



Laplace, LA – Sep 2021





Laplace, LA – Sep 2021



Laplace, LA – Sep 2021



**“We didn’t think  
we were at risk...  
we are not in  
FEMA’s flood  
zone...”**







HURRICANE STUDY  
 COASTAL LOUISIANA AND VICINITY  
**HURRICANE PATH**  
**22 SEPTEMBER-2 OCTOBER 1915**

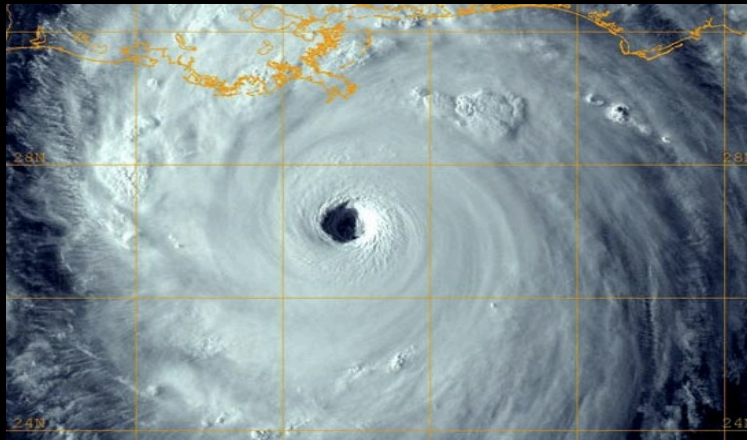
OF MILES

- This home would have absolutely flooded in:
  - Unnamed Storm (1915)
  - Hurricane Betsy (1965)
  - Hurricane Isaac (2012)
  - Hurricane Ida (2021)
- They flooded 4 times since 1900 (around every 30 years!)





# A Data-Driven Perspective on How to Make Ourselves Climate Resilient



Hal Needham, Ph.D.  
November 14, 2023



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Part 1 – Knowing Our Local Extreme Weather History

Part 2 – Taking A Look around The Neighborhood

Part 3 – How Environmental Change Shifts Data-Driven “Baselines”?

Part 4 – Winter Weather Outlook

Part 5 – The GeoTrek Project





## Part 1

# Knowing Our Local Extreme Weather History



# Major Hurricanes (Cat 3+) in South Florida 1966 – 2003 (38 Years)





# Population of Miami-Dade County



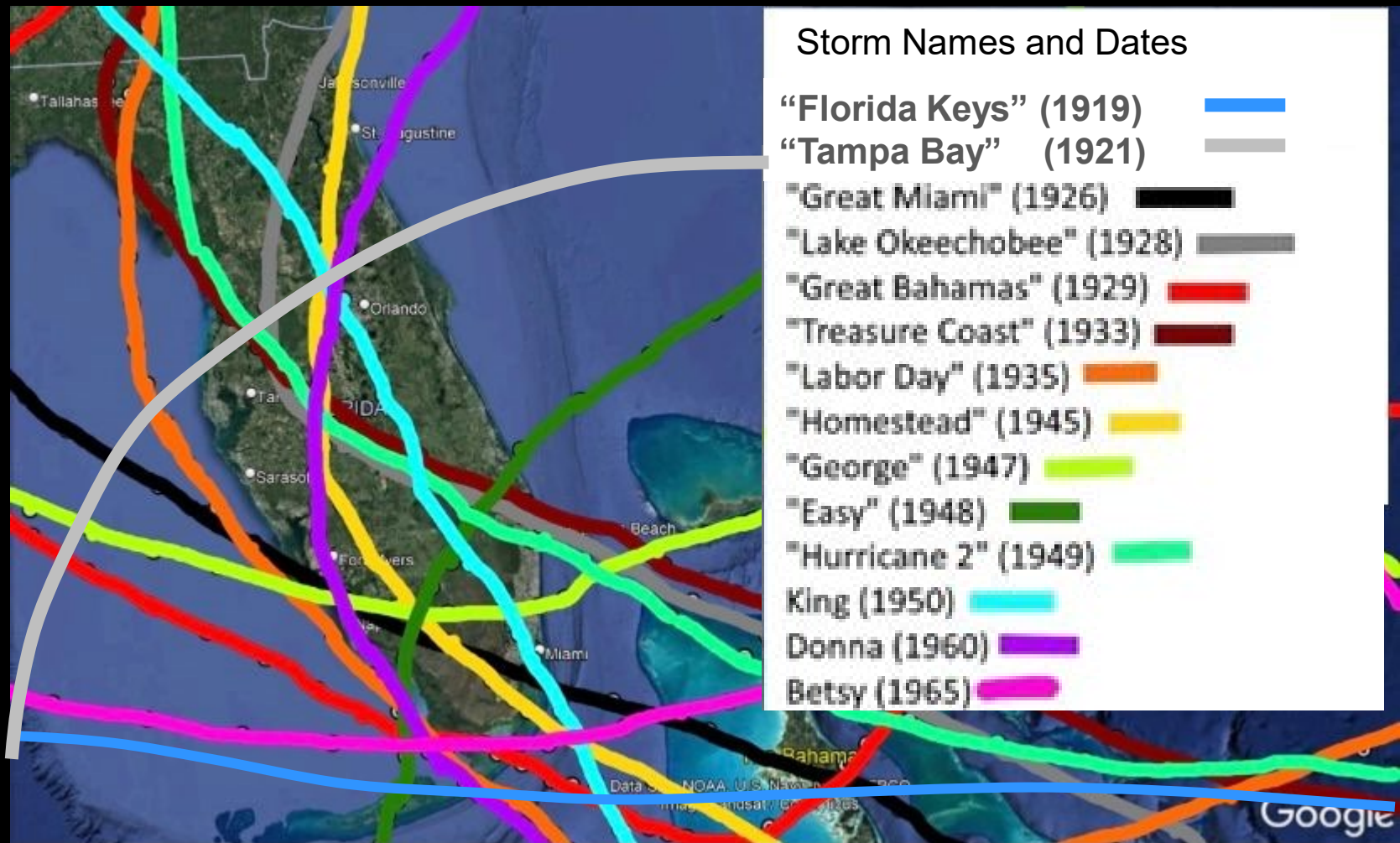
1966: 1.7 million



2003: 5.1 million

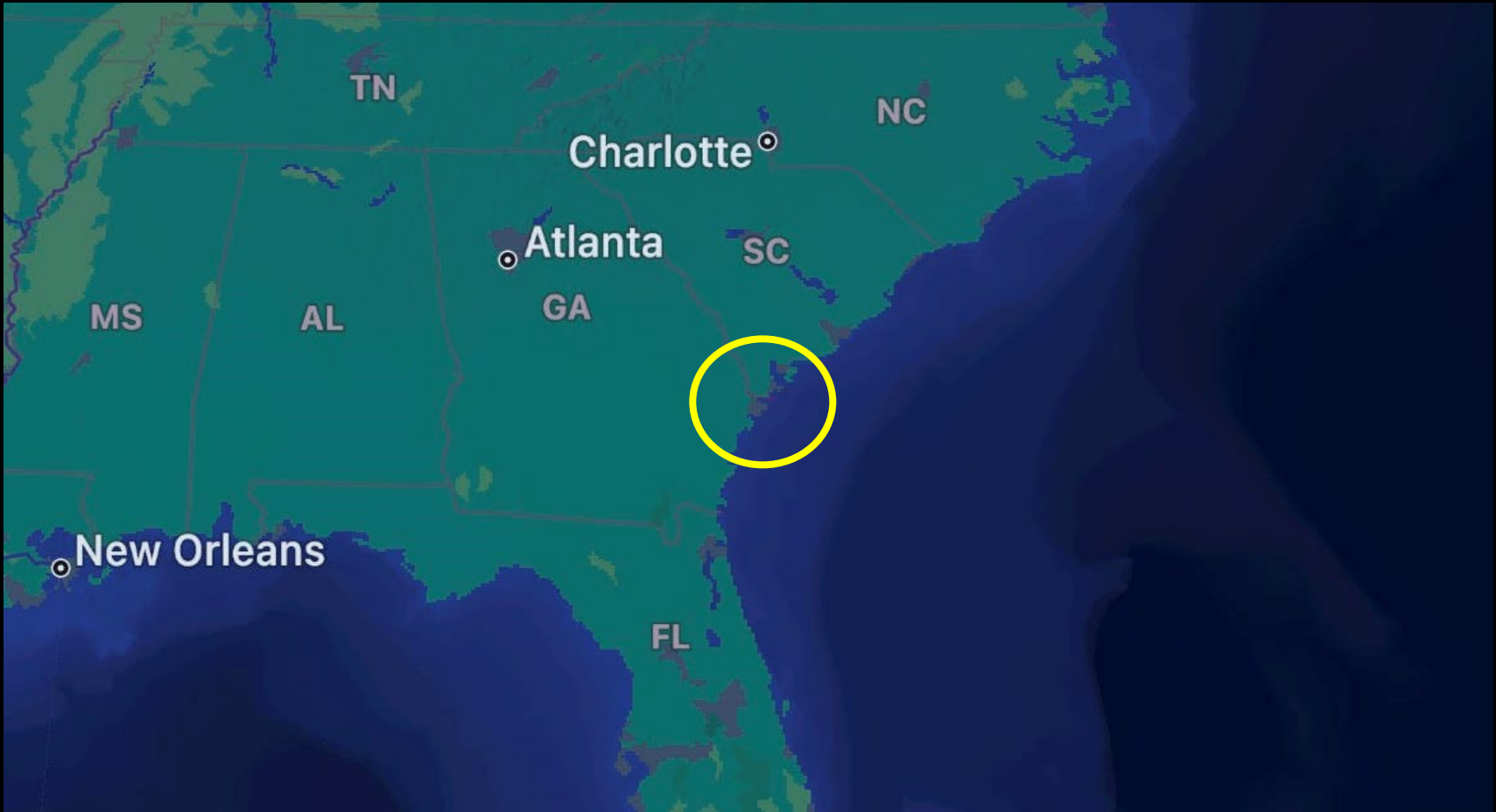
That's a 300% increase in 38 years!

# 14 Major (Cat 3+) Hurricane Landfalls 1916-1965 (50 Years)

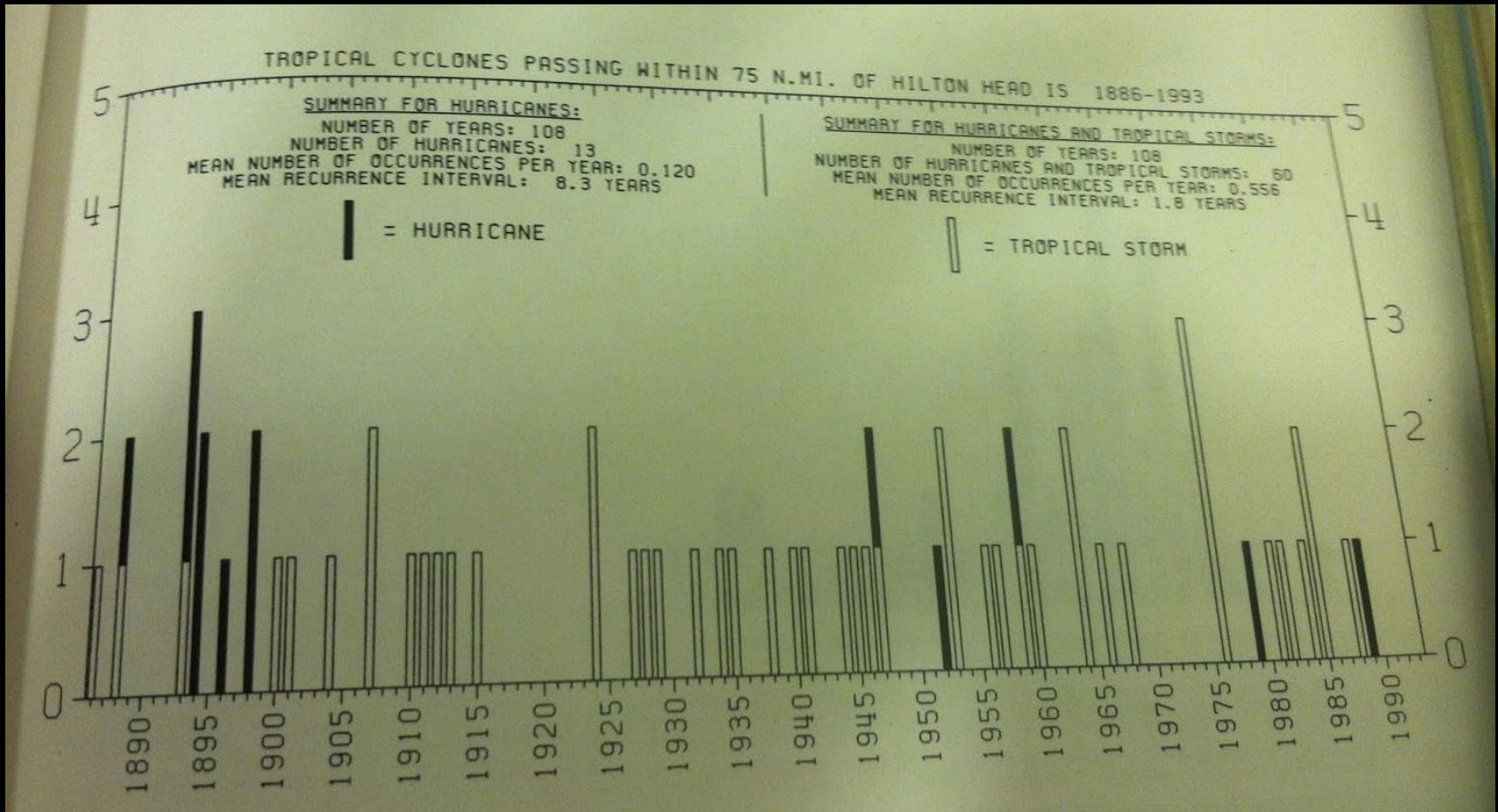




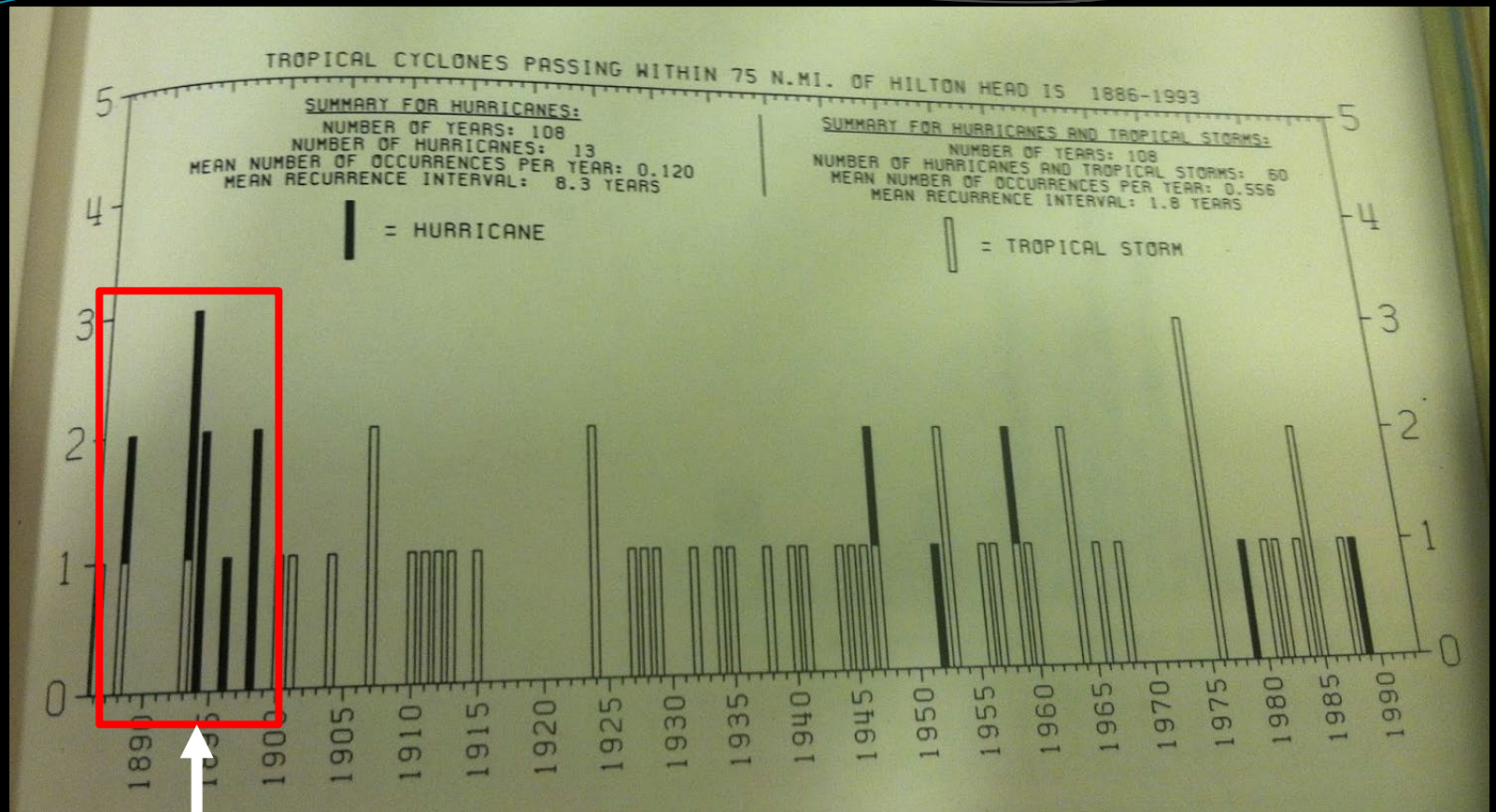
# Hurricanes and Tropical Storms Passing within 75 nautical miles of Hilton Head, SC



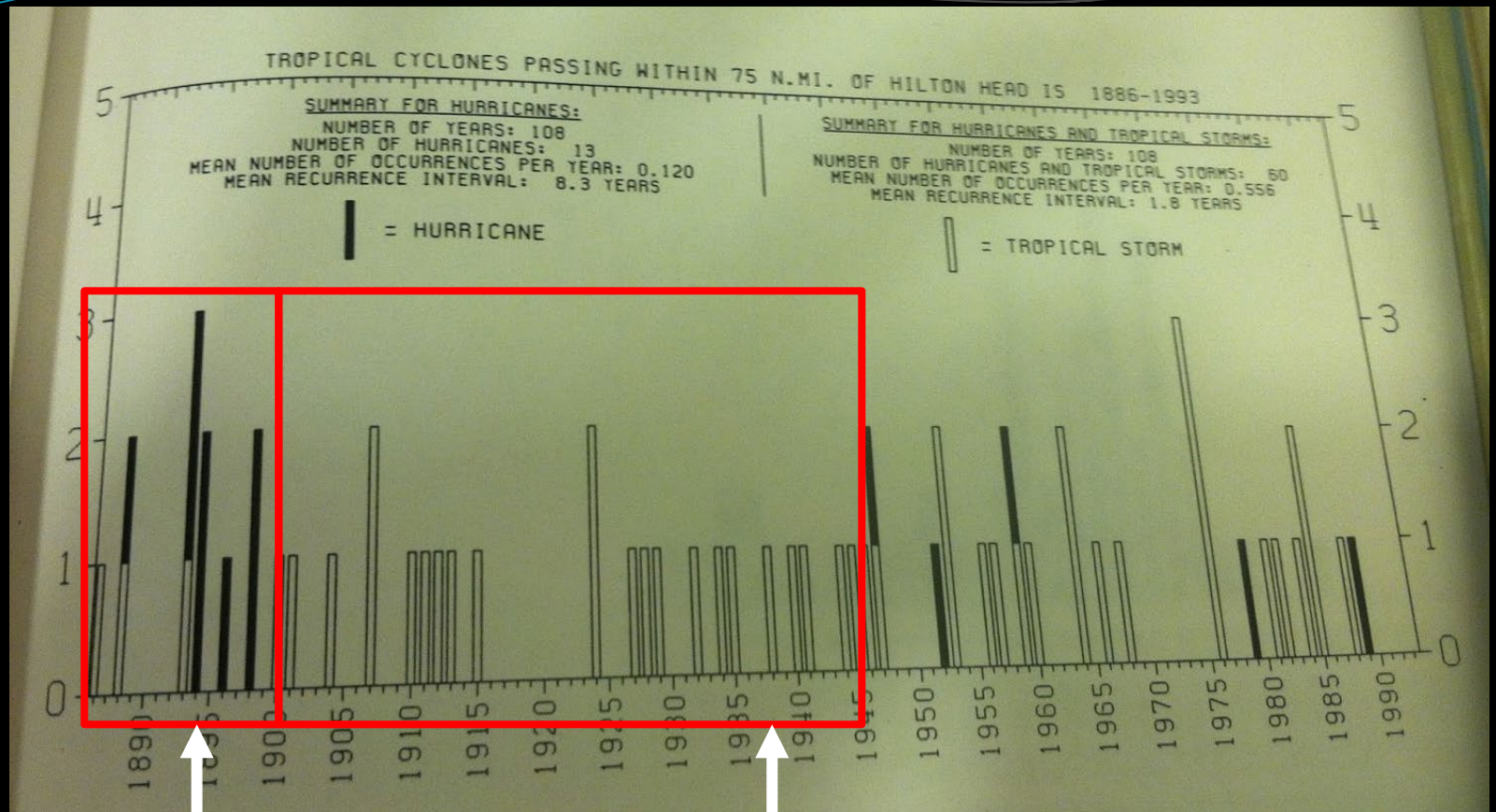
# Hurricanes and Tropical Storms Passing within 75 nautical miles of Hilton Head, SC







8 Hurricanes  
in 11 Years!



8 Hurricanes  
in 11 Years!

0 Hurricanes  
in 48 Years!





# U-SURGE

[HOME](#)

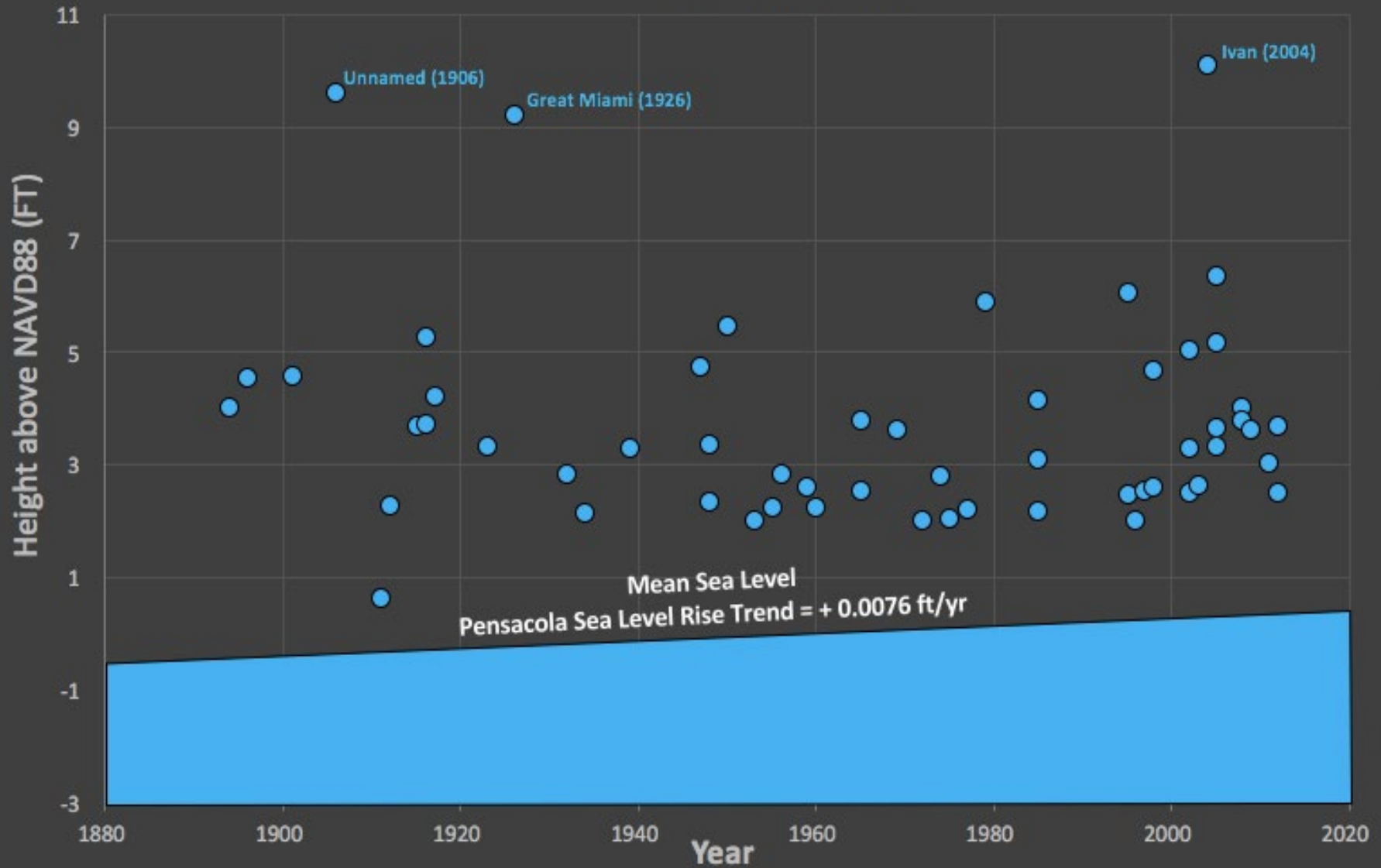
[ABOUT](#)

[U.S. CITIES](#)

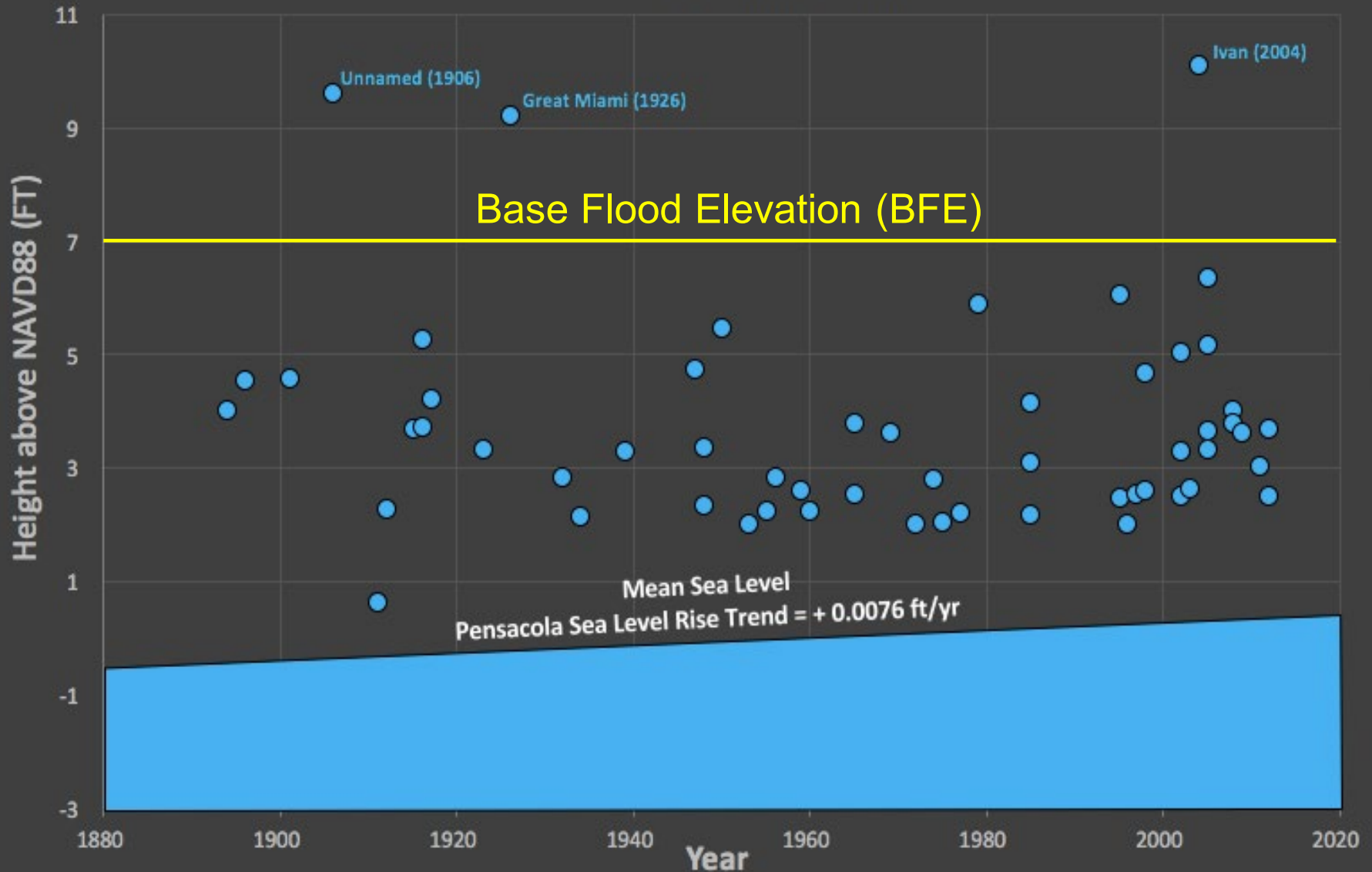
[CONTACT](#)



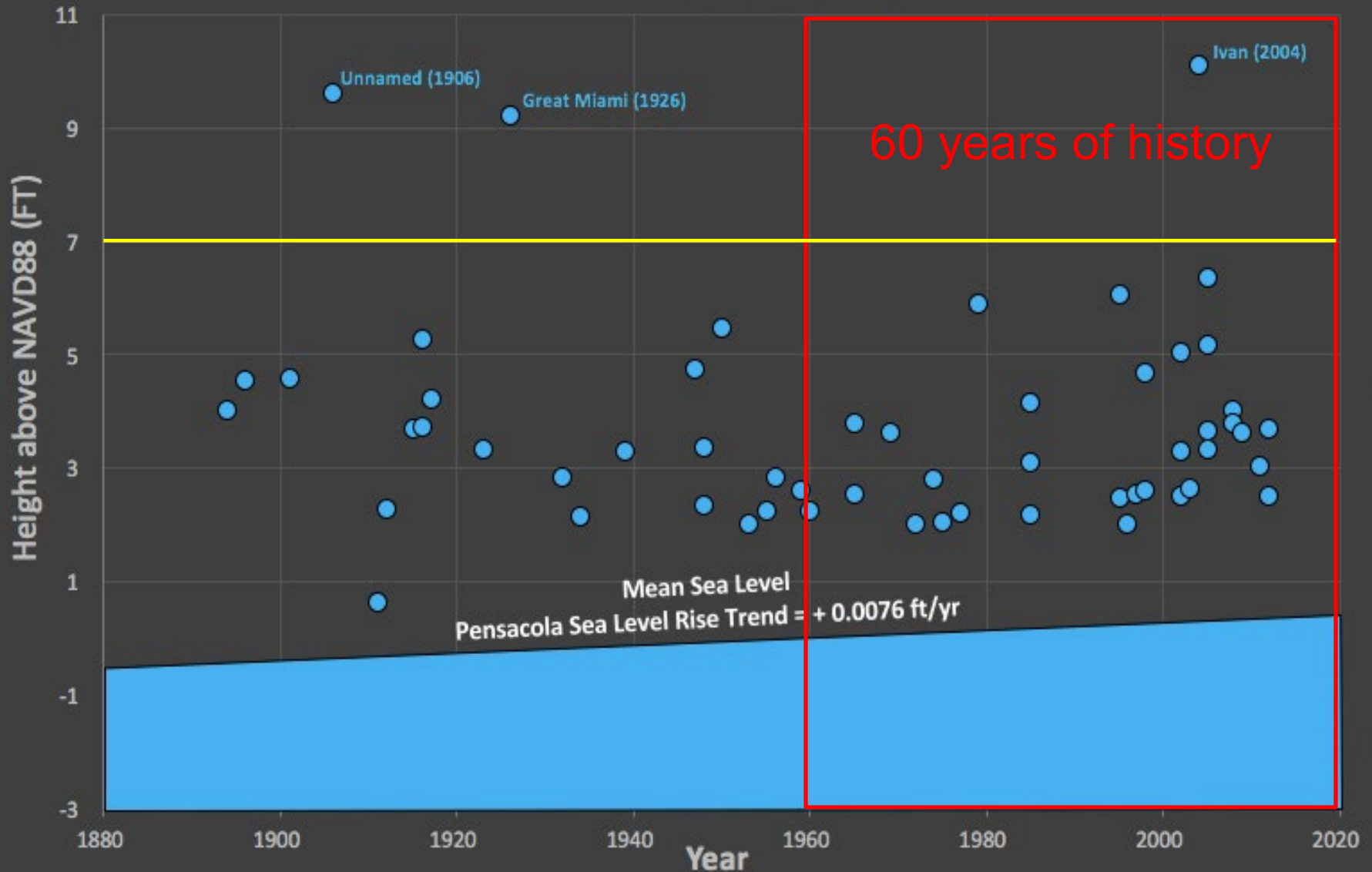
# Time Series of Storm Tides at Pensacola, FL 1890 - 2018 (129 Years)



# Time Series of Storm Tides at Pensacola, FL 1890 - 2018 (129 Years)

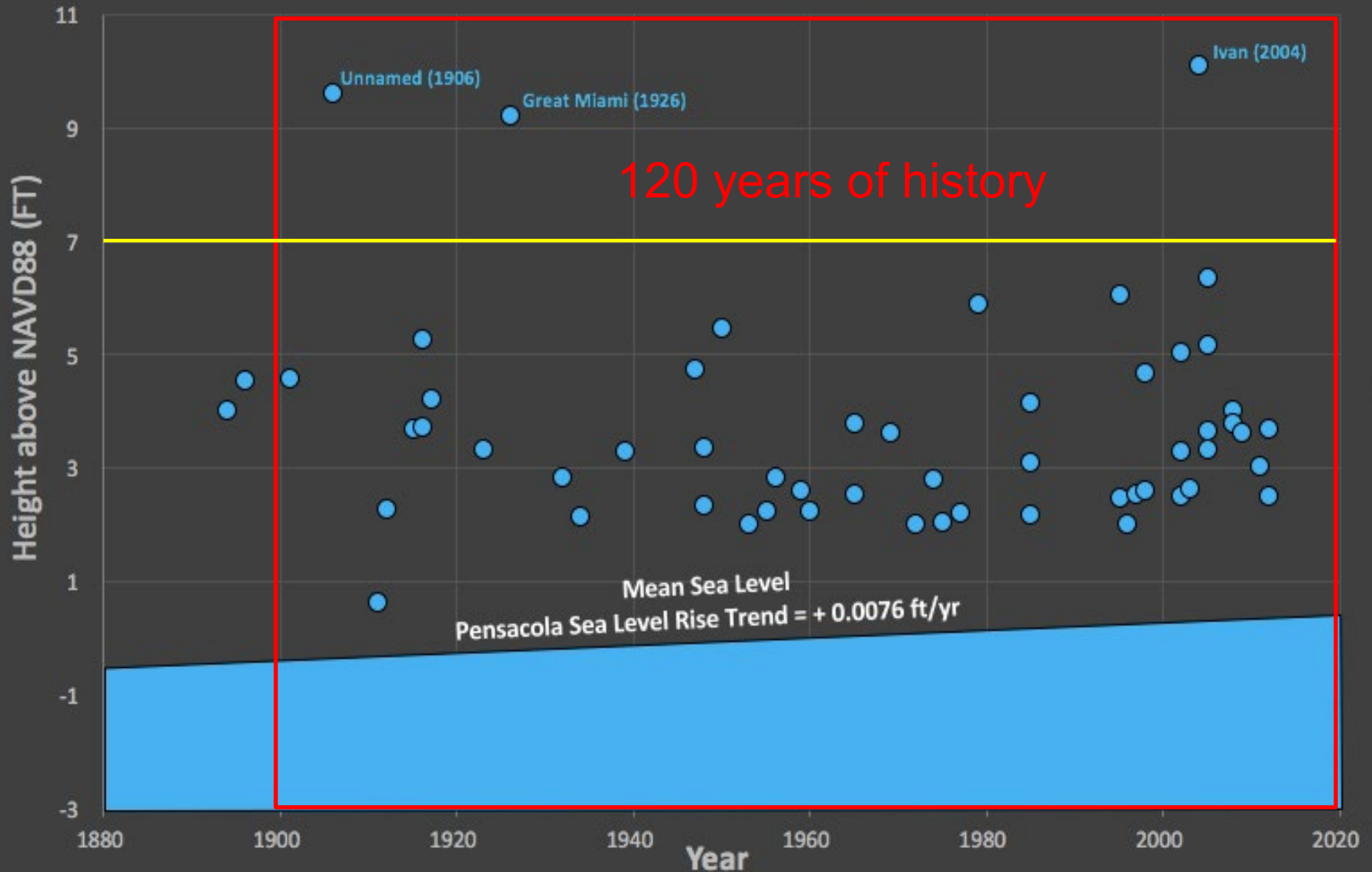


# Time Series of Storm Tides at Pensacola, FL 1890 - 2018 (129 Years)

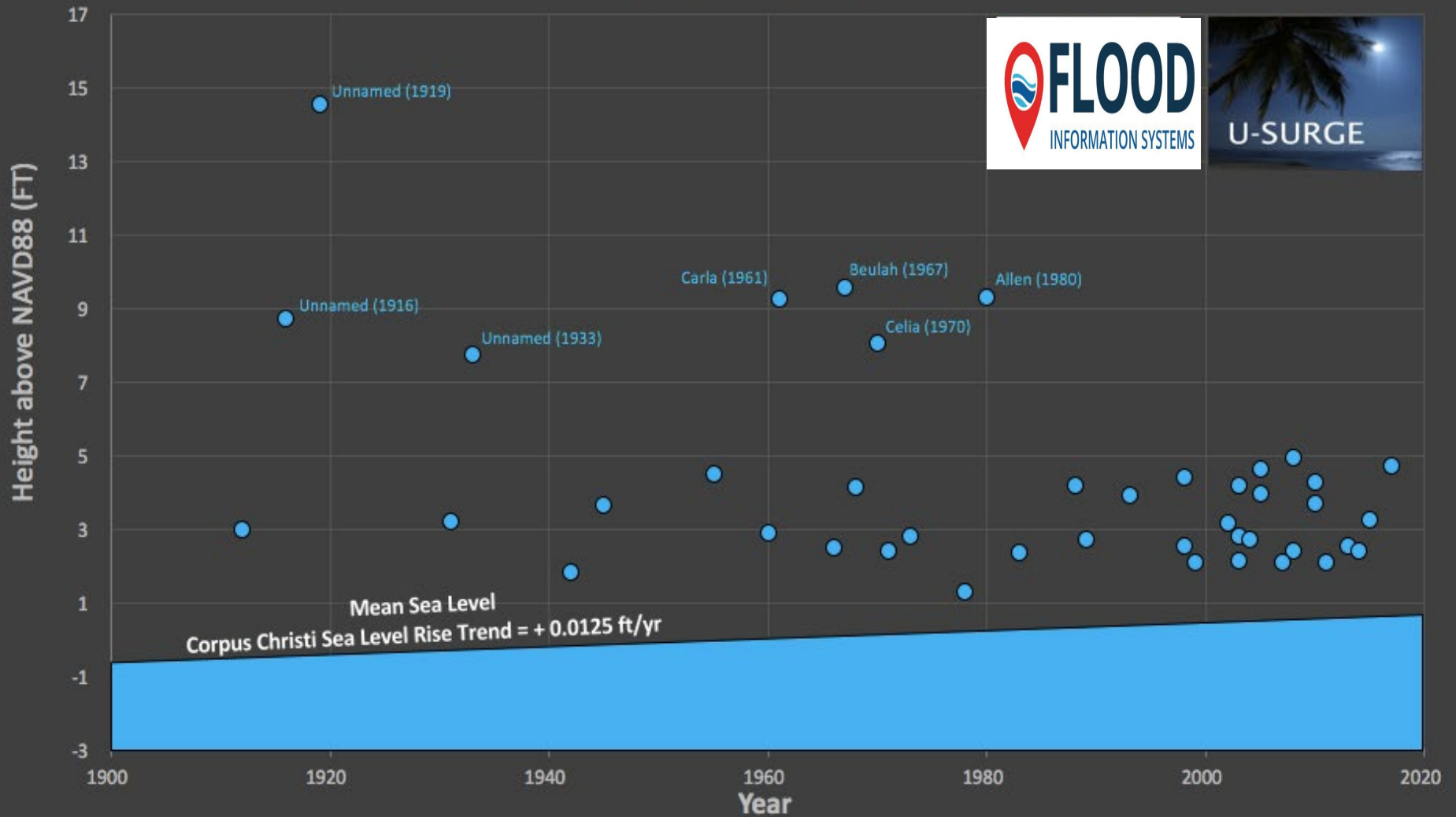




# Time Series of Storm Tides at Pensacola, FL 1890 - 2018 (129 Years)



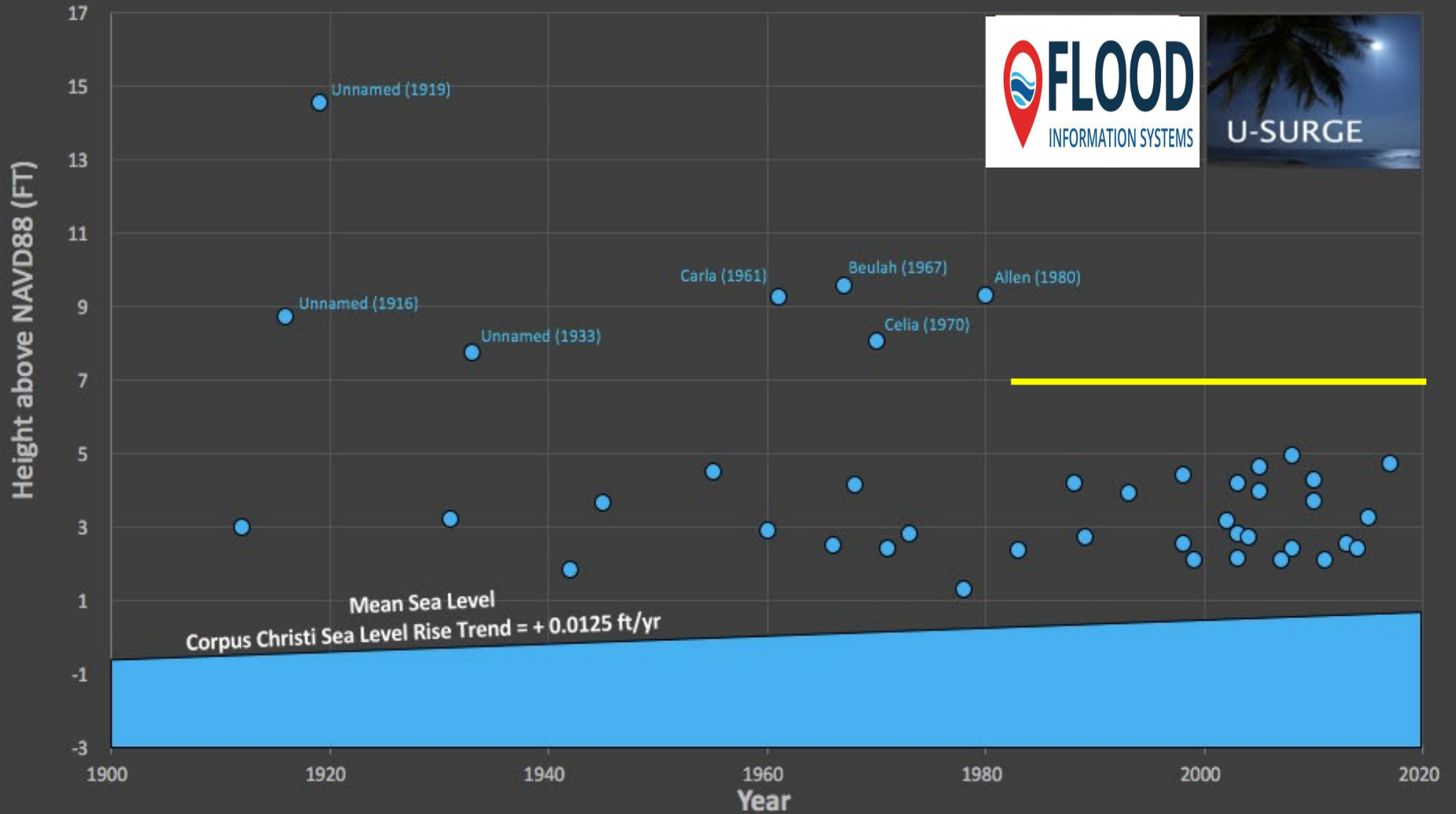
# Time Series of Storm Tides at Corpus Christi, TX 1900 - 2017 (118 Years)







# Time Series of Storm Tides at Corpus Christi, TX 1900 - 2017 (118 Years)





## #1 Mental Mistake:

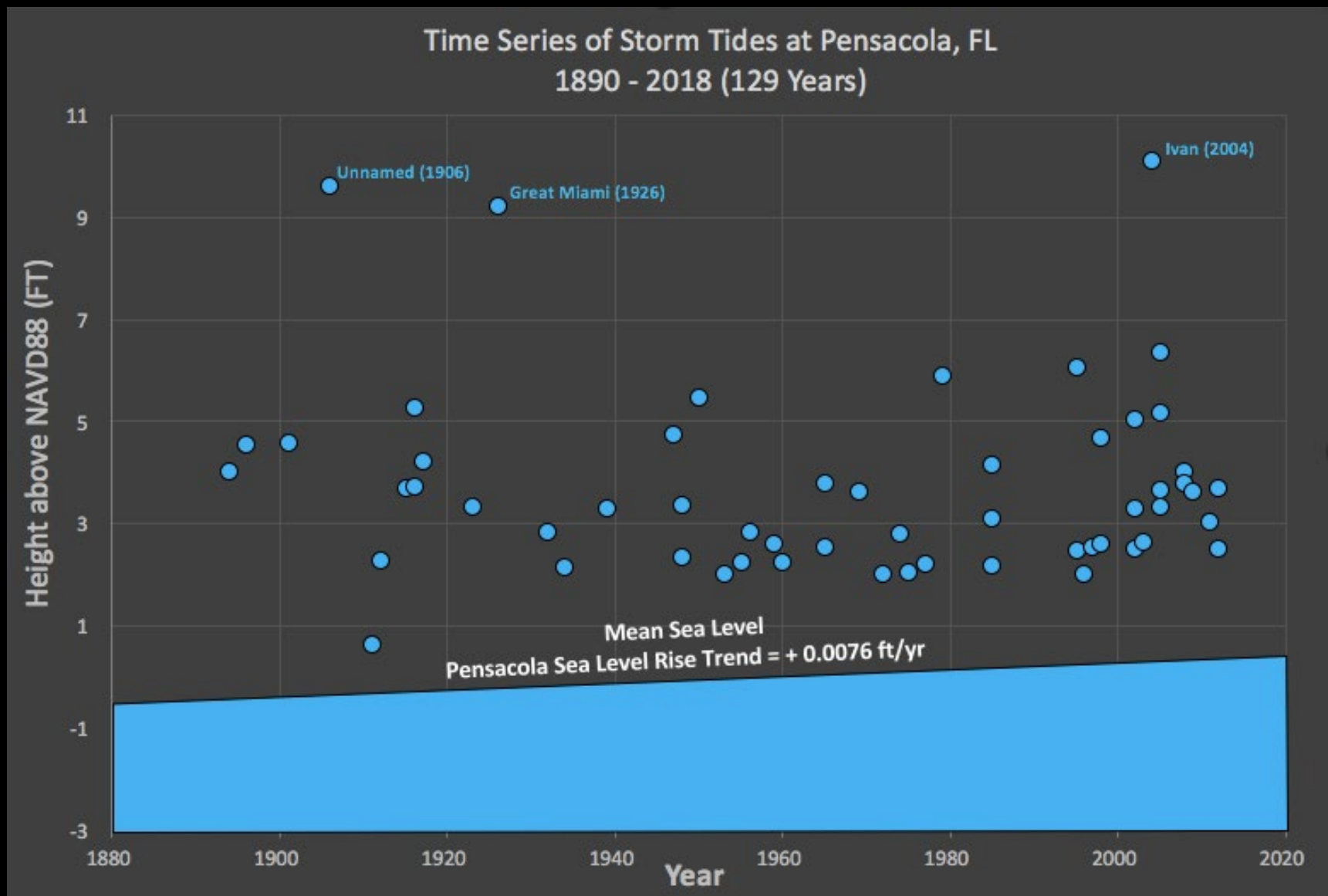
“I’ve lived here for (20, 30, 40) years and I’ve never flooded before... so I don’t need to think about floods...”

# How Do We Visualize Local Extreme Weather Data?



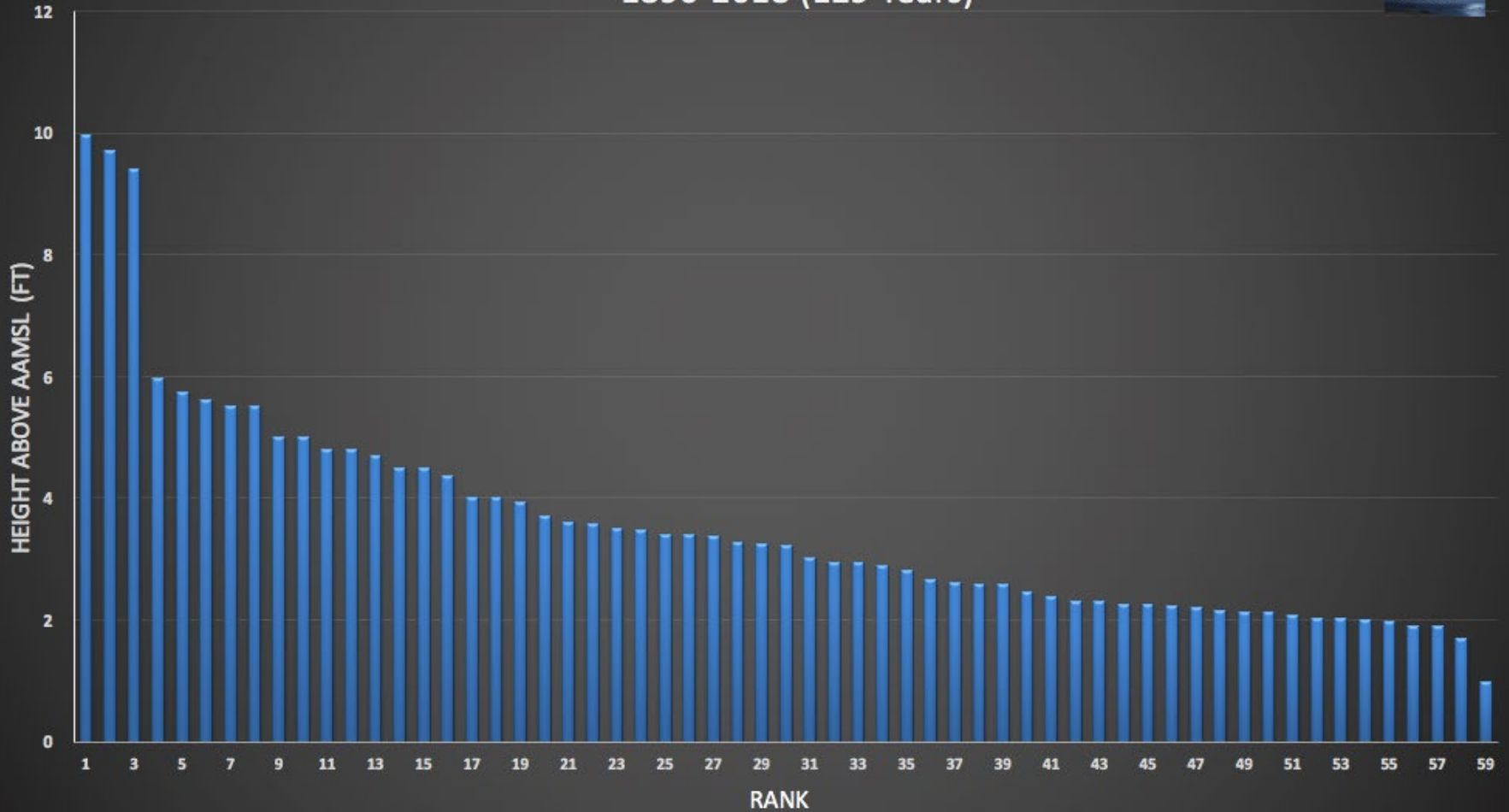


# Method #1: Time Series



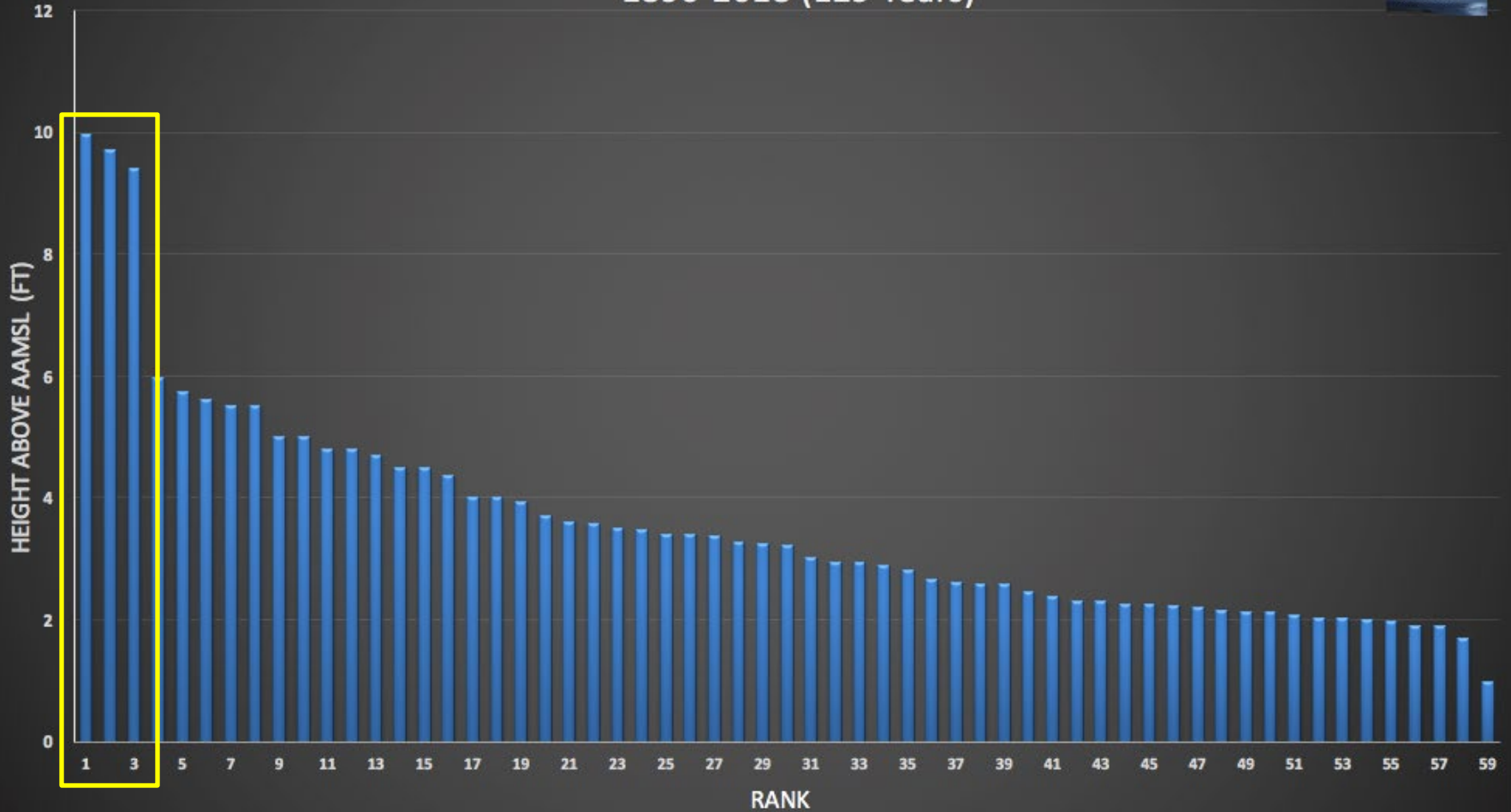
# Method #2: Histogram

Histogram of Storm Tides at Pensacola, FL  
1890-2018 (129 Years)



# Method #2: Histogram

Histogram of Storm Tides at Pensacola, FL  
1890-2018 (129 Years)





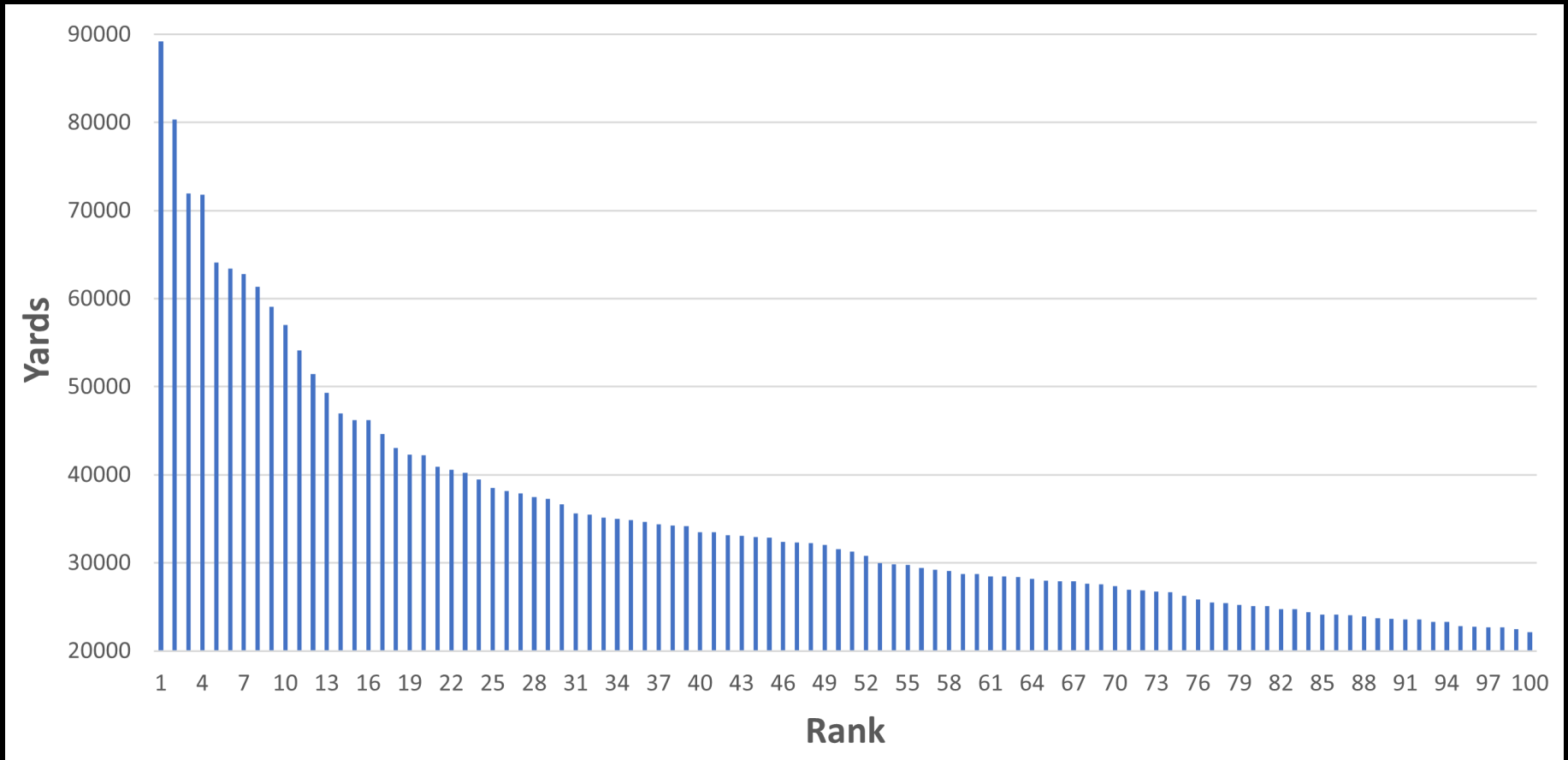
## Insights on Extreme Weather Statistics

- Focus on extremes, not averages
- Large sample size needed to capture most extreme events
- The highest-magnitude events are much higher than most events
- This pattern is observed for all types of data





# Top 100 All-Time NFL Passing Leaders

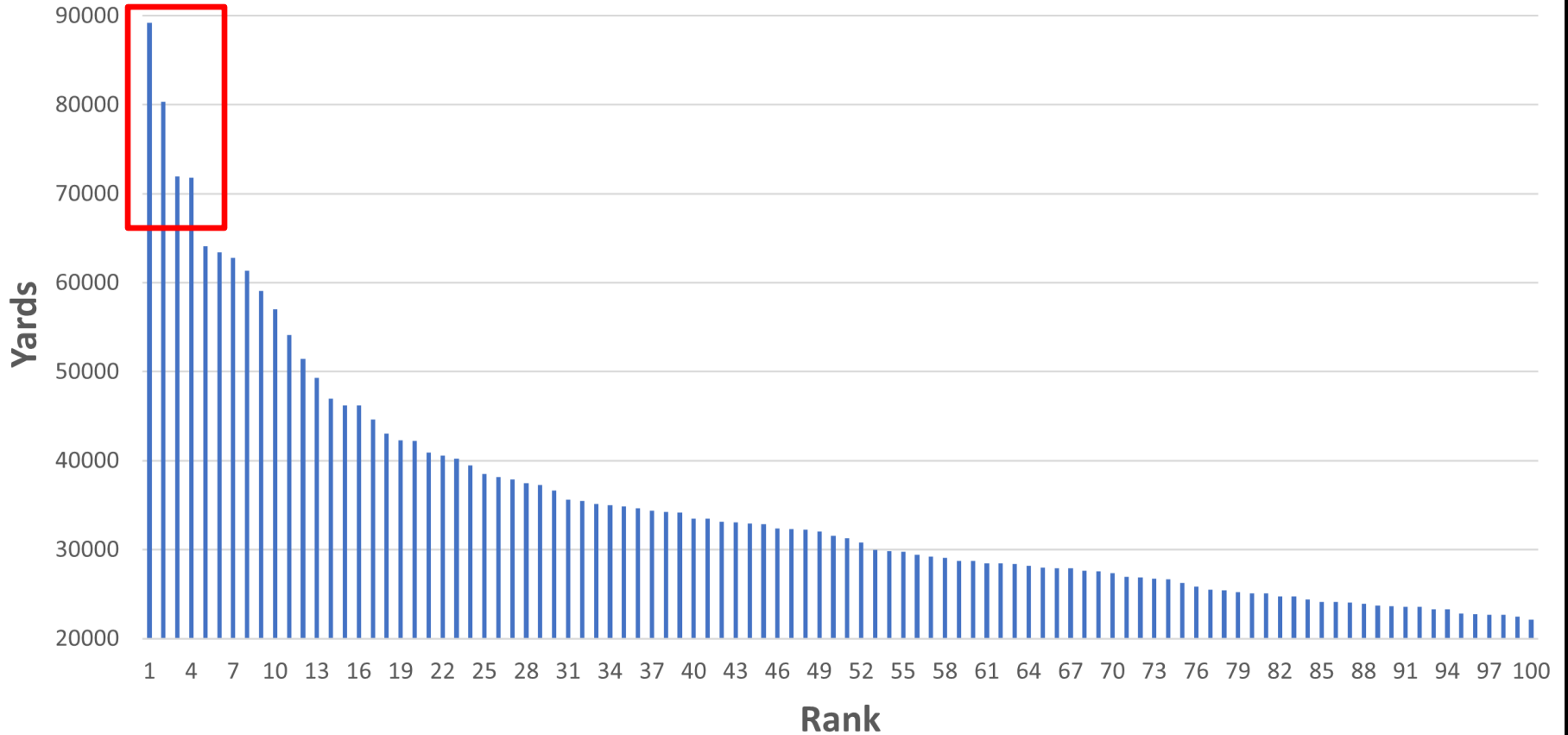


Source: [pro-football-reference.com/](http://pro-football-reference.com/)

Updated: Nov 13, 2023



# Top 100 All-Time NFL Passing Leaders



Source: [pro-football-reference.com/](https://pro-football-reference.com/)

Updated: Nov 13, 2023





#1: Tom Brady



#2: Drew Brees



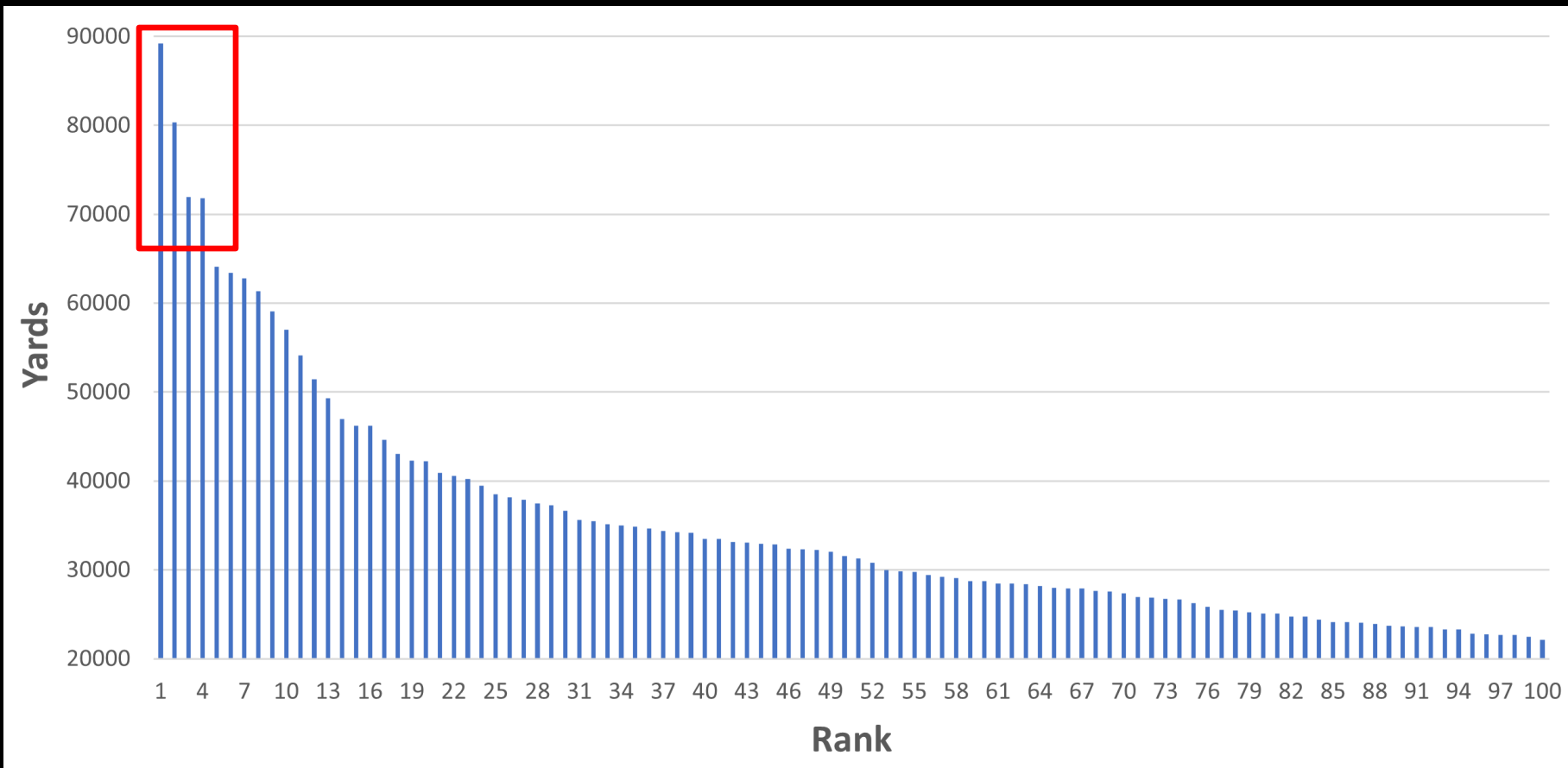
#3: Peyton Manning



#4: Brett Favre



# Top 100 All-Time NFL Passing Leaders



Source: [pro-football-reference.com/](https://pro-football-reference.com/)  
Updated: Nov 13, 2023



Hurricane/ Flood



Drought



Fire



Snow/ Cold



# Drought in Texas: A Comparison of the 1950–1957 and 2010–2015 Droughts



# SNOW











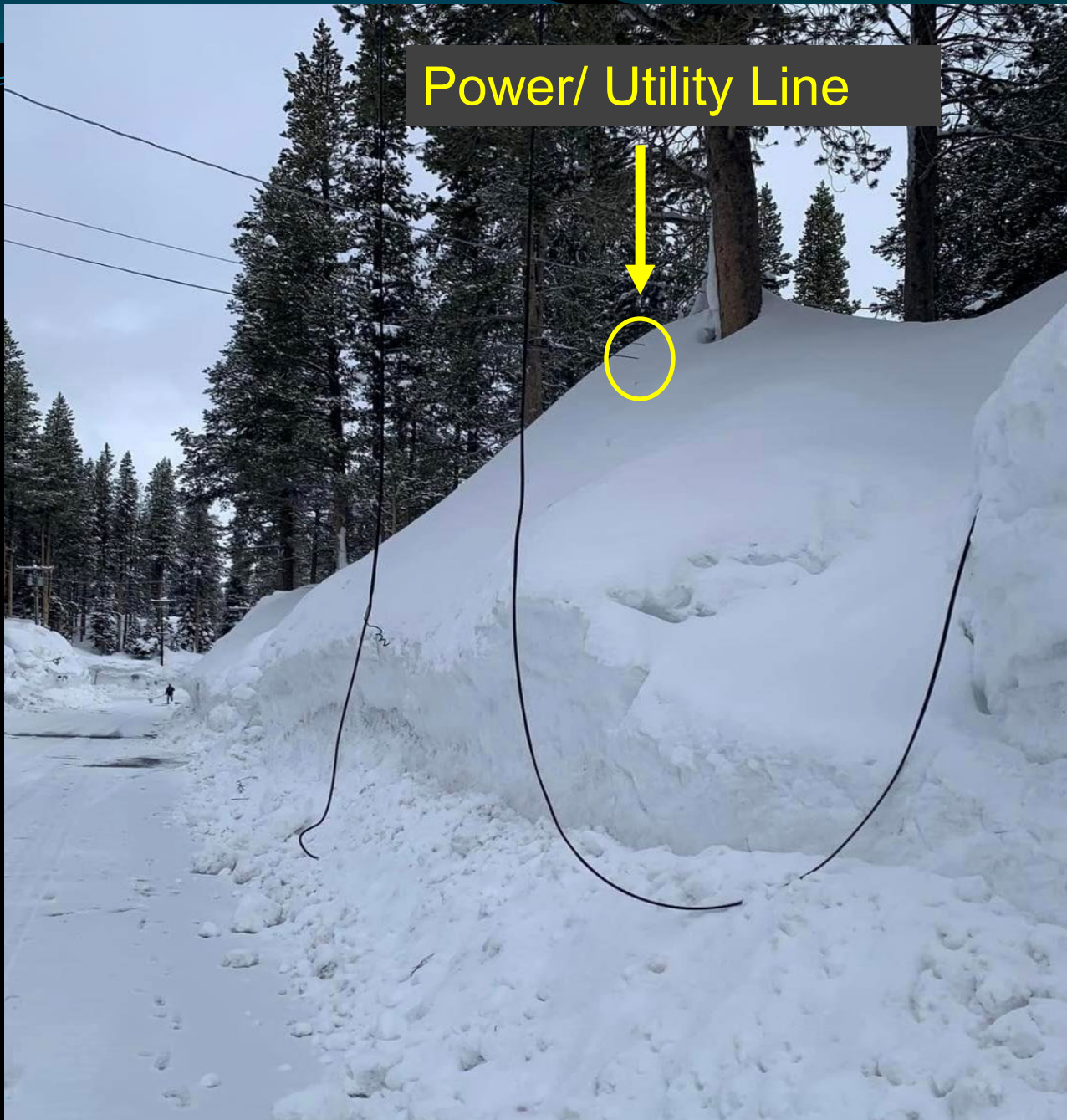
Power/ Utility Line







Power/ Utility Line













## Snowfall records since 1946

#1 Season: 1951-1952	812"	(~ 68 feet)
#2 Season: 2022-2023	715"	(~ 63 feet)

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## Part 2

# Take A Look Around The Neighborhood



Roll a die six times...



What will you see?

"*Foolish by Design* is no conventional Wall Street wisdom approximately what Warren Buffett's sleep-five-thirty note to the Cabela's Chair." —MARCUS GOLDMANN, author of *Abol*

**NASSIM NICHOLAS TALEB**

*New York Times* bestselling author of  
**THE BLACK SWAN**

*FOOLED BY*  
*RANDOMNESS*



The **HIDDEN ROLE OF CHANCE**  
in Life and in the Markets

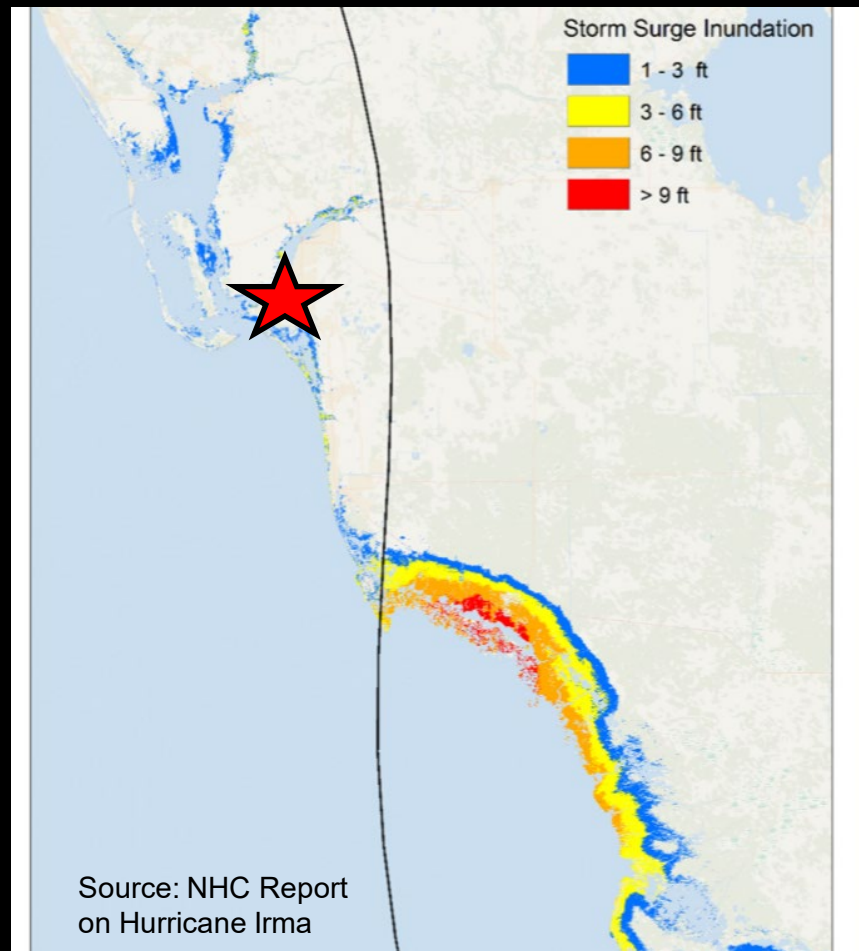
# Hurricane Ian (2022)





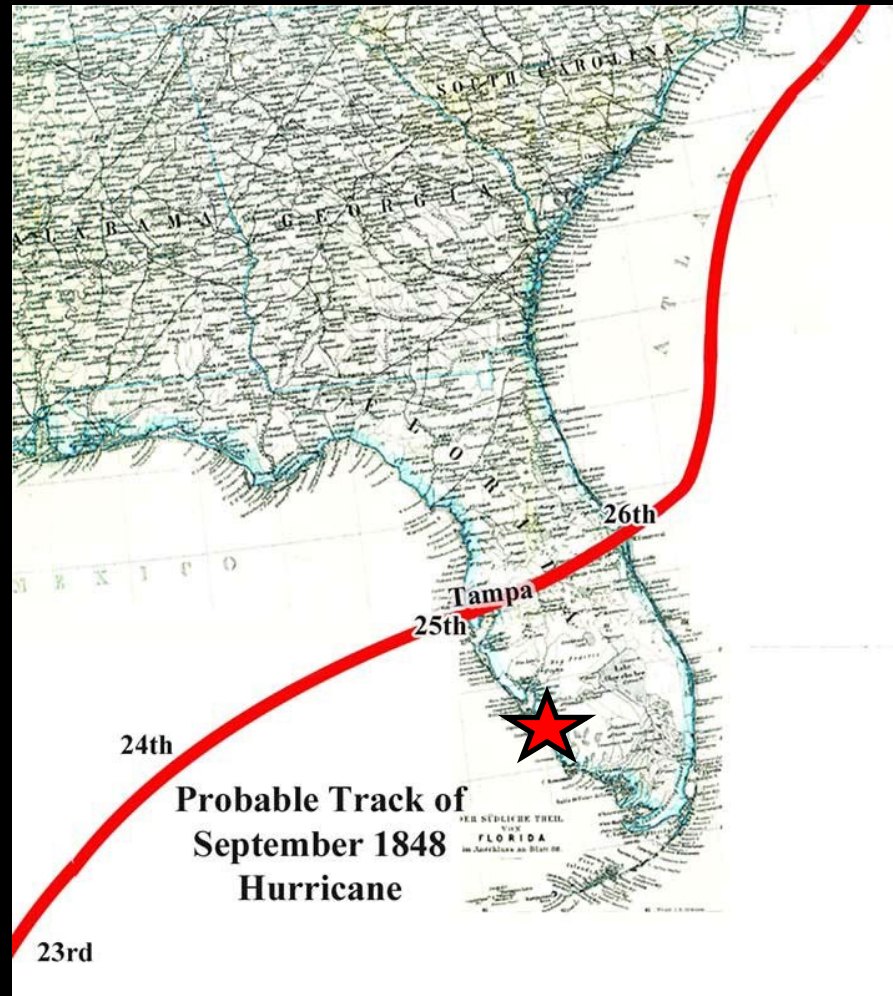
# Know Your Regional Disaster History

## Hurricane Irma (2017)



# Know Your Regional Disaster History

## Tampa Hurricane of 1848



Brown, Canter Jr. (2018) ""The Most Terrible Gale Ever Known" - Tampa and the Hurrican of 1848," *Sunland Tribune*: Vol. 24 , Article 6.

The soldiers' failure resulted from the speed with which the storm picked up force. Within two hours after 8:00 a.m., the winds had swung around from the southeast to the southwest. Then, at 10:00 a.m. the tide commenced to rise. A young woman who endured the storm insisted that "at one time it rose five feet in fifteen minutes." The water quickly submerged the shore, blown toward the post and village with terrific force by the hurricane winds. Meanwhile, the barometric pressure dipped to unprecedented levels, a fact that emphasizes the powerful natural forces that were battering the community. At 11:00 a.m. it stood at 30.122. Three hours later it bottomed out at 28.181. By then water stood fifteen feet above the mean low watermark.<sup>8</sup>

Caught unprepared, local residents panicked, especially those who lived near the water. Schoolmaster Wilson dismissed his students at 10:00 a.m., adding to the equation seared children trying to reach their homes in the face of the storm's force. "Our house was

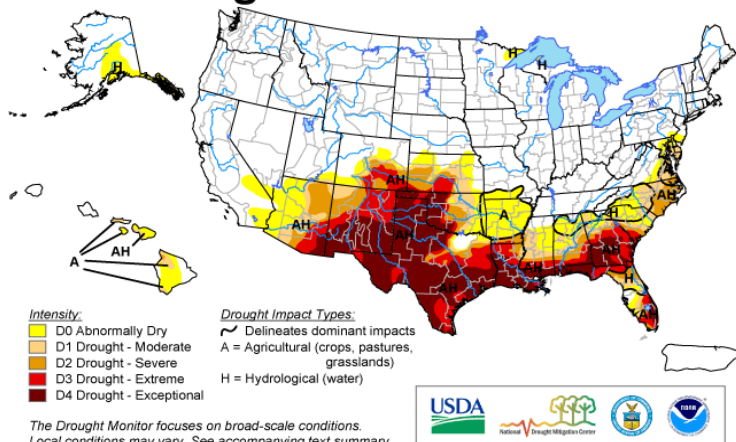
longer thought it advisable for anyone to remain there."<sup>10</sup>

Inhabitants of the Hillsborough River's western side fared no better. At the Robert Jackson home, wife Nancy Collar Jackson witnessed what she called a "tidal wave of alarming proportions." A friend preserved her story. "The waters overflowed the banks as never before known, and the immense steam-ways near their house were washed off their piers and were floating," described Cynthia K. Farr. "Mr. Jackson, an invalid at the time, had taken the older children to a little store nearby, to divert them and to relieve their mother of their care, but realizing that danger was threatening her in the home, sent an employee to bring her and the babe away."<sup>11</sup>

The details of Nancy's escape illustrate the immediacy of the storm's threat to life and limb. "On nearing the house the man saw the 'ways' floating and surging to and fro, and made all haste to tell Mrs. Jackson, who had

# U.S. Drought Monitor

June 28, 2011  
Valid 8 a.m. EDT



**Intensity:**  
 D0 Abnormally Dry  
 D1 Drought - Moderate  
 D2 Drought - Severe  
 D3 Drought - Extreme  
 D4 Drought - Exceptional

**Drought Impact Types:**  
 ~ Delineates dominant impacts  
 A = Agricultural (crops, pastures, grasslands)  
 H = Hydrological (water)



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Released Thursday, June 30, 2011

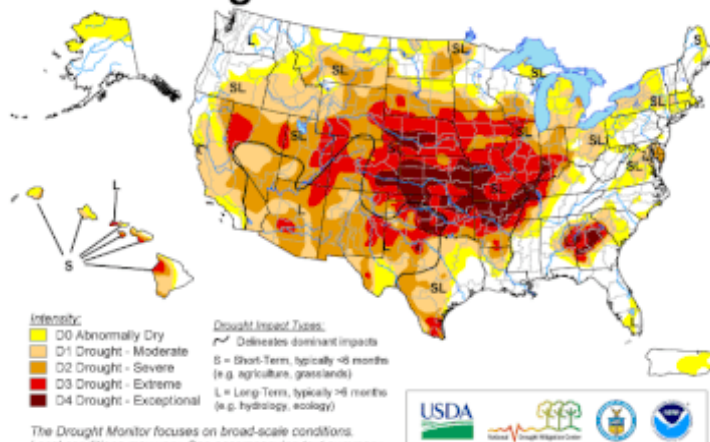
Author: Richard Heim/Liz Love-Brotak, NOAA/NESDIS/NCDC

<http://drought.unl.edu/dm>

## June 2011

# U.S. Drought Monitor

August 21, 2012  
Valid 7 a.m. EDT



**Intensity:**  
 D0 Abnormally Dry  
 D1 Drought - Moderate  
 D2 Drought - Severe  
 D3 Drought - Extreme  
 D4 Drought - Exceptional

**Drought Impact Types:**  
 ~ Delineates dominant impacts  
 S = Short-Term, typically <6 months (e.g. agriculture, grasslands)  
 L = Long-Term, typically >6 months (e.g. hydrology, ecology)



The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

Released Thursday, August 23, 2012

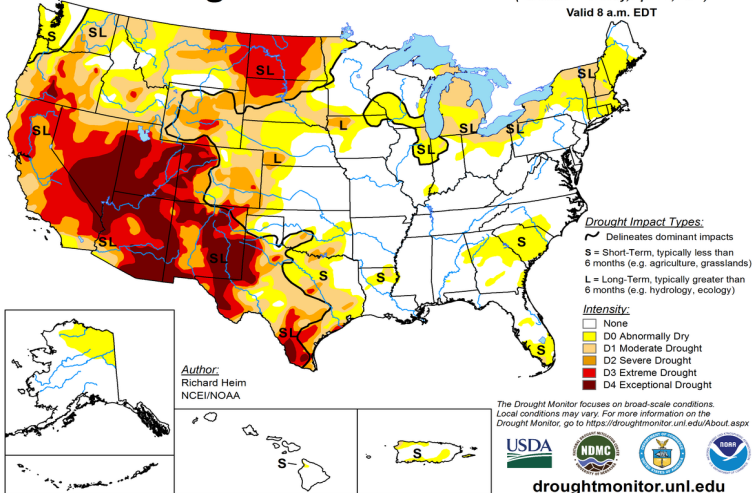
Author: Michael Brewer/Liz Love-Brotak, NOAA/NESDIS/NCDC

<http://droughtmonitor.unl.edu/>

## August 2012

# U.S. Drought Monitor

April 20, 2021  
(Released Thursday, Apr. 22, 2021)  
Valid 8 a.m. EDT



**Drought Impact Types:**  
 ~ Delineates dominant impacts  
 S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)  
 L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

**Intensity:**  
 None  
 D0 Abnormally Dry  
 D1 Moderate Drought  
 D2 Severe Drought  
 D3 Extreme Drought  
 D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. For more information on the Drought Monitor, go to <https://droughtmonitor.unl.edu/About.aspx>



[droughtmonitor.unl.edu](http://droughtmonitor.unl.edu)

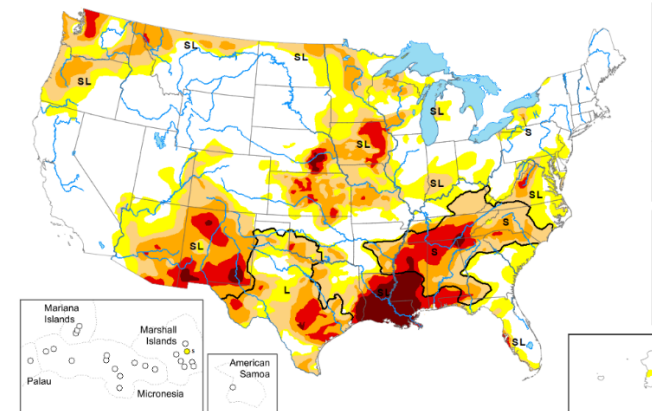
Author:  
Richard Heim  
NCEI/NOAA

## April 2021

# Map released: November 9, 2023

Data valid: November 7, 2023

View grayscale version of the map



United States and Puerto Rico Author(s):

Pacific Islands and Virgin Islands Author(s):

## November 2023





UNITED STATES OF AMERICA

LIBERTY

IN GOD WE TRUST

QUARTER DOLLAR

S

## Fake Sequence

1. H
2. T
3. H
4. H
5. T
6. H
7. T
8. T
9. H
10. H

## Real Sequence

## Fake Sequence

1. H
2. T
3. H
4. H
5. T
6. H
7. T
8. T
9. H
10. H

## Real Sequence

1. H
2. T
3. H
4. H
5. T
6. T
7. T
8. T
9. T
10. H



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# Part 3

## How Environmental Change Shifts Data-Driven “Baselines”





Climate Change



Population Change





## Climate Change

“True Climate Change Is Tied To A  
Physical Process”

# Higher Temps and Drought



- Lower Relative Humidity  
(If water content unchanged)
- Higher Evapotranspiration

# Higher Temps and Drought



- Lower Relative Humidity  
(If water content unchanged)
- Higher Evapotranspiration

Look into:

Changes in atmospheric circulation?

Changes in precipitation patterns?

# Tropical Weather

- Sea Level Rise
- Rapid Intensification of Hurricanes
- Slower-Moving Hurricanes and Tropical Storms
- Increased Moisture = More Rain
- But NOT necessarily more named storms



# Sea Level Rise



Photo: Dr. Hal Needham

**now you see it**



photo: William O. Field

**now you don't**

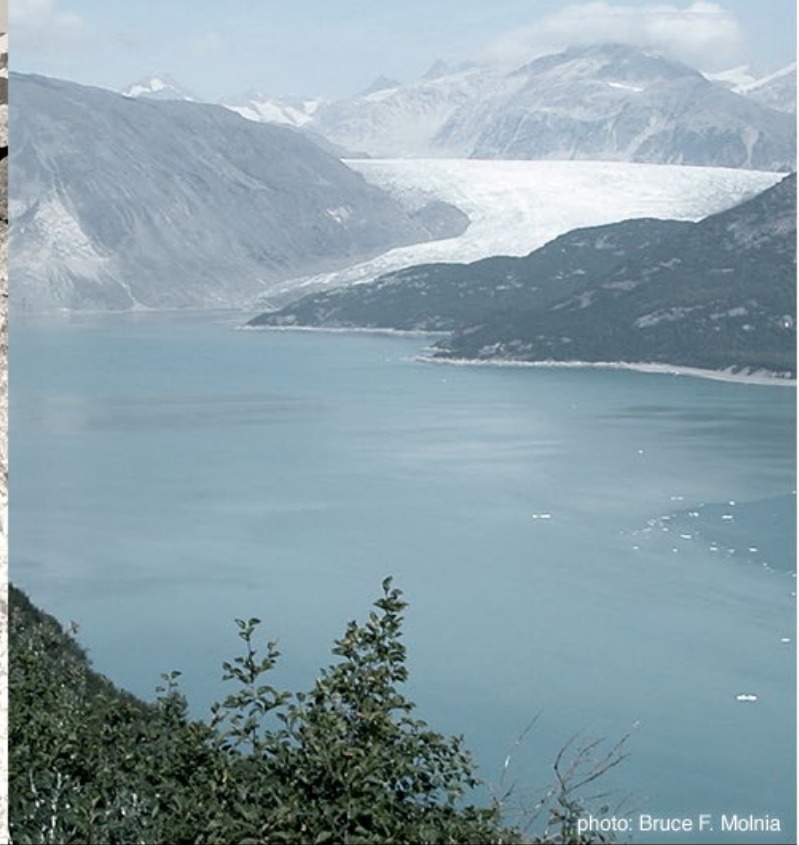


photo: Bruce F. Molnia

Muir Glacier, Alaska: August 13, 1941 and August 31, 2004



**CLIMATE 365**

[climate365.tumblr.com](http://climate365.tumblr.com) | [go.nasa.gov/climate365](http://go.nasa.gov/climate365)



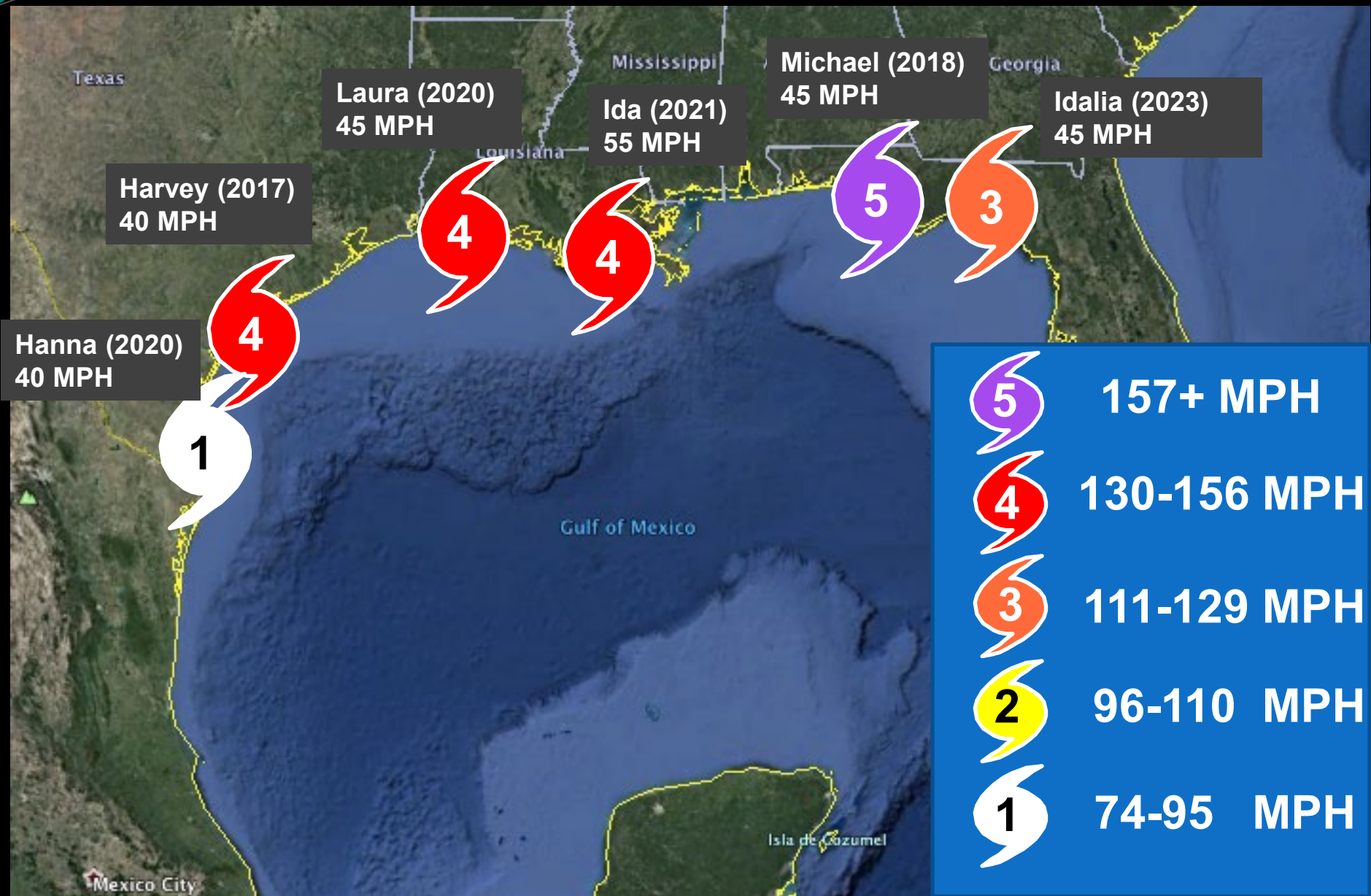




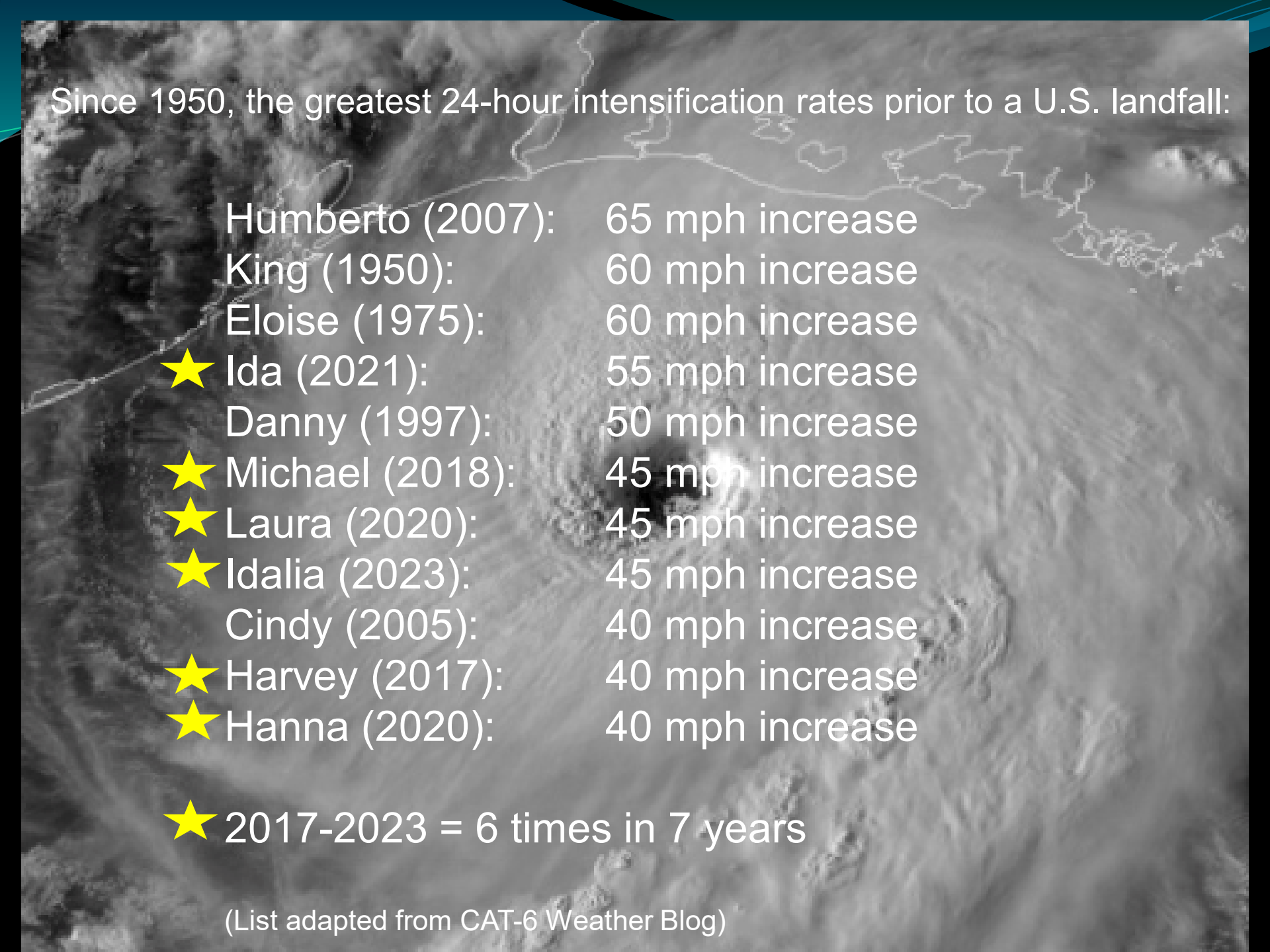
Rapid Intensification of Hurricanes



# Rapid Intensification Over the Past 7 Years



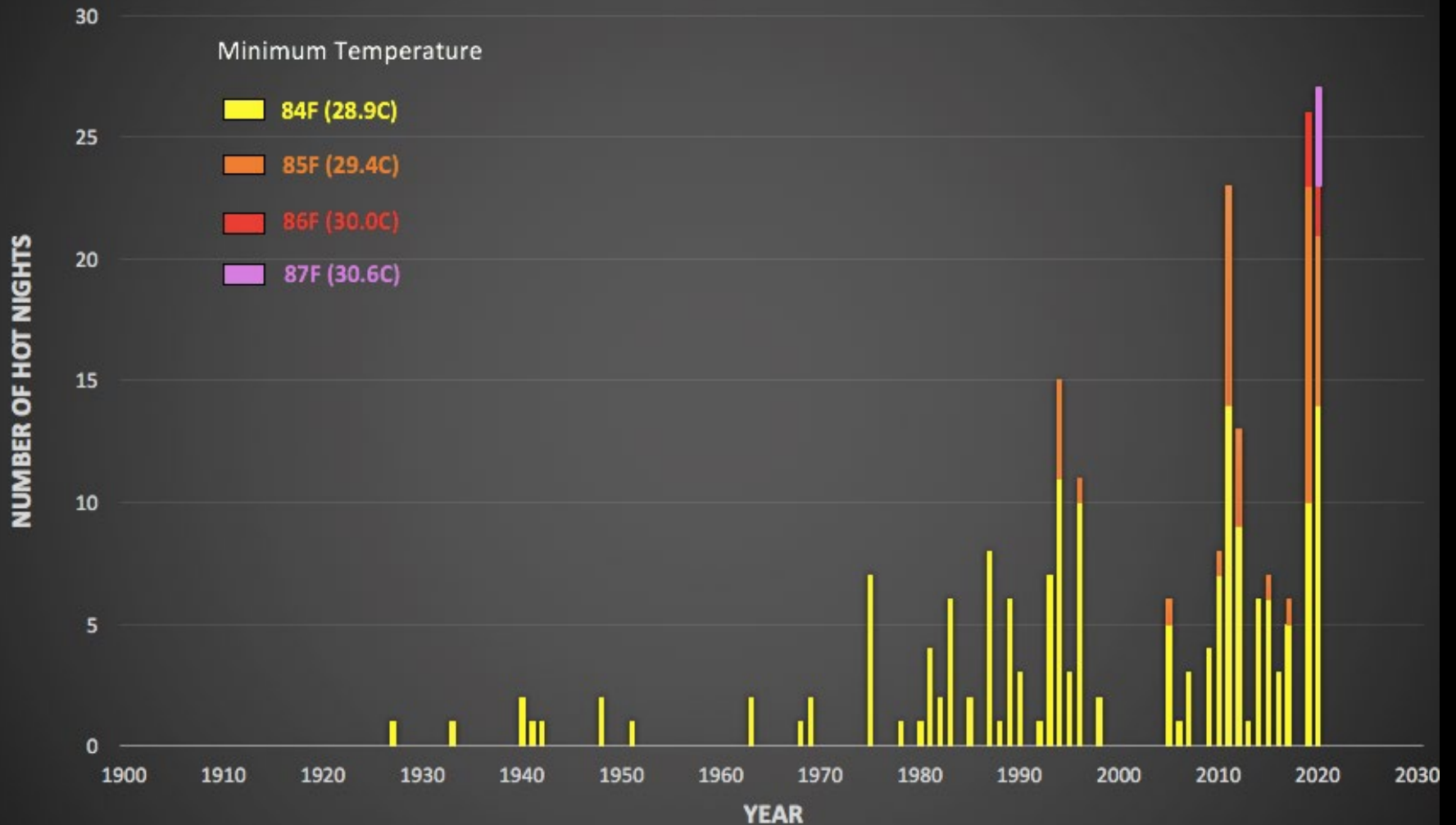
Since 1950, the greatest 24-hour intensification rates prior to a U.S. landfall:



Humberto (2007):	65 mph increase
King (1950):	60 mph increase
Eloise (1975):	60 mph increase
★ Ida (2021):	55 mph increase
Danny (1997):	50 mph increase
★ Michael (2018):	45 mph increase
★ Laura (2020):	45 mph increase
★ Idalia (2023):	45 mph increase
Cindy (2005):	40 mph increase
★ Harvey (2017):	40 mph increase
★ Hanna (2020):	40 mph increase
★ 2017-2023 = 6 times in 7 years	

(List adapted from CAT-6 Weather Blog)

## Number of Hot Nights in Galveston, Texas from 1900-2020 (121 Years)





# “How a Warming World May have Caused Hurricane Florence to Stall”





## Our Approach:

1. Build a data-driven baseline
2. Look at regional “neighborhood”
3. Consider environmental change and build buffers

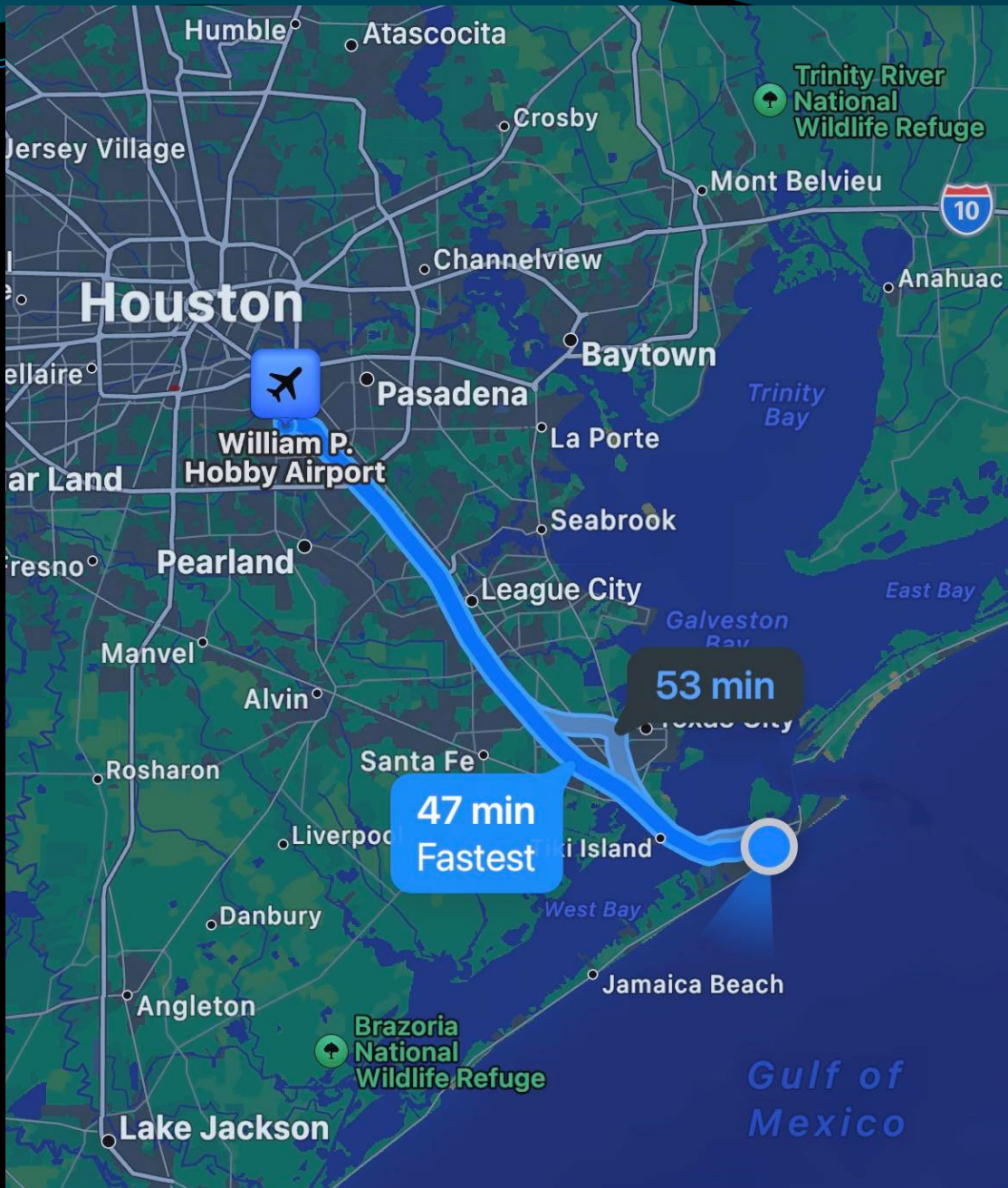


Our Ultimate Goal:

Align Our Analysis with Reality  
As Much As Possible









45 NORTH  
Houston

EXIT 1C  
188 275  
Teichman Rd  
Harborside Dr

MOTEL 6

EXIT 35  
M.P.H.

Get Your DMV

RESTAURANT

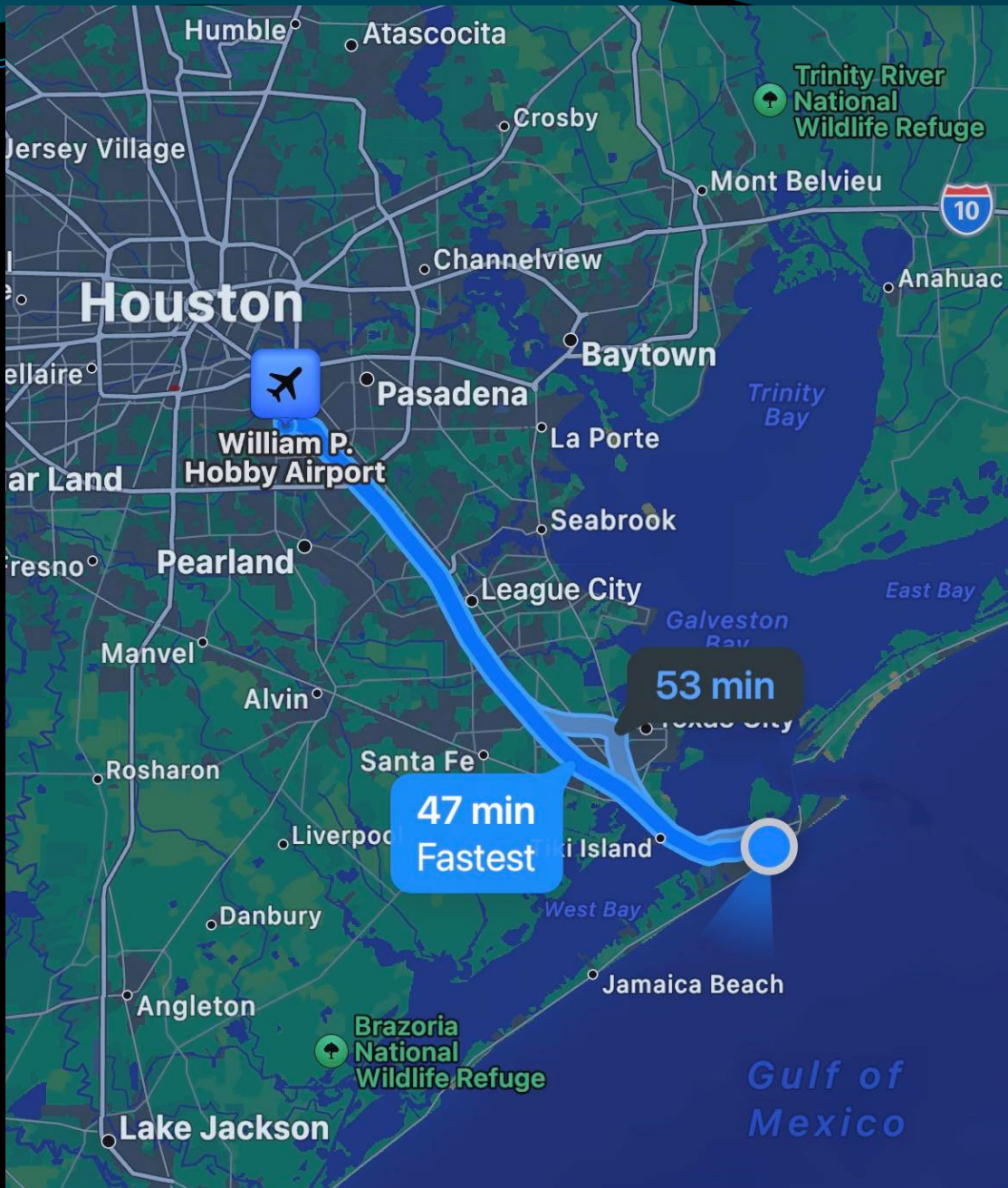
HYUNDAI

EXIT 1C













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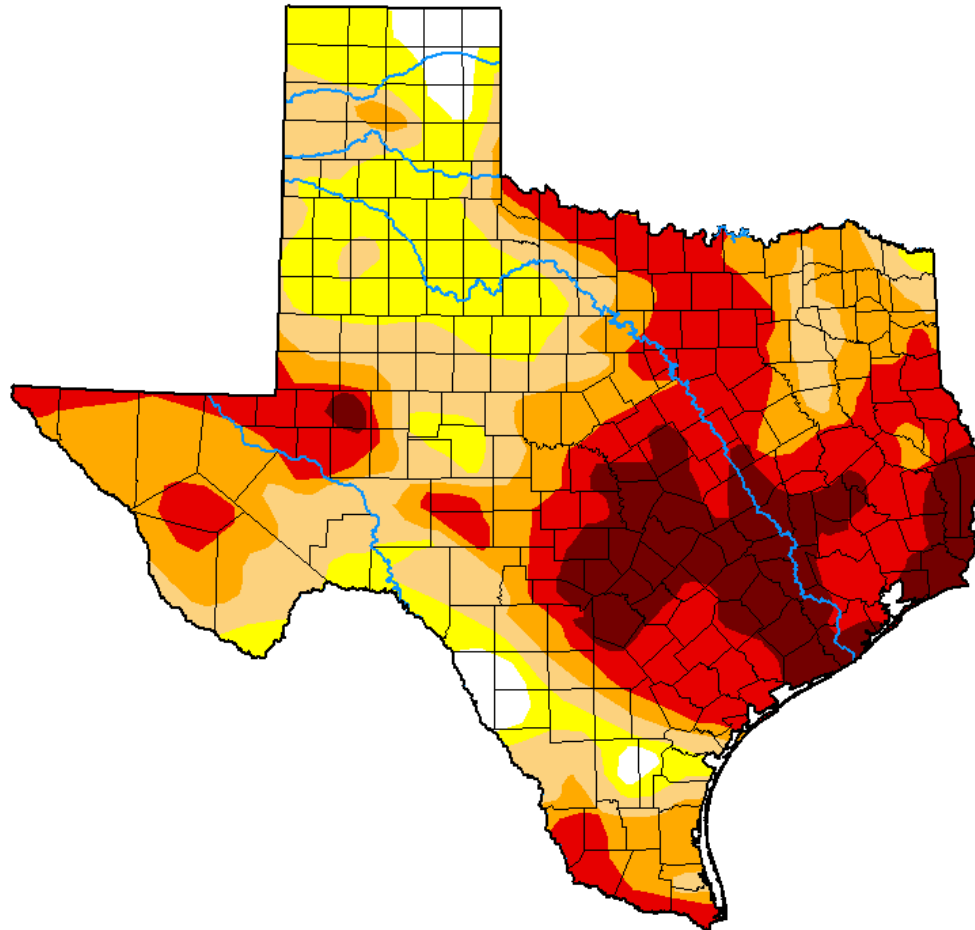


# Part 4

## Winter Weather Outlook










# U.S. Drought Monitor: Sep 26, 2023



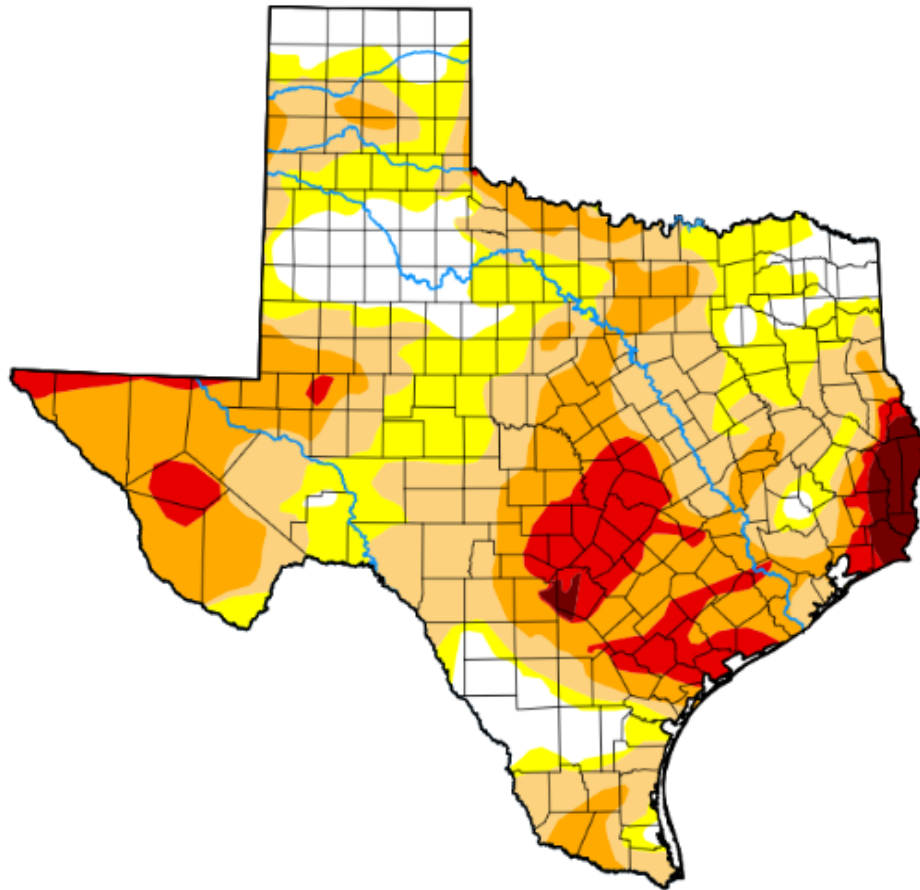
Level	9/26
D1+	81%
D2+	60%
D3+	38%
D4	13%

## Intensity

	None
	D0 (Abnormally Dry)
	D1 (Moderate Drought)
	D2 (Severe Drought)
	D3 (Extreme Drought)
	D4 (Exceptional Drought)
	No Data

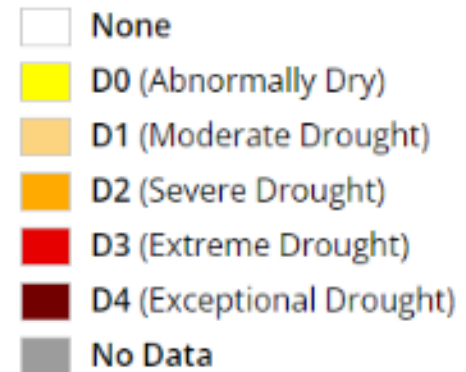


# U.S. Drought Monitor: Nov 7, 2023

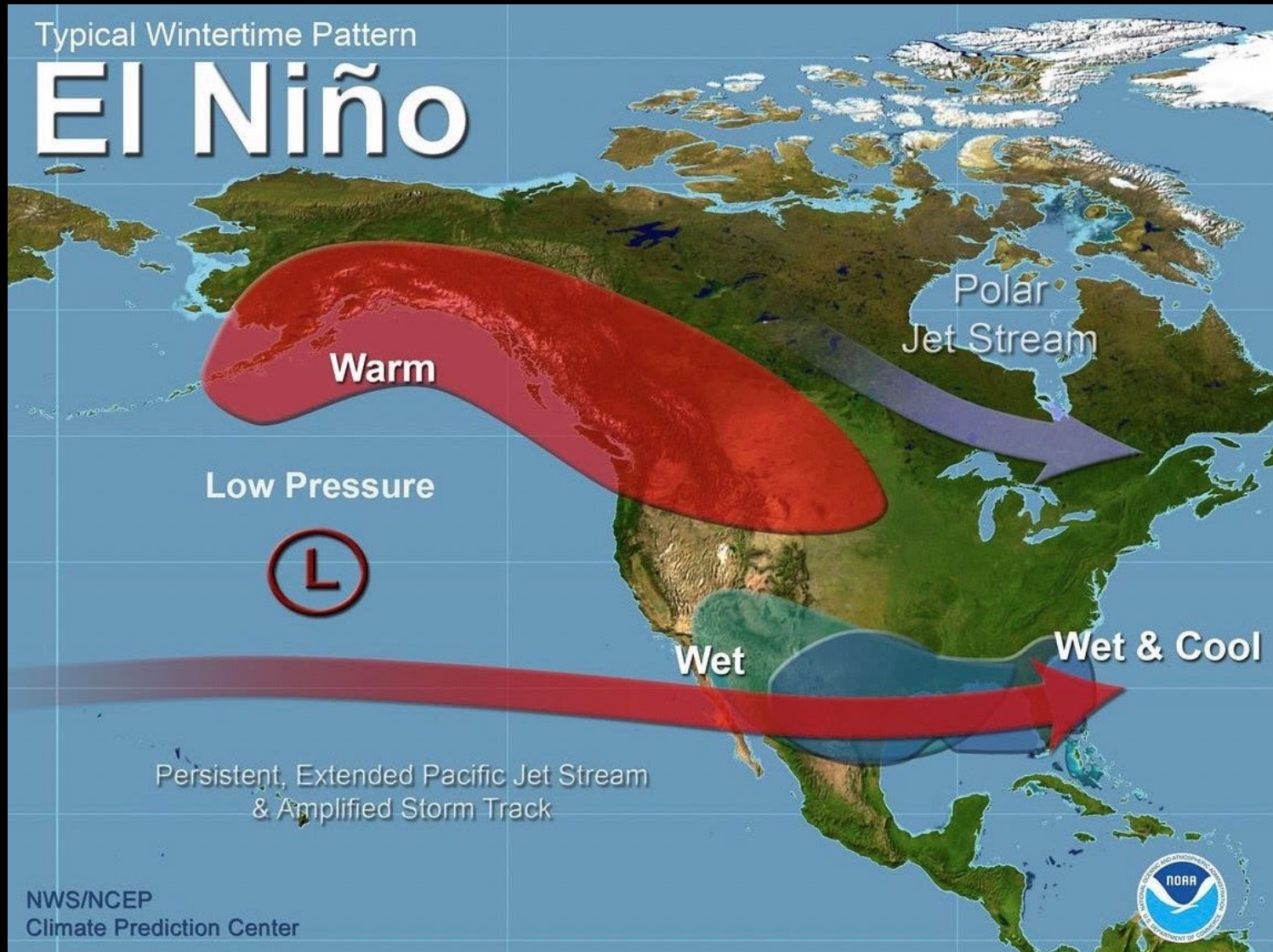


Level	9/26	11/7
D1+	81%	65%
D2+	60%	36%
D3+	38%	11%
D4	13%	2%

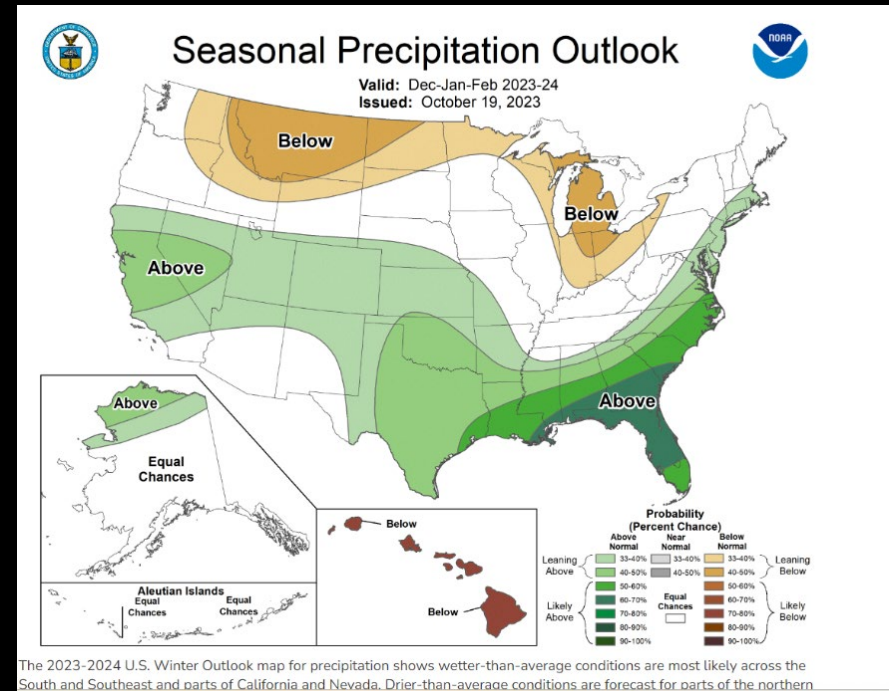
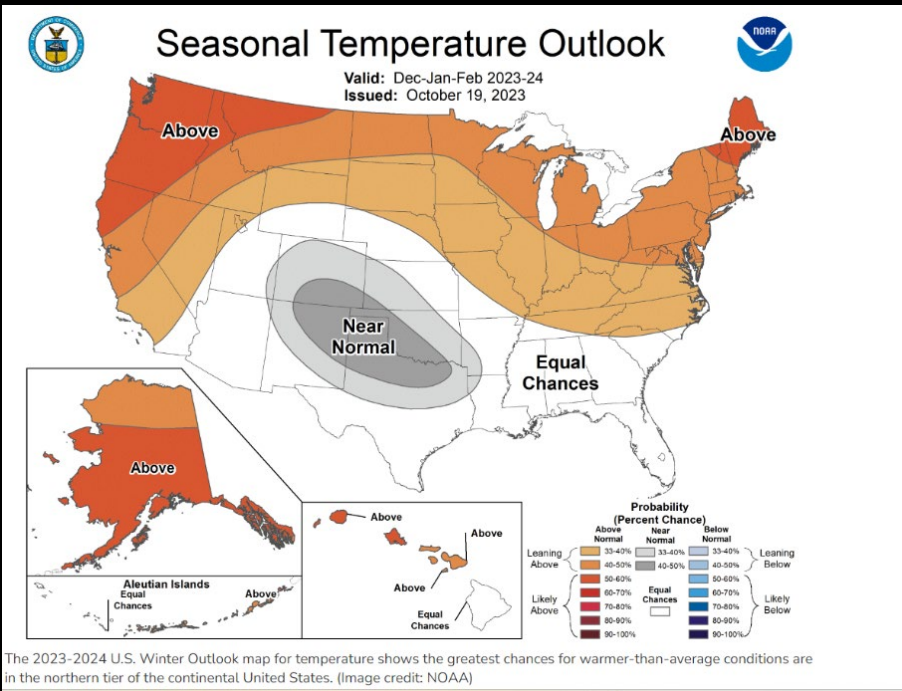
## Intensity



# NOAA Climate Prediction Center



# NOAA Seasonal Climate Outlook

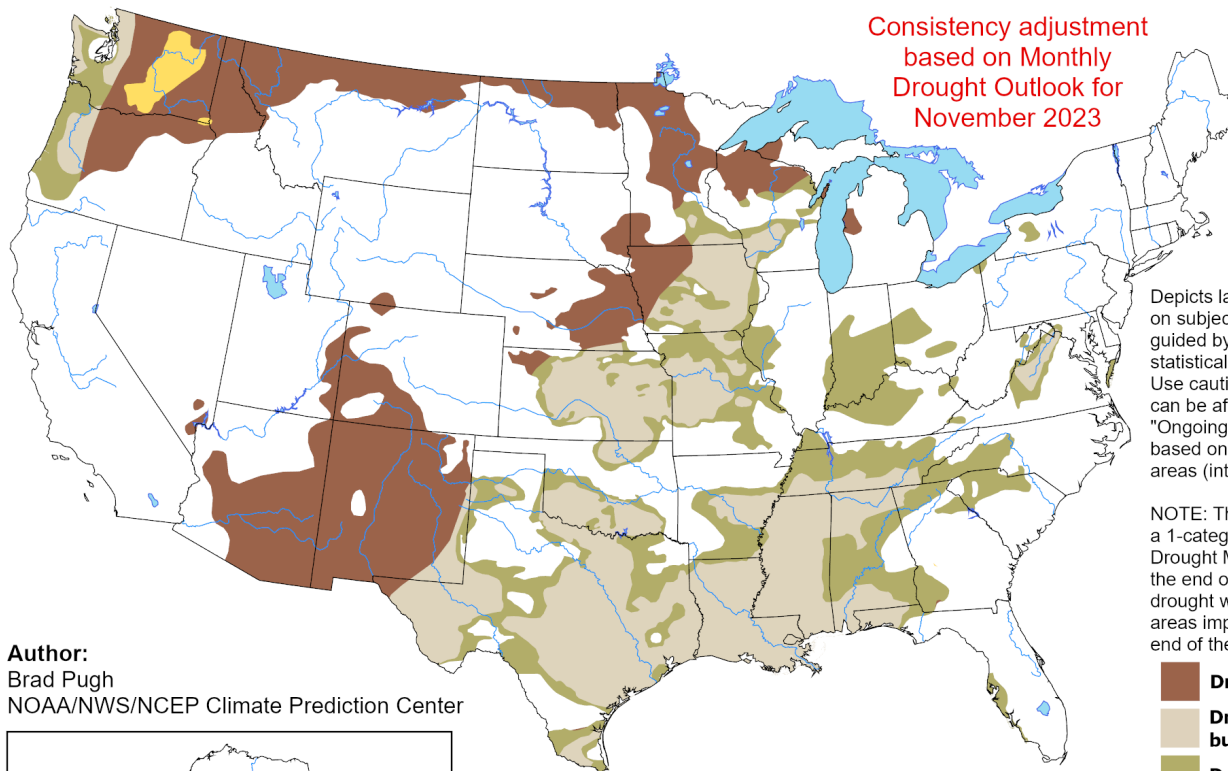


# NOAA Climate Prediction Center

## ***U.S. Seasonal Drought Outlook*** Drought Tendency During the Valid Period

Valid for November 1, 2023 - January 31, 2024  
Released October 31, 2023

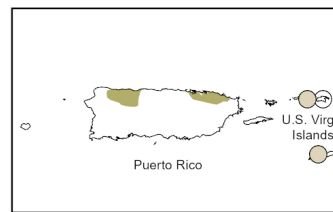
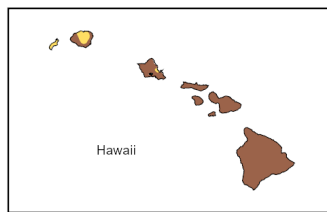
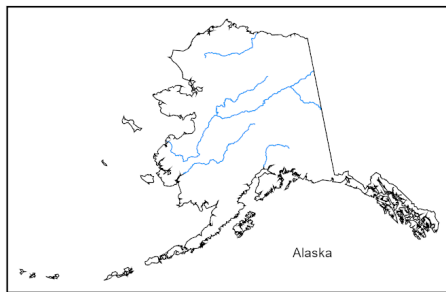
Consistency adjustment  
based on Monthly  
Drought Outlook for  
November 2023






Depicts large-scale trends based on subjectively derived probabilities guided by short- and long-range statistical and dynamical forecasts. Use caution for applications that can be affected by short lived events. "Ongoing" drought areas are based on the U.S. Drought Monitor areas (intensities of D1 to D4).

NOTE: The tan areas imply at least a 1-category improvement in the Drought Monitor intensity levels by the end of the period, although drought will remain. The green areas imply drought removal by the end of the period (D0 or none).

**Author:**  
Brad Pugh  
NOAA/NWS/NCEP Climate Prediction Center



-  **Drought persists**
-  **Drought remains, but improves**
-  **Drought removal likely**
-  **Drought development likely**
-  **No drought**



<https://go.usa.gov/3eZ73>



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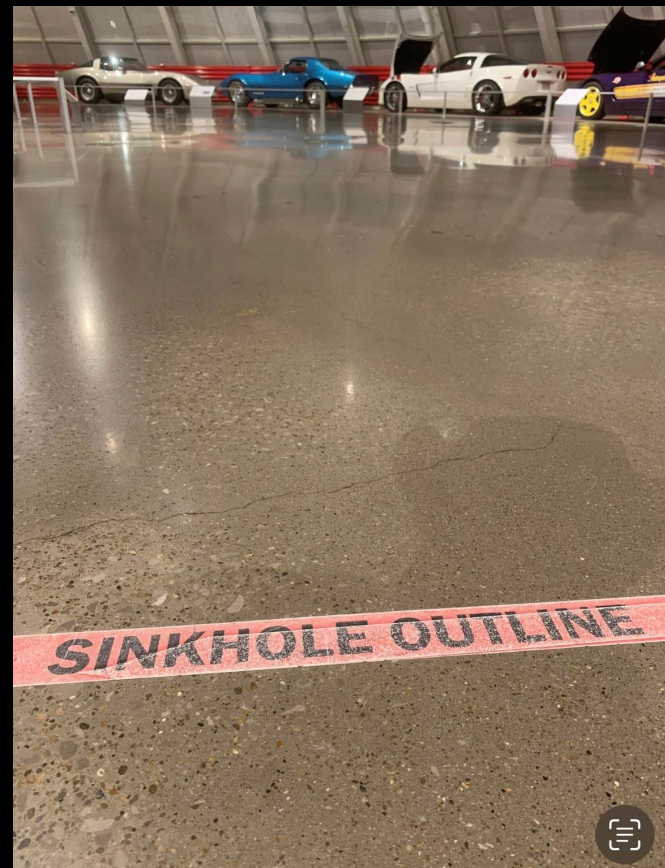


**Changing how people  
view and prepare for  
extreme weather.**

[How We Do It](#)

[Be the Change](#)

# Episode 59: The Sinkhole That Gobbled Up Eight Corvettes





## Episode 58: Sinkholes and Caves in West Virginia





## Contact Info

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Extreme Weather and Disaster Scientist  
GeoTrek/ Flood Information Systems

Based in Galveston, Texas

409-502-4672

[halneedham@cnc-resource.com](mailto:halneedham@cnc-resource.com)

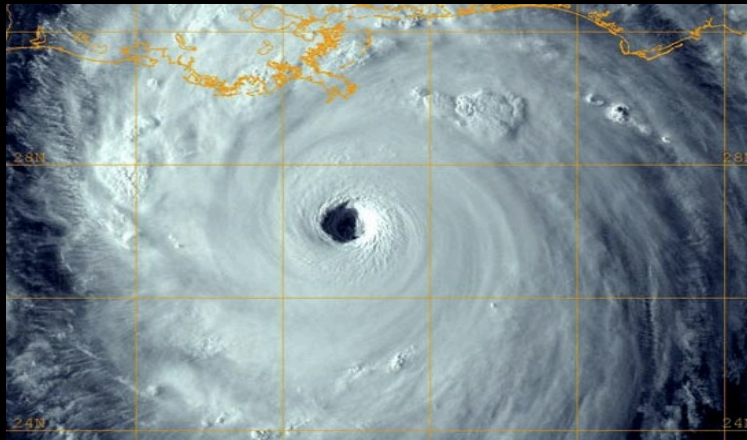
Geo-trek.com

Floodinformationsystems.com

Check out GeoTrek Podcast!



# A Data-Driven Perspective on How to Make Ourselves Climate Resilient



Hal Needham, Ph.D.  
November 14, 2023

