South Florida
Extreme Weather and Weather Threats

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Miami-Dade County Healthcare Preparedness Coalition
2023 Annual Symposium
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Top Miami-Dade Hazard Based on FEMA NRI ?

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Which weather hazard is most concerning to you?

a. Tornadoes
b. Lightning
c. Hurricanes
d. Flooding
e. Heat
f. Other

FEMA National Risk Index (NRI)

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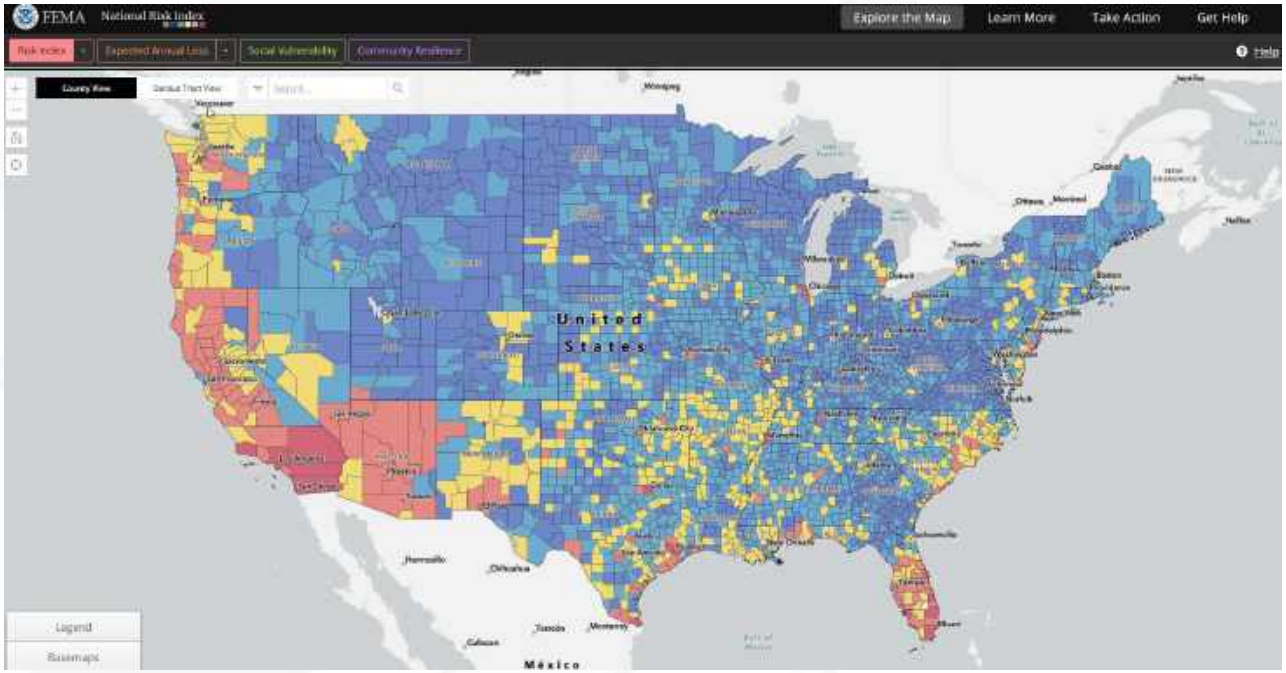

https://hazards.fema.gov/nri/map

FEMA National Risk Index

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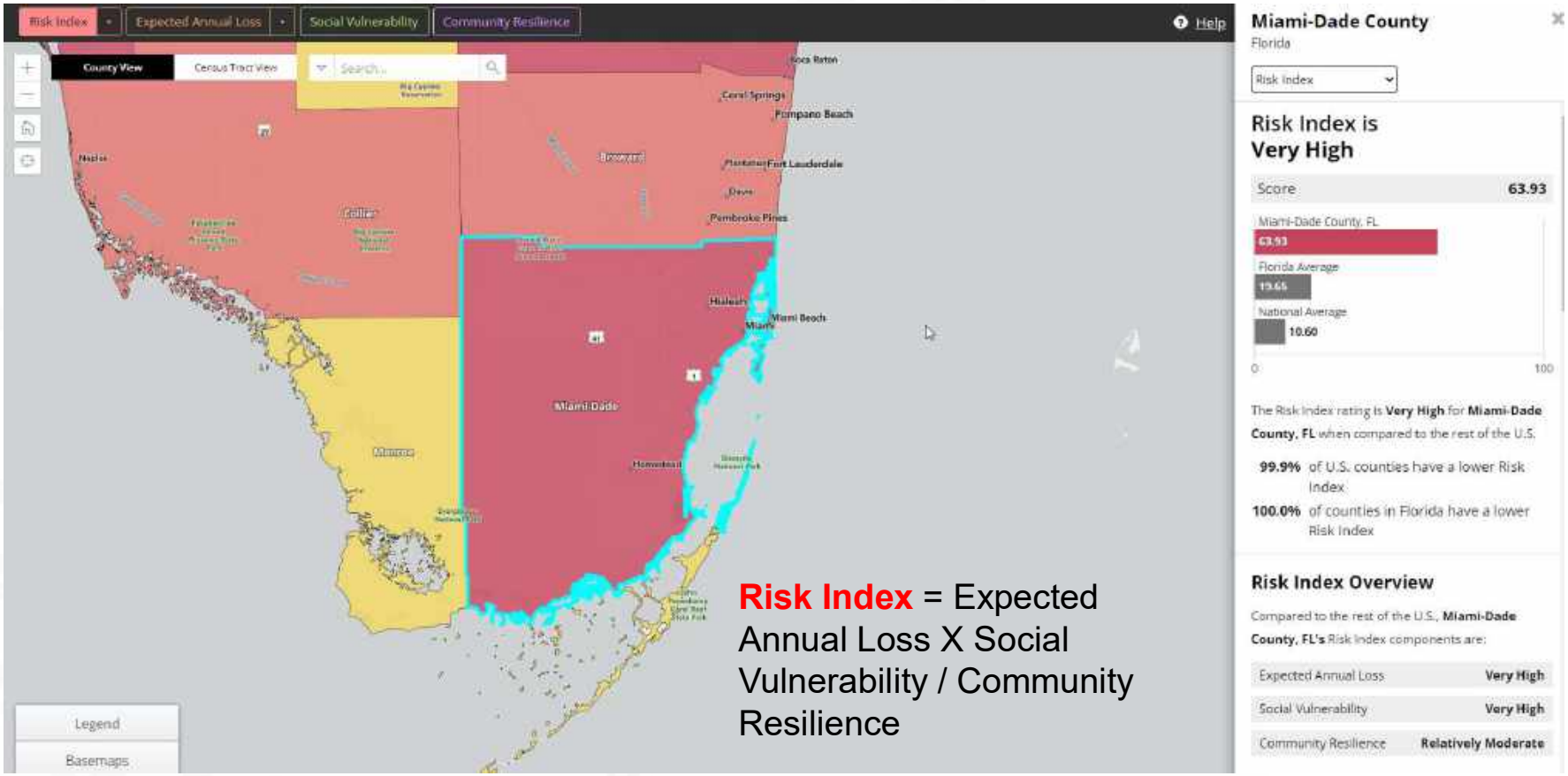

Risk Index = Expected Annual Loss X Social Vulnerability / Community Resilience

Which hazard has the highest NRI score in Miami-Dade County?

a. Tornadoes
b. Lightning
c. Hurricanes
d. Flooding

Top Miami-Dade Hazards Based on FEMA NRI

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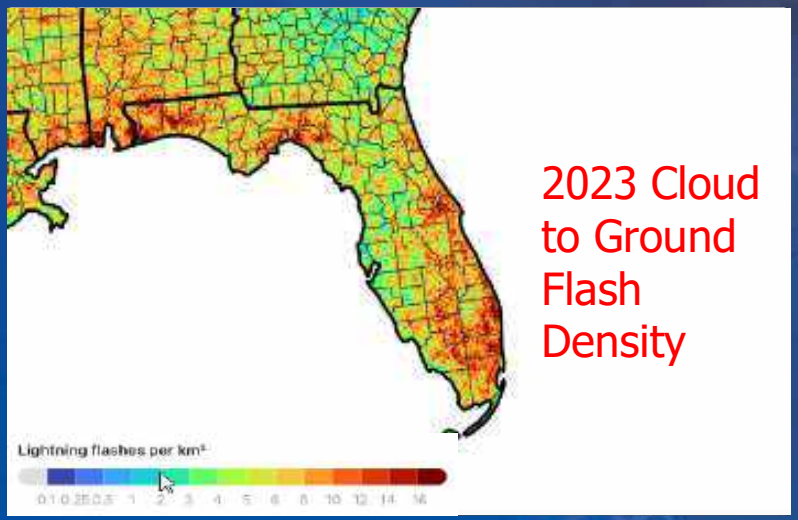
1. Lightning
2. Coastal Flooding (includes storm surge)
3. Tornadoes
4. Riverine Flooding
5. Cold Wave
6. Hurricanes (wind only?)

When Thunder Roars, Go Indoors
See a Flash, Dash Inside

127 average lightning events per square mile per year in Miami-Dade County (2016-2023)



2023 Cloud to Ground Flash Density

When Thunder Roars, Go Indoors
See a Flash, Dash Inside

South Florida is Hurricane Country!

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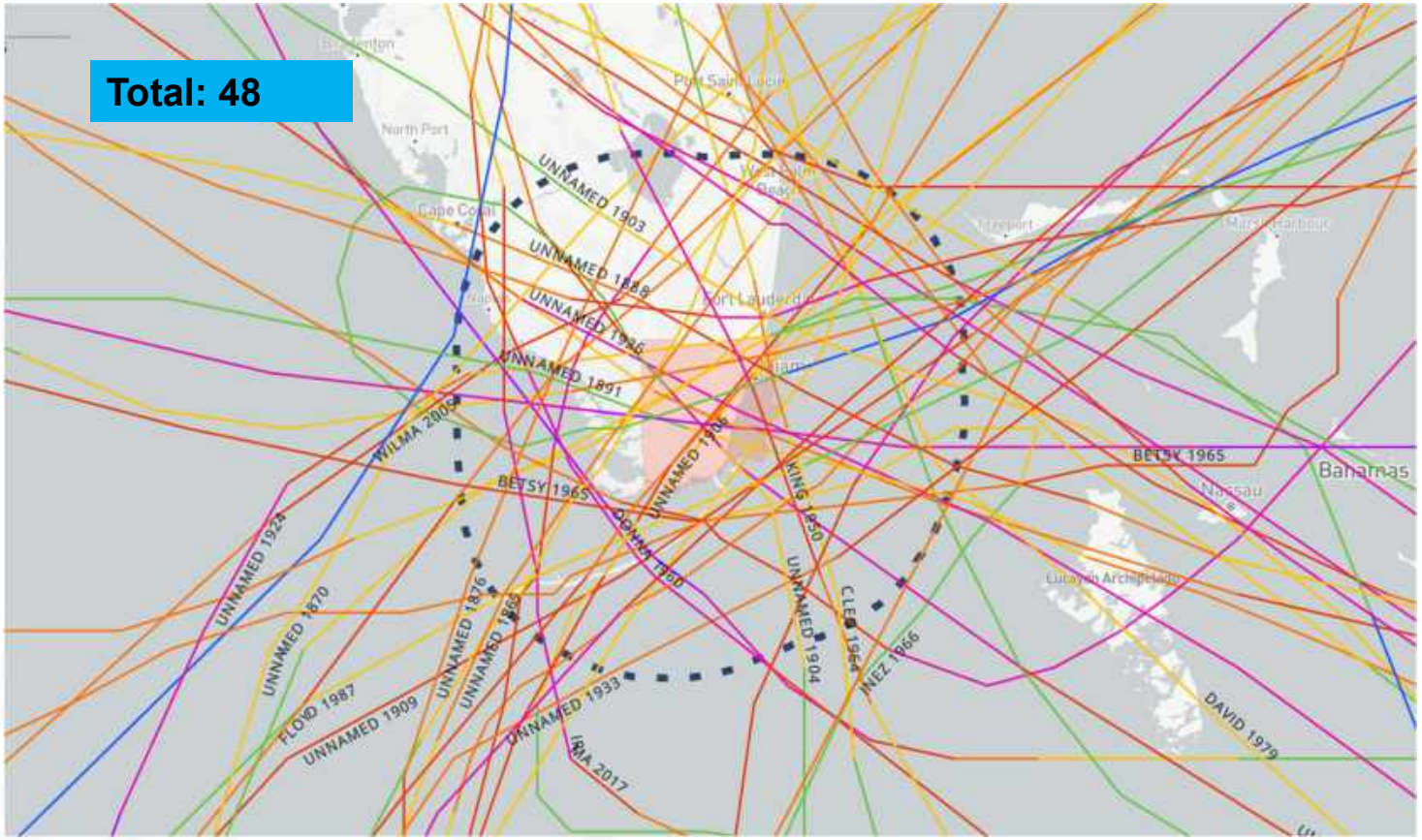
Tracks of Center of Hurricanes Passing Within 60 Miles of Miami Since 1865



Hurricane Strikes vs Population

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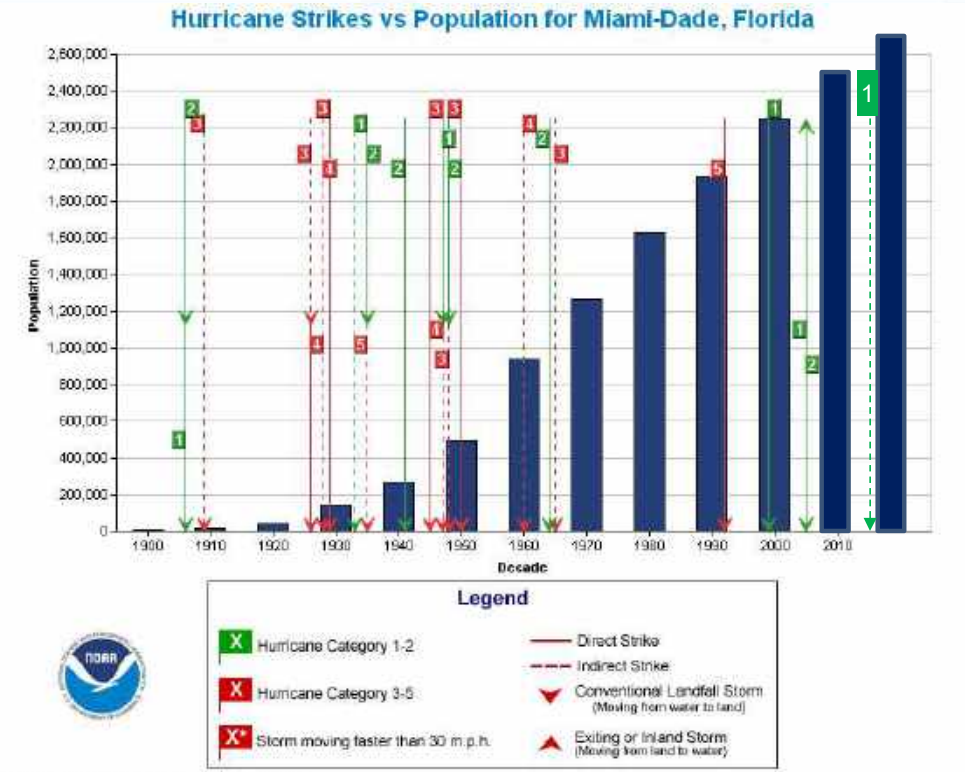

Hurricane Strike Data: National Hurricane Center
Population Data: U.S. Census Bureau
NOTE:Population values may be missing in some counties, particularly for earlier periods. This is most often attributable to the fact that the county had not yet been established.
NOTE:There may be discrepancies between the strike data shown in this chart and the HURDAT strike data used in the Historical Hurricanes Tracks Tool. The National Hurricane Center is currently updating the strike data used for these charts.
For more information visit http://www.aoml.noaa.gov/hrd/data_sub/re_anal.html
NOTE:Population data is current as of 2000 U.S. Census. X-axis on graphs depict years through 2010 to illustrate storms that have occurred from 2000-2006.

Miami-Dade County:

- Highest historical frequency of major hurricanes (Category 3 or higher) of any U.S. coastal county

Hurricane Rapid Intensification (RI)

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- **Ten storms in 2020 had sustained winds increase by 35 mph or more within 24 hours or less, and 5 in 2021. Hurricane Ian (2022) was another example**
- **In 2020, Eta and Iota broke records with 80 mph increases as they neared landfall on the coast of Nicaragua**
- **Number of RI storms have increased, and some believe this will continue to be the trend in the future**
- **Forecasting RI storms improving**

Not Every Storm Will Give Us Several Days or a Week to Track Before Affecting South Florida!!

4 hurricanes (Michael, Andrew, Camille, Labor Day 1935) have made landfall in the U.S. as a Category 5

ALL 4 were tropical storms 72 hours before landfall!!

Short Lead Time

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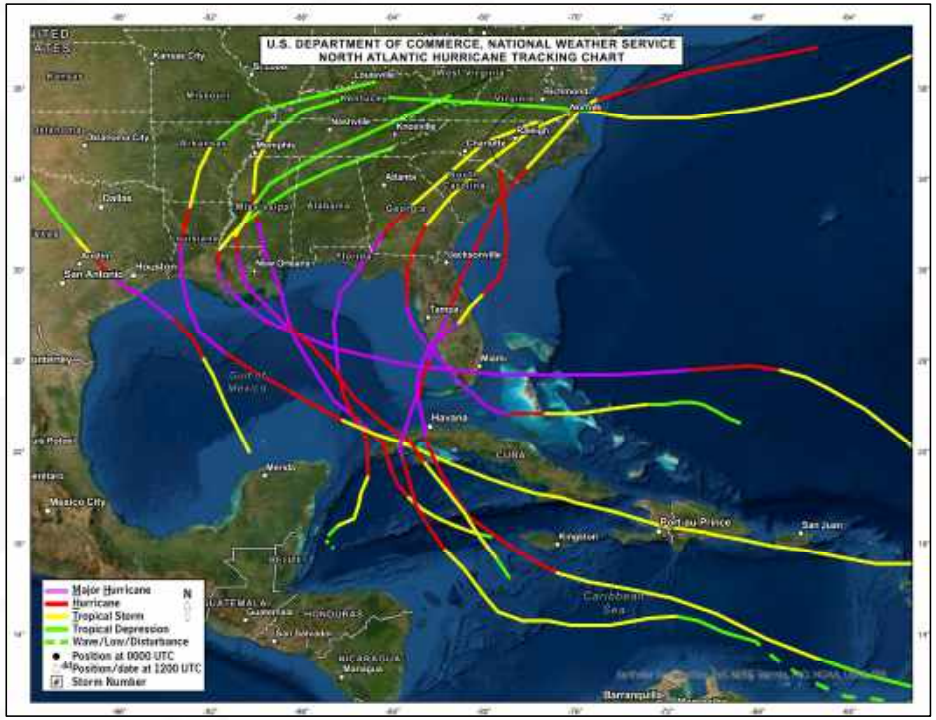
The Nation's Strongest Hurricanes (150+ MPH) in the last 100 years were all Tropical Storms 3 Days Before Landfall

1932 – Storm 2
1935 – Labor Day
1969 – Camille
1992 – Andrew
2004 – Charley
2018 – Michael
2020 – Laura
2021 – Ida
2022 – Ian



Forecasts are Improving – Still a communications challenge

Tropical Cyclones are multi-hazard IMPACT events!

Hurricane Categories

Saffir-Simpson WIND Scale

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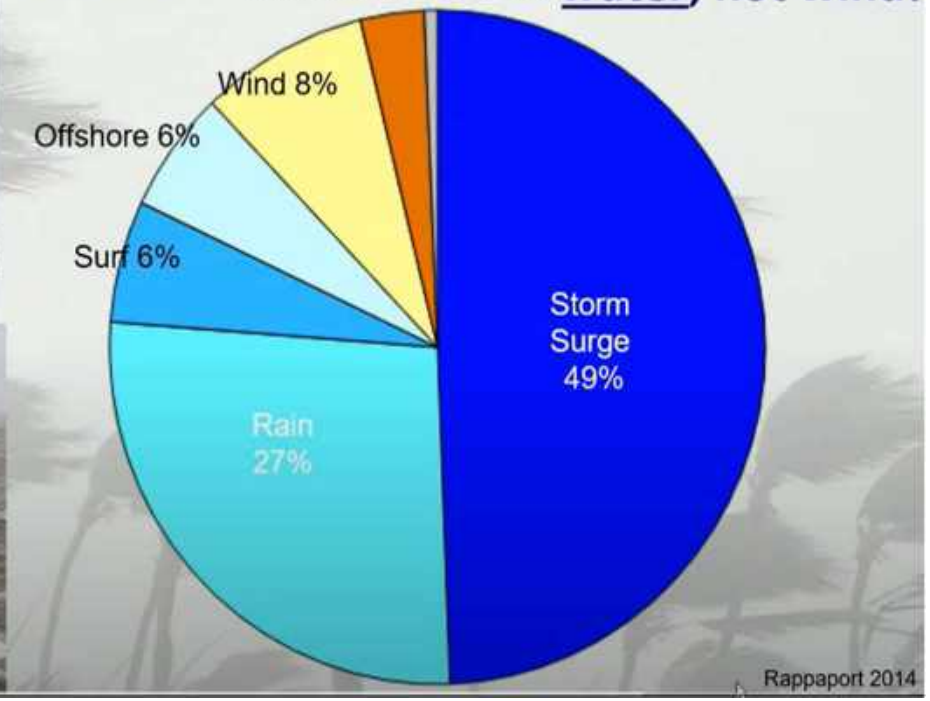
Water is What KILLS!!!

9 out of 10 people die from *water*, not wind!



Water is What Kills

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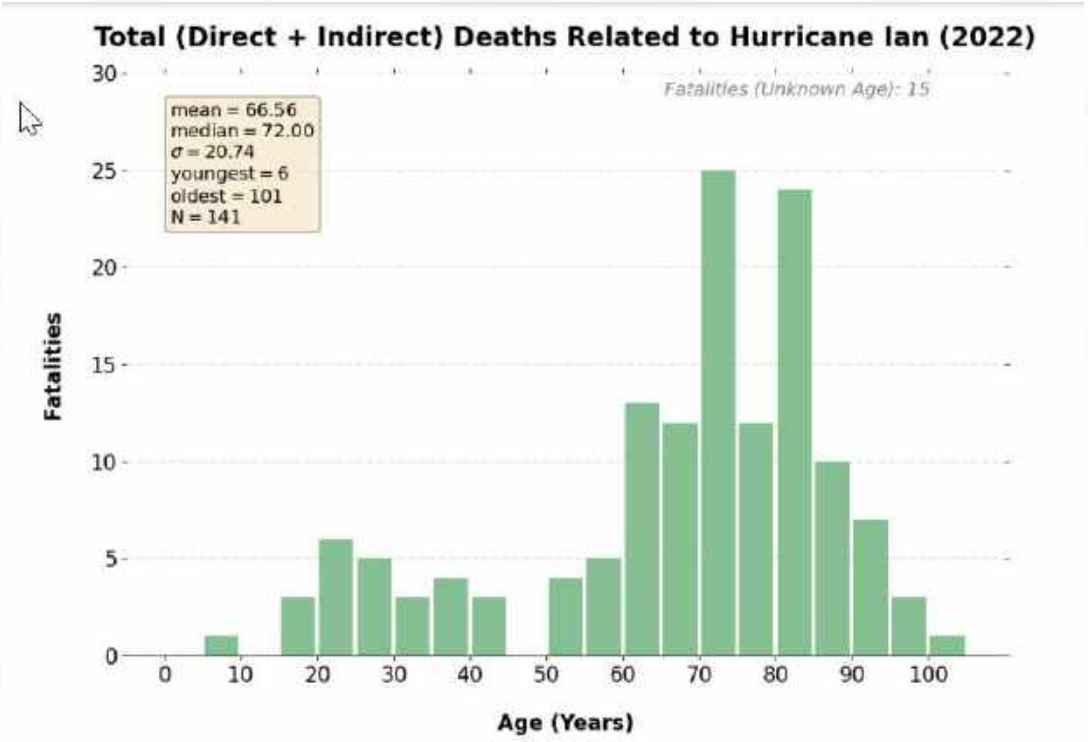

HURRICANE IAN

- At least 141 fatalities – 66 direct

- 41 deaths from storm surge, and 12 from rainfall flooding

- 4 wind-related

Storm Surge – Leading Cause of Death in Hurricanes

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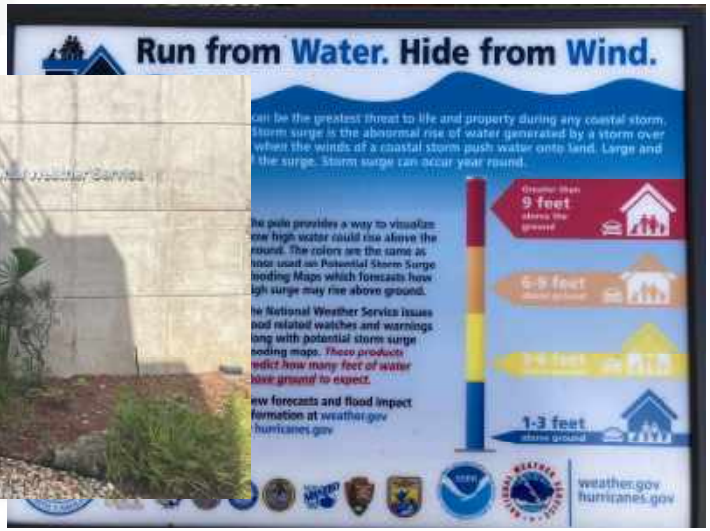
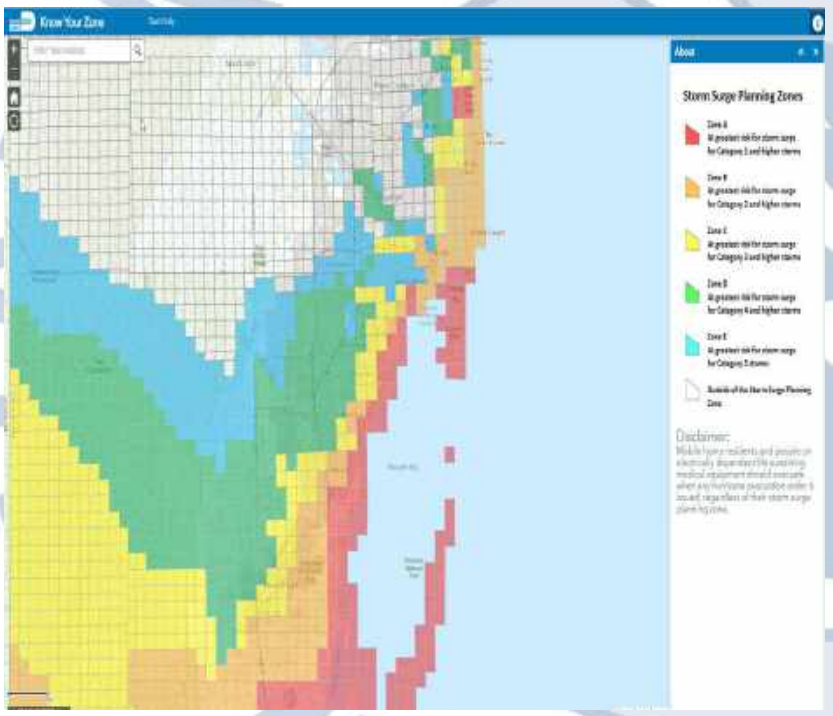
3 storm surge drowning deaths in Naples area occurred in water that was likely no deeper than 5-6 feet



3-5 feet of MOVING water is life-threatening!

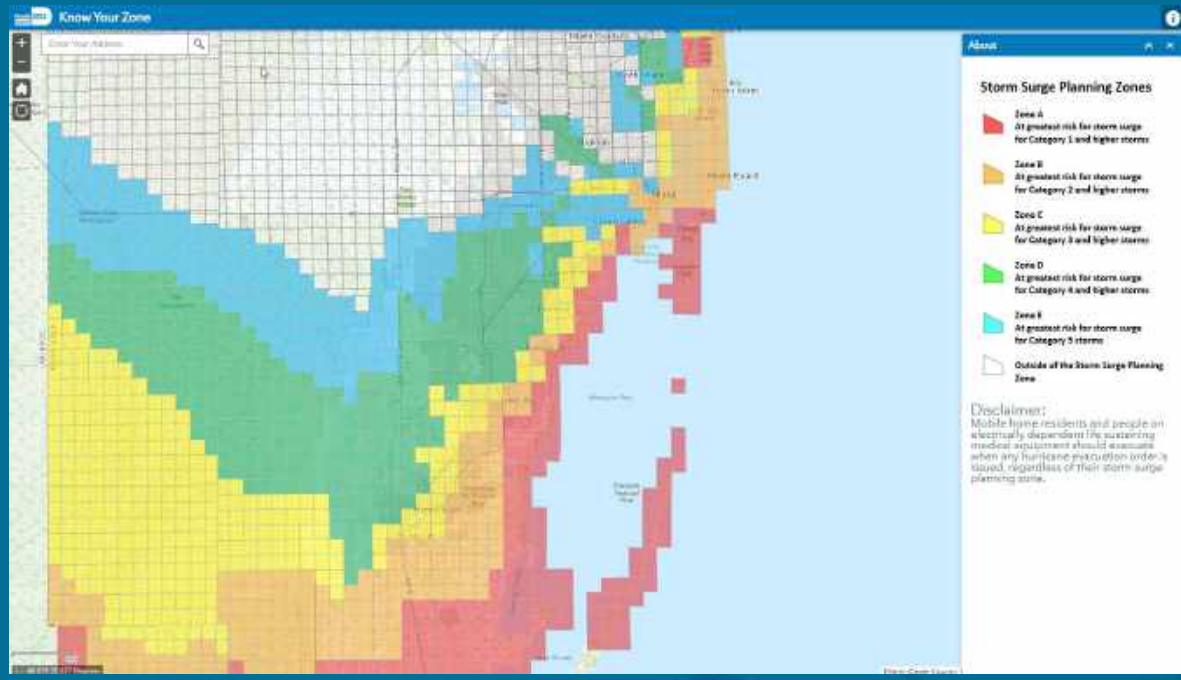
Know Your Evacuation Zones



- Based on storm surge models and detailed elevation studies (LIDAR)
- Storm surge not always dependent on hurricane category (remember that the Saffir-Simpson Scale is a WIND scale only)
- **Storm Surge impacts are HIGHLY localized and HIGHLY dependent on the exact track and intensity of a storm**

Storm Surge Flooding

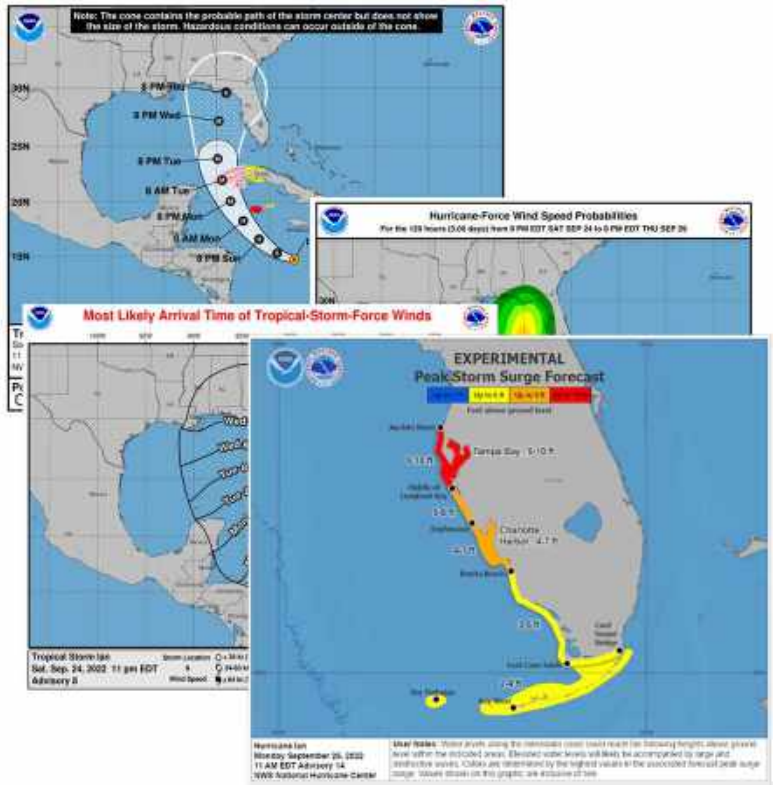
- ***Storm surge events are relatively rare and HIGHLY dependent on exact storm track/size/intensity***
- ***Increasing sea levels could make future storm surge events more severe and/or cover larger areas***



Miami-Dade County Storm Surge Planning Zones – based on NOAA SLOSH model data

There are a myriad of tropical forecast graphics available during a potential storm event

These graphics provide context to the forecast, and add value for decision making



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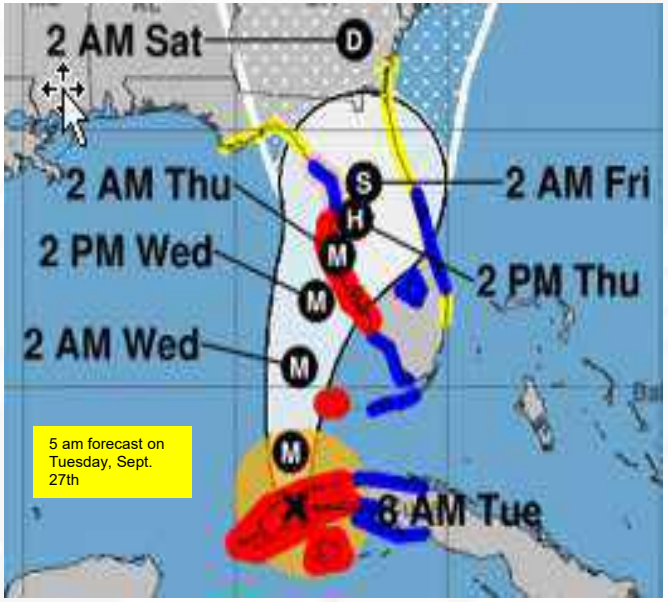
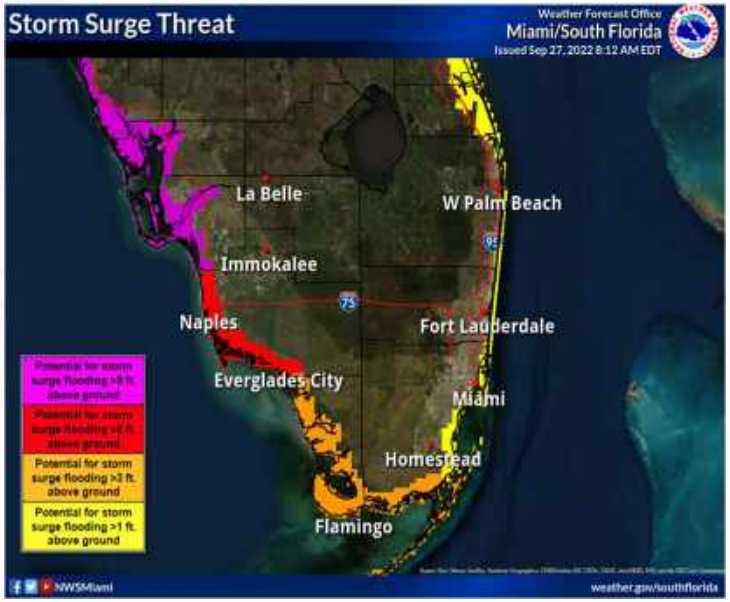
Tropical Storm/Hurricane Impacts Extend Well Outside the Cone!





Hurricane Ian – September 2022

Wind Speed Probability Graphics

Tropical Storm Force

Strong Tropical Storm Force

Hurricane Force

Depicts cumulative probability of tropical storm force (39 mph), strong tropical storm force (58 mph), or hurricane force winds (74+ mph) for a specific location over the next 5 days

Takes into account more than just the center of the storm

Tropical Storm Force Wind Speed Time of Arrival Graphics

Earliest Reasonable

Only 1 in 10 chance of tropical storm force winds arriving earlier than noted time

Best for users with low risk tolerance

Most Likely

Equal chances of tropical storm force winds arriving before or after the time listed

Preparations should be completed by this time

Hurricane Threats and Impacts

Local Threat and Impact Information

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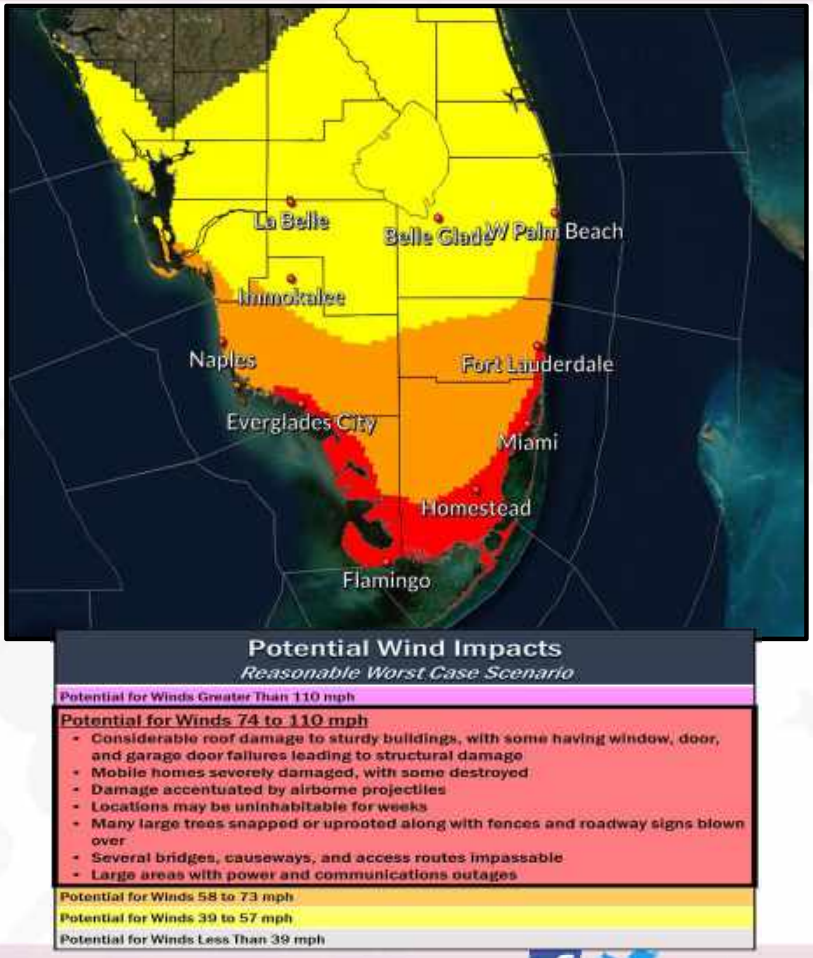

- Hurricane Threats and Impacts graphics show the potential level of impact **AND** geographical extent for each of the storm's four primary hazards, based on a ***reasonable worst case scenario***
- Provides a **whole picture of the potential threat levels for each hazard with any given storm**
- Based on a range of possible scenarios, not only the official forecast

Hurricane Threats and Impacts

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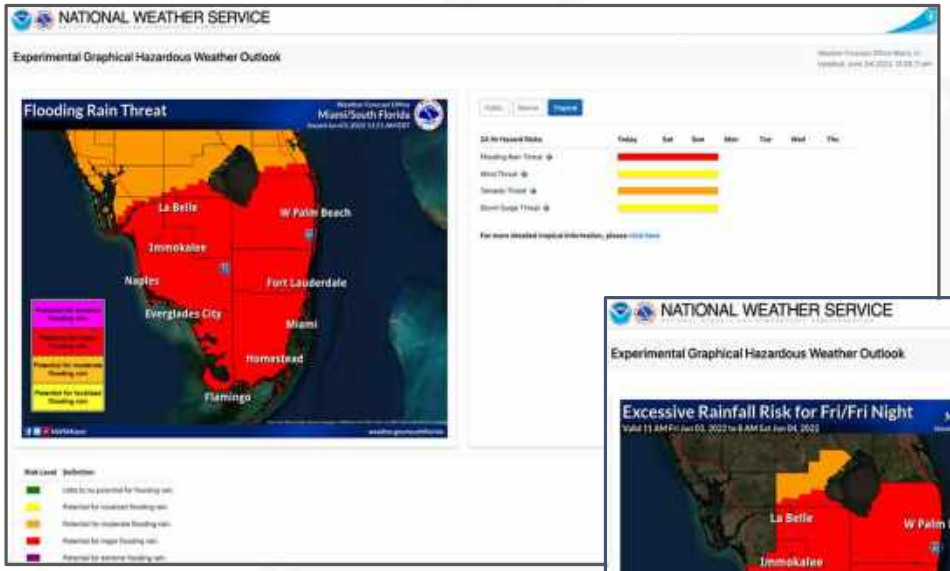

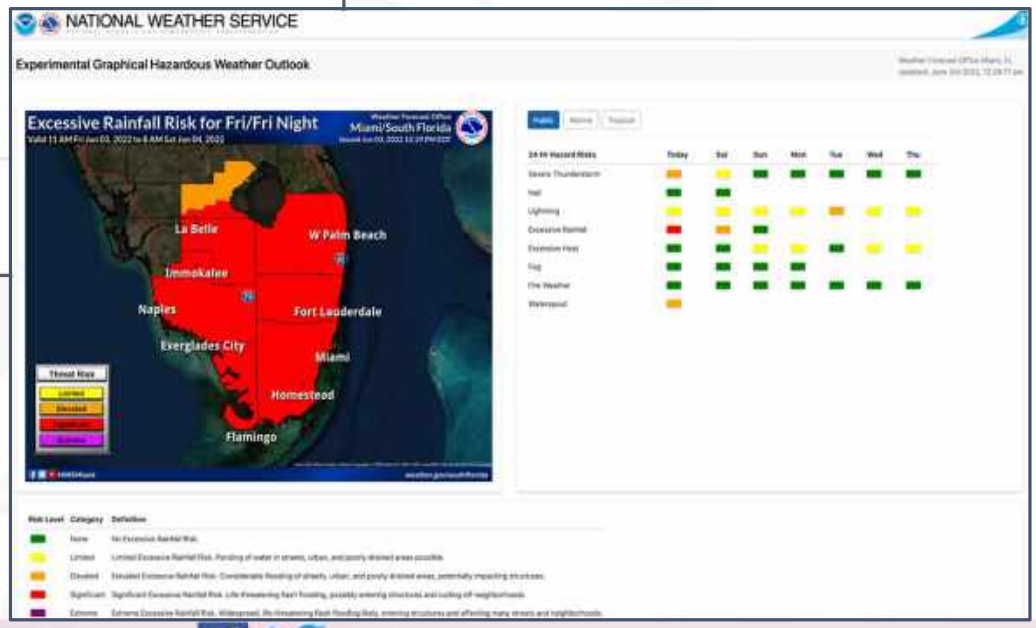

weather.gov/miami

Hurricane Threats and Impacts

Local Threat and Impact Information

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Look Beyond the Cone!!

- Shows the potential level of impact **AND** geographical extent for each of the storm's four primary hazards, based on a ***reasonable worst case scenario***
- Provides a **whole picture of the potential threat levels for each hazard with any given storm**
- Based on a range of possible scenarios, not only the official forecast
- ***What to prepare for, given a safety margin***

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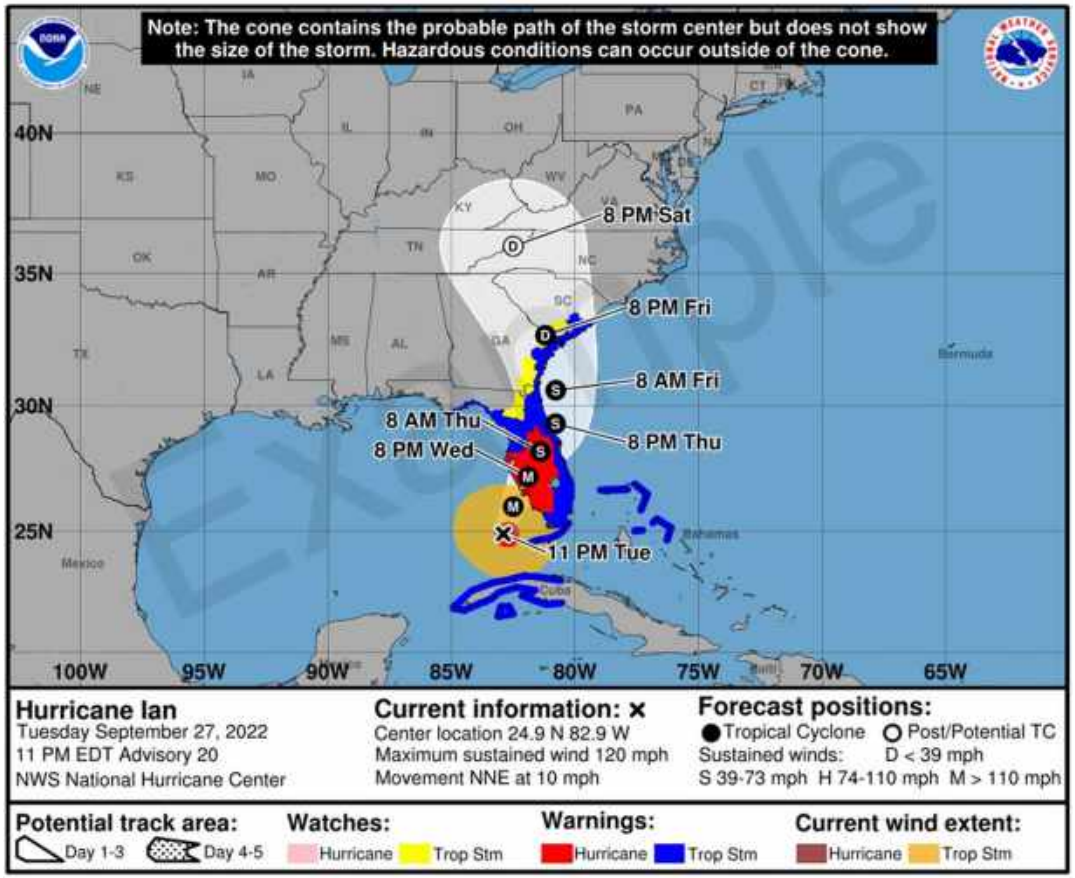
Depicting Inland Watches/Warnings on Cone



- New experimental cone graphic depicting inland U.S. tropical storm and hurricane watches and warnings will become available in 2024
- Will help convey wind hazard risk
- Graphic may not be available as soon as the current cone graphic due to the time need to compile complete inland watch and warning information
- Will be available beginning on or around August 15, 2024

Heat

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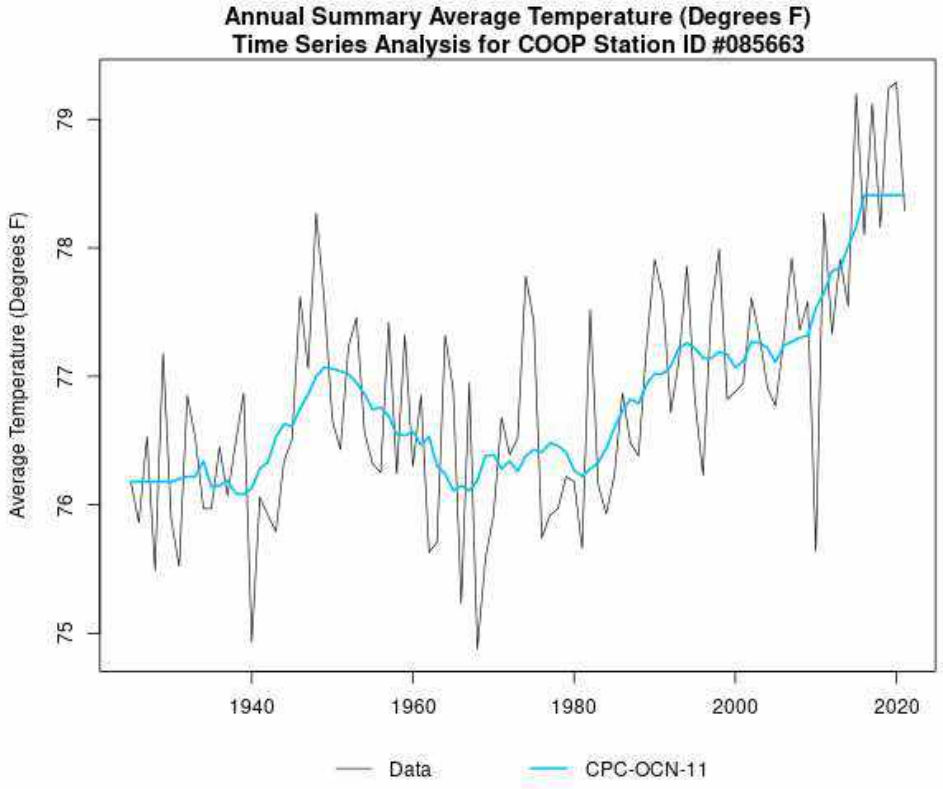

Miami is part of a general global trend of increasing temperatures (about 2F on average since 1980)

Urban Heat Island effect is a contributing factor

Heat

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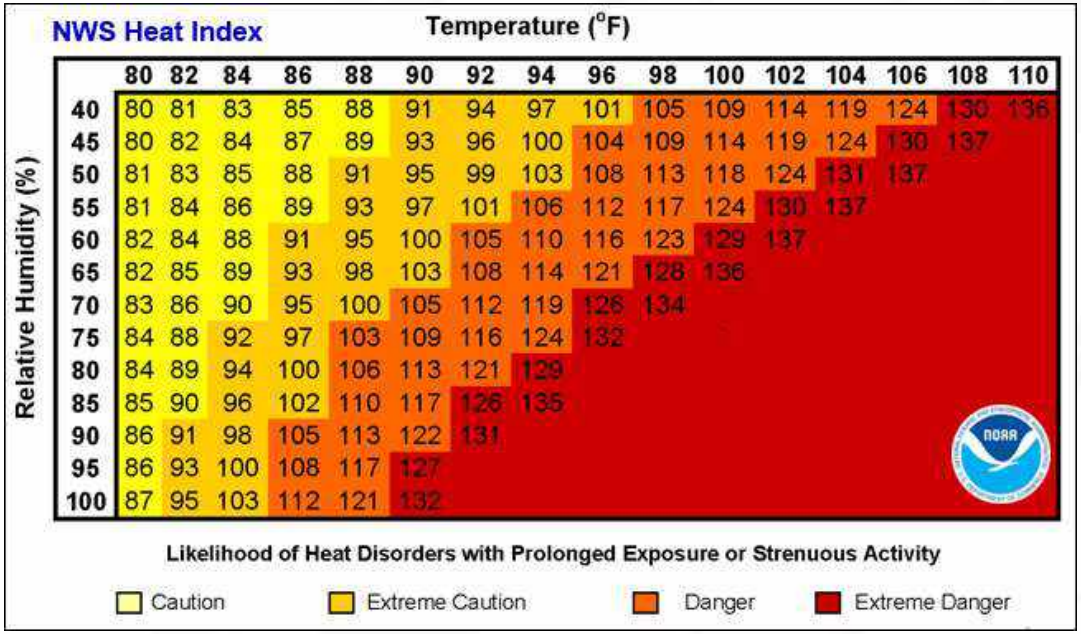

Heat is the #1 weather killer in the U.S.

Undercounted heat impacts in Miami

CDC-documented 34 heat-related deaths in Miami-Dade County 1999-2020

Heat

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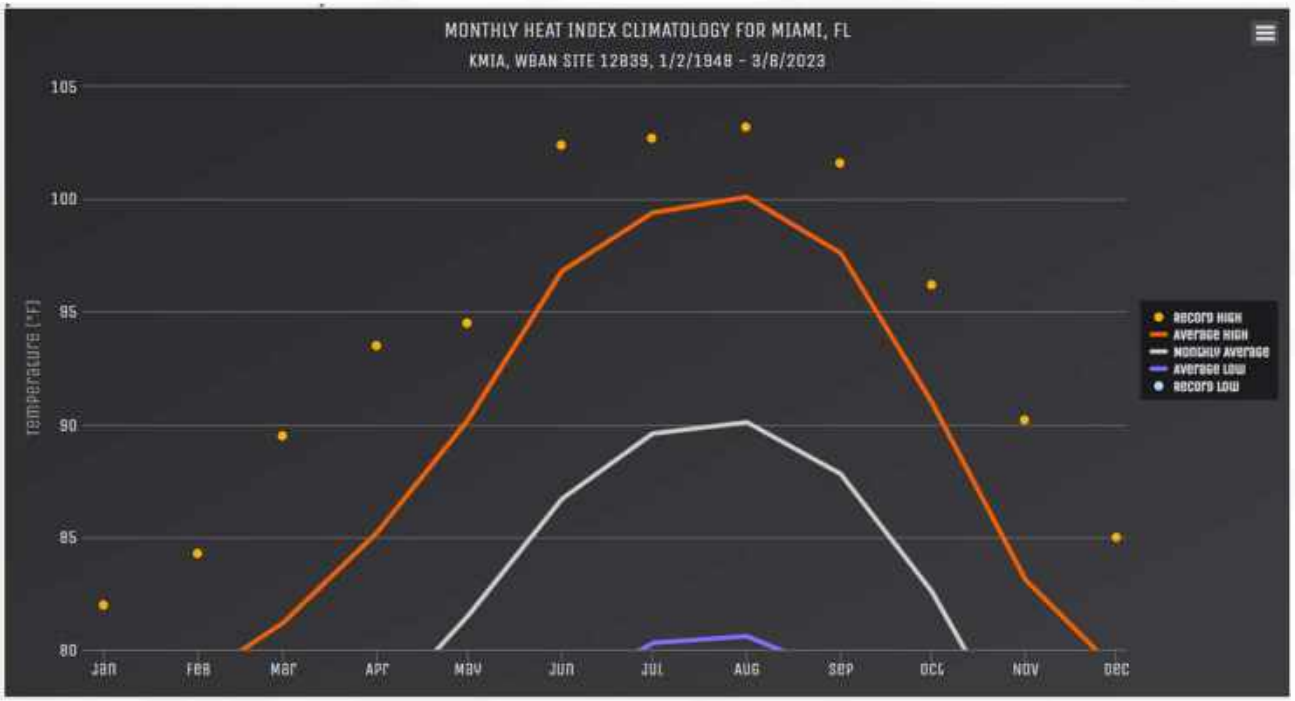


- **Average Miami heat index is at dangerous levels from May until October**
- **Urban areas have higher heat index values**
- **Vulnerable populations especially at risk**

2023: A Historically Hot Heat Season for South Florida

- 2023 was the warmest wet season (May 15 – Oct 14) on record at MIA in terms of average max temperature, 3rd warmest at APF, 6th warmest at PBI, and (not shown) 14th warmest at FLL.

Miami International Airport

Rank	Ending Date	Mean Max Temperature May 15 to Oct 14	Missing Count
1	2023-10-14	92.0	1
2	2019-10-14	90.9	0
3	2017-10-14	90.8	0
4	2009-10-14	90.7	0
5	2011-10-14	90.6	0
6	2020-10-14	90.5	0
-	1998-10-14	90.5	0
8	2022-10-14	90.3	0
-	2010-10-14	90.3	0
-	1989-10-14	90.3	0

Naples Municipal Airport

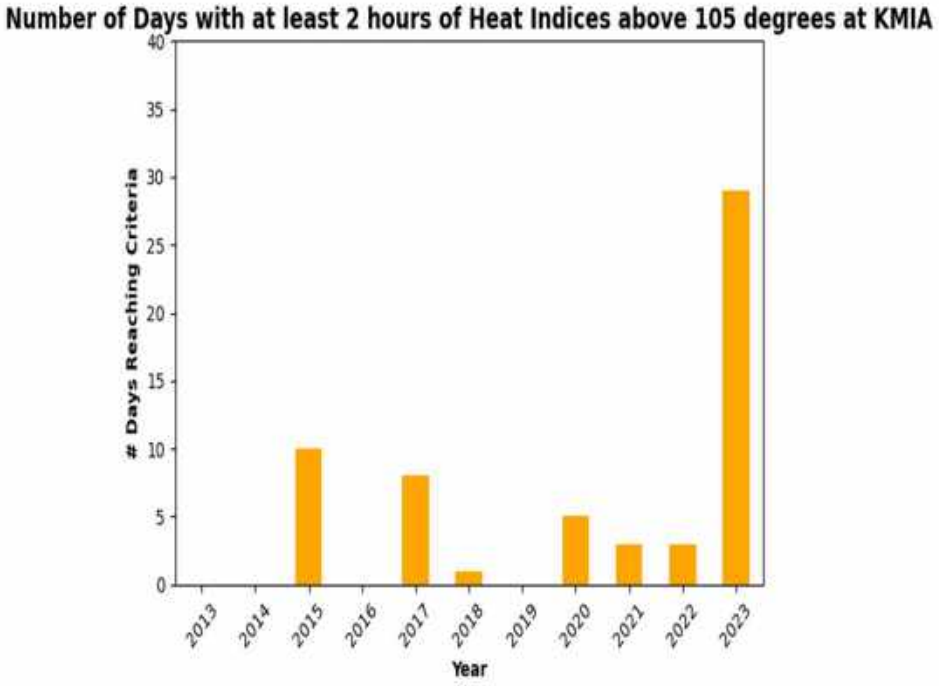
Rank	Ending Date	Mean Max Temperature May 15 to Oct 14
1	2009-10-14	92.5
-	1944-10-14	92.5
3	2023-10-14	92.4
4	2002-10-14	92.2
5	2010-10-14	92.1
-	2003-10-14	92.1
7	2004-10-14	92.0
-	1975-10-14	92.0
9	1998-10-14	91.8
10	1943-10-14	91.6

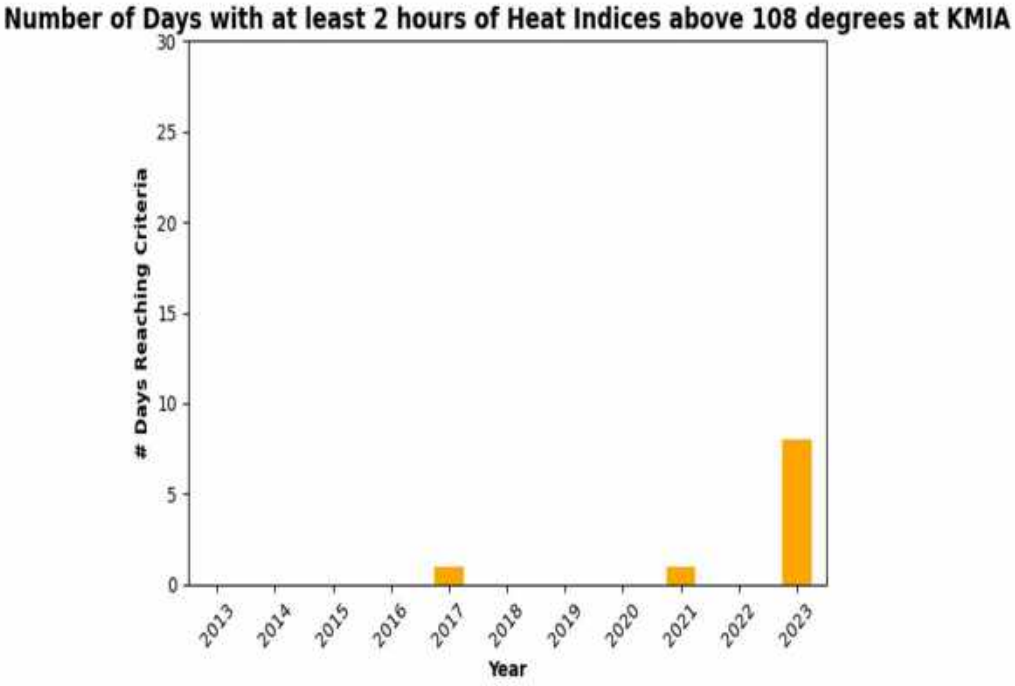
West Palm Beach International

Rank	Ending Date	Mean Max Temperature May 15 to Oct 14
1	1893-10-14	92.8
2	1895-10-14	92.3
3	2011-10-14	90.9
4	1951-10-14	90.8
5	1952-10-14	90.7
6	2023-10-14	90.6
-	1998-10-14	90.6
-	1943-10-14	90.6
9	1990-10-14	90.4
-	1981-10-14	90.4

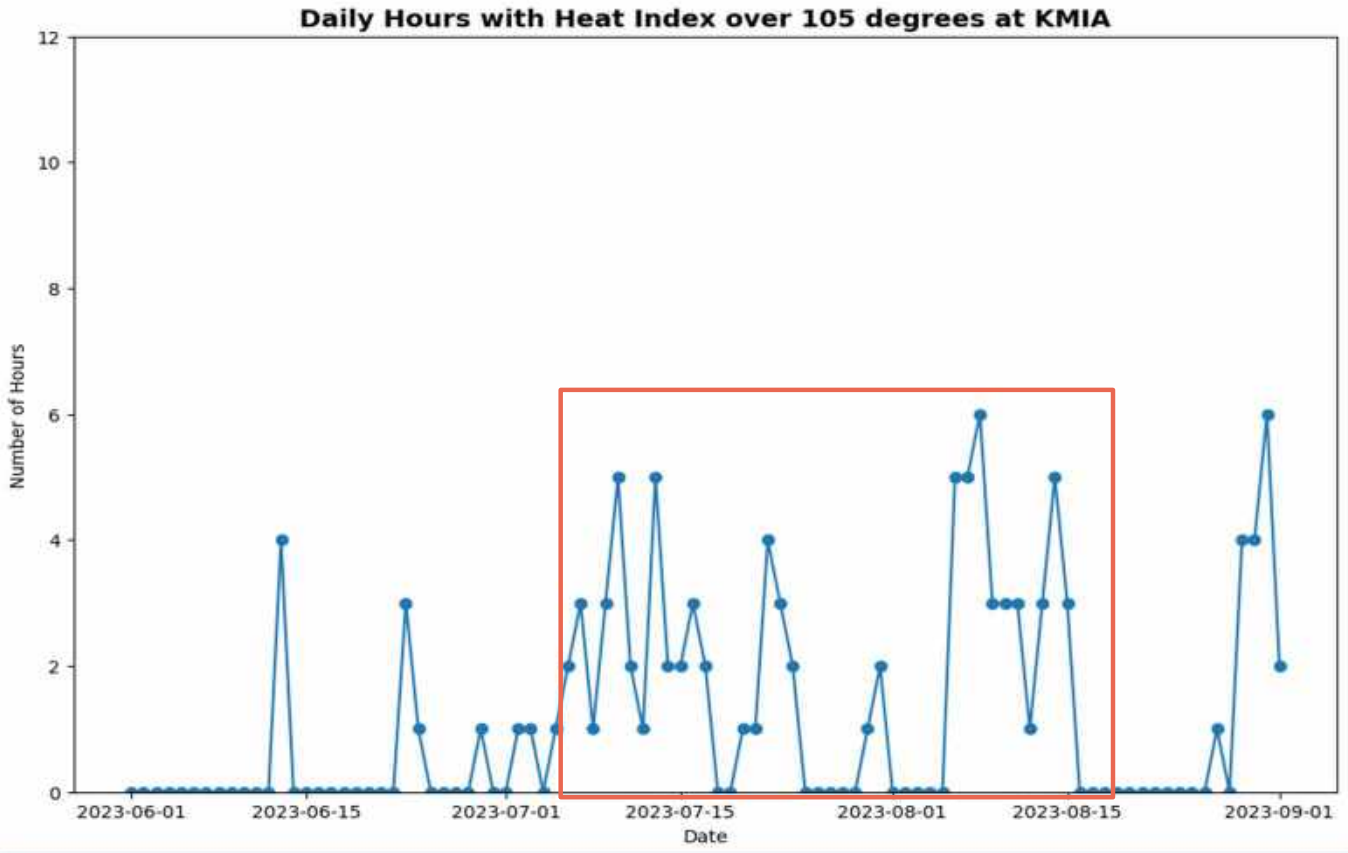
Heat Indices were even more oppressive in 2023

- As warm as the temperatures were, the max heat indices were even more impressive compared to the historical record

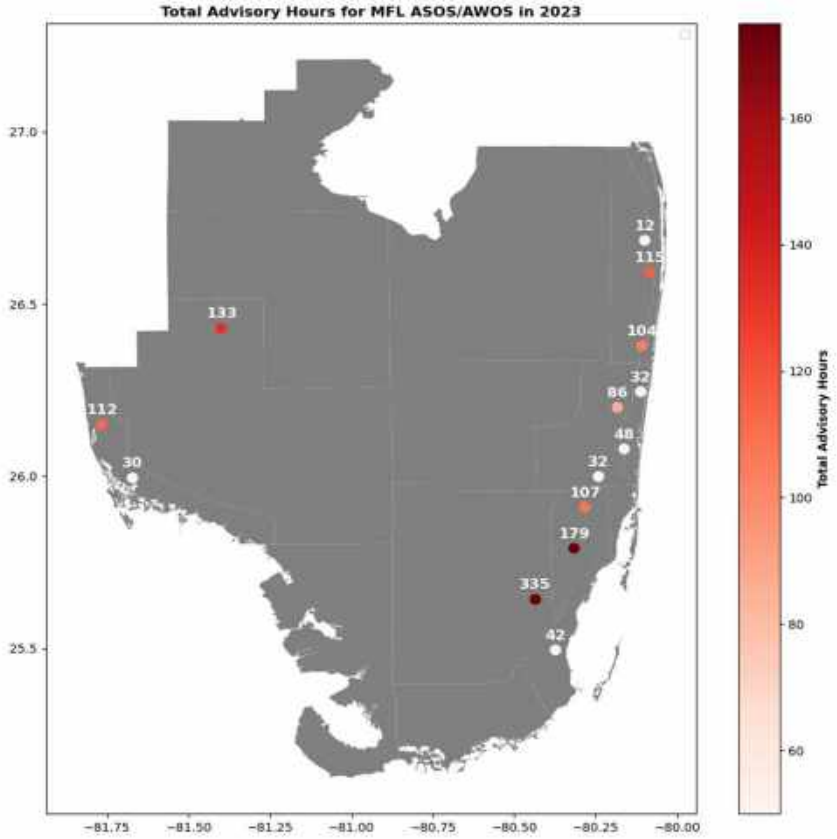


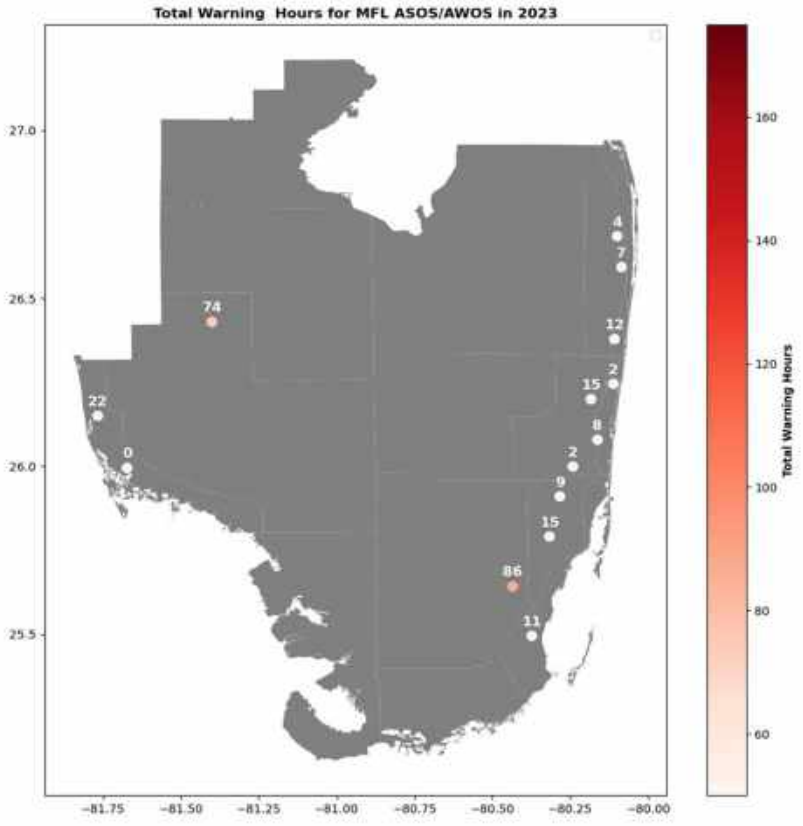


The Stretch from early July to Mid August was Particularly Oppressive



Many NWS airport sites had over 100 hours of heat indices above advisory thresholds this summer!

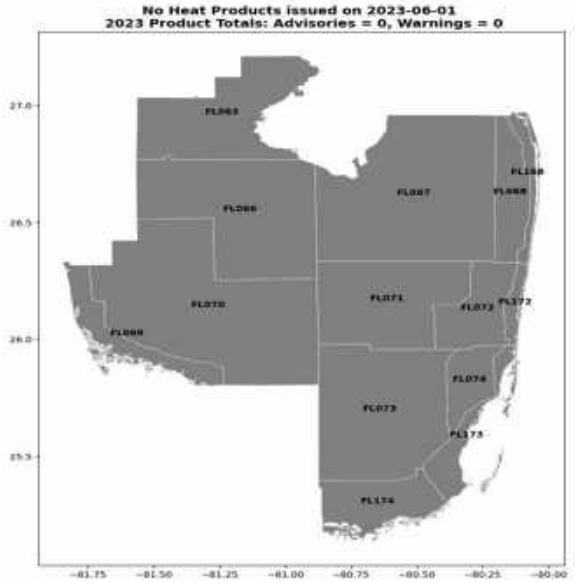


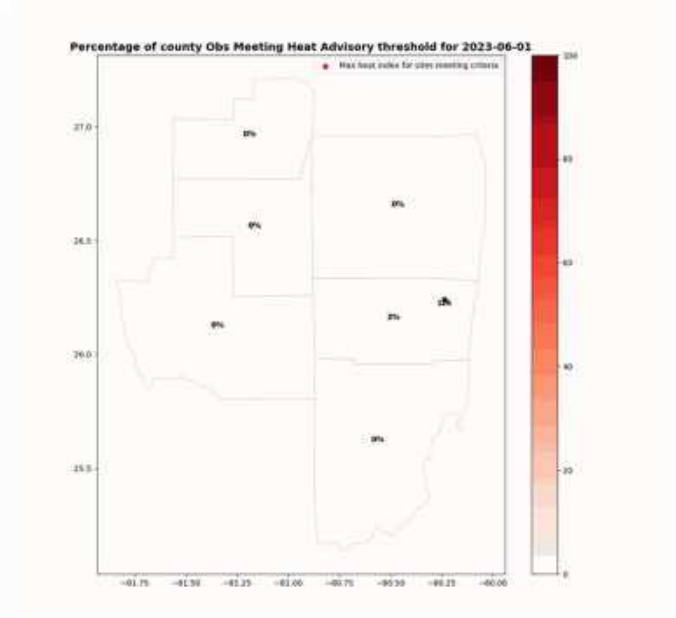


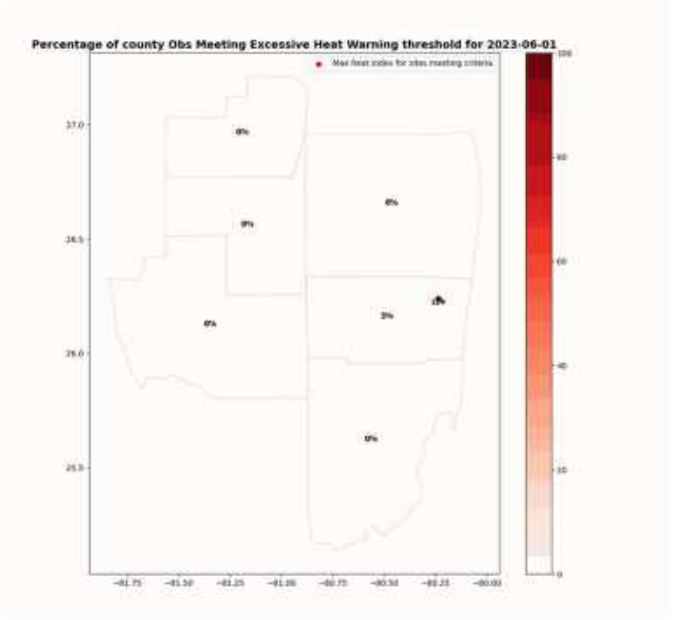
The Record-Setting Heat Resulted in an Unprecedented Amount of Heat Products Issued

- 43 days with heat advisories issued over at least part of South Florida (historical average 2-4 days) *.
- 7 days with excessive heat warnings (which had prior to 2023 never been issued for South Florida)*

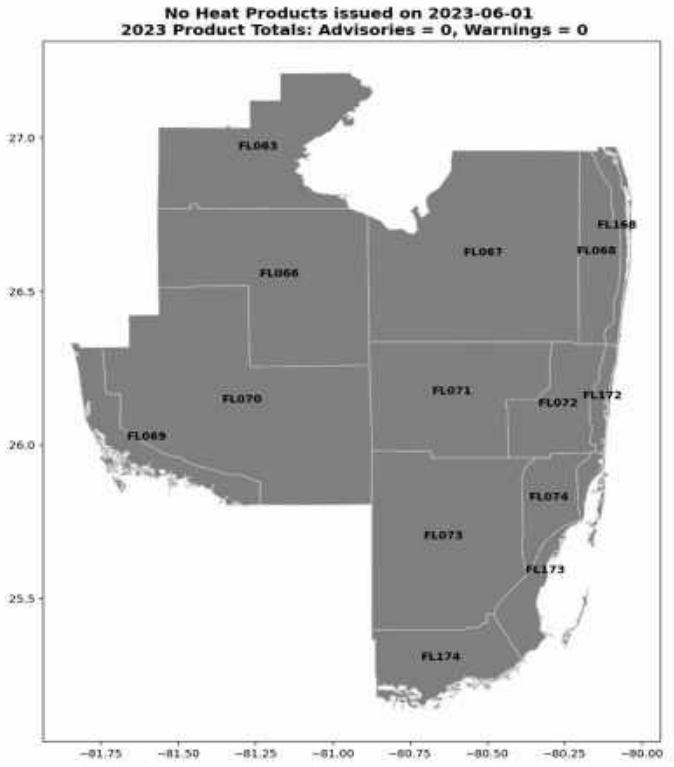
** Miami Dade County lowered their heat products ApparentT criteria 3 degrees for this warm season*







Despite the reduced criteria for Miami-Dade, the number of heat products issued by county was not overly skewed towards Miami-Dade



County	Days with Advisory	Days with Warning
Miami-Dade	37	7
Broward	38	5
Palm Beach	39	3
Glades	33	3
Hendry	33	3
Collier	35	4

Verification of 2023 Heat Advisories

County/# of observation sites	Percent of sites reaching criteria
Miami-Dade (23 sites)	54.4
Broward (33 sites)	34.8
Palm Beach (30 sites)	38.7
Collier (16 sites)	43.7

Miami-Dade County: Maximum daily value 96% (July 22, August 7, August 31). Minimum daily value 0% (July 26 and October 14)

Verification of 2023 Excessive Heat Warnings

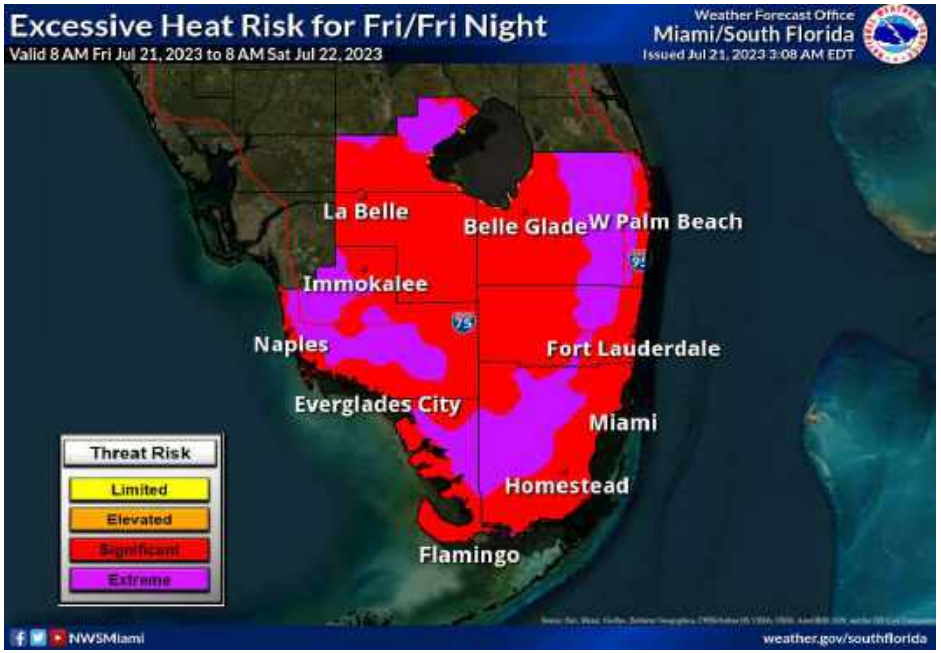
County/# of observation sites	Percent of sites reaching criteria
Miami-Dade (23 sites)	39.7
Broward (33 sites)	31.4
Palm Beach (30 sites)	43
Collier (16 sites)	28.3

Miami-Dade County: Maximum daily value 74% (August 9).
Minimum daily value 3% (August 8)

Forecast Tools and Other Heat Data

- Daily Graphical Hazardous Weather Outlooks
- Wet Bulb Globe Temperature (WBGT)

Graphical Hazardous Weather Outlooks



- Updated several times a day (at least twice)
- Provides a 7-day outlook of heat risk levels
- More localized (county level) maps can be provided as part of special partner briefings
- Regardless of advisory/warning thresholds, Hazardous Weather Outlook risk categories can play a role in **supporting community decisions/actions**, especially on sub-advisory days

https://www.weather.gov/erh/ghwo?wfo=mfl

In Public tab, look for Excessive Heat. Available April through October

Risk Level	Category	Definition
	None	No Excessive Heat Risk.
	Limited	Limited Excessive Heat Risk. Heat index 98-102 degrees. Heat exhaustion possible with prolonged exposure.
	Elevated	Elevated Excessive Heat Risk. Heat index 103-107 degrees. Heat exhaustion likely with prolonged exposure.
	Significant	Significant Excessive Heat Risk. Heat index 108-112 degrees. Dangerous and potentially deadly heat stroke likely with prolonged exposure.
	Extreme	Extreme Excessive Heat Risk. Heat index 113 degrees or higher. Dangerous and potentially deadly heat stroke likely with limited exposure.

Higher WBGT risk categories occur considerably more frequently than the associated heat index-based heat risk categories. This is logical given that WBGT is primarily designed to assess the heat risk in direct sunlight while performing physical labor, while heat index is a shaded measurement.

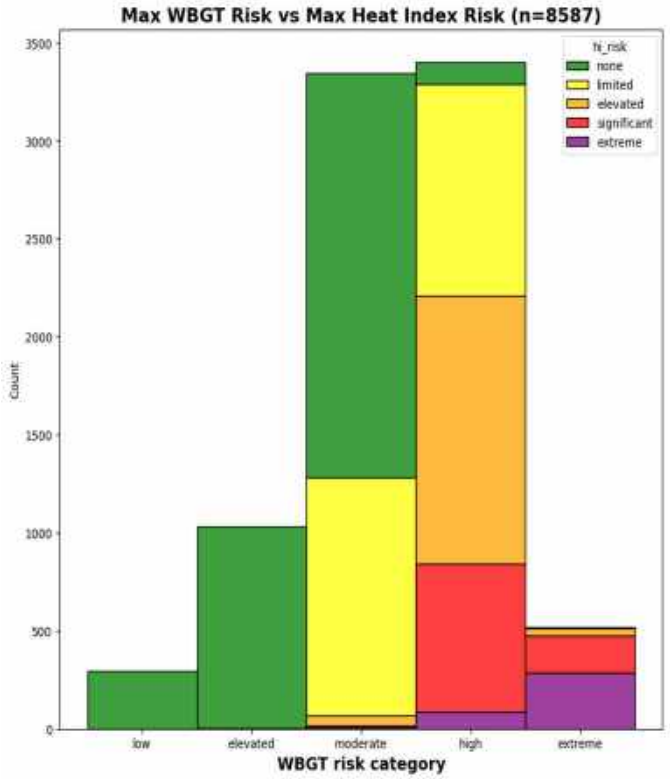


Figure 6: Stacked histogram showing frequency of NWS Southern Region heat index-based categories within WBGT Region 3 Risk Categories.

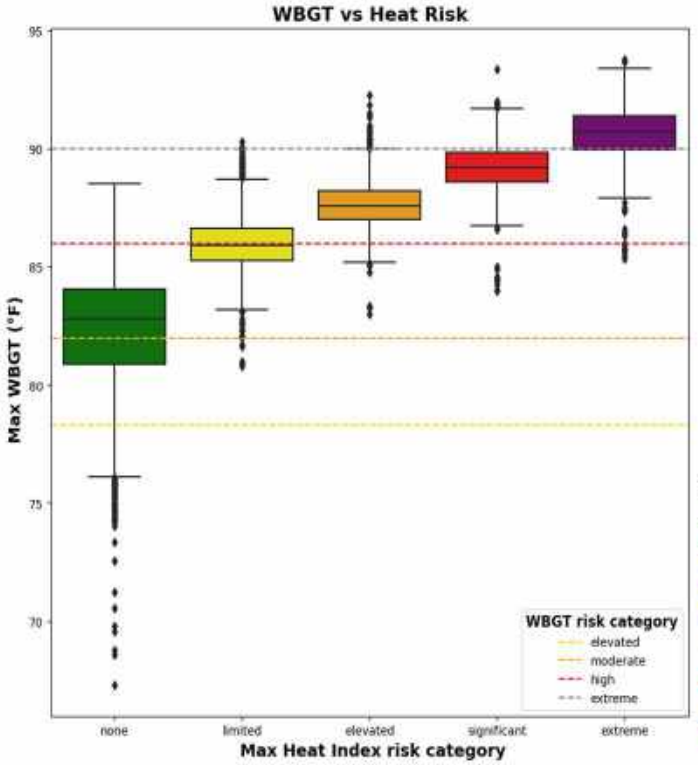


Figure 7: Distribution of daily max WBGT values within each NWS Southern Region heat index risk category

WBGT Risk Categories

WBGT by Region (°F)			Threat Level WBGT at these values increasing heat stress.
Region 1	Region 2	Region 3	
< 72.3	< 75.9	< 78.3	Low Threat
72.3 - 76.1	75.9 - 78.7	78.3 - 82.0	Elevated Threat
76.2 - 80.1	78.8 - 83.7	82.1 - 86.0	Moderate Threat
80.1 - 84.0	83.8 - 87.6	86.1 - 90.0	High Threat
>84.0	>87.6	>90.0	Extreme Threat

Heat Index Risk Categories

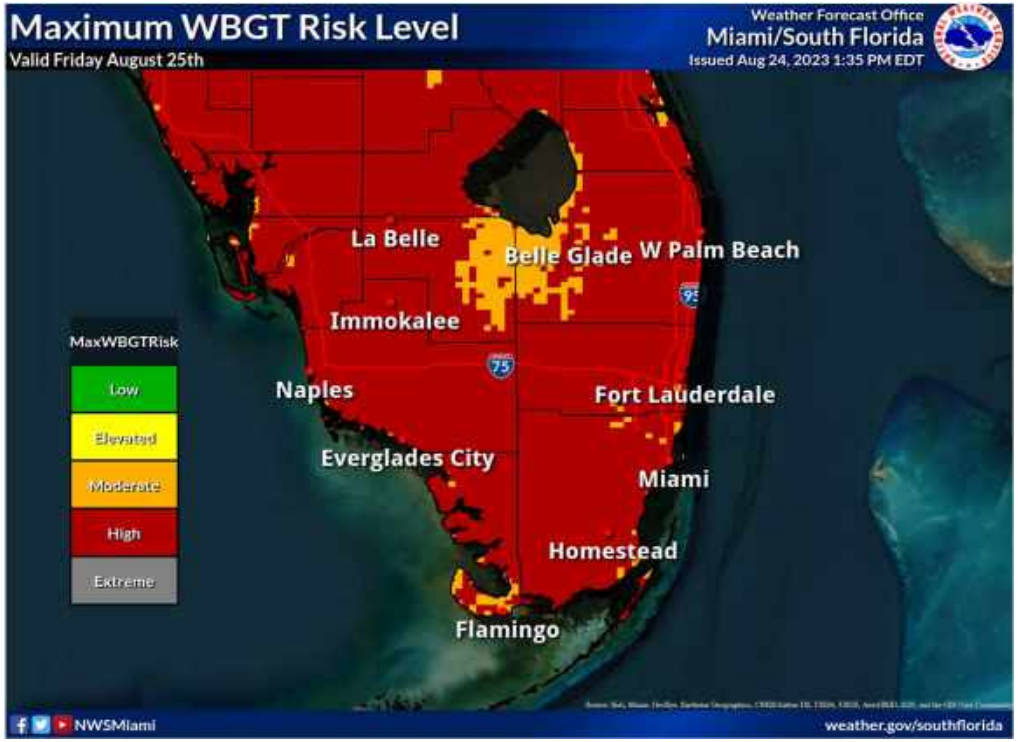
Risk Level	Category	Definition
	None	No Excessive Heat Risk.
	Limited	Limited Excessive Heat Risk. Heat index 98-102 degrees. Heat exhaustion possible with prolonged exposure.
	Elevated	Elevated Excessive Heat Risk. Heat index 103-107 degrees. Heat exhaustion likely with prolonged exposure.
	Significant	Significant Excessive Heat Risk. Heat index 108-112 degrees. Dangerous and potentially deadly heat stroke likely with prolonged exposure.
	Extreme	Extreme Excessive Heat Risk. Heat index 113 degrees or higher. Dangerous and potentially deadly heat stroke likely with limited exposure.

Table1: WBGT (Top) and Heat Index (Bottom) Risk Category definitions for NWS Miami Forecast Area

Future work will involve: the verification of hourly WBGT temperatures, developing new and creative ways to message WBGT based hazards to the core partners and the public, and employing statistical techniques to improve forecasts

Hourly Table

Day of week:	Friday 8/25							Saturday 8/26								
Time:	5PM	6PM	7PM	8PM	9PM	10PM	11PM	12AM	1AM	2AM	3AM	4AM	5AM	6AM	7AM	8AM
Weather:																
Temperature (°F):	92	89	88	86	83	82	82	81	80	79	79	78	78	77	77	79
Heat Index, °F:	100	96	95	93	89	88	88	86	84	79	79	78	78	77	77	79
Wet Bulb Globe T (°F):	83	82	81	82	81	81	81	81	80	79	79	79	79	78	78	79
Wind Speed (mph):	12	10	10	8	7	7	6	6	6	6	6	6	5	5	5	6
Wind Gust (mph):	17	16	14	12	10	10	9	9	8	9	8	7	7	7	7	7
Wind Direction (°):	50	60	60	50	40	30	20	10	0	0	350	350	340	340	340	340
Wind Direction:																
Prob. of Precip. (%):	8	6	5	3	2	1	1	2	2	1	1	1	1	1	2	2
Prob. of Thunder (%):	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Precip. Amount (in.):		0.00				0.00						0.00				
Snow (in.):		0.0				0.0						0.0				
Ice (in.):		0.00				0.00						0.00				
Dew Point (°F):	72	72	72	73	73	74	74	74	74	74	73	73	73	73	73	74
RH (%):	52	57	59	65	72	77	77	79	82	85	82	85	85	87	87	85
Sky Cover (%):	15	11	13	13	9	11	10	9	13	17	15	15	17	21	23	23



Potential methods for displaying and messaging WBGT data; NWS IDSS Points Forecast Page (top), and NWS Miami WBGT Maximum Daily Risk graphic (bottom).

Comments/Questions?

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