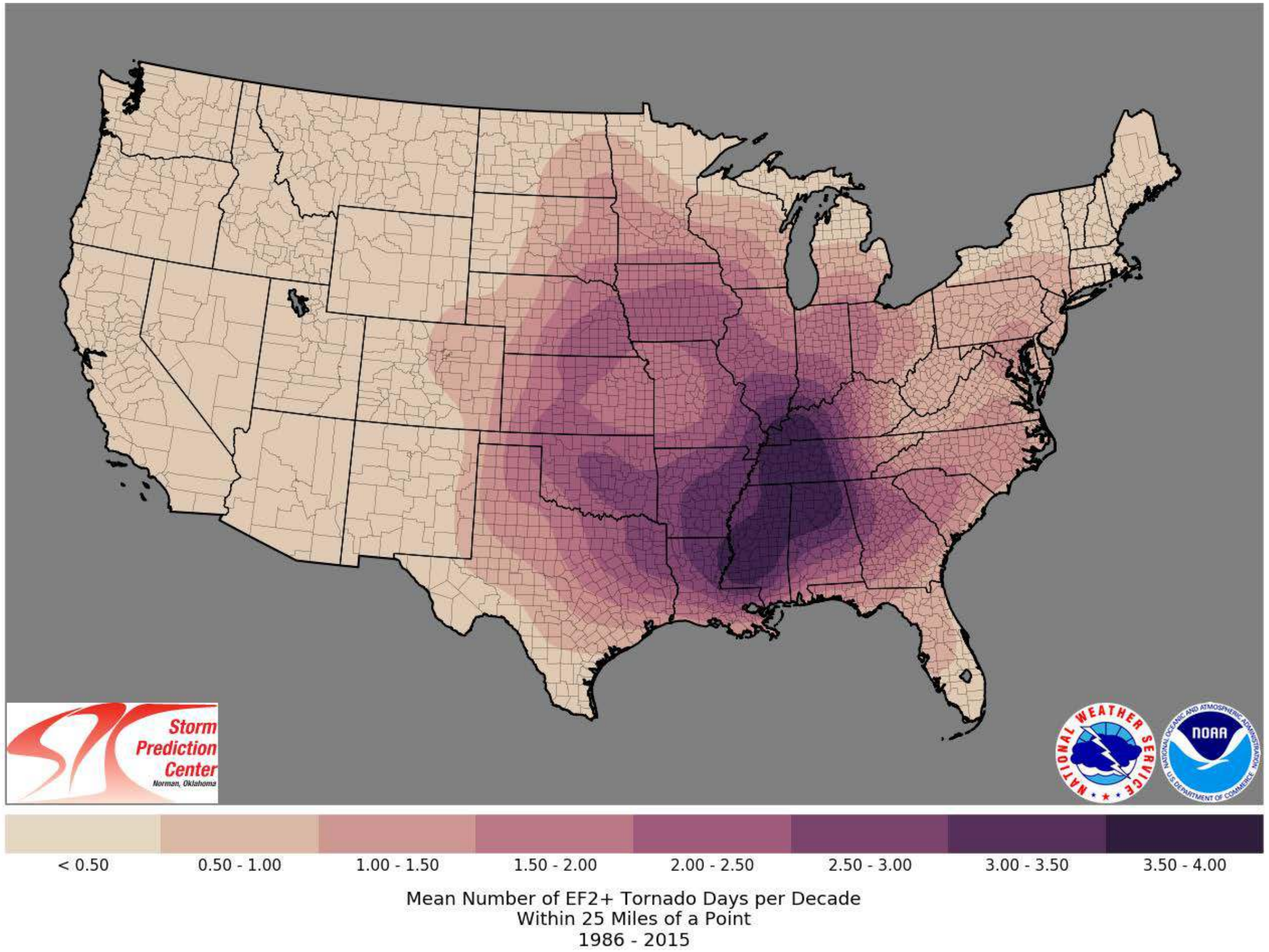
Tornadoes by Intensity/Decade - Caddo Parish
25
20
15
10
5
0
Number of Tornadoes by F/EF Scale Rating
1950s
1960s
1970s
1980s
1990s
2000s
2010s
2020s*
Decade
Tornado intensity
F/EF0
F/EF1
F/EF2
F/EF3
F/EF4

Where do tornadoes occur in the US?

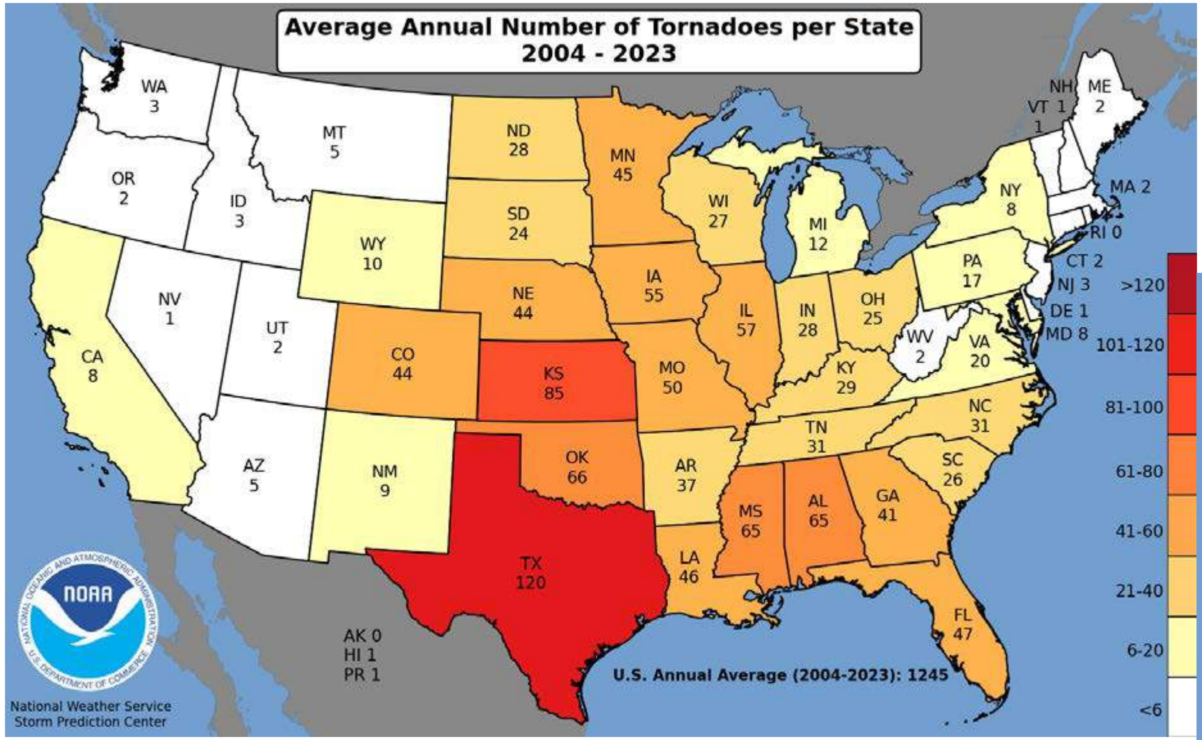


Average number of total tornadoes per year

Average number of EF2+ tornadoes per <u>decade</u>

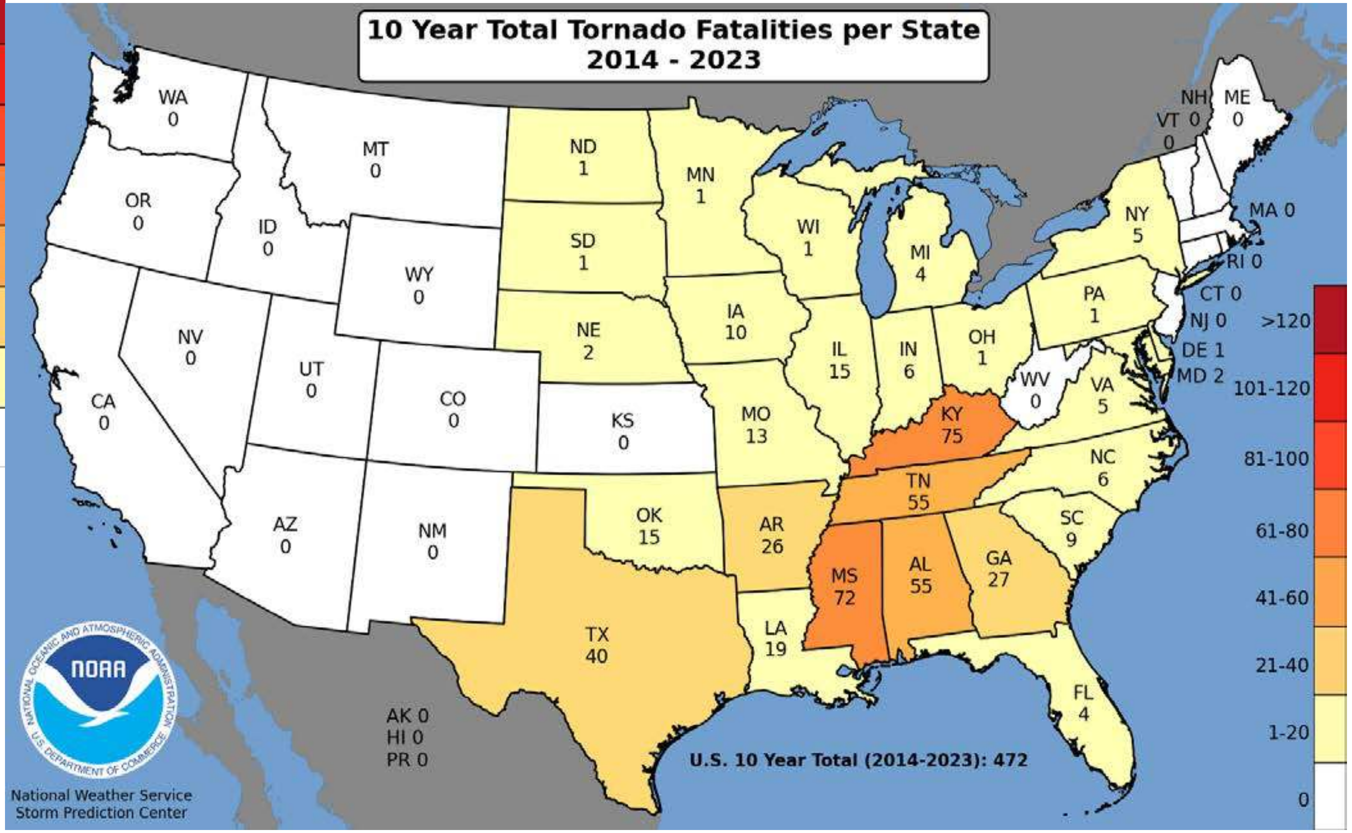


Some more tornado stats…

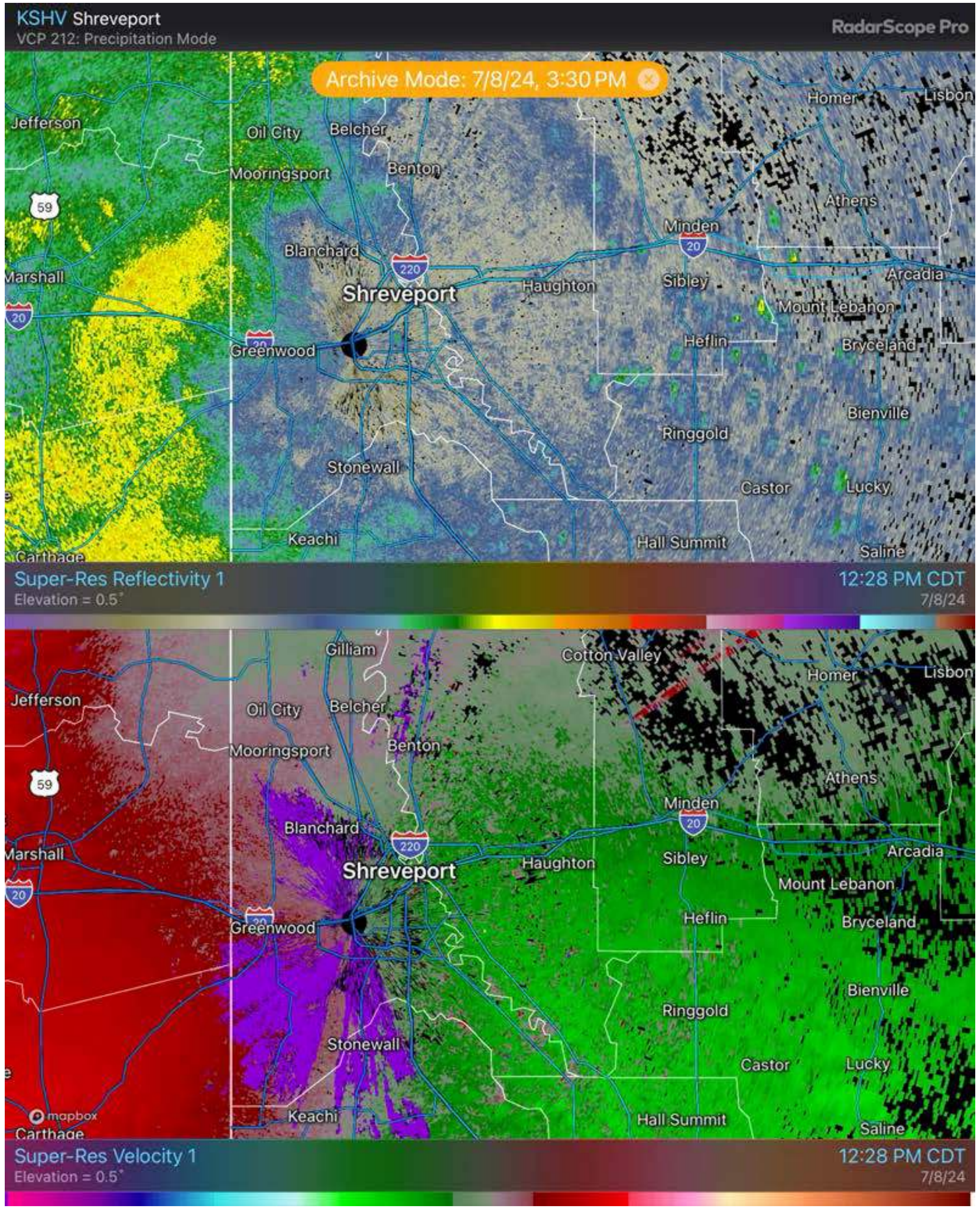


Louisiana averages 46 tornadoes per year for the last 20 years (2004-2023)

19 people have lost their lives due to tornadoes in Louisiana in the last 10 years (2014-2023)



TCs & Tornadoes



Hurricane Beryl - NOAA

Tropical Cyclones

Saffir-Simpson Hurricane Wind Scale (SSHWS)

Category	Wind (mph)	Damage
5	≥ 157	Catastrophic
4	130-156	Catastrophic
3	111-129	Devastating
2	96-110	Extensive
1	74-95	Some

Non-Hurricane Classifications

Tropical Storm	39-73	--
Tropical Depression	≤ 38	--

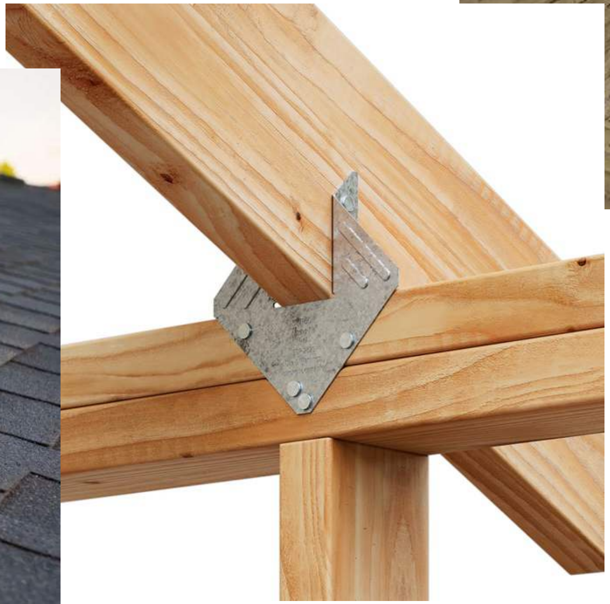
sciencenotes.org

What we expect from what we've seen…

- Much uncertainty remains in projecting short- and long-term trends.
- Despite this, there is some consensus on how damaging wind event risk will evolve with time.
- It is likely that severe thunderstorm events will become more pronounced, which may pose a higher risk of damaging wind events.
- Over the past 40 years, the number of tornadoes per event has increased, but is happening on fewer days per year.
- We have seen an increase in the number of high intensity tropical cyclones, including rapid intensification as they approach landfall. This trend is expected to continue.

Wind Mitigation – Roof Upgrades

- One of the most vulnerable spots on a home – the roof/wall connection
- Roof/Wall Straps and Braces
- Hurricanes Clips/Ties
- Impact resistant materials



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Wind Mitigation – Windows, Doors, Walls

- Impact resistant windows and doors
- Window Film
    - Helps reduce shattering risk
- Reinforced shutters
- Wall Braces
- Foundation anchors

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Questions?

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Hazard Planning

Darrian Bertrand

Climate Assessment Specialist
Southern Climate Impacts Planning Program
University of Oklahoma

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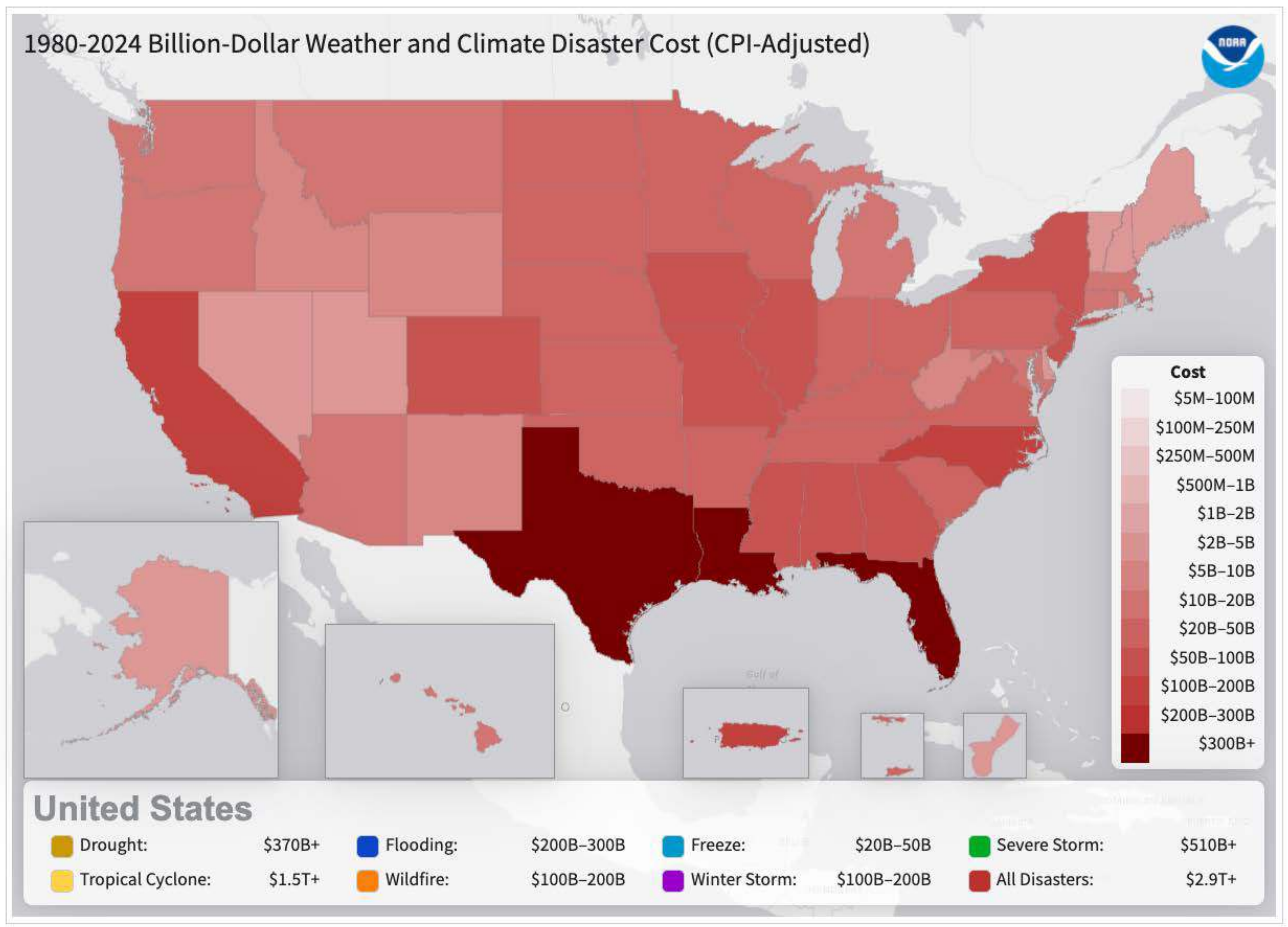
Billion-Dollar Weather & Climate Disasters

- Louisiana has experienced **106 billion-dollar disasters** since 1980.
- This resulted in **over $310 billion** in **damages***.
- Climate-informed planning and action can **reduce impacts** and **increase resilience**.



NCEI, March 2025

*Values represent total disaster costs – disasters often span multiple states

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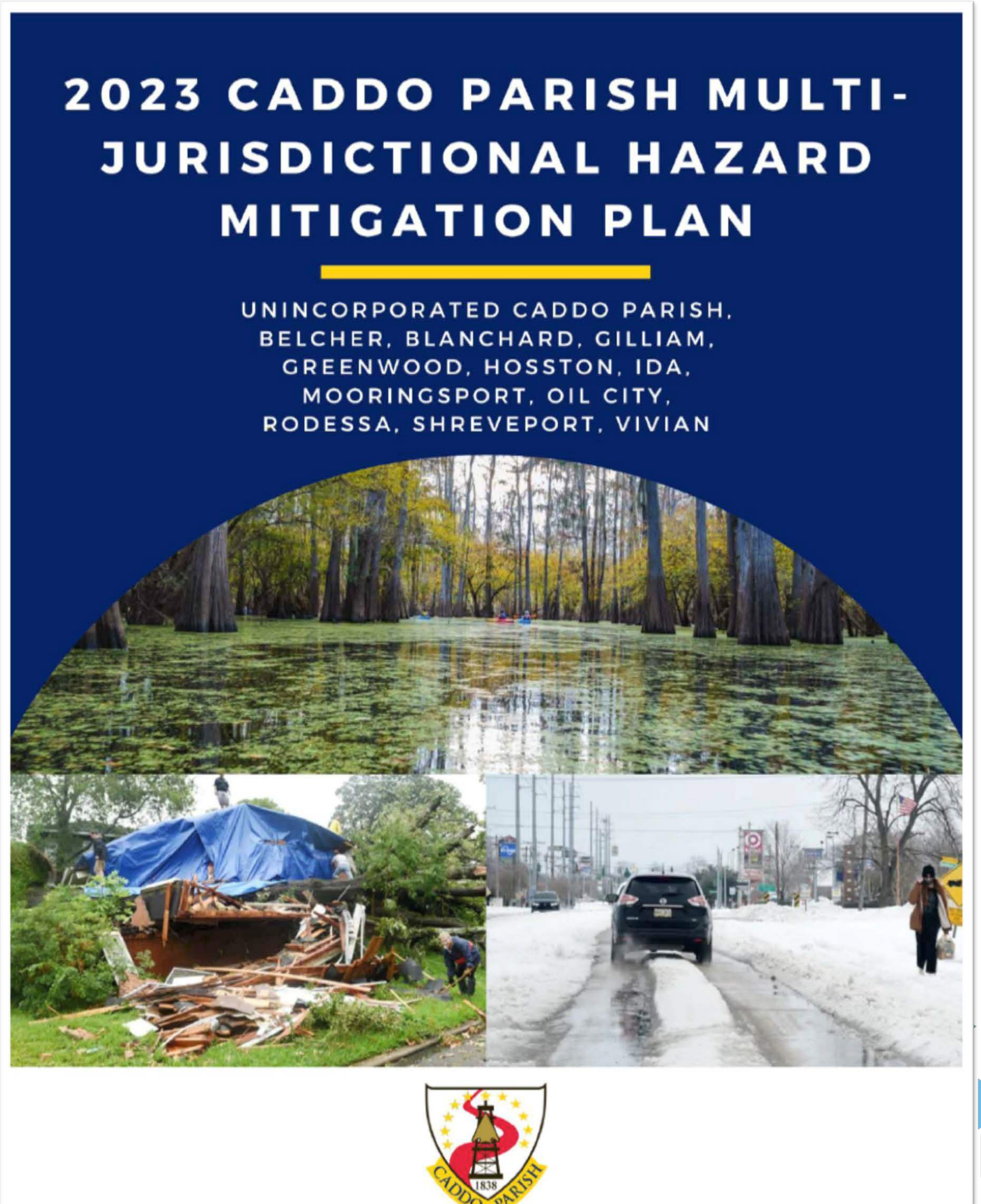
Hazard Mitigation Plan

Hazard Mitigation is defined as sustained actions taken to *reduce* or *eliminate long-term risk* from hazards and their effects.

Hazard Mitigation Planning is the process through which natural hazards that threaten communities are identified, likely impacts of those hazards are determined, mitigation goals are set, and appropriate strategies that would lessen the impacts are determined, prioritized, and implemented.

Hazard mitigation plans are updated every ~5 years.

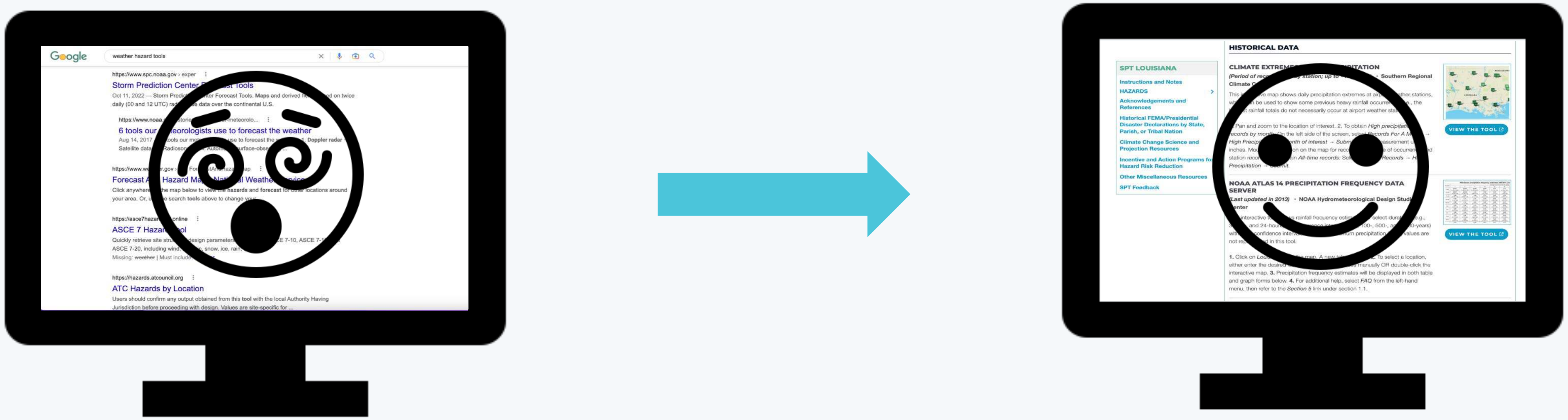
You MUST have a FEMA-approved HMP to be eligible for certain FEMA funding!



(to be adopted in April 2025)

Simple Planning Tool for Climate Hazards
What is It?

A compilation of relatively easy-to-use online interactive tools, maps, and graphs that can assist planners, emergency managers, and other decision makers who are assessing long-term climate risks, both historically and in the future.



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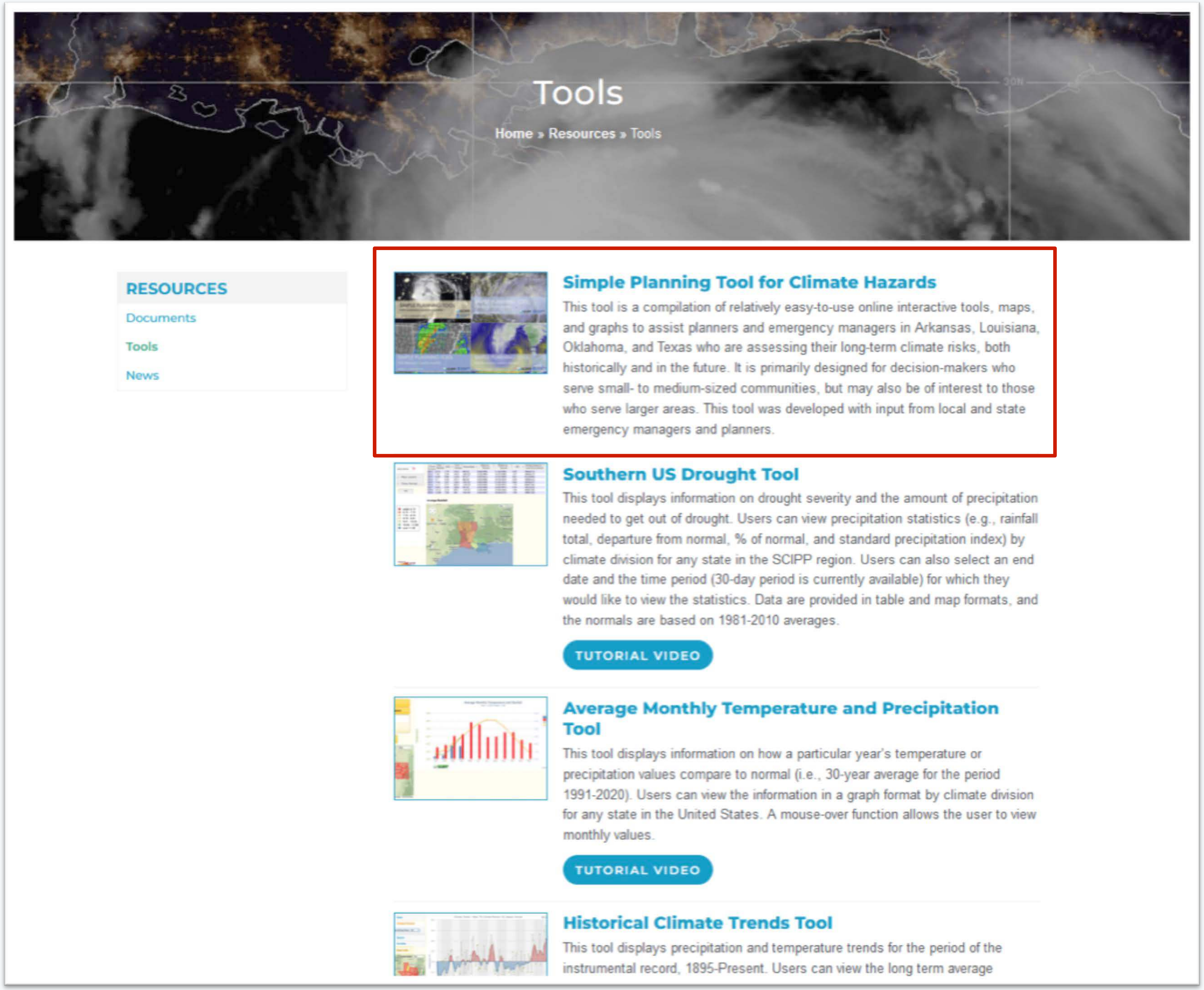
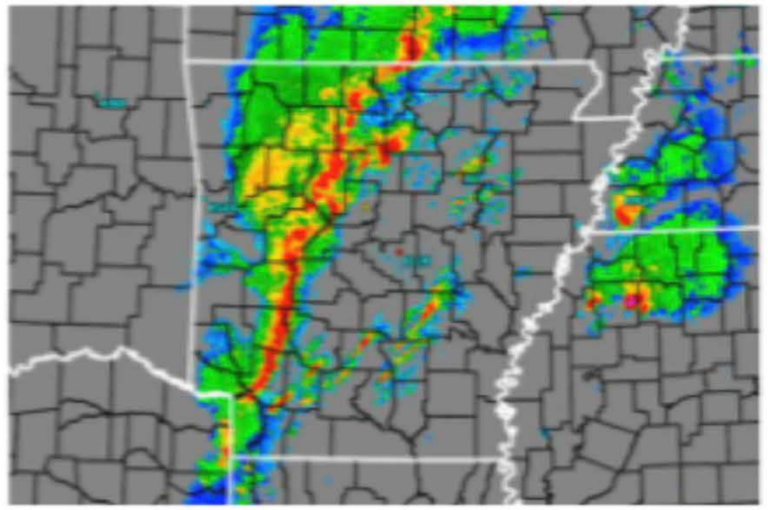


https://www.southernclimate.org/resources/tools/

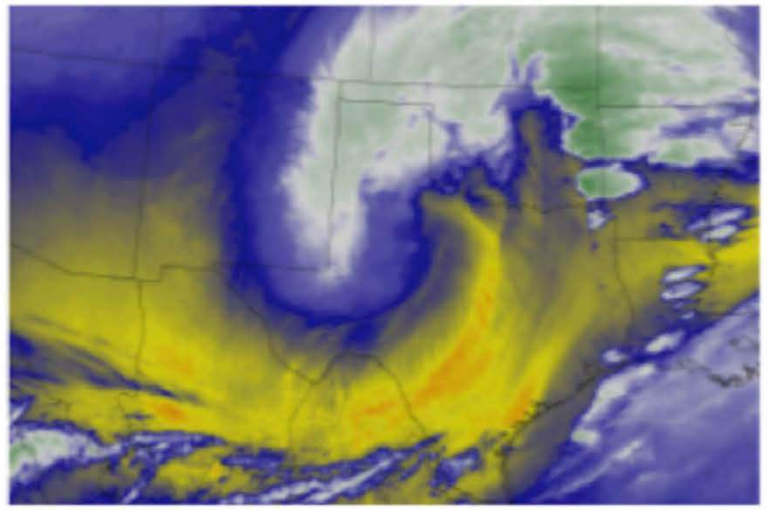
About the Simple Planning Tool

This tool is a compilation of relatively easy-to-use online interactive tools, maps, and graphs to assist planners and emergency managers in Arkansas, Louisiana, Oklahoma, and Texas who are assessing their long-term climate risks, both historically and in the future. It is primarily designed for decision-makers who serve small- to medium-sized communities, but may also be of interest to those who serve larger areas. This tool was developed with input from local and state emergency managers and planners. While it may not answer every question one has about hazard climatologies and future trends, it aims to cut through the internet clutter and point to relatively simple data tools that can be used during planning processes and in plans.

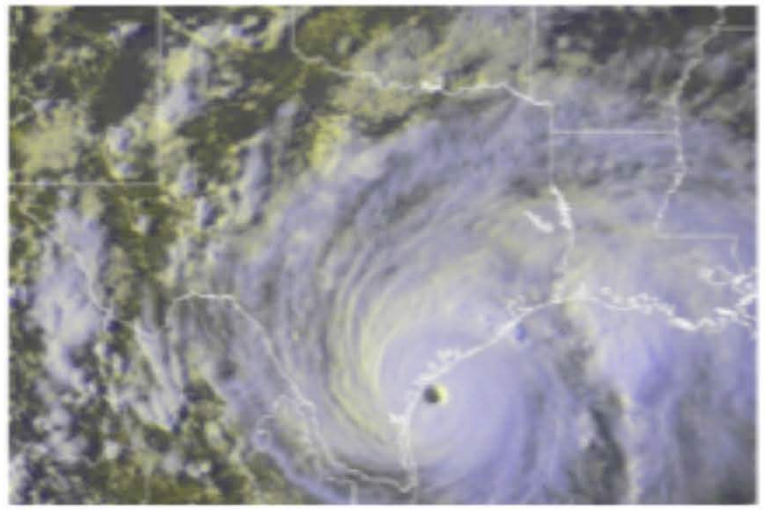


Arkansas

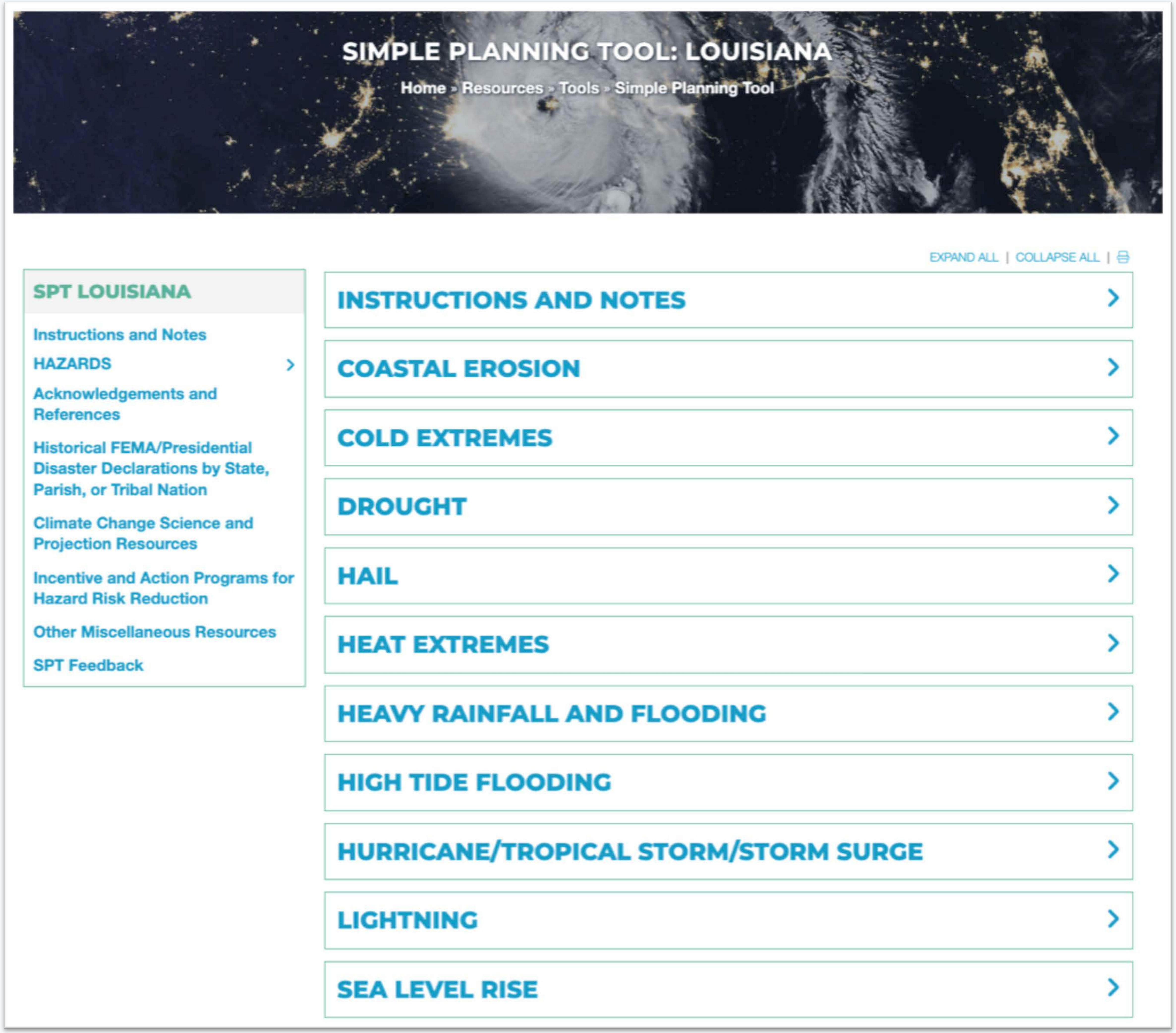
Louisiana



Oklahoma



Texas



SIMPLE PLANNING TOOL: LOUISIANA

Home » Resources » Tools » Simple Planning Tool

EXPAND ALL | COLLAPSE ALL |

SPT LOUISIANA

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- HAZARDS
- Acknowledgements and References
- Historical FEMA/Presidential Disaster Declarations by State, Parish, or Tribal Nation
- Climate Change Science and Projection Resources
- Incentive and Action Programs for Hazard Risk Reduction
- Other Miscellaneous Resources
- SPT Feedback

INSTRUCTIONS AND NOTES

COASTAL EROSION

COLD EXTREMES

DROUGHT

HAIL

HEAT EXTREMES

HEAVY RAINFALL AND FLOODING

HIGH TIDE FLOODING

HURRICANE/TROPICAL STORM/STORM SURGE

LIGHTNING

SEA LEVEL RISE

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Instructions and Notes

HAZARDS

- » Coastal Erosion
- » Cold Extremes
- » Drought
- » Hail
- » Heat Extremes
- » Heavy Rainfall and Flooding
- » High Tide Flooding
- » Hurricane/Tropical Storm/Storm Surge
- » Lightning
- » Sea Level Rise
- » Severe Thunderstorm Winds
- » Tornado
- » Wildfire
- » Winter Storm (Ice, Sleet, Snow)
- » Dam or Levee Failure
- » Earthquake
- » Poor Air Quality (Dust, Pollutants, Smoke)

Acknowledgements and References

INSTRUCTIONS AND NOTES ›

COASTAL EROSION ›

COLD EXTREMES ›

DROUGHT ›

HAIL ›

HEAT EXTREMES ›

HEAVY RAINFALL AND FLOODING ›

HIGH TIDE FLOODING ›

HURRICANE/TROPICAL STORM/STORM SURGE ›

LIGHTNING ›

SEA LEVEL RISE ›

HEAVY RAINFALL AND FLOODING

1

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DATA LIMITATIONS

There is a relatively long historical record of precipitation data. However, there can be gaps between station locations, so some rainfall events, including high rainfall amounts, may not be adequately represented in the data. Also, flood risk depends on a precipitation event, preceding events, the built environment, and flood mitigation techniques. Flooding can and does occur outside of the Federal Emergency Management Agency (FEMA) Special Flood Hazard Areas. Flood impacts are often extremely localized, so the data listed below may not adequately represent a single community or neighborhood flood risk or history.

DEFINITION AND DESCRIPTION

2

COPY TEXT

Definition

Heavy rainfall is rain with a rate of accumulation exceeding a specific value that is geographically dependent (AMS 2012). Flooding is any high flow, overflow, or inundation by water which causes or threatens damage (NWS 2009).

Description

Heavy rainfall is a subjective term, but is rain falling at a rate more than the underlying surface can handle, causing runoff, inundation of low-lying areas, and flooding. This may include short-duration thunderstorms lasting a few hours or rainfall accumulating over several days. Flooding is the result of heavy rainfall but also the underlying surface. The rate of infiltration (how quickly it is absorbed by the soil), how quickly runoff reaches the creeks and rivers, if there had been prior rainfall, if the ground is frozen, and other local factors affect runoff and flooding. Consequently, a rainfall of a given rate and amount may cause flooding in one circumstance but not in another. Flooding is most likely in low-lying areas, along the edges of water bodies (ponds, lakes, rivers), and over impermeable surfaces (such as streets and parking lots). Primary causes include slow-moving thunderstorms and storms that track over a location in rapid succession, or tropical systems. Flash flooding may occur with intense thunderstorms while river flooding usually requires rainfall accumulated over a longer duration.

Rainfall accumulations may be compared against previous occurrences through the concept of "return-period values". This is a statistical assessment of the frequency with which similar amounts have been recorded in the past at a specific location. These return periods, such as 1 in 25 years (a 4% chance of occurring in any given

HISTORICAL DATA

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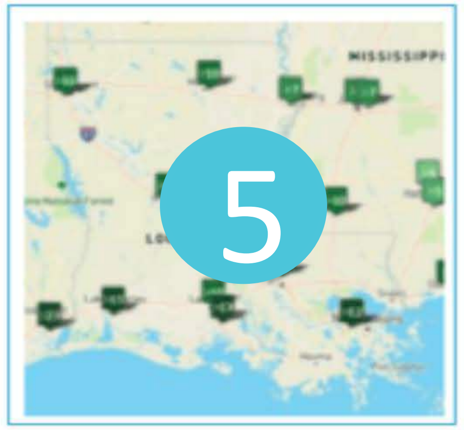
CLIMATE EXTREMES TOOL – PRECIPITATION

(Period of record varies by station; up to ~130 years) **• Southern Regional Climate Center**

This interactive map shows daily precipitation extremes at airport weather stations, which can be used to show some previous heavy rainfall occurrences (i.e., the highest rainfall totals do not necessarily occur at airport weather stations).

4

1. Pan and zoom to the location of interest. 2. To obtain *High precipitation records by month:* On the left side of the screen, select *Records For A Month → High Precipitation → Month of interest → Submit.* **3.** The measurement unit is inches. Mouse over the icon on the map for record details (date of occurrence and station record). **4.** To obtain *All-time records:* Select *All-Time Records → High Precipitation → Submit.*



5

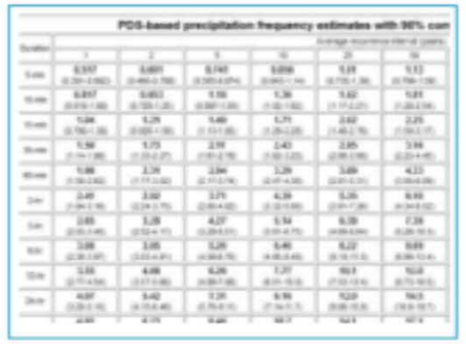
VIEW THE TOOL

NOAA ATLAS 14 PRECIPITATION FREQUENCY DATA SERVER

(Last updated in 2013) **• NOAA Hydrometeorological Design Studies Center**

This interactive tool shows rainfall frequency estimates for select durations (e.g., 3-, 12-, and 24-hours) and recurrence intervals (e.g., 100-, 500-, and 1000-years) with 90% confidence intervals. Probable maximum precipitation (PMP) values are not represented in this tool.

1. Click on *Louisiana* from the map. A new tab will open. **2.** To select a location, either enter the desired location, station, or address manually OR double-click the interactive map. **3.** Precipitation frequency estimates will be displayed in both table and graph forms below. **4.** For additional help, select *FAQ* from the left-hand menu, then refer to the *Section 5* link under section 1.1.



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6

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CLIMATE CHANGE TRENDS

COPY TEXT

Total annual precipitation has largely been above average in Louisiana since 1970, and the frequency of 4-inch extreme precipitation events have been above average since 1980 (Frankson et al. 2022). Across Louisiana, the intensity of hourly rainfall has increased over time (Brown et al. 2019). While annual precipitation amounts are not projected to change much, heavy precipitation events may increase in frequency and intensity (Hayhoe et al. 2018). By the end of the century, the heaviest 1% of rainfall events are projected to increase by up to 40% in intensity under a higher emissions scenario in northern Louisiana and up to 20-30% in southern Louisiana (Hayhoe et al. 2018). With the possibility of more intense rainfall from tropical storms and increased sea level rise and subsidence, flooding risks further increase in coastal and low-lying areas of Louisiana. Intense rainfall, including from tropical storms, has already increased by 6-7% compared to a century ago (Hayhoe et al. 2018). Flooding can cause overflow of sewage systems and contaminants of water resources, displacement of communities, disruption of critical services, and more. Read more about future heavy rainfall events in *Climate Change Science and Projection Resources*.

RISK FACTOR

(Present risk and 30- year future projections) **· First Street Foundation**

This tool provides information on flood risk and how it is changing. It shows the trend in number of properties at risk, a specific property's flood risk score, the flood history of an area, and how an area's flood risk is expected to change.

VIEW THE TOOL

1. Type in the county, city, or zip code of interest. **2.** Click the *Flood Factor* tab near the top of the page. **3.** Scroll down the page to view flood risk information. ***Note:*** Many features on this tool are behind a paywall. If you want information for specific homes and businesses or want to dive deeper into the information, then payment is required. However, you can receive the baseline information above for free.

CLIMATE EXPLORER – CLIMATE MAPS AND GRAPHS TOOLS

(1950-2099) **· NOAA Climate Program Office and National Environmental Modeling and Analysis Center**

The Climate Explorer is an interactive tool that allows you to view and compare the average number of days with precipitation greater than 1", 2", or 3" per year for the historical period and in the future under both higher and lower emissions scenarios.

VIEW THE TOOL

1. Type in the city or parish you are interested in. **2.** Click *Climate Maps*. **3.** From

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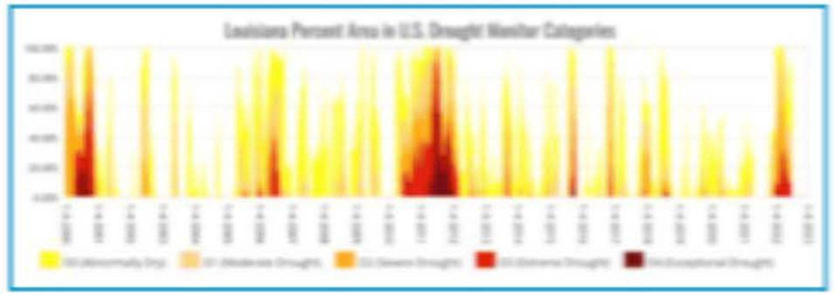
U.S. DROUGHT MONITOR TIME SERIES

(2000-present) • **National Drought Mitigation Center**



VIEW THE TOOL

This interactive graphing tool shows the frequency of drought conditions since 2000, along with each drought's maximum intensity and duration (shown by color scale). The U.S. Drought Monitor is the official source for aid decisions by the USDA and several other agencies and programs.

1. In the top banner, next to Area type choose ***State, Climate Division,*** or ***County*** (parish). **2.** Next to ***Area,*** select *LA* if you chose state-level information, or type a climate division or parish of interest. You can also type *LA* to view a drop-down list of all LA climate divisions/parishes. **3.** Next to Index, select *USDM.* **4.** Zoom in by clicking inside graph and dragging over a specific time-period.

U.S. Drought Monitor

Current | Maps | Data | Summary | About | Conditions & Outlooks | Ag in Drought | En Español | NADM

Time Series

Home / Data / Time Series

The values in this chart are for places represented as areas. To see the drought status of areas represented by points, please visit the OCONUS Time Series page.

To zoom in, click and drag the cursor. To return to the full time series, double-click anywhere in the chart.

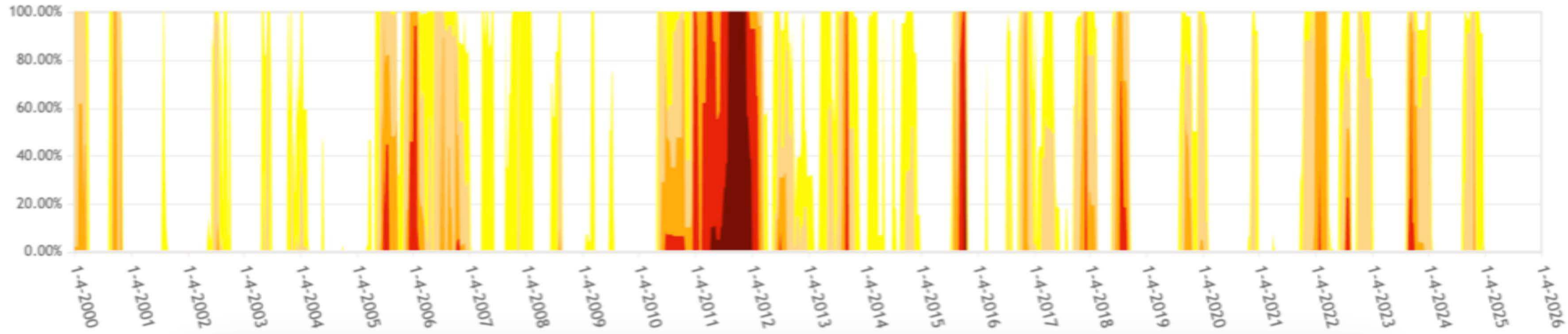
Area Type: County ?

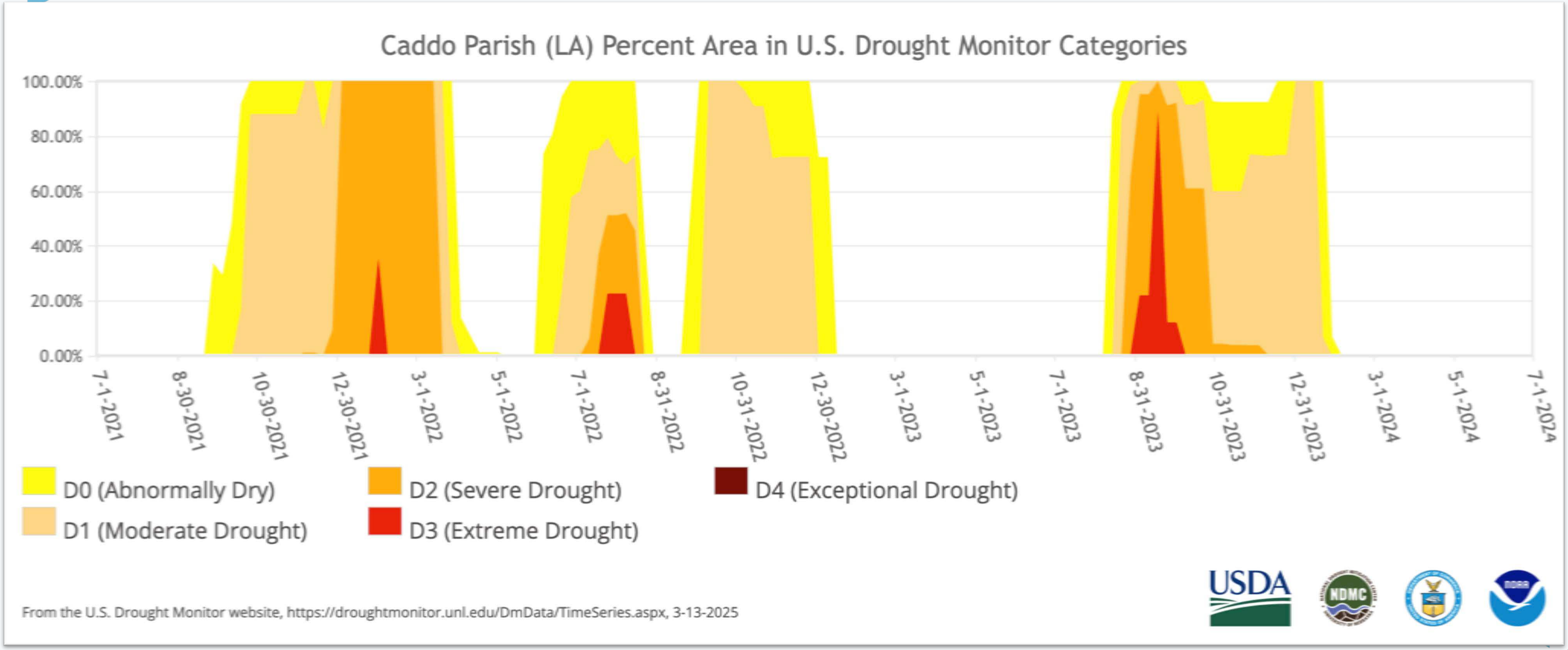
Area: Caddo Parish (LA)

Index: USDM ?

Fill area | D0 | D1 | D2 | D3 | D4 | Chart Export Options

Caddo Parish (LA) Percent Area in U.S. Drought Monitor Categories





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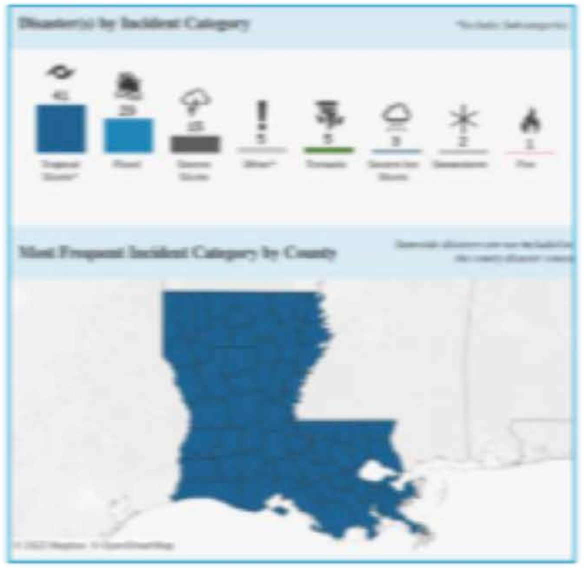
HISTORICAL FEMA/PRESIDENTIAL DISASTER DECLARATIONS BY STATE, PARISH, OR TRIBAL NATION

The data visualization interactive reference page below displays statistics of disaster declarations for both states and tribal nations, dating back to 1953.

DISASTER DECLARATIONS FOR STATES AND COUNTIES

This page contains an interactive tool that allows the exploration of historic federal disaster declarations by state, parish, hazard, and year. To access information from this page, first select a date range and state/territory from the menus. Information on federally declared disasters within the selected region will be displayed below.



VIEW THE TOOL

The tool provides the following information:

- Number of disasters by hazard type, county, year, and month,
- The cumulative number of disasters by hazard type, and
- The complete list of federal disaster declarations.

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- Instructions and Notes
- HAZARDS
- Acknowledgements and References
- Historical FEMA/Presidential Disaster Declarations by State, Parish, or Tribal Nation
- Climate Change Science and Projection Resources
- Incentive and Action Programs for Hazard Risk Reduction
- Other Miscellaneous Resources
- SPT Feedback

INCENTIVE AND ACTION PROGRAMS FOR HAZARD RISK REDUCTION

Below is a list of resources providing information on incentive and action programs intended to assist in reducing hazard risk for your community. The list is not comprehensive. Please reference the provided links for more information on each program.

ALL HAZARDS

Integrating Hazards into the Comprehensive Plan – Webinar (https://www.planningforhazards.com/webinars, scroll to bottom of page): This one-hour webinar focuses on how local governments and communities can reduce their risk and vulnerability by integrating hazard risk reduction strategies into their comprehensive plan. Colorado planners describe the processes, practices used, and lessons they learned when integrating hazards into their comprehensive plans. This webinar was developed in consideration for Colorado, but concepts can be similarly applied and adapted for Louisiana.

Louisiana Mitigation Assistance Resource Guide (https://www.fema.gov/sites/default/files/documents/fema_mitigation-assistance-resource-guide-louisiana.pdf): FEMA Region 6 created this guide to compile many federal and state resources that offer potential funding or technical assistance for mitigation projects into one place. The guide includes a table with the program/resource name, resource type (grant, loan, or technical assistance), hazards addressed, and mitigation type (education and outreach, natural systems protection, planning and regulations, or structure and infrastructure). It also provides more details about the resource and next steps for Louisiana communities.

Natural Hazard Mitigation Saves: 2019 Report (https://www.nibs.org/projects/natural-hazard-mitigation-saves-2019-report): The National Institute of Building Sciences issued this report to highlight the benefit of four broad avenues for implementing mitigation strategies. (1) The Institute's project team analyzed 23 years of federally funded mitigation grants and found that hazard mitigation funding can save the nation $6 in future disaster costs for every $1 spent. (2) The team looked at scenarios that focus on designing new buildings to exceed provisions of the 2015 model building codes, and the findings revealed that investing in exceeding these building codes can save the nation $4 for every $1 spent. (3) They analyzed benefits of adopting 2018 I-Codes vs. 1990-era design for buildings and found that there's a national benefit of $11 for every $1 spent. (4) The team looked at private sector retrofit for older buildings. Utilizing more modern retrofitting on existing residential buildings produces $4 of national benefit for every $1 invested.

National Institute of BUILDING SCIENCES™

	ADOPT CODE	ABOVE CODE	BUILDING RETROFIT	LIFELINE RETROFIT	FEDERAL GRANTS
Overall Benefit-Cost Ratio	11:1	4:1	4:1	4:1	6:1
Cost ($ billion)	$1/year	$4/year	$520	$0.6	$27
Benefit ($ billion)	$13/year	$16/year	$2200	$2.5	$160
Riverine Flood	6:1	5:1	6:1	8:1	7:1
Hurricane Surge	not applicable	7:1	not applicable	not applicable	not applicable
Wind	10:1	5:1	6:1	7:1	5:1
Earthquake	12:1	4:1	13:1	3:1	3:1
Wildland-Urban Interface Fire	not applicable	4:1	2:1	not applicable	3:1

Natural Hazard Mitigation Saves 2019

$6 saved for every **$1 spent** on hazard mitigation with federal grants
$11 saved for every **$1 spent** when adopting new **building codes** (I-Codes)

Louisiana benefits $10-100 BILLION from federal grants for flood, wind, earthquake, and fire mitigation.

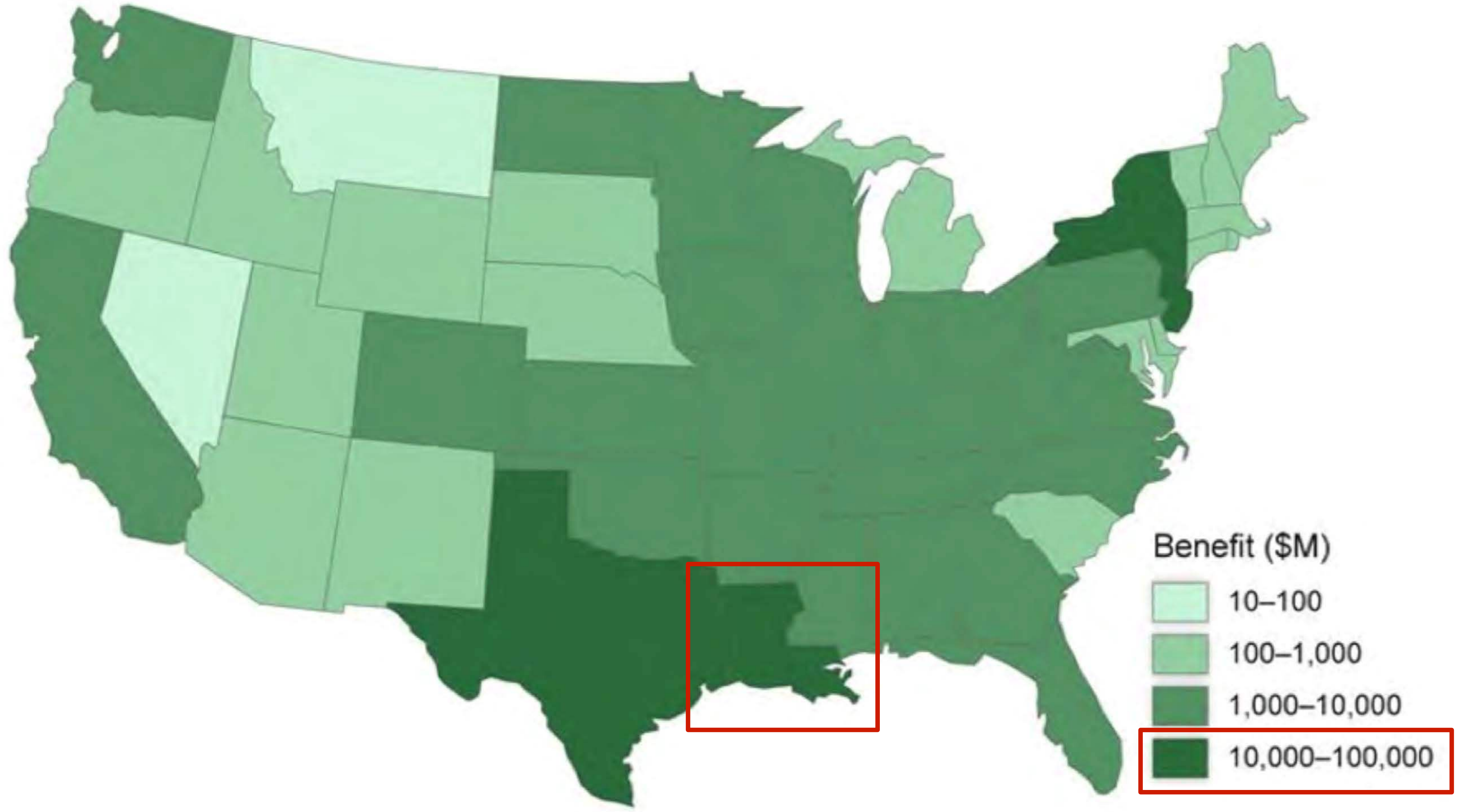

Figure 2-74: Aggregate benefit by state from federal grants for flood, wind, earthquake, and fire mitigation.

Natural Hazard Mitigation Saves 2019

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Proposed Mitigation Actions

2023 Caddo Parish HMP: Shreveport Actions

- Building retrofits
- Drainage improvements
- Generators for continuity of operations and government
- Lightning mitigation (lightning rods and surge protectors for public buildings)
- Dam and levee failure working group
- Drought ordinances
- Wildfire ordinances
- Cooling stations

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SPT Use Examples

Riley (2021)

"The SPT made it very easy to find the information I need quickly. Without it, I'm not sure I would really know where to begin."

- County Emergency Manager/Planner in OK serving a population of 100,000-499,999

“We are using the SPT more in our planning processes and within our development services department for current/past/future weather impacts and for future community expansions. Great tool.”

- City/Community Emergency Manager in OK serving a population of 10,000-49,999

Try it Out!

https://www.southernclimate.org/resources/tools/simple-planning-tool/

Darrian Bertrand
dbertrand@ou.edu
Southern Climate Impacts Planning Program
University of Oklahoma

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www.southernclimate.org

Discussion

How have you used weather and climate data in your planning (e.g., comprehensive plan, stormwater management plan, etc.)?

Discussion

Who should be involved in the next hazard mitigation plan?

Protecting People & Property

Mitigation

- Protecting Property
  - High Winds
  - Other Storm Impacts
  - Flooding
- Protecting People
  - Heat/Cold

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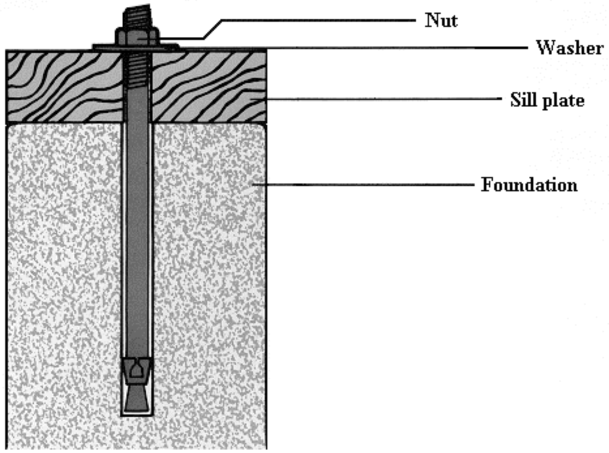
Keep the Building Intact

- Hurricane Clips (straps)
  - Nails can be pulled out by upward force of wind
  - Wrap around walls to roof beams
  - Uses screws – harder to back out

- Anchor Bolts
  - Connect wood frame to deep in foundation



http://www.youtube.com/watch?v=JbGCxFN7nfM

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Keep the Wind Out

- Primary points of failure
  - Wind or debris causes doors, windows, garage door to fail
  - Force of wind on interior pushes upward and outward
- Shutters
- Reinforced (steel) doors
- Garage door braces
- Reinforced fabric sheets
- Shatterproof WIndows

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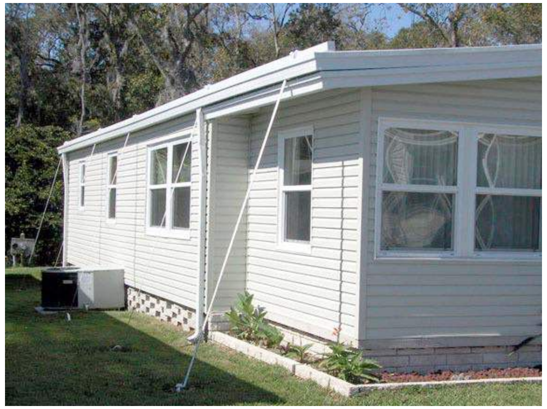
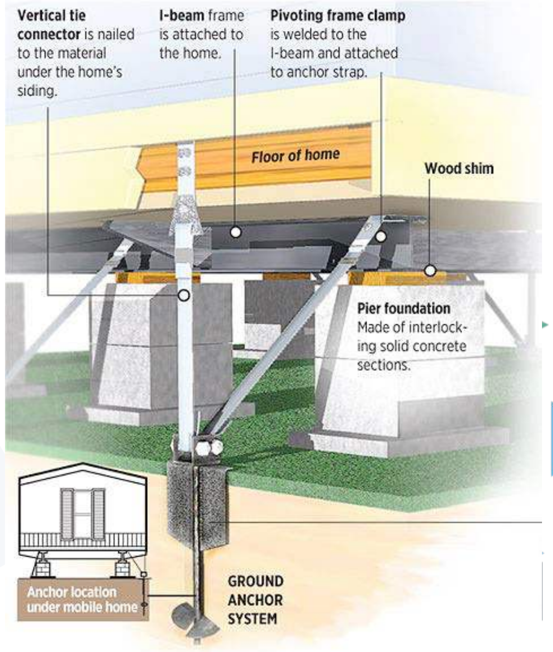
Manufactured Homes

- More vulnerable than permanent homes
- Comparatively light-weight
- Built on frames rather than foundations
- Elevated: wind can get underneath
- Types of tie-downs:
  - Over-the-top: resist uplift
  - Diagonal frame: resist lateral forces





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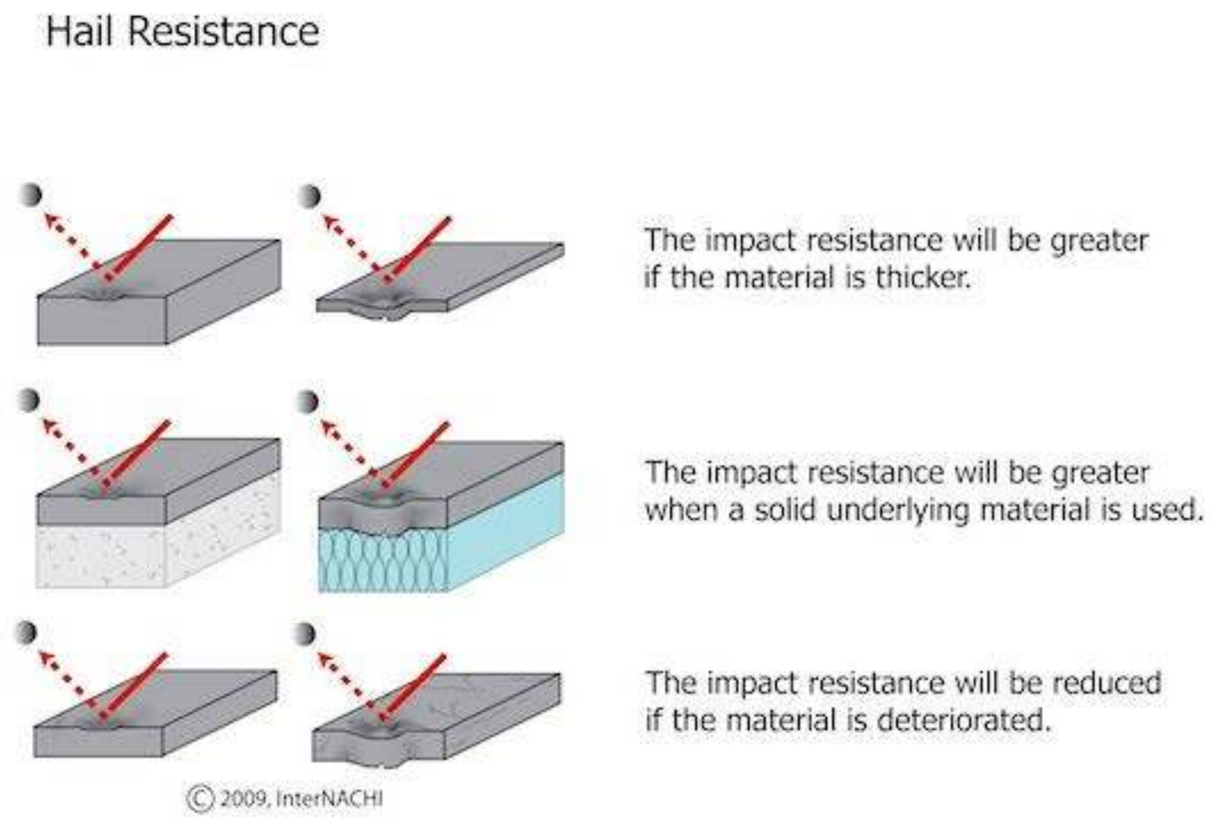
The Difference

http://www.youtube.com/watch?v=RD8ZZjeQmC4

Hail

- Roof damage is very costly
- Thicker shingles absorb the force of hailstones
- Even better to have layers
- Like anything exposed to the weather, the material will deteriorate over time and needs to be replaced



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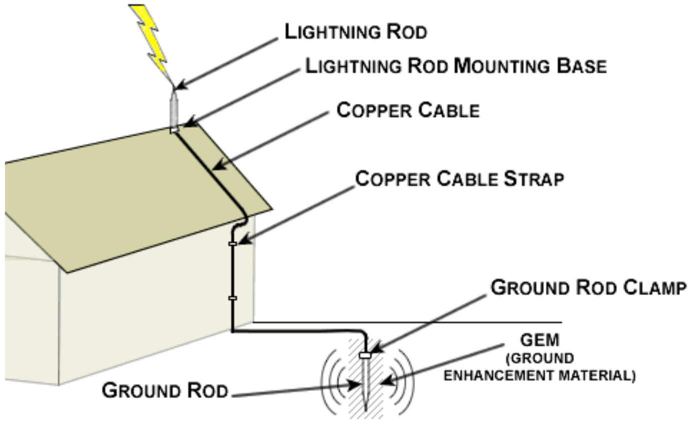
Lightning

- Metal pole with sharp point mounted at highest point
- Aluminum or copper cable connects pole to underground cables (grid)
- Lightning strikes high point (pole), travels down insulated cable (least resistance), and dissipates harmlessly in ground



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Increases in Flooding

- Land use changes
  - Conversion from forest to agriculture increases erosion and sedimentation
- Dam construction
  - Increases sedimentation upstream, erosion downstream
- Urbanization
  - Impervious surfaces increase runoff in small basins
  - Decrease lag time from precipitation to peak
  - Debris clogs channels
  - Increased pollutant levels

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Urbanization

Before urbanization:

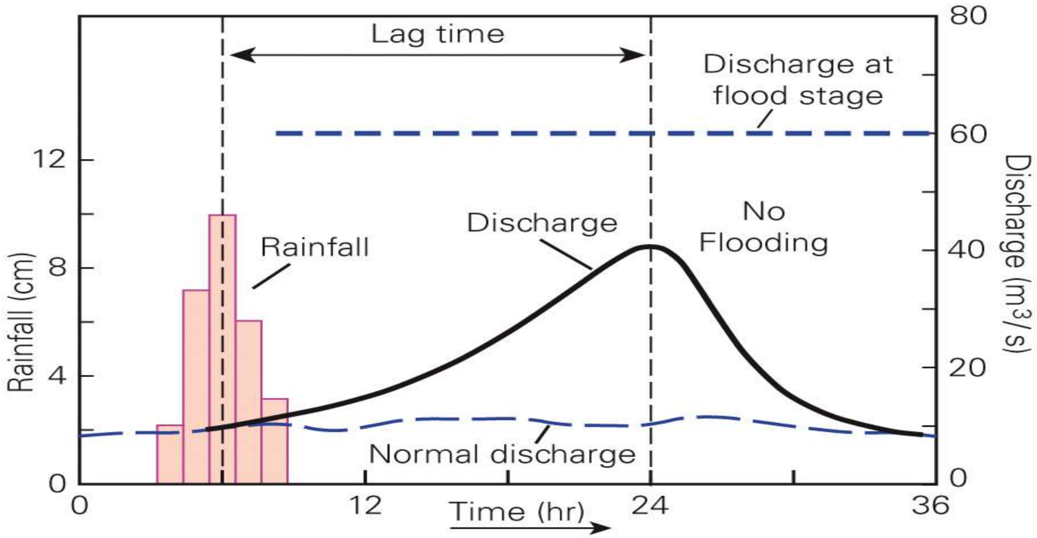
Rainwater infiltrates the ground.

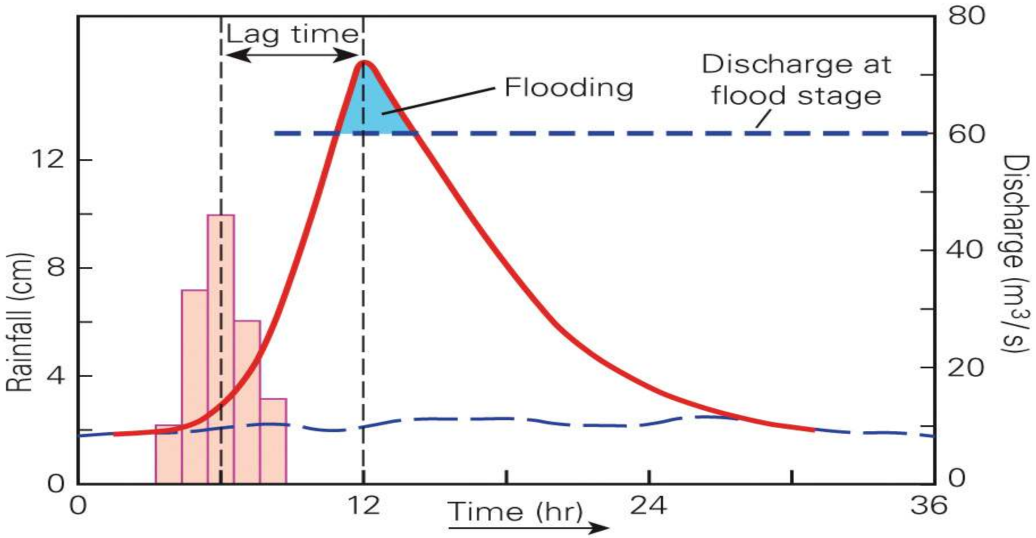
Less discharge, and peak occurs after a long lag time

After urbanization:

Rainwater flows directly into streams.

More discharge, and peak occurs after a short lag time





Other Dangers?

Rich Willson paddles through the miniature golf course in Guerneville.
Karl Mondon/MediaNews Group via Getty Images

What Can Be Done?

- Building Levees
- Creating Impoundments
- Improving Channels
- Restoring Landscape along Banks
- Debris Removal
- Elevating or Relocating Structures
- Financial Support – Disaster Aid, Insurance
- Legal – Zoning, Urban Design

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Impoundments

- Designed to catch runoff at its source
- Gradual release, lessens peak flows
- Allows some pollutants to settle out of water
- Provides habitat
- Can add to value of homes

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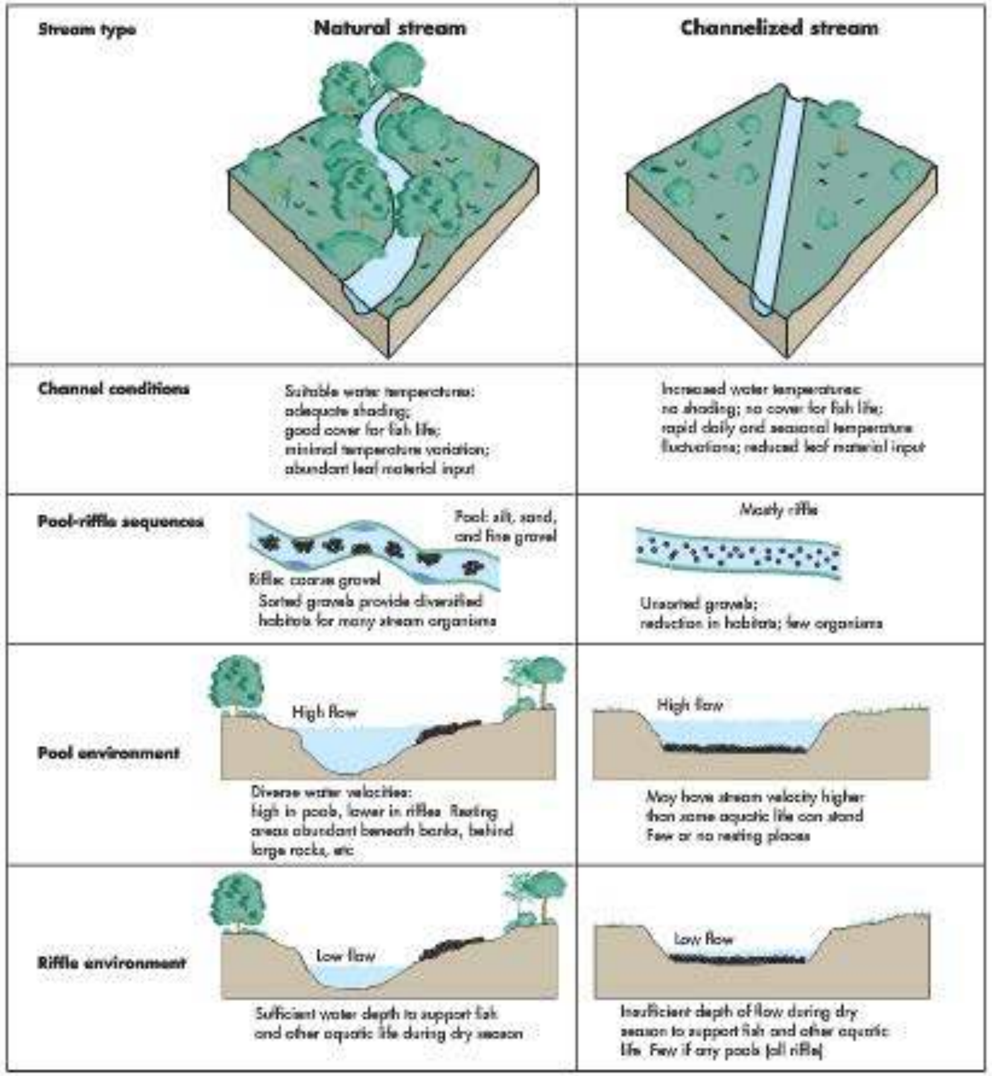
Stream Channels

- Types of Channelization
  - Straightening
  - Deepening
  - Widening
  - Clearing
  - Lining
- Control floods and erosion
- Move water off more quickly
  - But where does it go?



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Levees

- Barriers built alongside rivers or streams to contain waters during high flow (floods)
- Removes land from floodplains that would normally absorb water
- Very difficult to design structures that can withstand big events
- The Levee Effect
  - Following floods, pressure mounts for communities / government to install flood defenses (levees)
  - Perception develops that these areas are safe
  - Land values in these "protected" areas increase
  - Development follows, placing more property at risk

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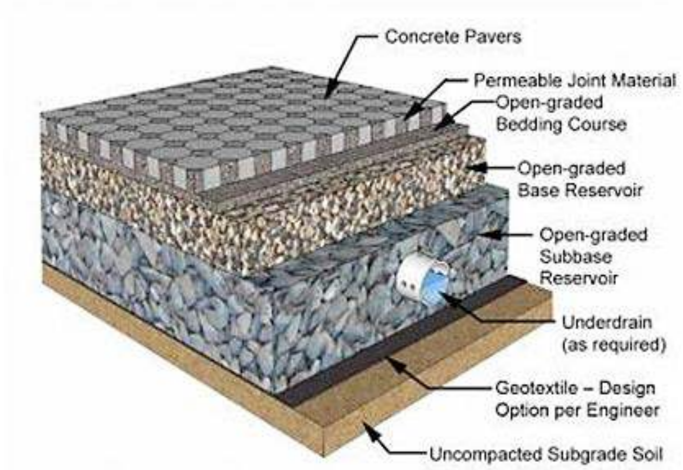
Permeable Pavement

- Designed to let more water soak in rather than run off
- Water can seep through openings and cracks
- Porous substrate lets water percolate downward
- May include a drain pipe to handle excess water



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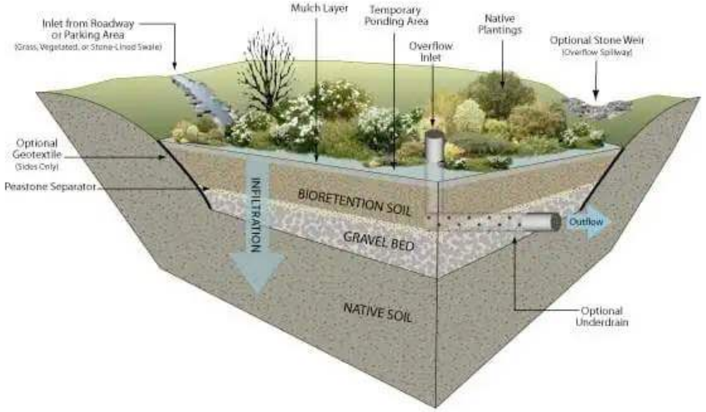
Bioswales & Rain Gardens

- Rainfall runs into small, vegetated areas
- Water will be retained and used by vegetation
- Excess water may exit via a drain pipe
- May include underground storage and infiltration systems



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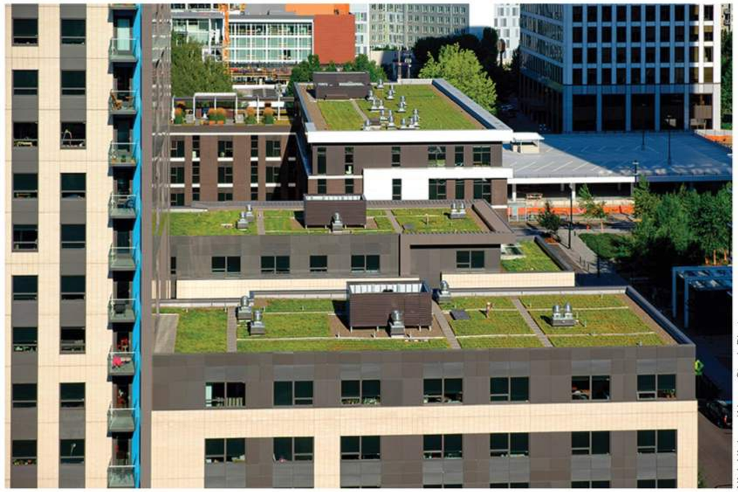
Managing Heat

- Cooling centers
- Misting – evaporation absorbs atmosphere's heat
- Fans?
  - If air temperature is above body temperature, fans act as a convection oven
- Adding vegetation (particularly in urban areas)
- Green roofs – change albedo of urban landscape



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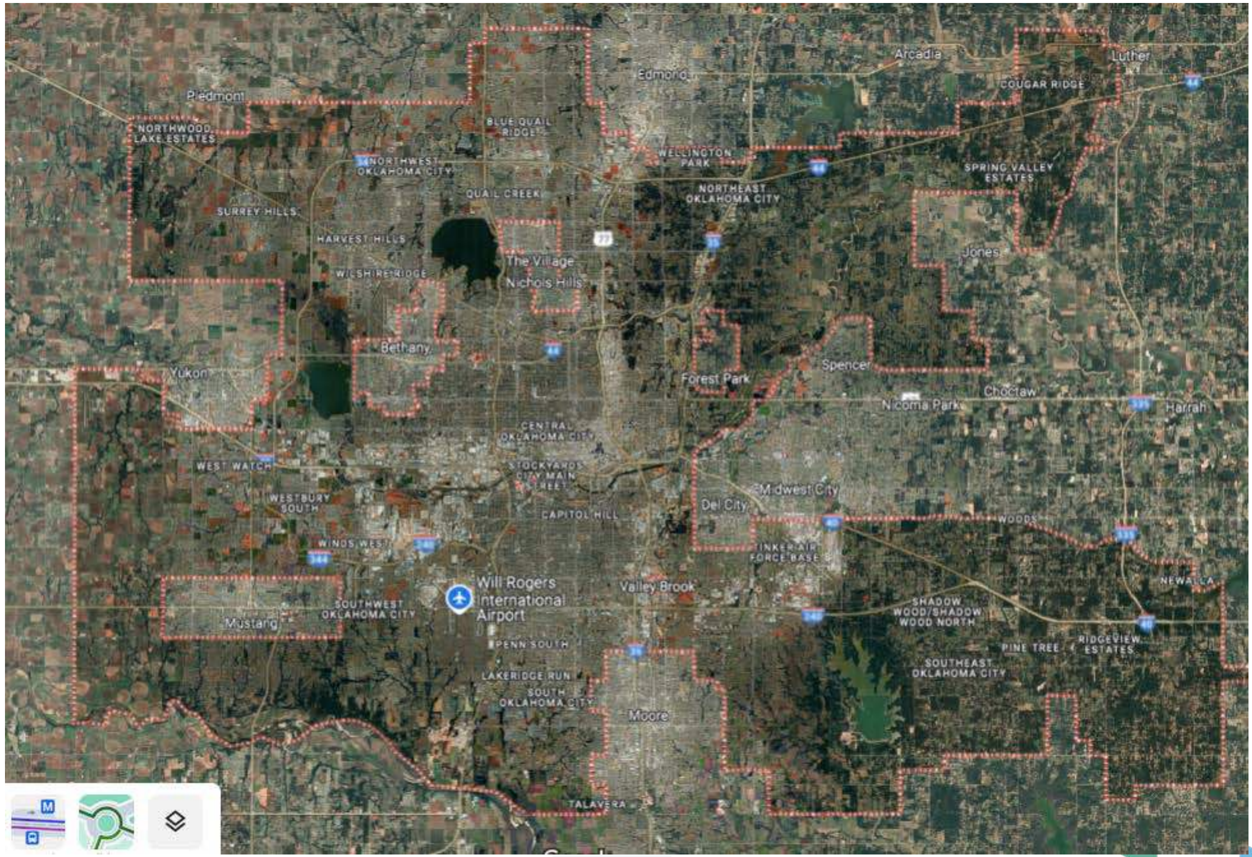
Urban Heat Island



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Cold Weather (Transportation)

- Impacts:
  - Vehicle accidents (70% of all winter-weather-related injuries)
  - Driving / slick roads
  - Roads becoming impassable (snow)
  - Black Ice – caused by melting & refreezing
  - Damage to roads from freeze/thaw
- Solutions
  - Prepare adequate supply of sand, salt, and snow-removal equipment
  - Make sure vehicles have full fuel before storm hits
  - Identify shelters for use in power outages or for stranded travelers

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Cold Weather (Power)

- Ice Accumulation
  - Trees: falling objects
  - Power lines: loss of power, electrocution
  - Outages may last days to weeks
  - Loss of heat
  - Carbon monoxide poisoning from alternative heating sources
- Solutions
  - Bury distribution powerlines (transmission lines generate too much heat)
  - Trim tree branches away from roofs and powerlines
  - Identify shelters for use in power outages or for stranded travelers
  - Stockpile food supplies at critical facilities

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Cold Weather (Other)

- Impacts:
  - Frozen Pipes
  - Buildings collapse from weight of snow
  - Intense snow may cause “white out” conditions
  - Wind chill, frostbite, hypothermia

Solutions

- Develop and enforce building codes for snow load
- Include snow melt in stormwater management plans
- Insulate pipes
- Spray sensitive fruit trees with water (heat from condensation keeps warm as ice forms)

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Preparing & Adapting

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Big Picture: National Risk Index

- Risk Index Categories: social, economic, environmental, infrastructure
- Risk = $\dfrac{\text{Expected Annual Loss} \times \text{Social Vulnerability}}{\text{Community Resilience}}$
- Expected Annual Loss
  - Exposure
  - Annualized Frequency
  - Historic Loss
- Social Vulnerability: Social Vulnerability Index (SoVI)
- Community Resilience: Baseline Resilience Indicators for Communities (BRIC)

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National Risk Index

- 18 natural hazards
- Measures relative risk for each census tract
- Updating emergency operations & hazard mitigation plans
- Prioritizing and allocating resources
- Community-level risk communication and engagement
- Enhanced codes and standards

https://www.fema.gov/flood-maps/products-tools/national-risk-index

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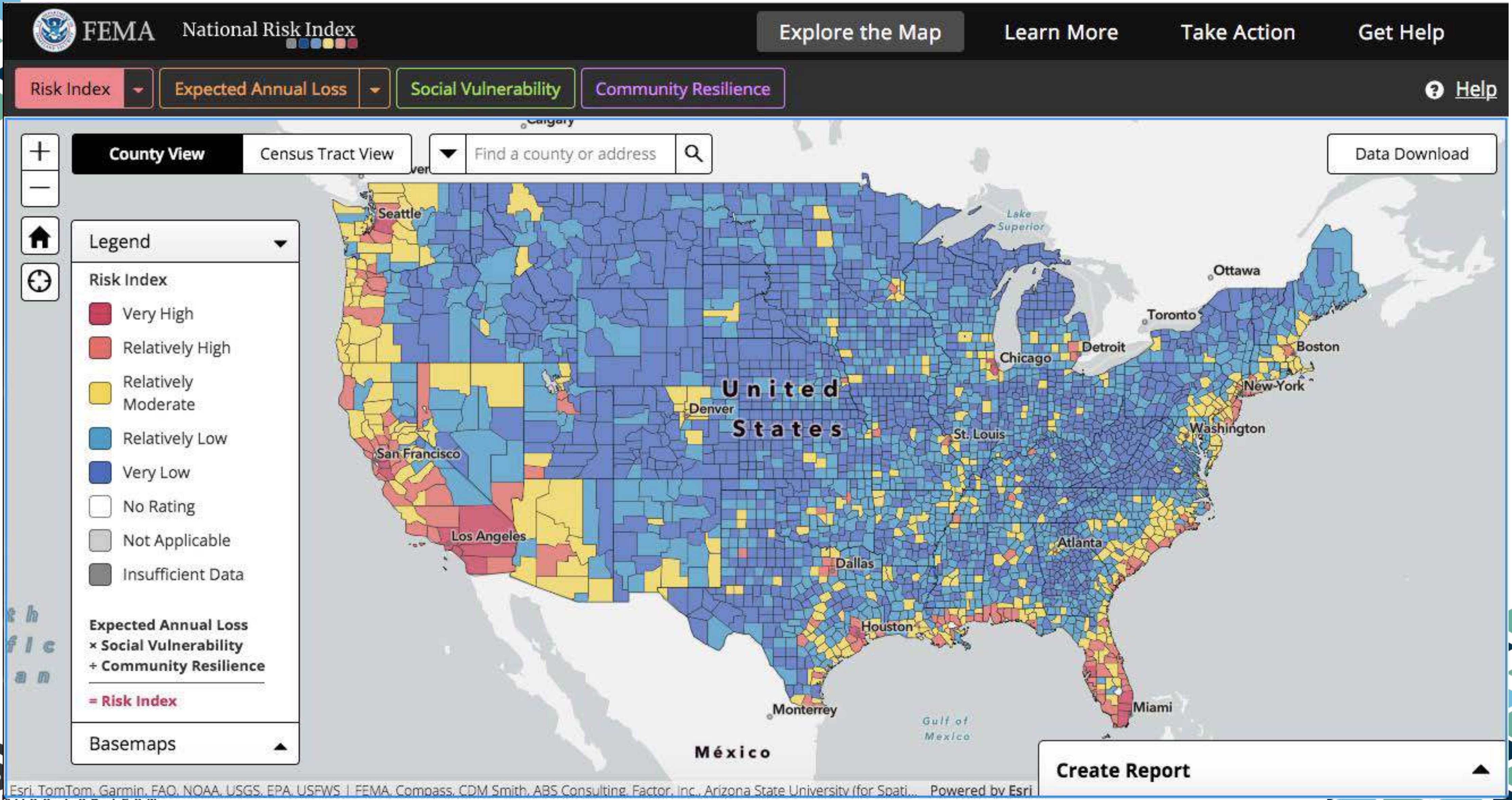
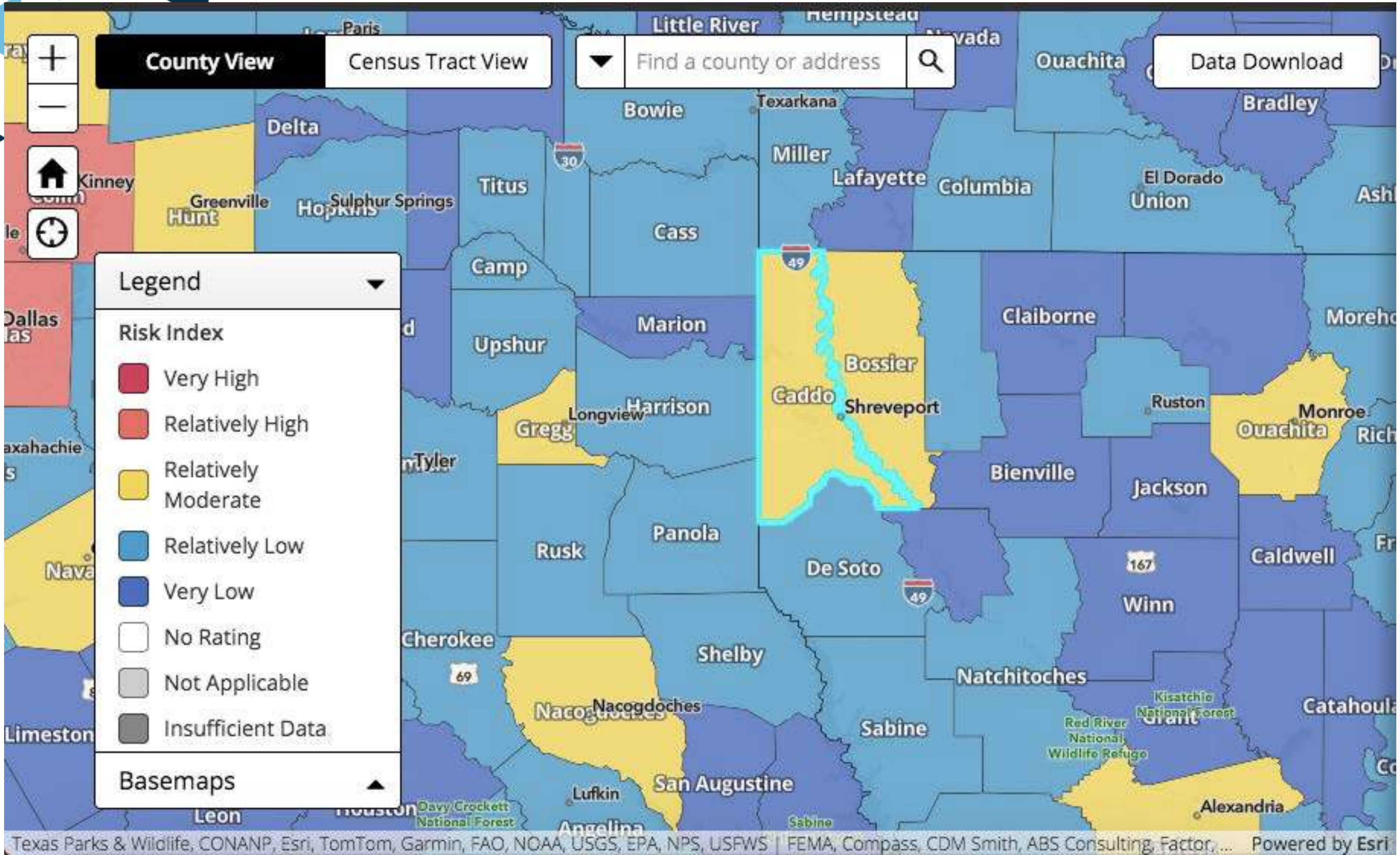
National Risk Index



National Risk Index



Caddo Parish

Louisiana

Risk Index

Risk Index is Relatively Moderate

Score	89.6

National Percentile: 89.60

Percentile Within Louisiana: 70.30

0 – 100

The Risk Index rating is **Relatively Moderate** for **Caddo Parish, LA** when compared to the rest of the U.S.

Risk Index Overview

Compared to the rest of the U.S., **Caddo Parish, LA's** Risk Index components are:

Expected Annual Loss	**Relatively Moderate**
Social Vulnerability	**Very High**
Community Resilience	**Relatively Moderate**

Flood Mapping

- Through the National Flood Insurance Program(NFIP), FEMA estimates the likelihood of flooding along creeks, rivers, and coastal areas
- Maps the 1% chance (100-year) and 0.2% chance (500-year) flood plains
- Does not handle urban flooding well
- Does not handle tributary streams well (which can back up from flooding downstream)

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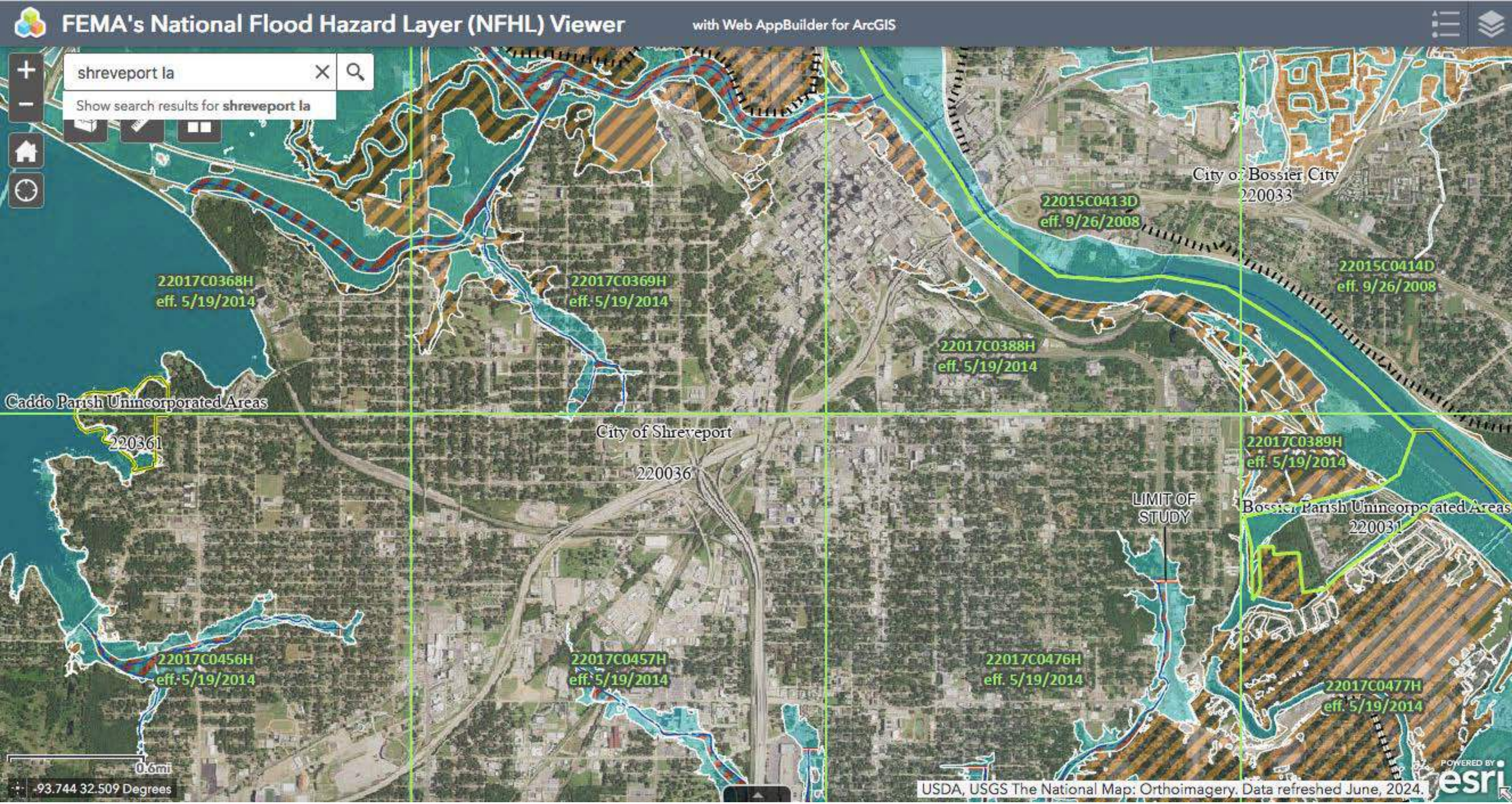
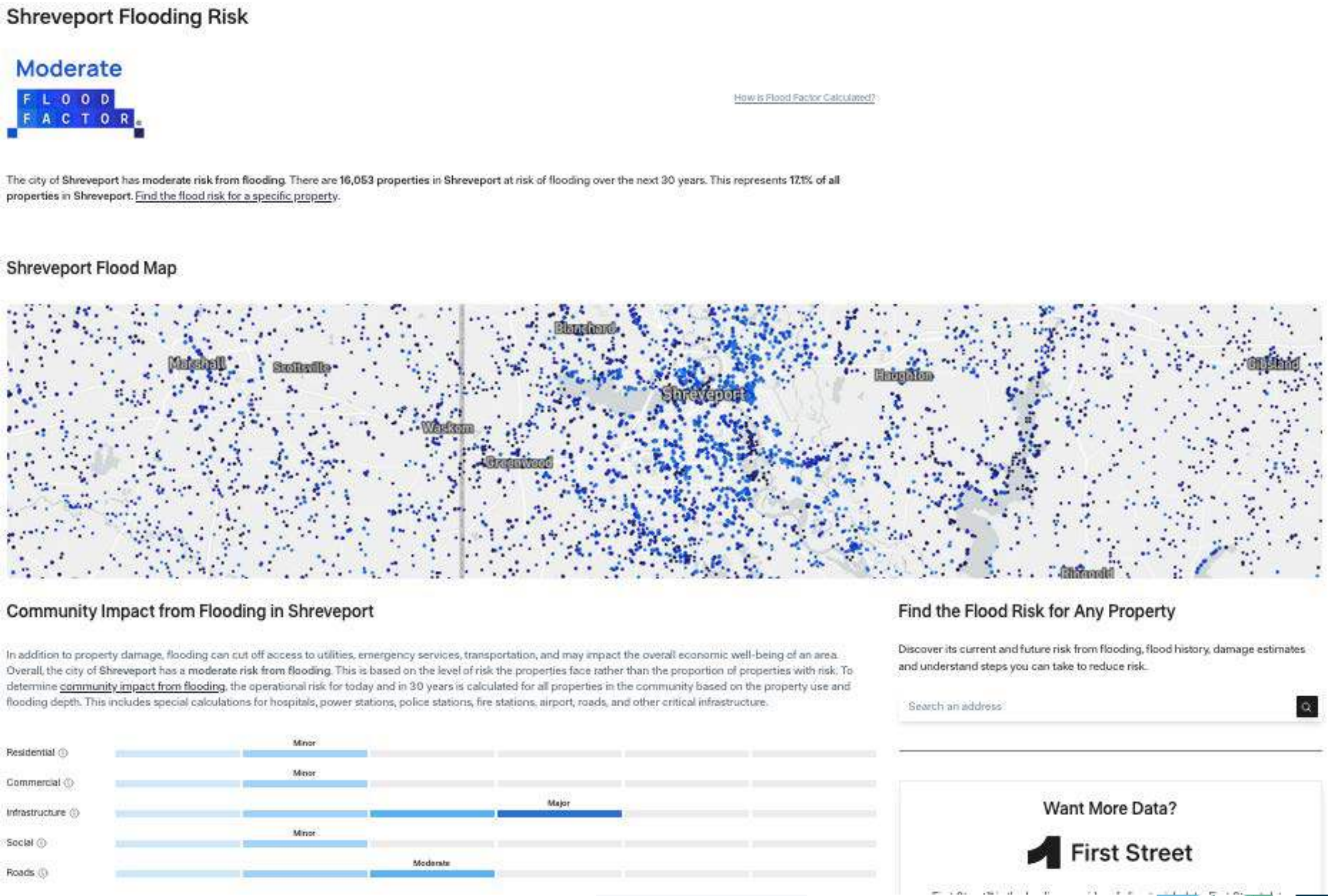


https://www.arcgis.com/apps/webappviewer/index.html?id=8b0adb51996444d4879338b5529aa9cd

Flood Factor

- From First Street Foundation
- Improved methodology that better represents localized urban flooding
- Maps at individual property level
- Available for any address
- https://riskfactor.com/



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Flood Insurance

- Federal expenditures on flood-related disasters growing rapidly in 1960s
- Private insurance companies did not offer policies in high-risk areas
- Federal payouts to individuals capped at about $30k (today's $), not sufficient to rebuild
- This left many people affected – putting pressure on government representatives – but unable to recover
- National Flood Insurance Program created to provide access to insurance and to reduce risk

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National Flood Insurance Program

- Insurance program backed by the Federal Government
- Backs (and subsidizes) private flood insurance (reinsurance)
  - Community Rating System (CRS) 1-10
  - 5% reduction on premium for each point
- Flood Mitigation Assistance Program grants
- Maps flood hazard areas (Special Flood Hazard Area - SFHA)
  - Areas with a 1% annual chance of flooding
  - Also known as 100-year flood plains
- Currently covers 5 million homes (down from 5.5 million in 2010)

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Adaptive Resilience

- Actions carried out during and after disasters that permit social entities to cope and bounce back from loss and disruption
  - mobilization of inherent resilience
  - novel and emergent forms of behavior and social organization
- Blending of novel and pre-planned activities
- Surprise evokes need for agility; workarounds, new strategies
- Prior planning important but so does deviating from plans and creating new ones

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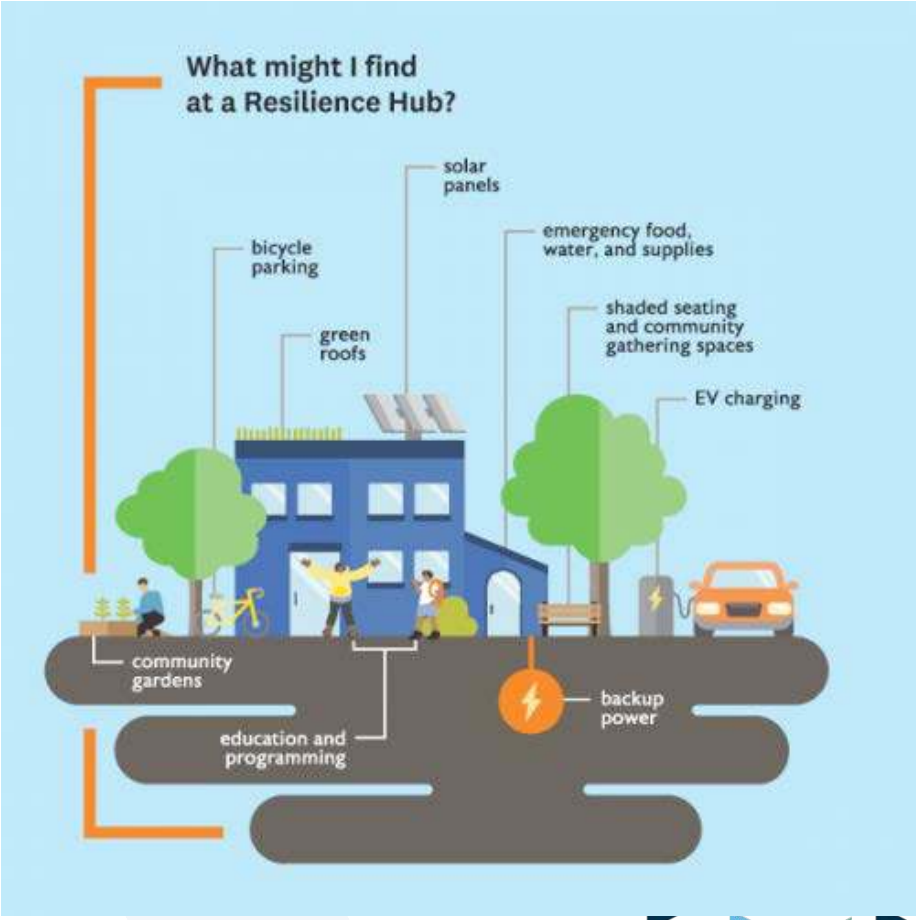
Organizational Adaptation

- Existing – little change from normal operations
- Expanding – gain additional temporary personnel (fire, police Red Cross)
- Extending – suspend normal operations to perform disaster-related tasks (facilities used for sheltering)
- Emergent – loosely organized collections that may become gradually more organized and permanent
    - most are short-lived
    - combination of altruism and belief that needs are not being met by other (governmental) channels

Resilience Hubs

- Community-serving facilities
- Support residents, coordinate communication, distribute resources, enhance quality of life
- Provides resources & essential services at a neighborhood level so people do not have to travel to a central location
- Can provide capacity in everyday operating conditions as well as during disruption and recovery



Resilience Hubs

- Services and programs: promote preparedness and improve health & well-being
- Communications: source of information for area residents year-round
- Buildings & Landscapes: facility meets operational goals in all conditions
- Power: reliable backup power to the facility; a place where people can charge devices
- Operations: trained personnel to operate under any conditions

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Telling a Good Story

- Risk Communication is designed to convey potential threats and encourage action
- Telling a good story is better than presenting data
- Listening is important
- Needs to be persuasive and emotionally compelling
- Overcoming a challenge, especially with a human-interest angle
- A process, not a product

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Thank You!

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