

# **UNIT TWO**

*There is a Storm. What's the info?*

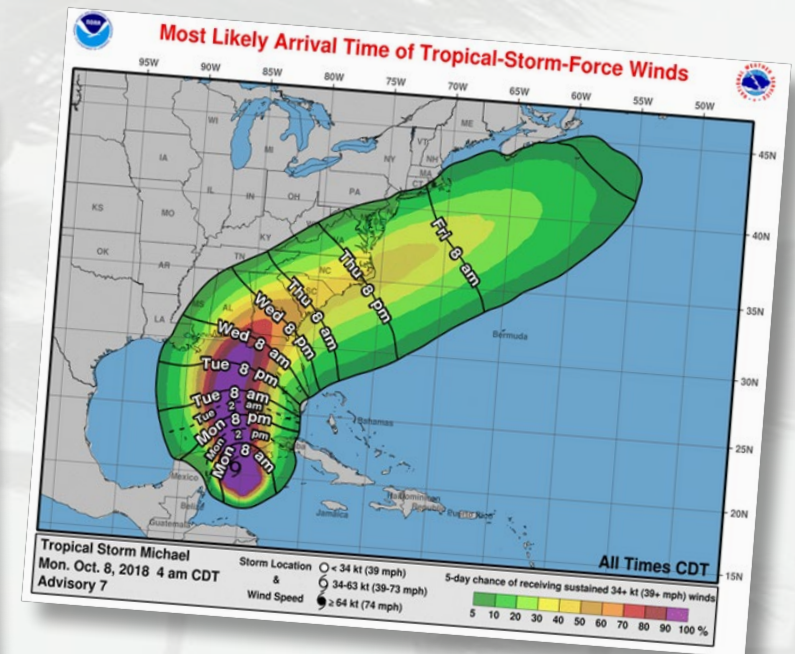
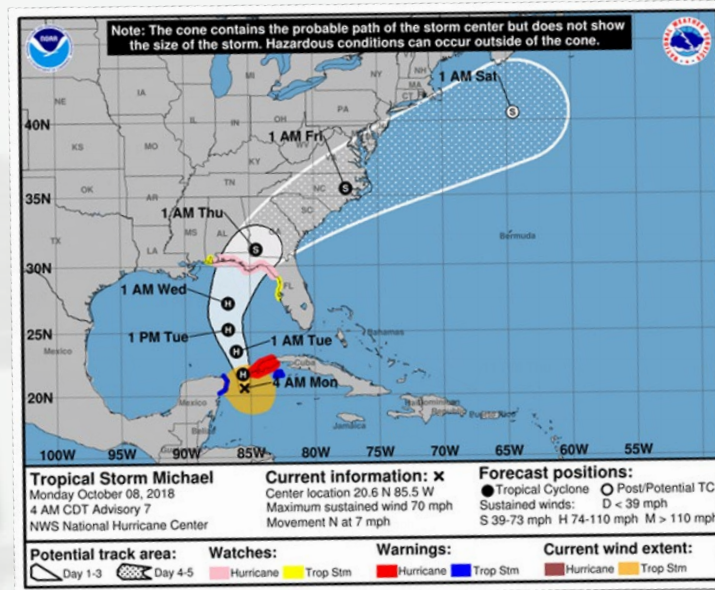
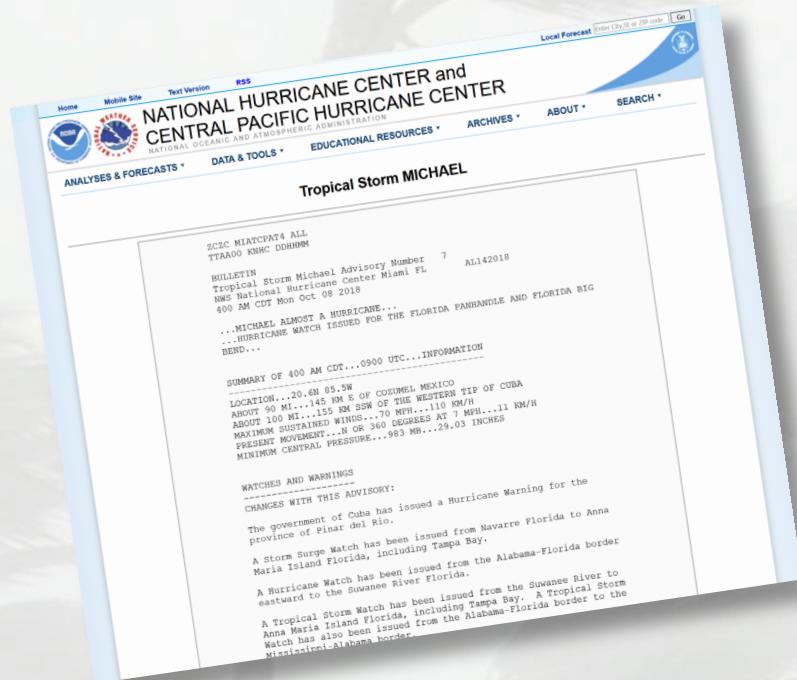
# NATIONAL WEATHER SERVICE

## *Tropical Cyclone Products*



## TROPICAL CYCLONES

NHC provides the 'big picture' that complements and guides local NWS forecast office products

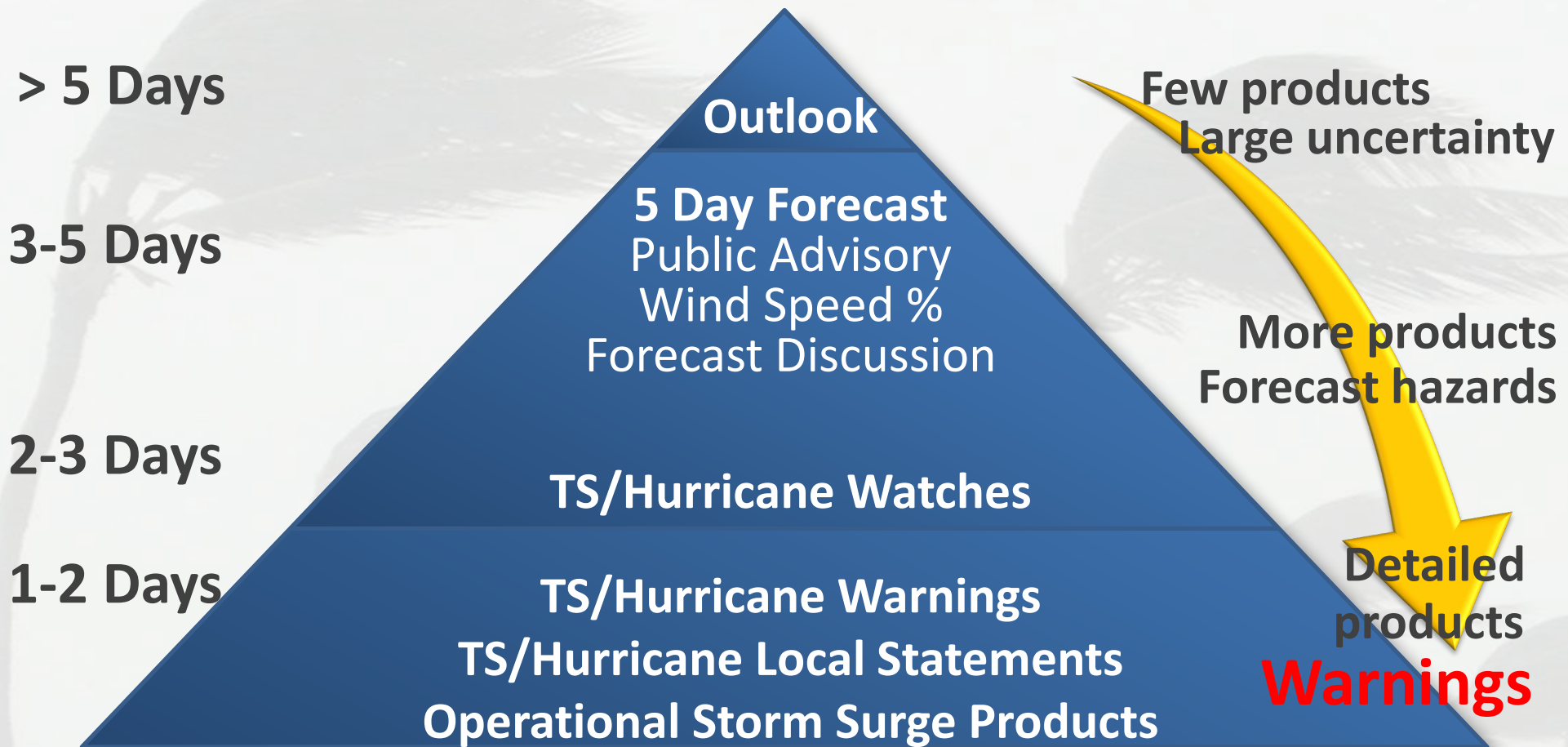


# NATIONAL WEATHER SERVICE

## *Tropical Cyclone Products*



FEMA





## **FAQs**

- What's going on in the tropics?
- Any potential for development?
- Should we be concerned?

- **Tropical Outlook**

## OUTLOOK SCHEDULE

- Issued May 15 through November 30
- *A Special Tropical Outlook* can be issued at anytime for significant or unexpected changes

- 2 am – **Tropical Outlook**
- 8 am – **Tropical Outlook**
- 2 pm – **Tropical Outlook**
- 8 pm – **Tropical Outlook**

**TIMES IN EDT**

# TROPICAL OUTLOOK

## *Assessment of Tropical Activity*



TROPICAL WEATHER OUTLOOK  
NWS NATIONAL HURRICANE CENTER MIAMI FL  
800 PM EDT MON OCT 20 2014

For the North Atlantic...Caribbean Sea and the Gulf of Mexico:

Bay of Campeche:

Showers and thunderstorms associated with an area of low pressure located over the southwestern Bay of Campeche have changed little in organization since this afternoon. This system has the potential to become a tropical cyclone during the next couple of days while it moves slowly eastward across the southern Bay of Campeche. Later in the week, the low is forecast to interact and possibly merge with a frontal system over the southeastern Gulf of Mexico or northwestern Caribbean Sea. An Air Force Reserve reconnaissance aircraft is scheduled to investigate the disturbance tomorrow afternoon, if necessary. Interests in the Yucatan Peninsula should monitor the progress of this system.

- \* Formation chance through 48 hours...medium...50 percent.
- Formation chance through 5 days...medium...60 percent.

Forecaster Brown

Potential for development?  
Headed where?

# TROPICAL OUTLOOK

## *Assessment of Tropical Activity*



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### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

#### TROPICAL WEATHER OUTLOOK

NWS NATIONAL HURRICANE CENTER MIAMI FL

800 PM EDT MON OCT 20 2014

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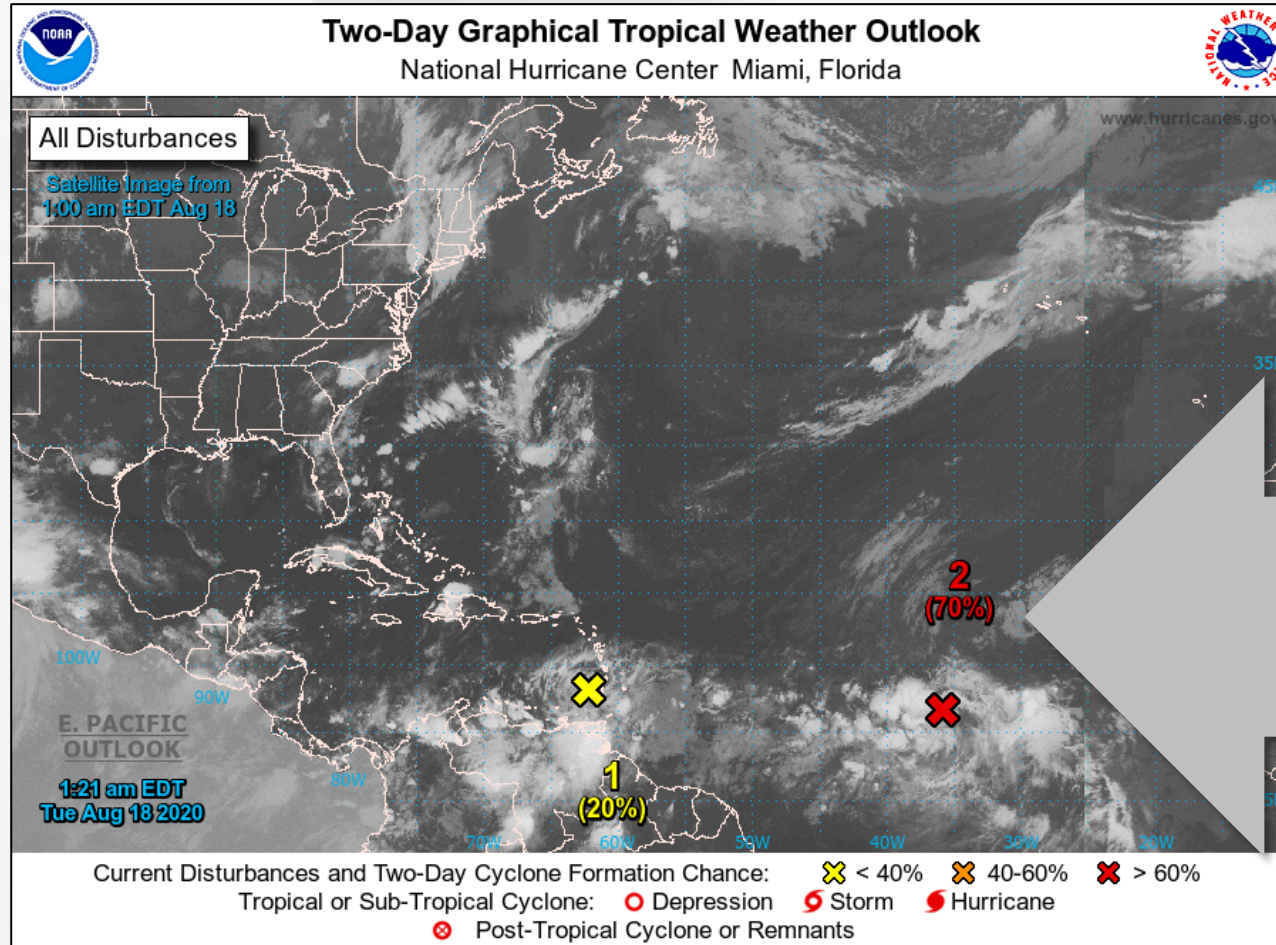
Forecaster Brown

Sending a plane?



# TROPICAL OUTLOOK

## 2-Day Formation Potential



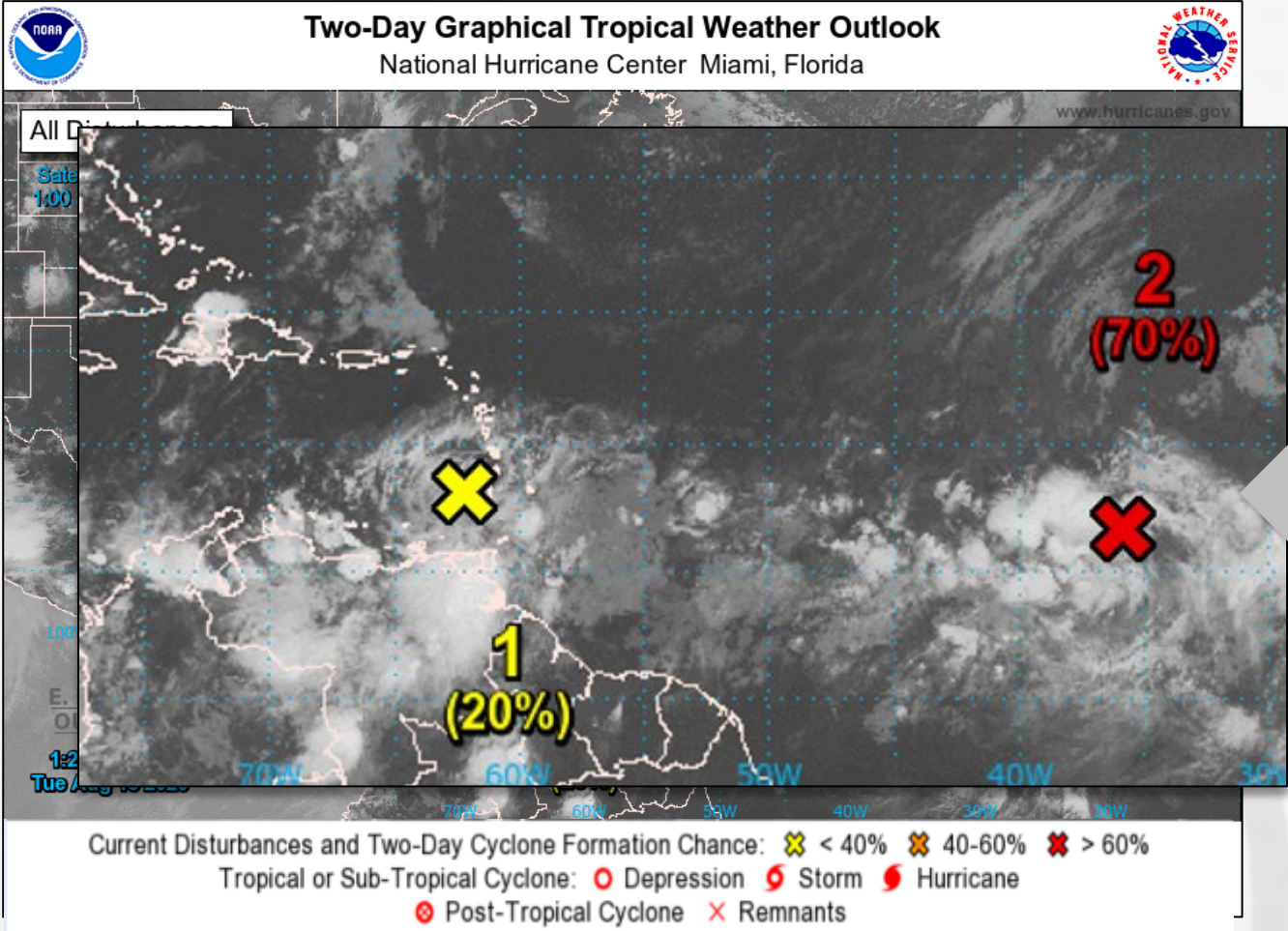
- Current location of disturbances
- Formation chance during the next 48 hrs

- **CATEGORICAL**  
(Low, Medium, and High)
- **PROBABILITIES**



# TROPICAL OUTLOOK

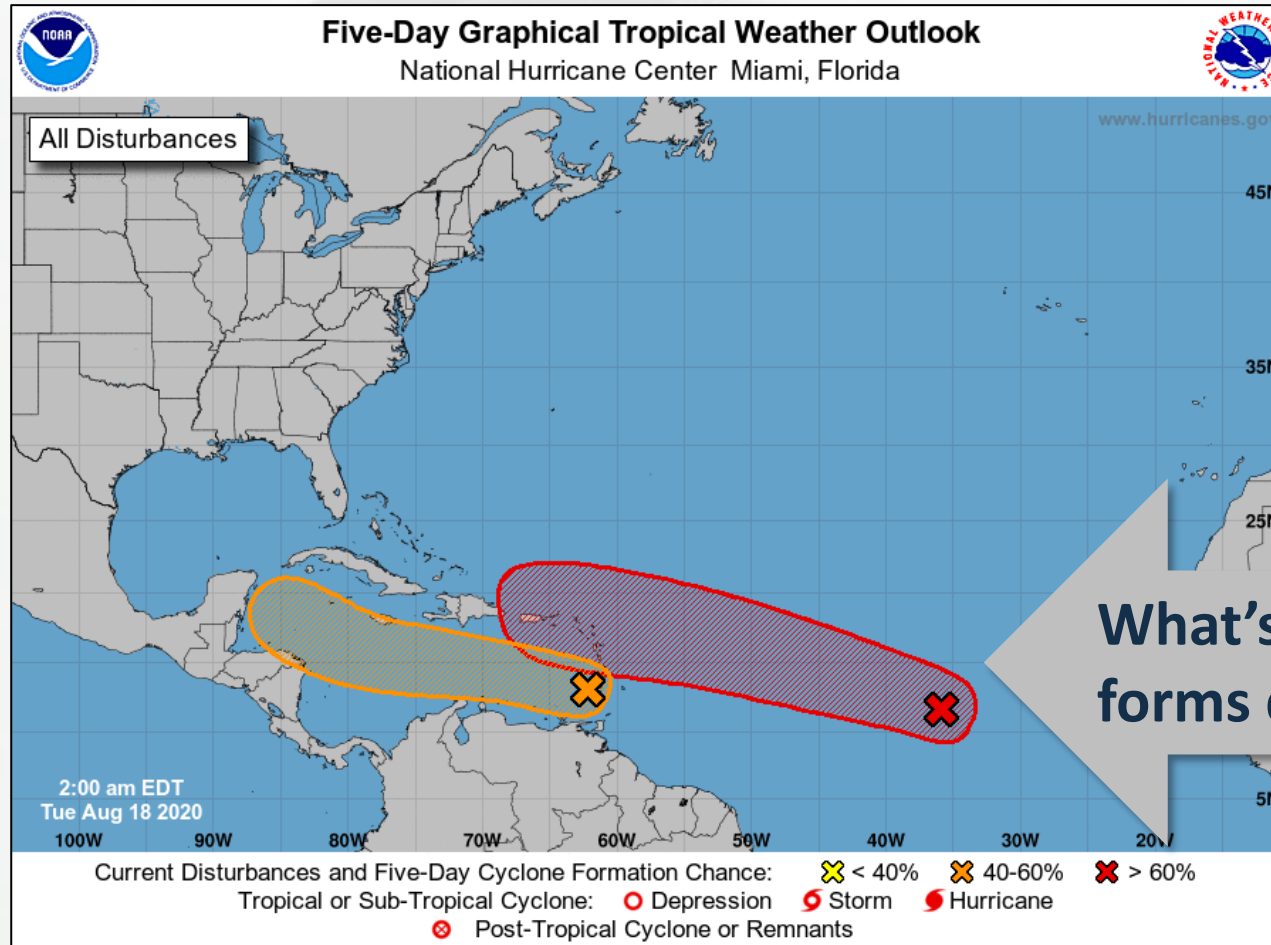
## 2-Day Formation Potential



Should we be concerned?

# TROPICAL OUTLOOK

## 5-Day Formation Potential

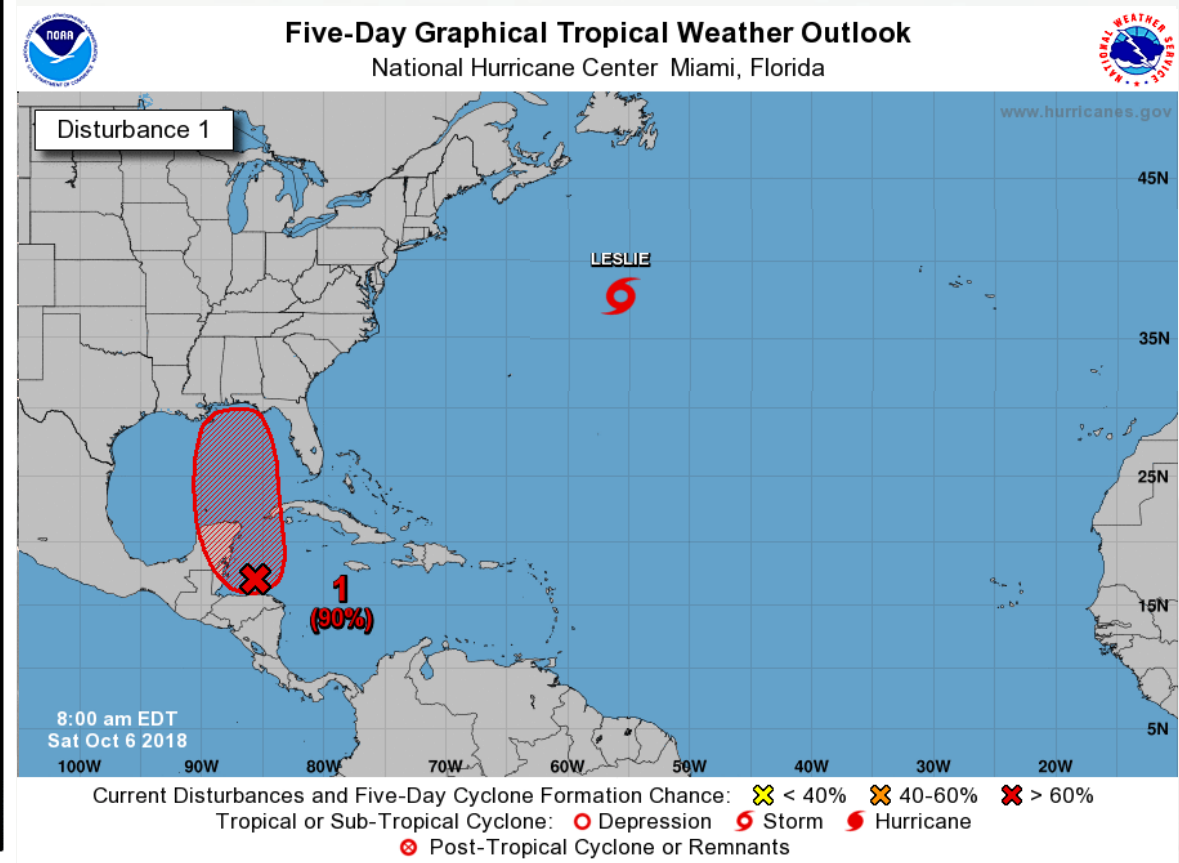
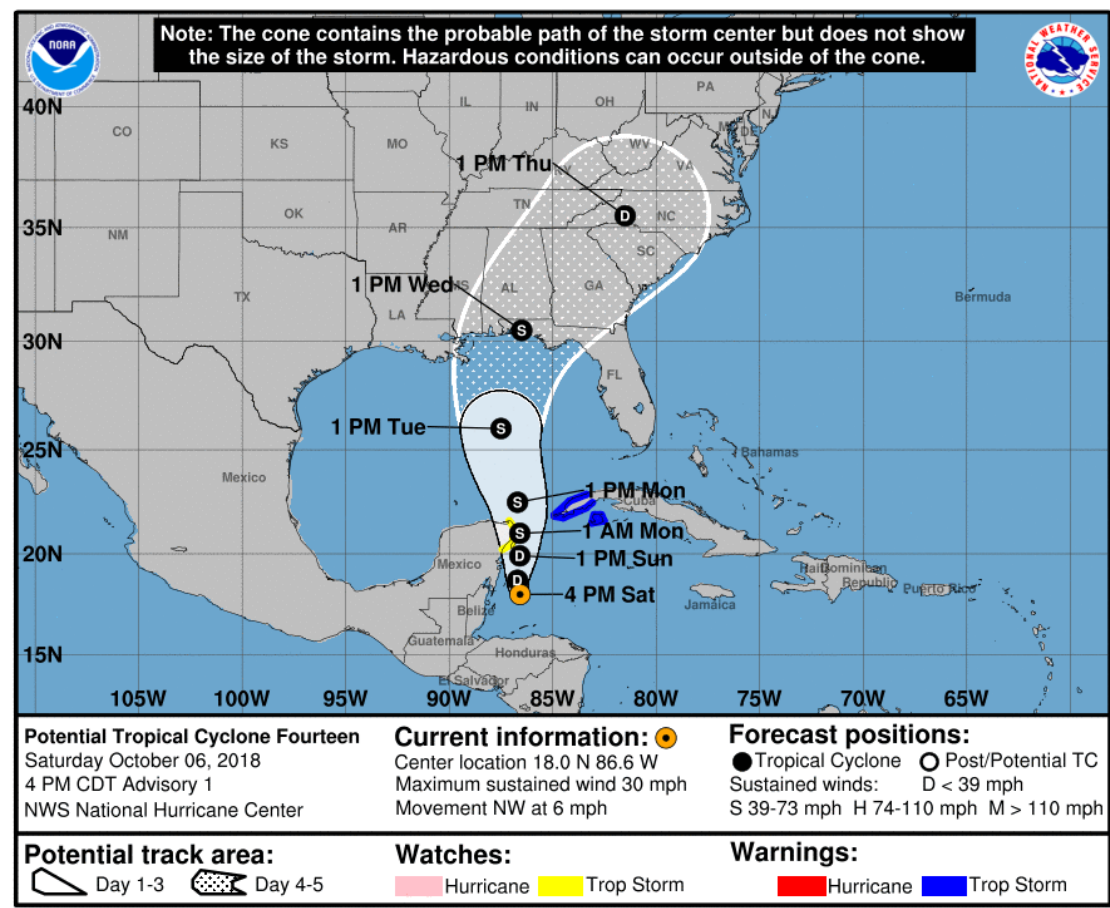


- Initial location of disturbance (x) indicated
- Formation potential during the next 5 days
  - Shading represents formation area

What's the chance this area forms during the next 5 days?

# TROPICAL OUTLOOK

## 5-Day Formation Potential





# SPECIAL TROPICAL OUTLOOK

## *Significant or Unexpected Changes*



SPECIAL TROPICAL WEATHER OUTLOOK  
NWS NATIONAL HURRICANE CENTER MIAMI FL  
430 PM EDT MON JUN 30 2014

Special outlook issued to update discussion of the area of low pressure east of Florida.

Updated: An Air Force Reserve unit reconnaissance aircraft is investigating the area of low pressure centered about 110 miles east of Melbourne, Florida. While the low is well defined, the associated thunderstorm activity is just below the organizational threshold required to initiate tropical cyclone advisories. Environmental conditions continue to be favorable for development, and only a slight increase in the organization and persistence of the thunderstorm activity would result in the formation of a tropical depression.

Data from the reconnaissance aircraft indicate that peak sustained winds with the low are about 30-35 mph. The low is moving southwestward at around 5 mph, but is expected to turn westward tonight and northward by Wednesday when it will be near the east coast of Florida. If this system becomes a tropical cyclone, a tropical storm watch could be required for portions of the central or northern Atlantic coast of Florida. A turn toward the northeast near the southeastern U.S. coast is expected by Thursday.

\* Formation chance through 48 hours...high...80 percent.

\* Formation chance through 5 days...high...80 percent.

Why is it being issued?



# SPECIAL TROPICAL OUTLOOK

## *Significant or Unexpected Changes*



FEMA



### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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What did the aircraft find?

# SPECIAL TROPICAL OUTLOOK

## *Significant or Unexpected Changes*



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### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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← Watches possible?



## NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION



### Tropical Storm Michael

**...MICHAEL ALMOST A HURRICANE... ...HURRICANE WATCH ISSUED FOR THE FLORIDA PANHANDLE AND FLORIDA BIG BEND...**

**4:00 AM CDT Mon Oct 8**

Location: 20.6°N 85.5°W  
Moving: N at 7 mph  
Min pressure: 983 mb  
Max sustained: 70 mph

**Public  
Advisory  
#7**

400 AM CDT

**Aviso  
Publico  
#7**

400 AM CDT

**Forecast  
Advisory  
#7**

0900 UTC

**Forecast  
Discussion  
#7**

400 AM CDT

**Wind Speed  
Probabilities  
#7**

0900 UTC

**NWS Local  
Products  
613 AM CDT**

**US Watch/  
Warning  
452 AM CDT**



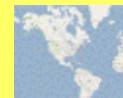
Wind Speed  
Probabilities



Arrival Time  
of Winds



Wind  
History



Warnings/Cone  
Interactive Map



Warnings/Cone  
Static Images



Warnings and  
Surface Wind



Key  
Messages



Storm Surge  
Inundation



Storm Surge  
Watch/Warning



U.S. Rainfall  
Potential



Flash Flood  
Potential

# NATIONAL HURRICANE CENTER

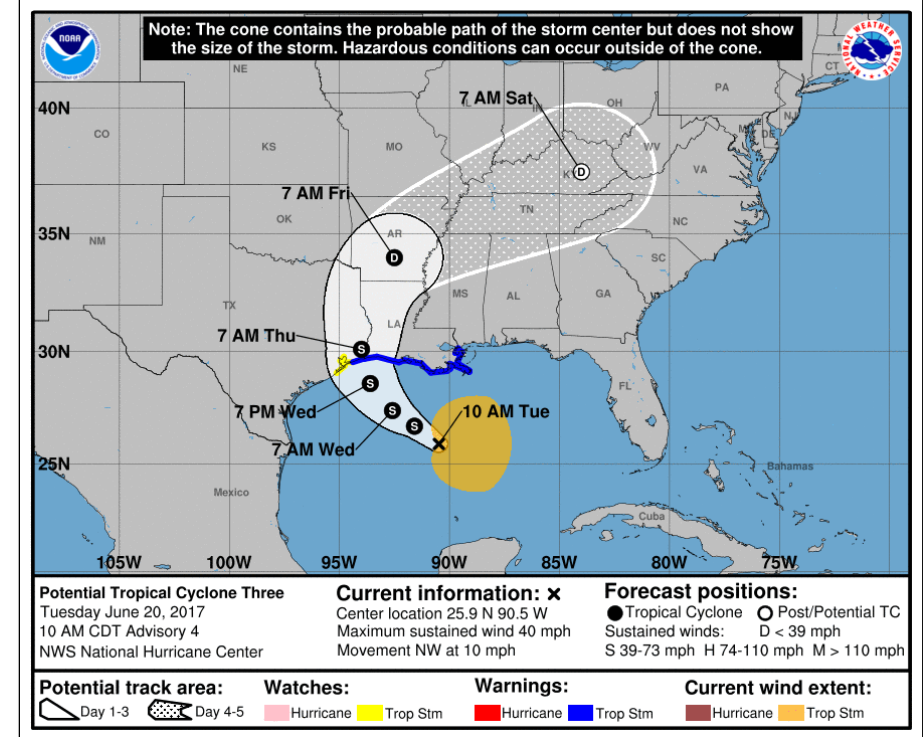
## *Potential, Post-, Tropical Cyclones*



## NHC ADVISORIES

- **Tropical Cyclones**
  - Tropical Depressions
  - Tropical Storms
  - Hurricanes
- **Post-Tropical Cyclones**
  - Remains a threat to land (e.g., Sandy & Hermine)
- **Potential Tropical Cyclones**
  - Systems not yet a tropical cyclone
  - Threat of TS-force winds to land within 48 hours. (Introduced in 2017)

### Potential Tropical Cyclone Three (Cindy 2017)





## **FAQs**

- When is new information available?
- When is a good time for a conference call?

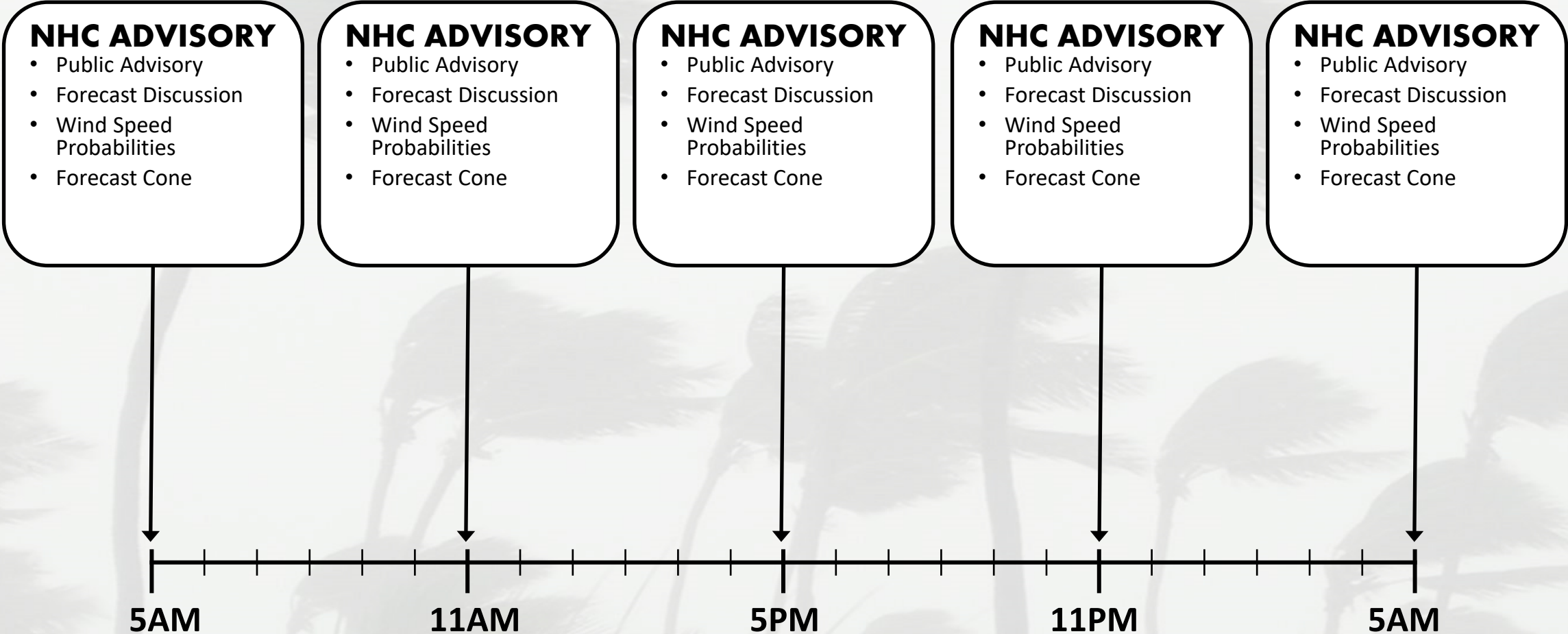
- **NHC Advisory Timeline**

# NHC ADVISORY TIMELINE

*Scheduled Updates*



## NO WATCHES/WARNINGS

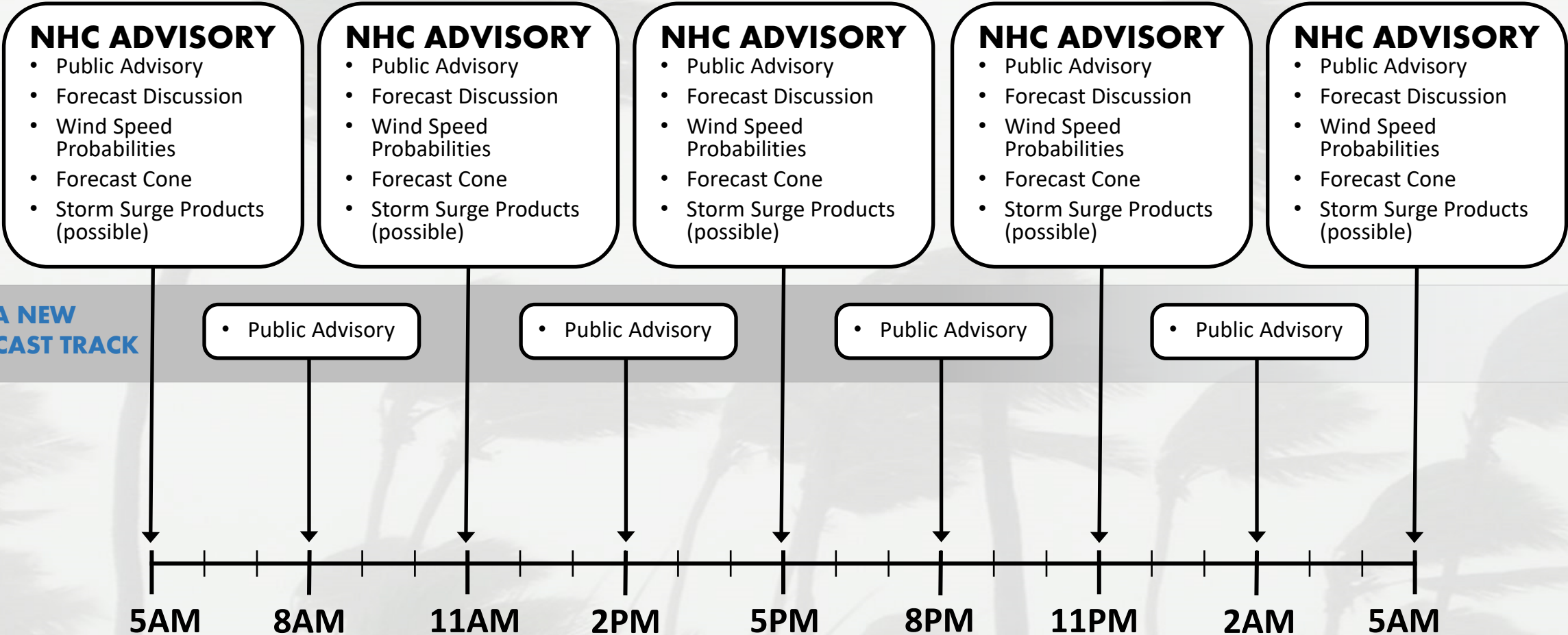


# NHC ADVISORY TIMELINE

*Scheduled Updates*



## WATCHES/WARNINGS *in effect*

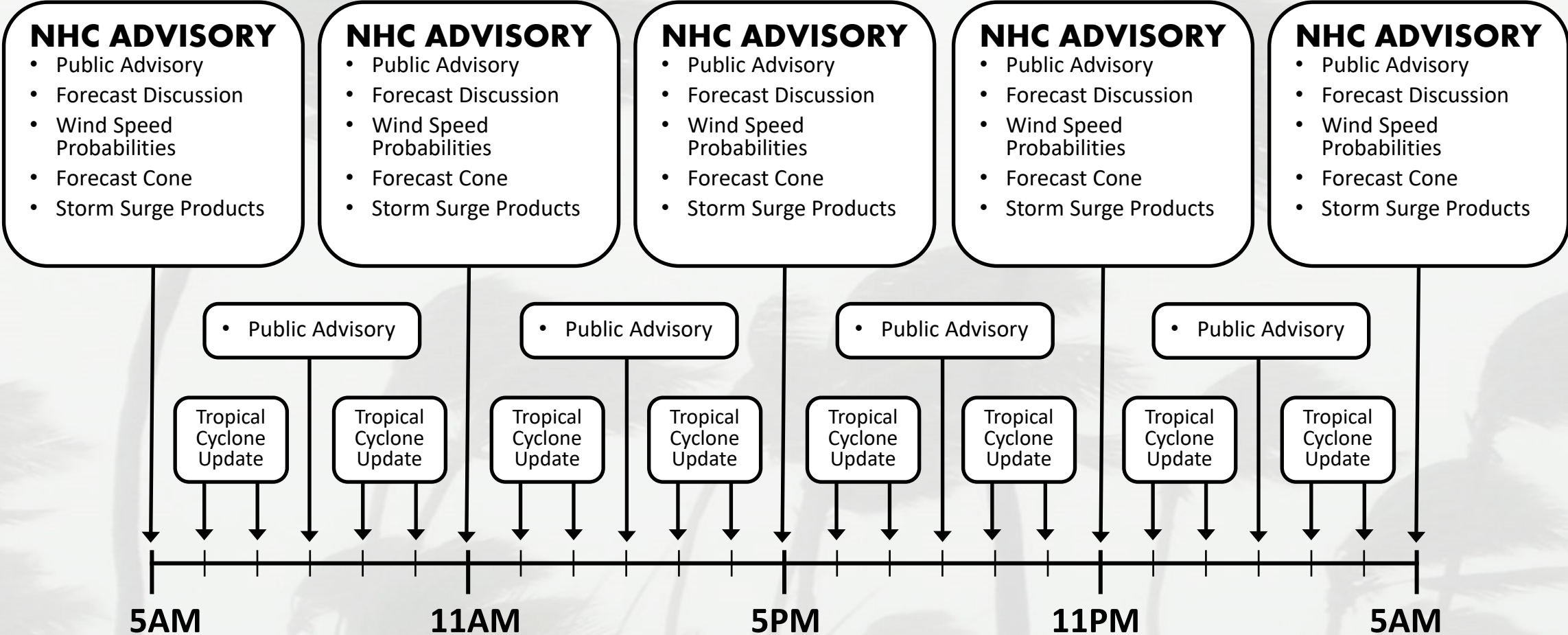


# NHC ADVISORY TIMELINE

*Scheduled Updates*



## WATCHES/WARNINGS *in effect and eye tracked by radar*





## SPECIAL ADVISORIES

- Issued at any time whenever an unexpected significant change has occurred
  - Aircraft or satellite estimate finds storm is stronger than forecast
- When U.S. watches or warnings are issued between regularly scheduled advisories
  - Watches or Warnings may be discontinued on intermediate Public Advisories

## **FAQs**

- How strong is the storm?
  - What are the hazards?
  - Are there any warnings?
- **Public Advisory**

# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



FEMA



Tropical Storm Michael Advisory Number 7  
NWS National Hurricane Center Miami FL AL142018  
400 AM CDT Mon Oct 08 2018

...MICHAEL ALMOST A HURRICANE...  
...HURRICANE WATCH ISSUED FOR THE FLORIDA PANHANDLE AND BIG BEND...

SUMMARY OF 400 AM CDT...0900 UTC...INFORMATION  
-----

LOCATION...20.6N 85.5W  
ABOUT 90 MI...145 KM E OF COZUMEL MEXICO  
ABOUT 100 MI...155 KM SSW OF THE WESTERN TIP OF CUBA  
MAXIMUM SUSTAINED WINDS...70 MPH...110 KM/H  
PRESENT MOVEMENT...N OR 360 DEGREES AT 7 MPH...11 KM/H  
MINIMUM CENTRAL PRESSURE...983 MB...29.03 INCHES

WATCHES AND WARNINGS  
-----

A Storm Surge Watch is in effect for...

\* Navarre Florida to Anna Maria Island Florida, including Tampa Bay

A Hurricane Watch is in effect for...

\* Alabama-Florida border to Suwanee River Florida

A Tropical Storm Watch is in effect for...

\* Suwanee River to Anna Maria Island Florida, including Tampa Bay

\* Alabama-Florida border to the Mississippi-Alabama border

Where is the  
storm located?

# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



FEMA



### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Tropical Storm Michael Advisory Number 7  
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How strong is the storm?



# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



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### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Tropical Storm Michael Advisory Number 7  
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← Watches or Warnings?

# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



FEMA



### DISCUSSION AND OUTLOOK

At 400 AM CDT (0900 UTC), the center of Tropical Storm Michael was located by an Air Force Reserve Hurricane Hunter aircraft near latitude 20.6 North, longitude 85.5 West. Michael is moving toward the north near 7 mph (11 km/h). A northward motion at a slightly faster forward speed is expected through Tuesday night, followed by a northeastward motion on Wednesday and Thursday. On the forecast track, the center of Michael will move northward across the Yucatan Channel later today, and then across the eastern Gulf of Mexico this evening through Wednesday. Michael is expected to move inland over the Florida Panhandle or Florida Big Bend area on Wednesday, and then move northeastward across the southeastern United States Wednesday night and Thursday.

Data from the Hurricane Hunter aircraft indicate that maximum sustained winds have increased to near 70 mph (110 km/h) with higher gusts. Additional strengthening is forecast, and Michael is expected to become a hurricane later today. Michael is forecast to be near or at major hurricane strength when it reaches the northeastern Gulf of Mexico Tuesday night and Wednesday.

Tropical-storm-force winds extend outward up to 175 miles (280 km) from the center.

The minimum central pressure based on aircraft data is 983 mb (29.03 inches).

Where is the storm headed?

# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



FEMA



### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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**Forecast to  
weaken?  
Strengthen?**

# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



### HAZARDS AFFECTING LAND

**STORM SURGE:** The combination of a dangerous storm surge and the tide will cause normally dry areas near the coast to be flooded by rising waters moving inland from the shoreline. The water has the potential to reach the following heights above ground if peak surge occurs at the time of high tide...

Indian Pass to Crystal River...7-11 ft  
Crystal River to Anclote River...4-6 ft  
Okaloosa/Walton County Line to Indian Pass...4-7 ft  
Anclote River to Anna Maria Island including Tampa Bay...2-4 ft  
Navarre to Okaloosa/Walton County Line...2-4 ft

**WIND:** Hurricane conditions are expected across the far western part of the Cuban province of Pinar del Rio later today. Tropical storm conditions are expected across the remainder of the warning areas in Cuba and the Yucatan Peninsula later today.

Hurricane conditions are possible within the hurricane watch area along the U.S. Gulf coast by Wednesday, with tropical storm conditions possible by Tuesday night or early Wednesday. Tropical storm conditions are possible within the tropical storm watch area by Tuesday night or early Wednesday.

**RAINFALL:** Michael is expected to produce the following rainfall amounts through Wednesday night...

What is the peak storm surge forecast?



# PUBLIC ADVISORY

## *Location. Strength. Hazards. Warnings*



FEMA



### HAZARDS AFFECTING LAND

-----

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Hurricane conditions are possible within the hurricane watch area along the U.S. Gulf coast by Wednesday, with tropical storm conditions possible by Tuesday night or early Wednesday. Tropical storm conditions are possible within the tropical storm watch area by Tuesday night or early Wednesday.

**RAINFALL:** Michael is expected to produce the following rainfall amounts through Wednesday night...

Florida Panhandle and Big Bend into southern Georgia...4 to 8 inches, with isolated maximum amounts of 12 inches. This rainfall may lead to life threatening flash floods.

Florida Keys...2 to 4 inches.

Yucatan Peninsula...1 to 2 inches.

### NEXT ADVISORY

-----

Next intermediate advisory at 700 AM CDT.

How much rain  
is forecast?

## **FAQs**

- How confident are the forecasters?
- Key messages?

- **Forecast Discussion**

# FORECAST DISCUSSION

## *Confidence. Scenarios. Key Messages.*



FEMA



Tropical Storm Michael Discussion Number 7  
NWS National Hurricane Center Miami FL AL142018  
400 AM CDT Mon Oct 08 2018

An Air Force Reserve Hurricane Hunter aircraft made several passes through the system and found that the central pressure has fallen to about 983 mb and maximum winds have increased to near 60 kt. This increase in intensity indicates that despite the shear, Michael has by definition rapidly intensified during the past 24 hours. Decreasing vertical shear and very warm sea surface temperatures are expected to support continued strengthening, and due to the favorable conditions, the NHC intensity forecast follows a blend of the IVCN consensus and the HCCA model. This new official forecast brings the intensity to just below major hurricane strength in 48 hours, and since the storm will still be over water for a time between 48 and 72 hours, there is a real possibility that Michael will strengthen to a major hurricane before landfall.

Nearly all of the track models have shifted westward after 24 hours, which left the previous forecast near the eastern edge of the guidance envelope. Due to this shift, the new NHC track forecast has also been adjusted westward close to the consensus aids. Overall the track guidance is in fairly good agreement up until landfall along the Florida Panhandle or Florida Big Bend, which has yielded a fairly confident track forecast.

- Forecast reasoning
- Relevant Observations
- Model Guidance
- Forecast Uncertainties

# FORECAST DISCUSSION

## *Confidence. Scenarios. Key Messages.*



FEMA



### Key Messages:

1. Hurricane conditions are expected over portions of western Cuba, where a hurricane warning is now in effect. Tropical storm conditions are expected over the northeastern Yucatan Peninsula and the Isle of Youth today.

2. Michael is expected to produce heavy rainfall and flash flooding over portions of western Cuba and the northeastern Yucatan Peninsula of Mexico during the next couple of days.

3. Michael is forecast to be a hurricane, and possibly a major hurricane, when it reaches the northeastern Gulf Coast by mid-week, and storm surge and hurricane watches are now in effect for portions of the area. Some areas along the Florida Gulf Coast are especially vulnerable to storm surge, regardless of the storm's exact track or intensity. Residents in the watch areas should monitor the progress of this system and follow any advice given by local officials.

### Key Messages

- Forecast Confidence
- Highlight Threats



# KEY MESSAGES

*Highlights hazards and forecast uncertainty.*



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## Key Messages for Tropical Storm Michael

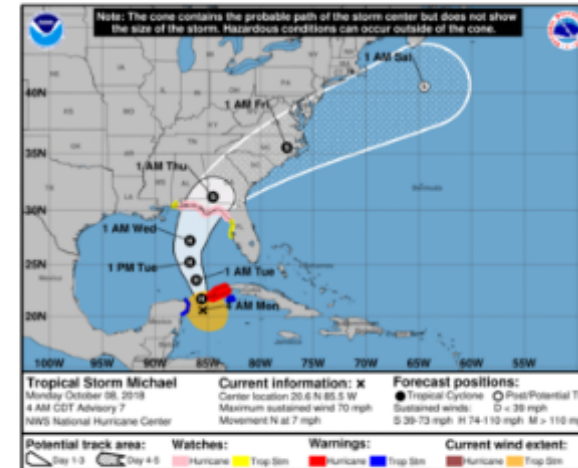
Advisory 7: 4:00 AM CDT Mon Oct 08, 2018



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For more information go to [hurricanes.gov](https://hurricanes.gov)

# FORECAST DISCUSSION

## *Confidence. Scenarios. Key Messages.*



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### FORECAST POSITIONS AND MAX WINDS

INIT	08/0900Z	20.6N	85.5W	60 KT	70 MPH	
12H	08/1800Z	21.7N	85.6W	70 KT	80 MPH	
24H	09/0600Z	23.5N	86.1W	85 KT	100 MPH	
36H	09/1800Z	25.2N	86.7W	90 KT	105 MPH	
48H	10/0600Z	27.2N	86.7W	95 KT	110 MPH	
72H	11/0600Z	31.2N	84.5W	55 KT	65 MPH...	INLAND
96H	12/0600Z	35.5N	77.5W	50 KT	60 MPH...	INLAND
120H	13/0600Z	40.5N	64.5W	50 KT	60 MPH...	POST-TROP/EXTRATROP

\$\$

Forecaster Berg

NNNN

Table of track and intensity forecasts

## **FAQs**

- How large is the storm?
- Where is the storm headed?

- **Forecast Advisory**

# FORECAST ADVISORY

*Position. Size. Radii. Intensity.*



The NOAA logo, featuring a blue and white circular emblem with a wave and a sun.

The NHC logo, featuring a red and white circular emblem with a hurricane.

## NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

TROPICAL STORM MICHAEL FORECAST/ADVISORY NUMBER 7  
NWS NATIONAL HURRICANE CENTER MIAMI FL AL142018  
0900 UTC MON OCT 08 2018

A TROPICAL STORM WATCH HAS BEEN ISSUED FROM THE SUWANEE RIVER TO ANNA MARIA ISLAND FLORIDA...INCLUDING TAMPA BAY.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT...

A STORM SURGE WATCH IS IN EFFECT FOR...

- \* NAVARRE FLORIDA TO ANNA MARIA ISLAND FLORIDA...INCLUDING TAMPA BAY

A HURRICANE WATCH IS IN EFFECT FOR...

- \* ALABAMA-FLORIDA BORDER TO SUWANEE RIVER FLORIDA

A TROPICAL STORM WATCH IS IN EFFECT FOR...

- \* SUWANEE RIVER TO ANNA MARIA ISLAND FLORIDA...INCLUDING TAMPA BAY
- \* ALABAMA-FLORIDA BORDER TO THE MISSISSIPPI-ALABAMA BORDER

TROPICAL STORM CENTER LOCATED NEAR 20.6N 85.5W AT 08/0900Z  
POSITION ACCURATE WITHIN 15 NM

PRESENT MOVEMENT TOWARD THE NORTH OR 360 DEGREES AT 6 KT

ESTIMATED MINIMUM CENTRAL PRESSURE 983 MB  
MAX SUSTAINED WINDS 60 KT WITH GUSTS TO 75 KT.  
50 KT..... 80NE 80SE 0SW 0NW.

Only source for all  
the forecast data

Watches and Warnings

Data is used in HURREVAC  
and other commercial  
tracking software



# FORECAST ADVISORY

*Position. Size. Radii. Intensity.*



A TROPICAL STORM WATCH IS IN EFFECT FOR...  
\* SUWANEE RIVER TO ANNA MARIA ISLAND FLORIDA...INCLUDING TAMPA BAY  
\* ALABAMA-FLORIDA BORDER TO THE MISSISSIPPI-ALABAMA BORDER

TROPICAL STORM CENTER LOCATED NEAR 20.6N 85.5W AT 08/0900Z  
POSITION ACCURATE WITHIN 15 NM

PRESENT MOVEMENT TOWARD THE NORTH OR 360 DEGREES AT 6 KT

ESTIMATED MINIMUM CENTRAL PRESSURE 983 MB  
MAX SUSTAINED WINDS 60 KT WITH GUSTS TO 75 KT.

50 KT..... 80NE 80SE 0SW 0NW.

34 KT.....120NE 150SE 90SW 100NW.

12 FT SEAS..135NE 120SE 30SW 60NW.

WINDS AND SEAS VARY GREATLY IN EACH QUADRANT. RADII IN NAUTICAL  
MILES ARE THE LARGEST RADII EXPECTED ANYWHERE IN THAT QUADRANT.

REPEAT...CENTER LOCATED NEAR 20.6N 85.5W AT 08/0900Z  
AT 08/0600Z CENTER WAS LOCATED NEAR 20.2N 85.5W

FORECAST VALID 08/1800Z 21.7N 85.6W  
MAX WIND 70 KT...GUSTS 85 KT.

64 KT... 30NE 30SE 0SW 0NW.

50 KT... 90NE 90SE 30SW 30NW.

34 KT...130NE 150SE 90SW 120NW.

FORECAST VALID 09/0600Z 23.5N 86.1W

Current wind radii

Forecast wind radii

# FORECAST ADVISORY

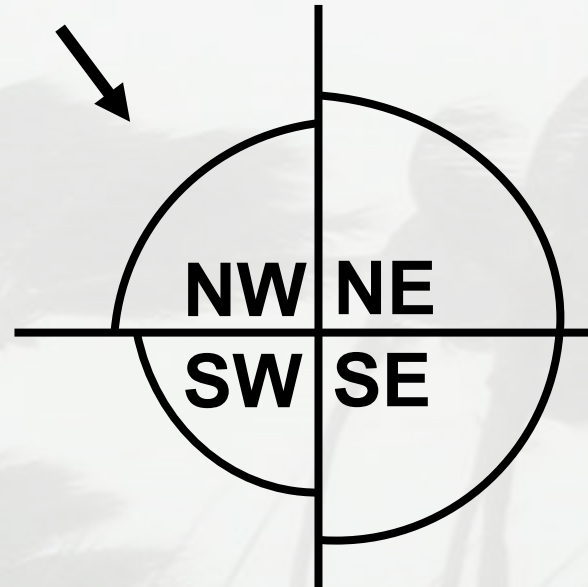
*Position. Size. Radii. Intensity.*



## WIND RADII

- NHC forecasts the wind radii in four quadrants

```
MAX WIND  70 KT...GUSTS  85 KT.  
64 KT... 30NE  30SE   0SW   0NW.  
50 KT... 90NE  90SE  30SW  30NW.  
34 KT...130NE 150SE  90SW 120NW.
```



Radii are the largest distance from the center in a quadrant

Leads to an inherent over-estimate of radii, especially near land

# FORECAST ADVISORY

*Position. Size. Radii. Intensity.*

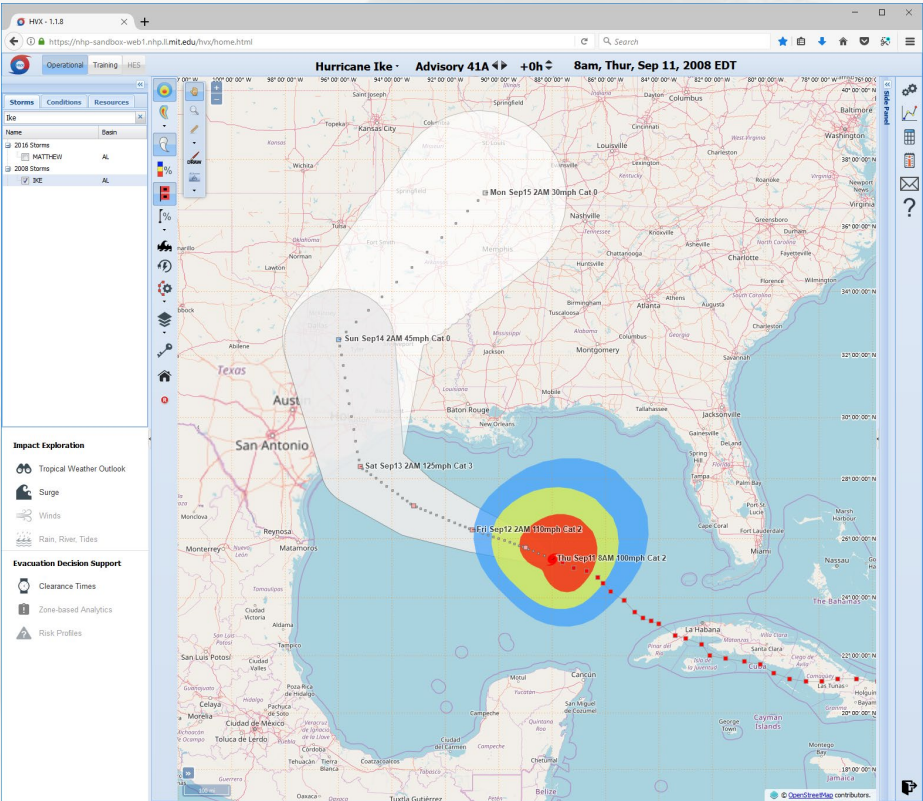


## WIND RADII

- NHC forecasts the wind radii in four quadrants

## FORECAST TIME

	34 kt	50 kt	64 kt
12 hr			
24 hr			
36 hr			
48 hr			
72 hr			N/A
96 hr	N/A	N/A	N/A
120 hr	N/A	N/A	N/A



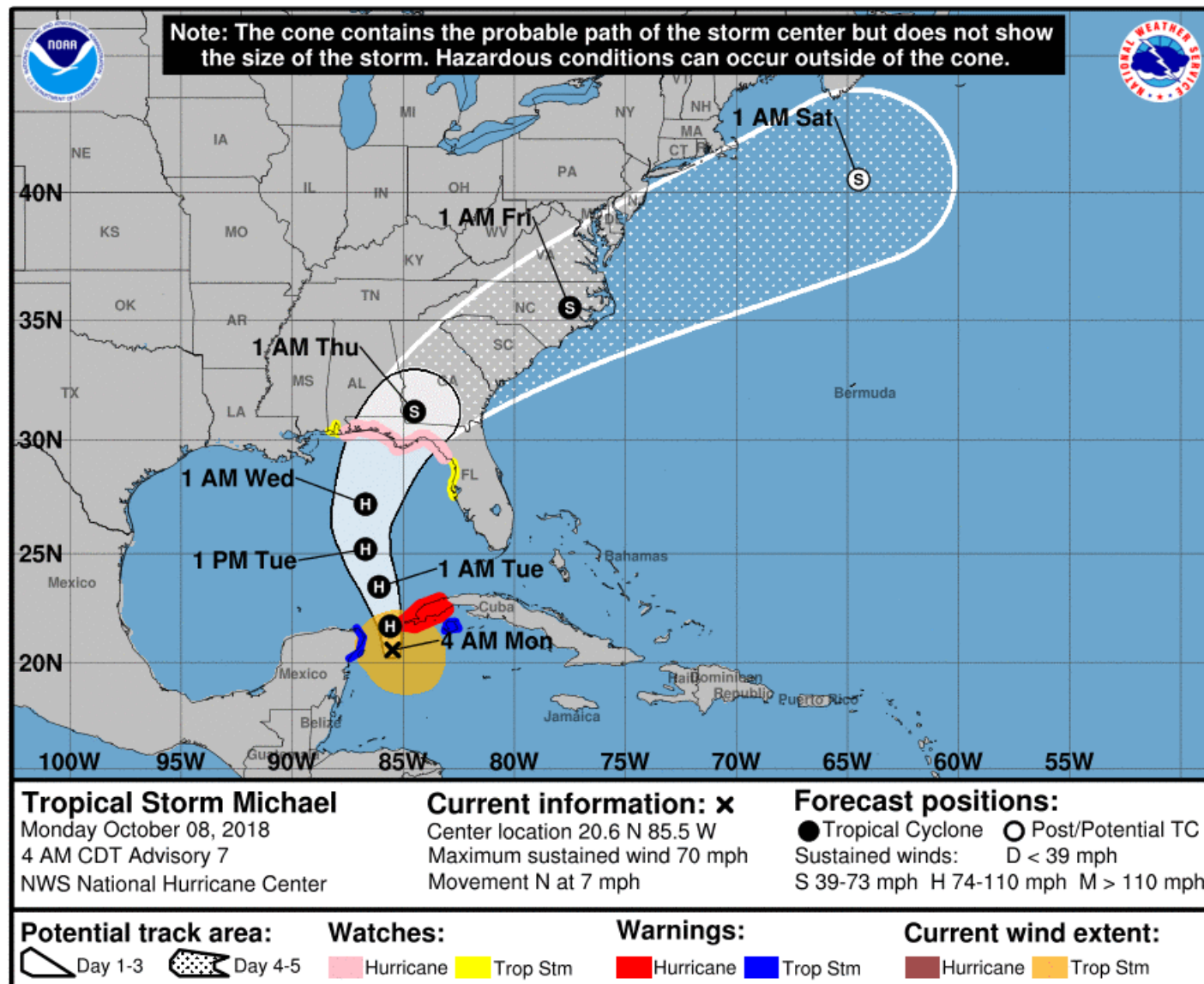


# FORECAST ERROR CONE

*Probable Track. Watches. Warnings.*



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# FORECAST ERROR CONE

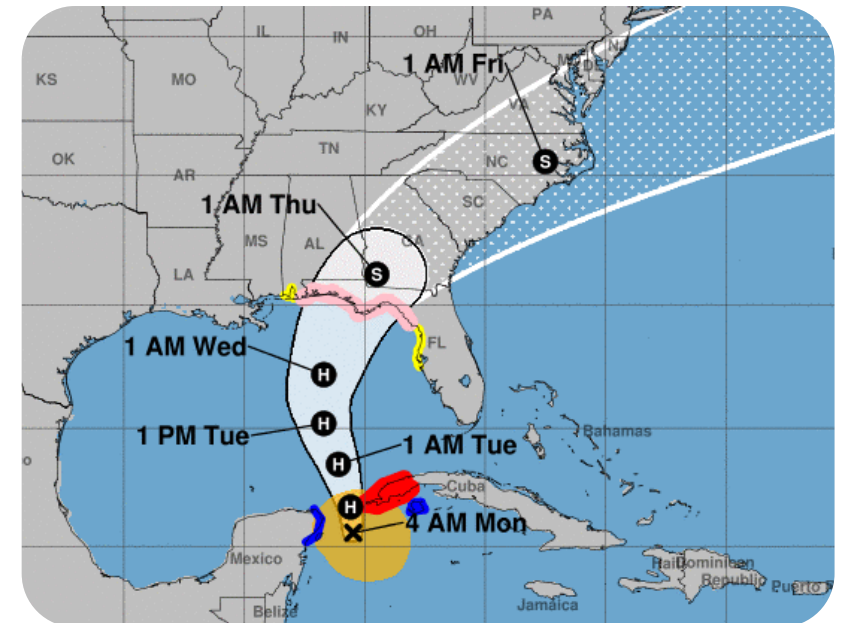
*What do you know?*



## QUIZ QUESTION

Which one of the following is used to construct the size of the NHC forecast error cone?

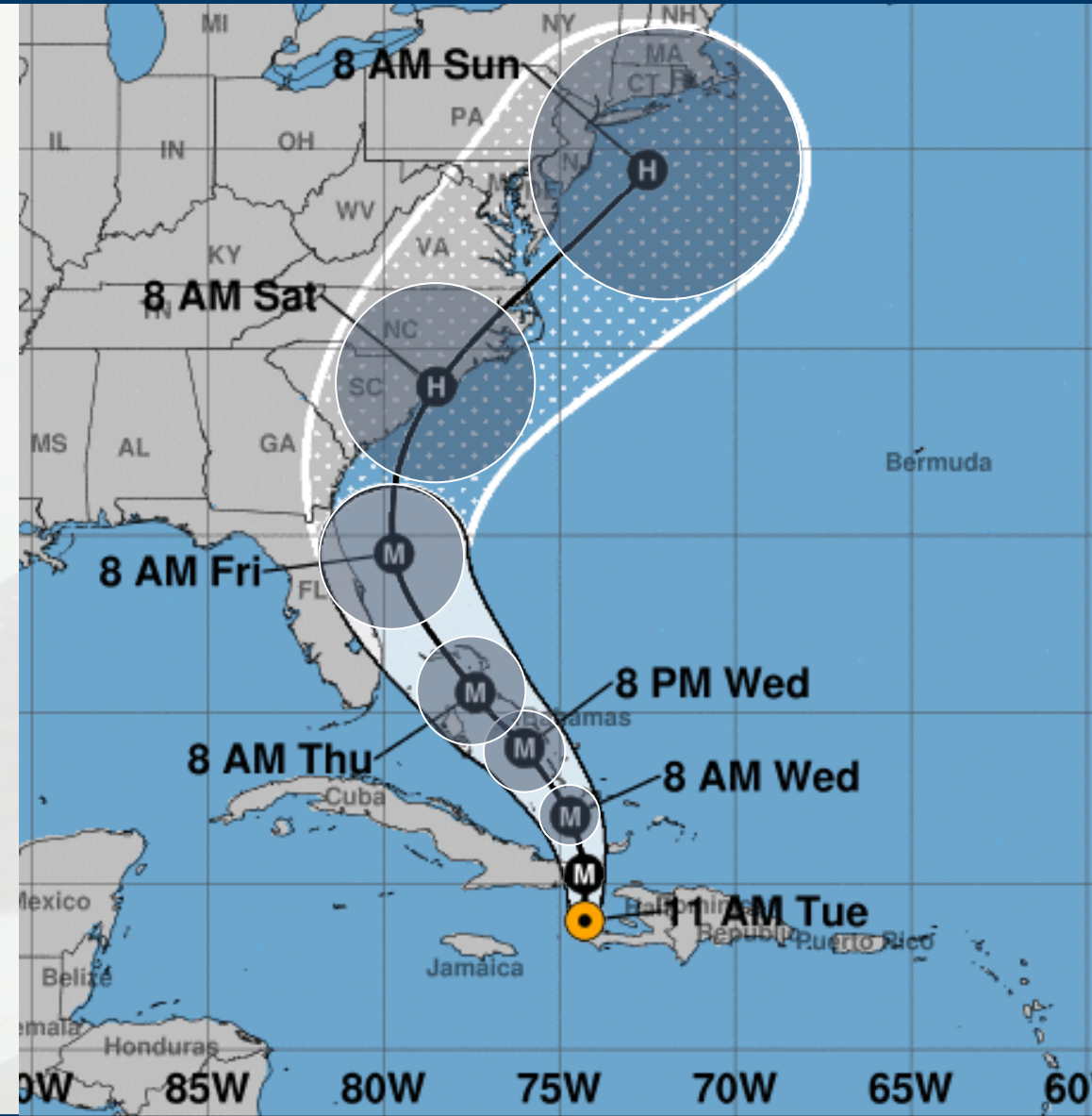
- A. Possible impact areas
- B. Size of the wind field
- C. Model spread
- D. Past 5 years of track forecast error



## *The cure for the skinny black line?*



- **Probable track of the center of the tropical cyclone**
- **Formed by connecting circles centered on each forecast point**
- **Each circle uses NHC historical (5-year) track errors**  
Actual storm position will be within the circle 67% of the time



# FORECAST ERROR CONE

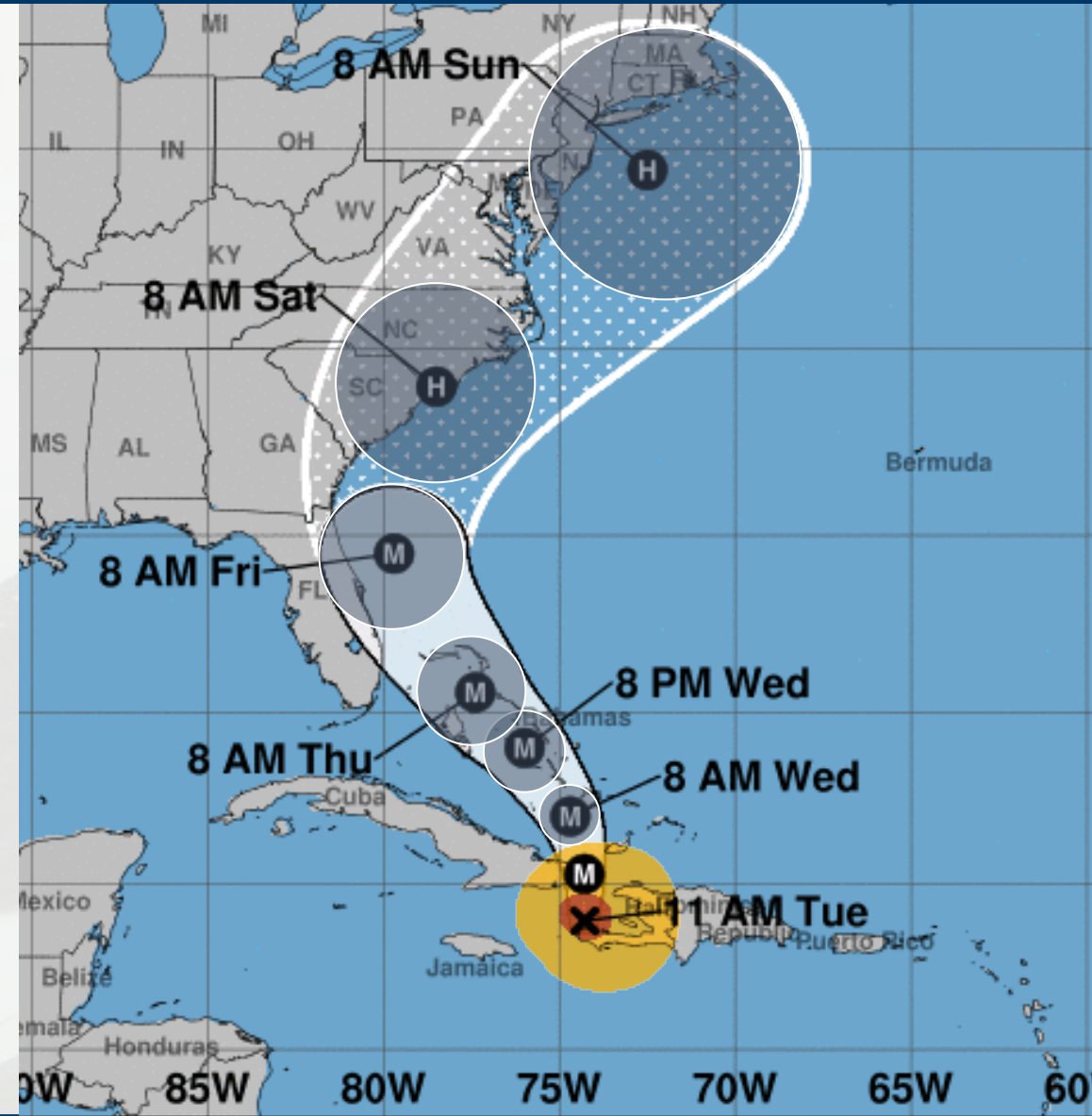
*No worries, not in the cone?*



FEMA

## ERROR CONE

- Only displays information about track uncertainty  
Nothing about specific impacts
- Impacts can occur well outside the area enclosed by the cone  
Center is expected to be outside the cone about 1/3 of the time



## **FAQs**

- **Chance for some effects?**
- **Are staging areas at risk?**
- **When is the earliest TS winds could begin?**



- **Wind Speed Probabilities**



# WIND SPEED PROBABILITIES

## Text Product





NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

TROPICAL STORM MICHAEL WIND SPEED PROBABILITIES NUMBER7

NWS NATIONAL HURRICANE CENTER MIAMI FLAL142018

0900 UTC MON OCT 08 2018

- - - - WIND SPEED PROBABILITIES FOR SELECTED LOCATIONS - - - -

TIME PERIODS

FROM 06Z MON TO 18Z MON

FROM 18Z MON TO 06Z TUE

FROM 06Z TUE TO 18Z TUE

FROM 18Z TUE TO 06Z WED

FROM 06Z WED TO 06Z THU

FROM 06Z THU TO 06Z FRI

FROM 06Z FRI TO 06Z SAT

FORECAST HOUR

(12)

(24)

(36)

(48)

(72)

(96)

(120)

- - - - -

LOCATION

KT

TALLAHASSEE FL 34

X

X ( X )

1 ( 1 )

6 ( 7 )

68 (75)

6 (81)

X (81)

TALLAHASSEE FL 50

X

X ( X )

X ( X )

1 ( 1 )

41 (42)

6 (48)

X (48)

TALLAHASSEE FL 64

X

X ( X )

X ( X )

X ( X )

20 (20)

4 (24)

X (24)

APALACHICOLA 34

X

X ( X )

5 ( 5 )

29 (34)

57 (91)

1 (92)

X (92)

APALACHICOLA 50

X

X ( X )

X ( X )

6 ( 6 )

59 (65)

2 (67)

X (67)

APALACHICOLA 64

X

X ( X )

X ( X )

1 ( 1 )

39 (40)

1 (41)

X (41)

PANAMA CITY FL 34

X

X ( X )

4 ( 4 )

26 (30)

60 (90)

1 (91)

X (91)

PANAMA CITY FL 50

X

X ( X )

X ( X )

6 ( 6 )

57 (63)

1 (64)

X (64)

PANAMA CITY FL 64

X

X ( X )

X ( X )

1 ( 1 )

37 (38)

X (38)

X (38)



### Location-Specific Probabilities

- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

# WIND SPEED PROBABILITIES

## Text Product





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FORECAST HOUR	(12)	(24)	(36)	(48)	(72)	(96)	(120)
LOCATION	KT						
TALLAHASSEE FL 34	X	X ( X )	1 ( 1 )	6 ( 7 )	68 (75)	6 (81)	X (81)
TALLAHASSEE FL 50	X	X ( X )	X ( X )	1 ( 1 )	41 (42)	6 (48)	X (48)
TALLAHASSEE FL 64	X	X ( X )	X ( X )	X ( X )	20 (20)	4 (24)	X (24)
APALACHICOLA 34	X	X ( X )	5 ( 5 )	29 (34)	57 (91)	1 (92)	X (92)
APALACHICOLA 50	X	X ( X )	X ( X )	6 ( 6 )	59 (65)	2 (67)	X (67)
APALACHICOLA 64	X	X ( X )	X ( X )	1 ( 1 )	39 (40)	1 (41)	X (41)
PANAMA CITY FL 34	X	X ( X )	4 ( 4 )	26 (30)	60 (90)	1 (91)	X (91)
PANAMA CITY FL 50	X	X ( X )	X ( X )	6 ( 6 )	57 (63)	1 (64)	X (64)
PANAMA CITY FL 64	X	X ( X )	X ( X )	1 ( 1 )	37 (38)	X (38)	X (38)


Location-Specific Probabilities

- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

# WIND SPEED PROBABILITIES

## Text Product





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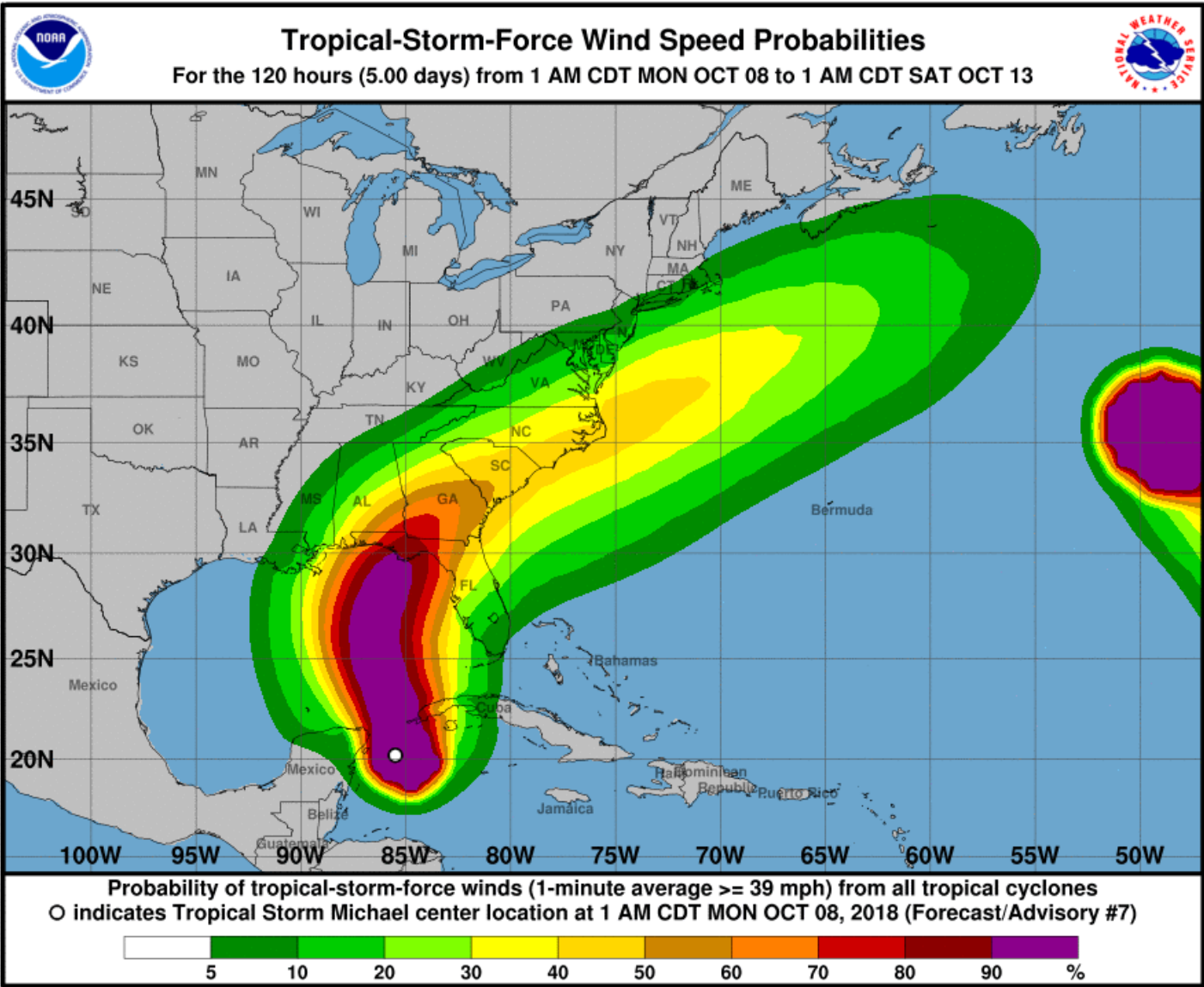
TIME PERIODS	FROM 06Z MON TO 18Z MON	FROM 18Z MON TO 06Z TUE	FROM 06Z TUE TO 18Z TUE	FROM 18Z TUE TO 06Z WED	FROM 06Z WED TO 06Z THU	FROM 06Z THU TO 06Z FRI	FROM 06Z FRI TO 06Z SAT
FORECAST HOUR	(12)	(24)	(36)	(48)	(72)	(96)	(120)
LOCATION	KT						
TALLAHASSEE FL 34	X	X ( X )	1 ( 1 )	6 ( 7 )	68 (75)	6 (81)	X (81)
TALLAHASSEE FL 50	X	X ( X )	X ( X )	1 ( 1 )	41 (42)	6 (48)	X (48)
TALLAHASSEE FL 64	X	X ( X )	X ( X )	X ( X )	20 (20)	4 (24)	X (24)
APALACHICOLA 34	X	X ( X )	5 ( 5 )	29 (34)	57 (91)	1 (92)	X (92)
APALACHICOLA 50	X	X ( X )	X ( X )	6 ( 6 )	59 (65)	2 (67)	X (67)
APALACHICOLA 64	X	X ( X )	X ( X )	1 ( 1 )	39 (40)	1 (41)	X (41)
PANAMA CITY FL 34	X	X ( X )	4 ( 4 )	26 (30)	60 (90)	1 (91)	X (91)
PANAMA CITY FL 50	X	X ( X )	X ( X )	6 ( 6 )	57 (63)	1 (64)	X (64)
PANAMA CITY FL 64	X	X ( X )	X ( X )	1 ( 1 )	37 (38)	X (38)	X (38)

### Location-Specific Probabilities

- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

# WIND SPEED PROBABILITIES

## 5-Day Cumulative Graphic



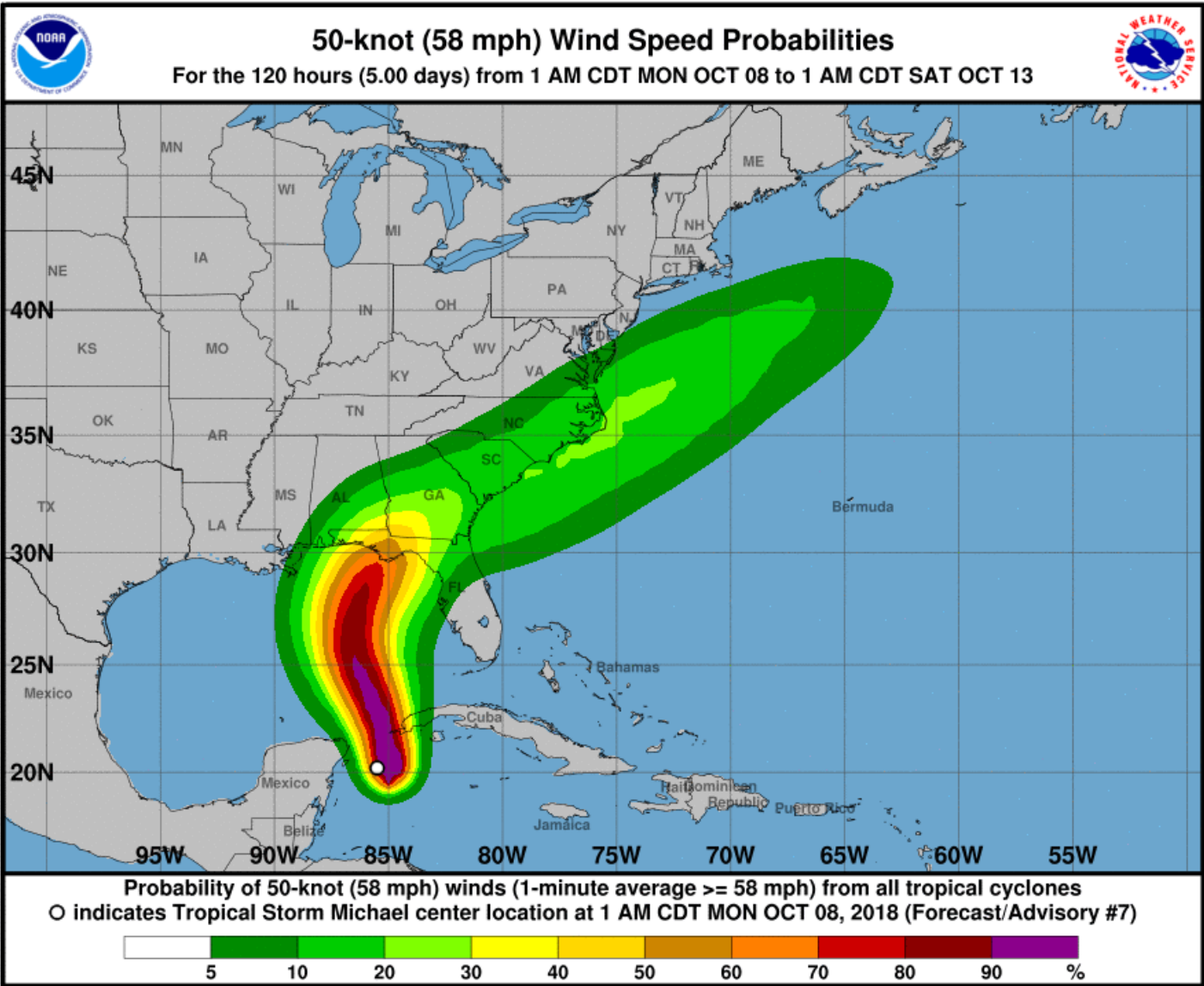
### Location-Specific Probabilities

- Tropical-Storm-Force
- 58 mph
- Hurricane-Force



# WIND SPEED PROBABILITIES

## 5-Day Cumulative Graphic



### Location-Specific Probabilities

- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

# WIND SPEED PROBABILITIES

## 5-Day Cumulative Graphic



### Location-Specific Probabilities

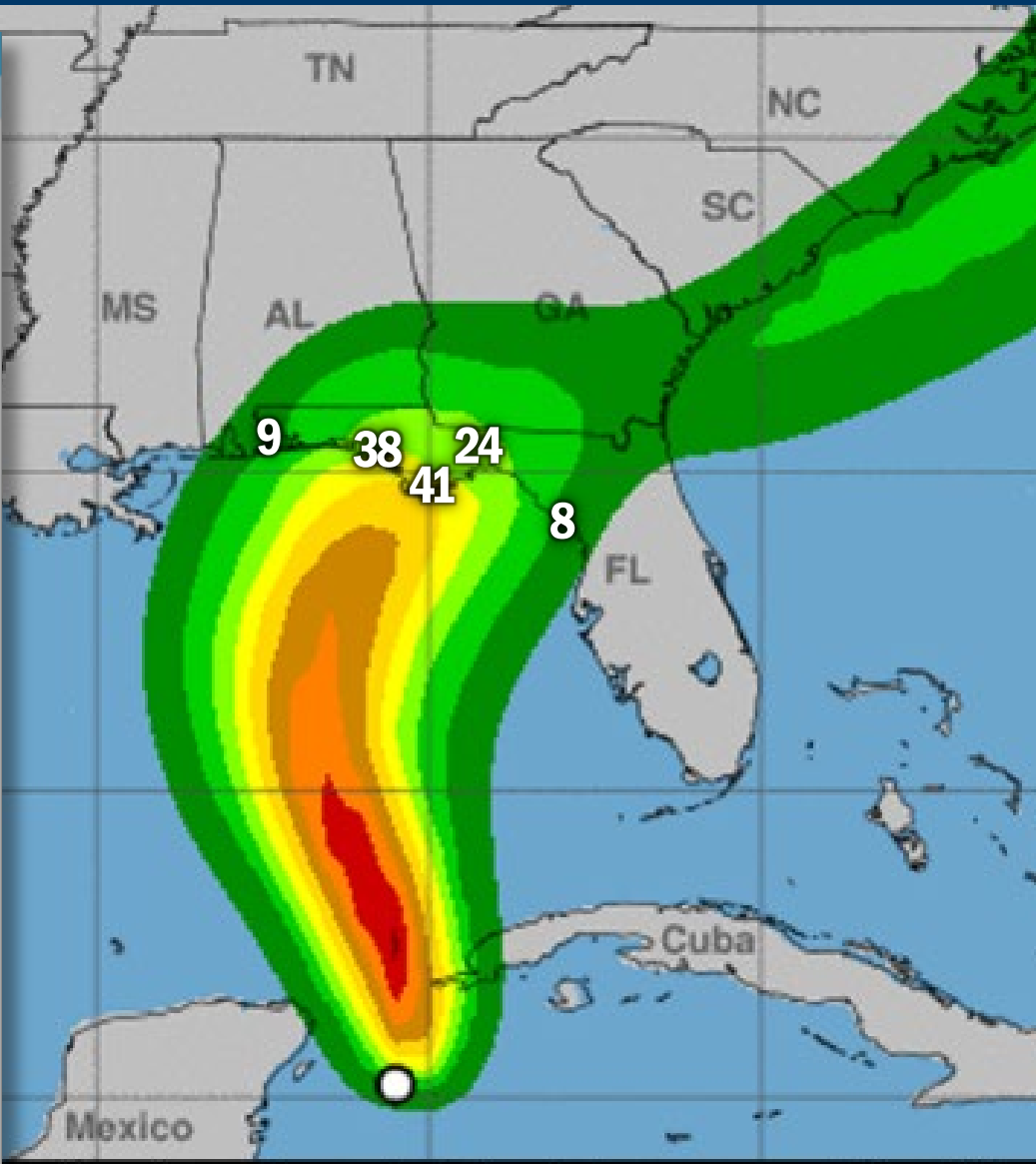
- Tropical-Storm-Force
- 58 mph
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# WIND SPEED PROBABILITIES

## 5-Day Cumulative Graphic



NATIONAL HURRICANE CENTER NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION								
TIME PERIODS	FROM 06Z MON TO 18Z MON	FROM 18Z MON TO 06Z TUE	FROM 06Z TUE TO 18Z TUE	FROM 18Z TUE TO 06Z WED	FROM 06Z WED TO 06Z THU	FROM 06Z THU TO 06Z FRI	FROM 06Z FRI TO 06Z SAT	
FORECAST HOUR	(12)	(24)	(36)	(48)	(72)	(96)	(120)	
LOCATION	KT							
CEDAR KEY FL	34	X	X ( X )	3 ( 3 )	15 (18)	43 (61)	2 (63)	X (63)
CEDAR KEY FL	50	X	X ( X )	X ( X )	1 ( 1 )	20 (21)	1 (22)	X (22)
CEDAR KEY FL	64	X	X ( X )	X ( X )	X ( X )	7 ( 7 )	1 ( 8 )	X ( 8 )
TALLAHASSEE FL	34	X	X ( X )	1 ( 1 )	6 ( 7 )	68 (75)	6 (81)	X (81)
TALLAHASSEE FL	50	X	X ( X )	X ( X )	1 ( 1 )	41 (42)	6 (48)	X (48)
TALLAHASSEE FL	64	X	X ( X )	X ( X )	X ( X )	20 (20)	4 (24)	X (24)
APALACHICOLA	34	X	X ( X )	5 ( 5 )	29 (34)	57 (91)	1 (92)	X (92)
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APALACHICOLA	64	X	X ( X )	X ( X )	1 ( 1 )	39 (40)	1 (41)	X (41)
PANAMA CITY FL	34	X	X ( X )	4 ( 4 )	26 (30)	60 (90)	1 (91)	X (91)
PANAMA CITY FL	50	X	X ( X )	X ( X )	6 ( 6 )	57 (63)	1 (64)	X (64)
PANAMA CITY FL	64	X	X ( X )	X ( X )	1 ( 1 )	37 (38)	X (38)	X (38)
PENSACOLA FL	34	X	X ( X )	1 ( 1 )	8 ( 9 )	43 (52)	2 (54)	X (54)
PENSACOLA FL	50	X	X ( X )	X ( X )	1 ( 1 )	20 (21)	1 (22)	X (22)
PENSACOLA FL	64	X	X ( X )	X ( X )	X ( X )	9 ( 9 )	X ( 9 )	X ( 9 )





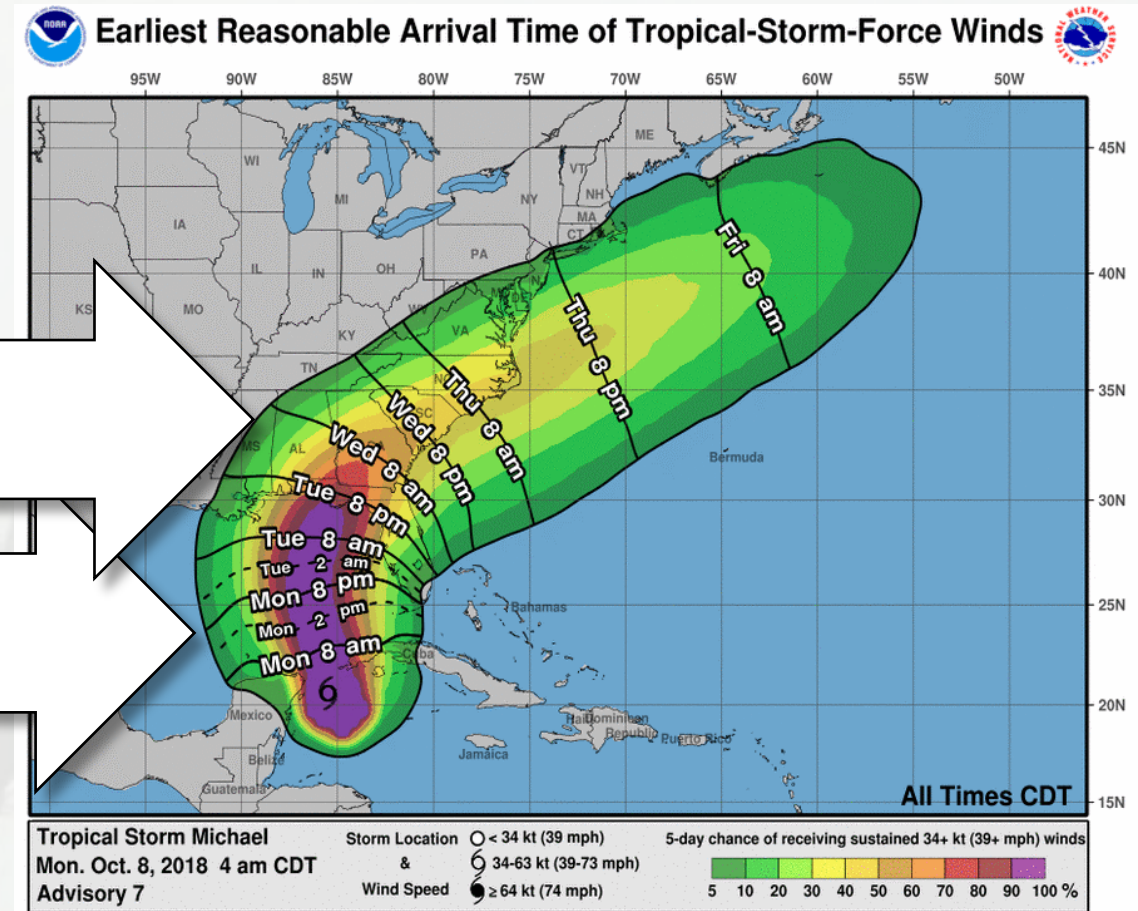
# TIME OF ARRIVAL GRAPHIC

## *Earliest Reasonable Onset of TS Winds*



### EARLIEST REASONABLE

- 10% chance of onset
  - Most conservative timing
- Arrival time of TS winds
  - Black contours
- 5-day cumulative TS probabilities
  - Color fill





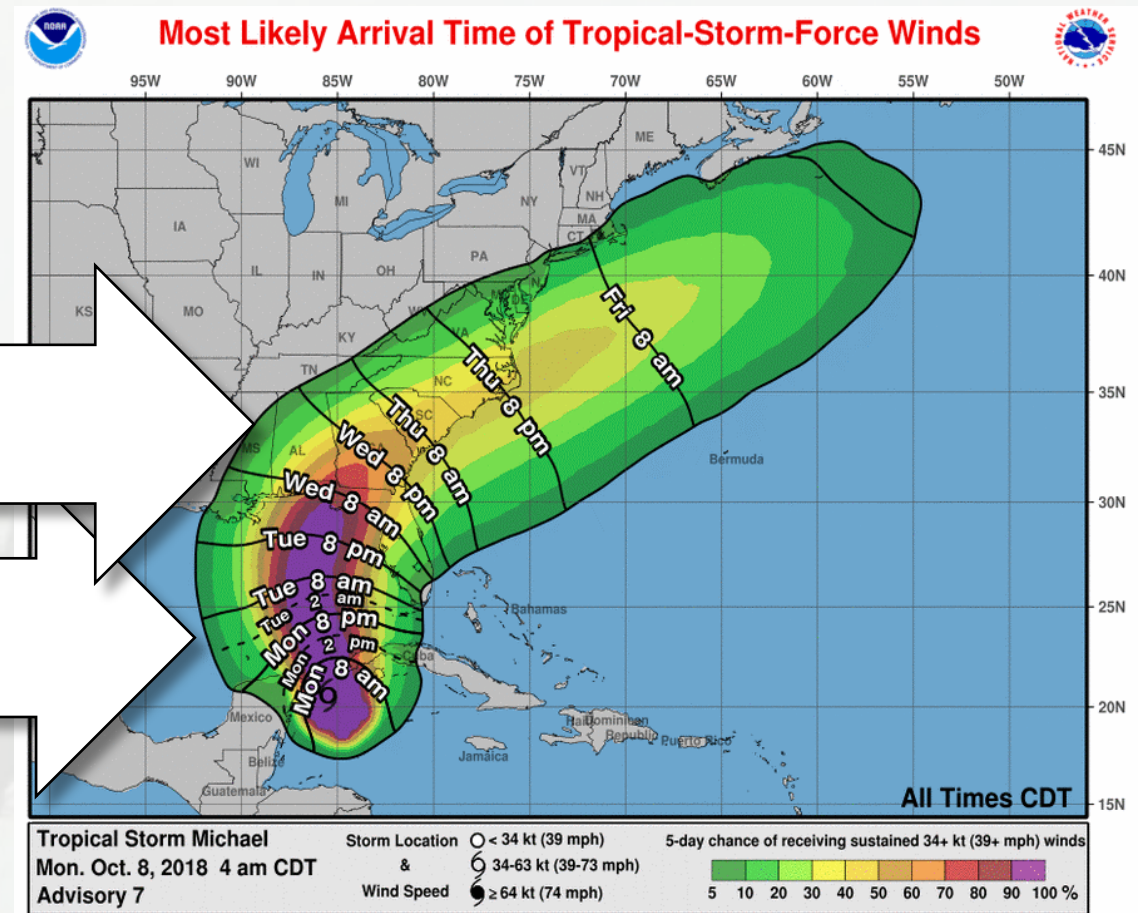
# TIME OF ARRIVAL GRAPHIC

## *Most Likely Onset of TS Winds*



### MOST LIKELY

- 50% chance of onset
  - Equally likely to occur before as after
- Arrival time of TS winds
  - Black contours
- 5-day cumulative TS probabilities
  - Color fill



## **FAQs**

- Where is the greatest concern?
- When will hurricane hazards begin?

- **Watches and Warnings**

# WATCHES & WARNINGS

*Where. When. What. Action.*

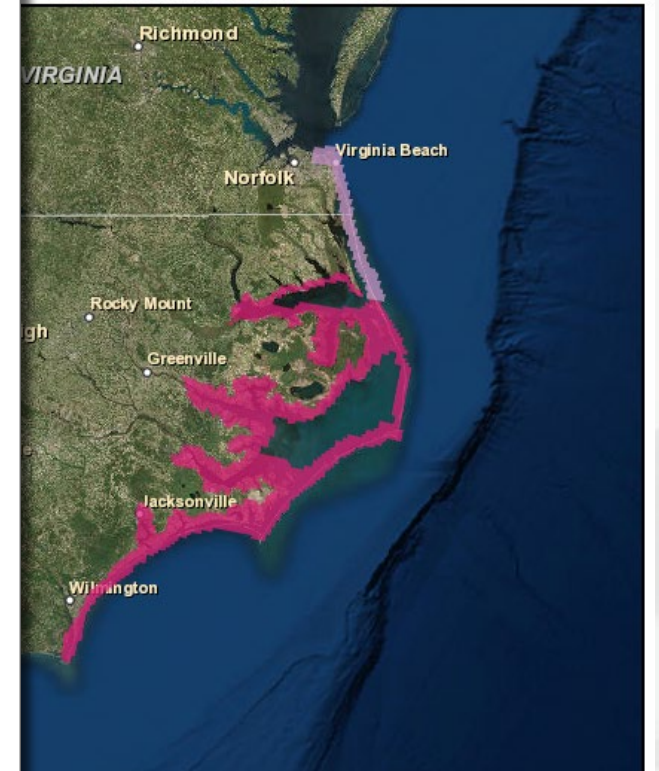


## STORM SURGE WATCH

There is the **possibility** of life-threatening inundation generally **within 48 hours**.

## STORM SURGE WARNING

There is a **danger** of life-threatening inundation generally **within 36 hours**.



# WATCHES & WARNINGS

*Where. When. What. Action.*



## HURRICANE WATCH

Hurricane conditions are **possible** within the watch area, generally **within 48 hours**

## HURRICANE WARNING

Hurricane conditions are **expected** within the warning area, generally **within 36 hours**

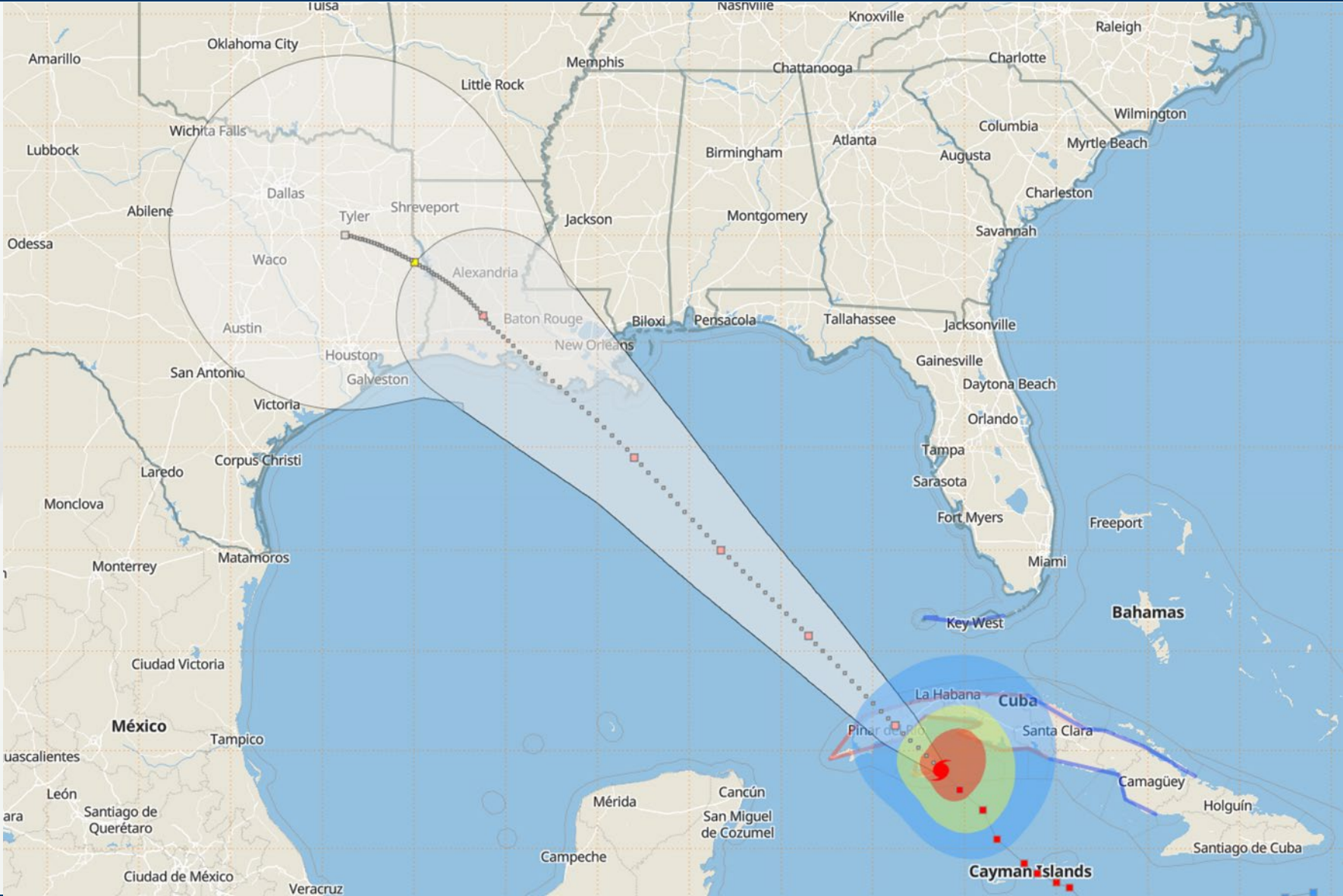
**Note:** The lead time for Hurricane Watches and Warnings is tied to the anticipated arrival time of tropical-storm-force winds





# WATCHES & WARNINGS

*Where. When. What. Action.*

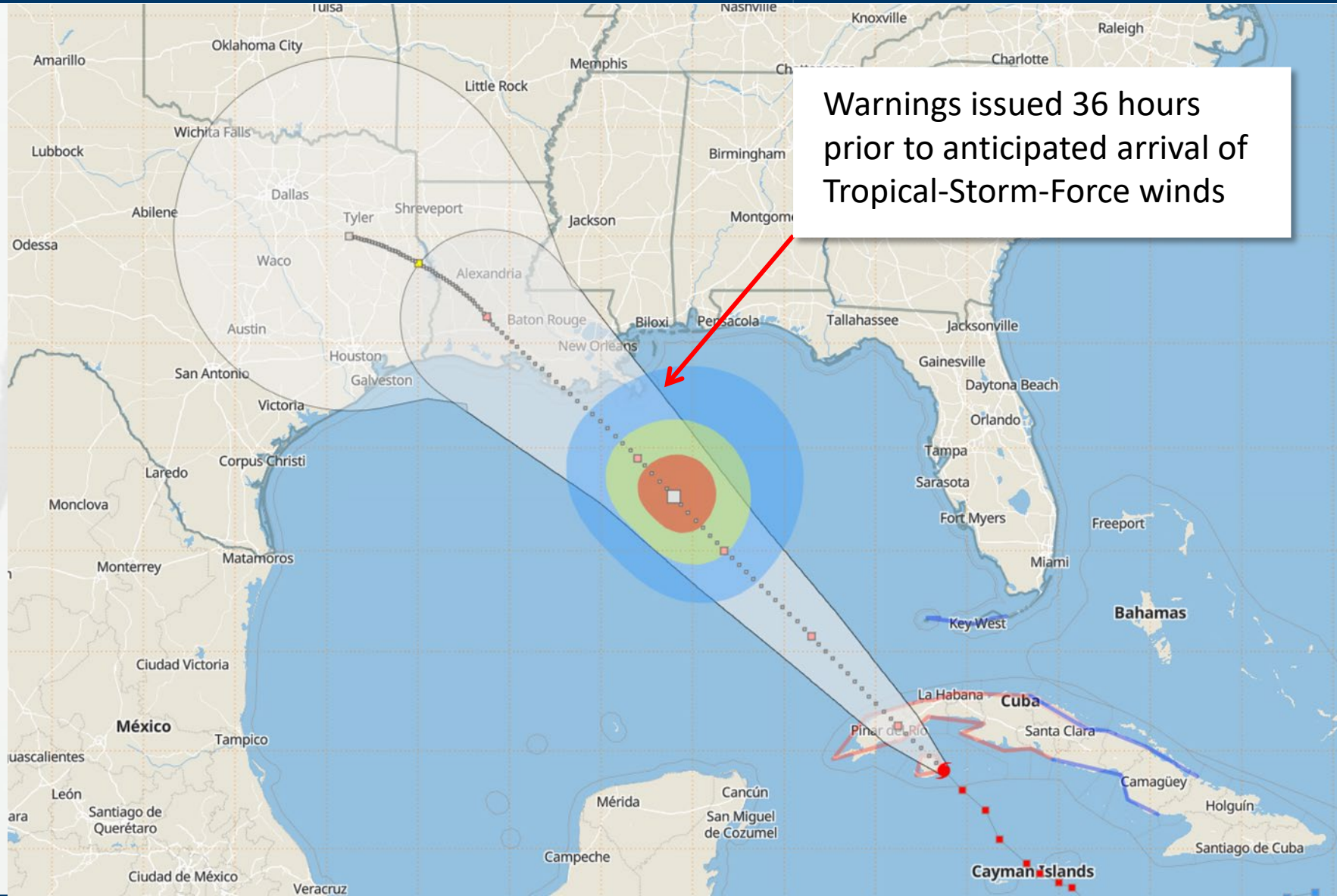


# WATCHES & WARNINGS

*Where. When. What. Action.*



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# WATCHES & WARNINGS

*Where. When. What. Action.*



FEMA



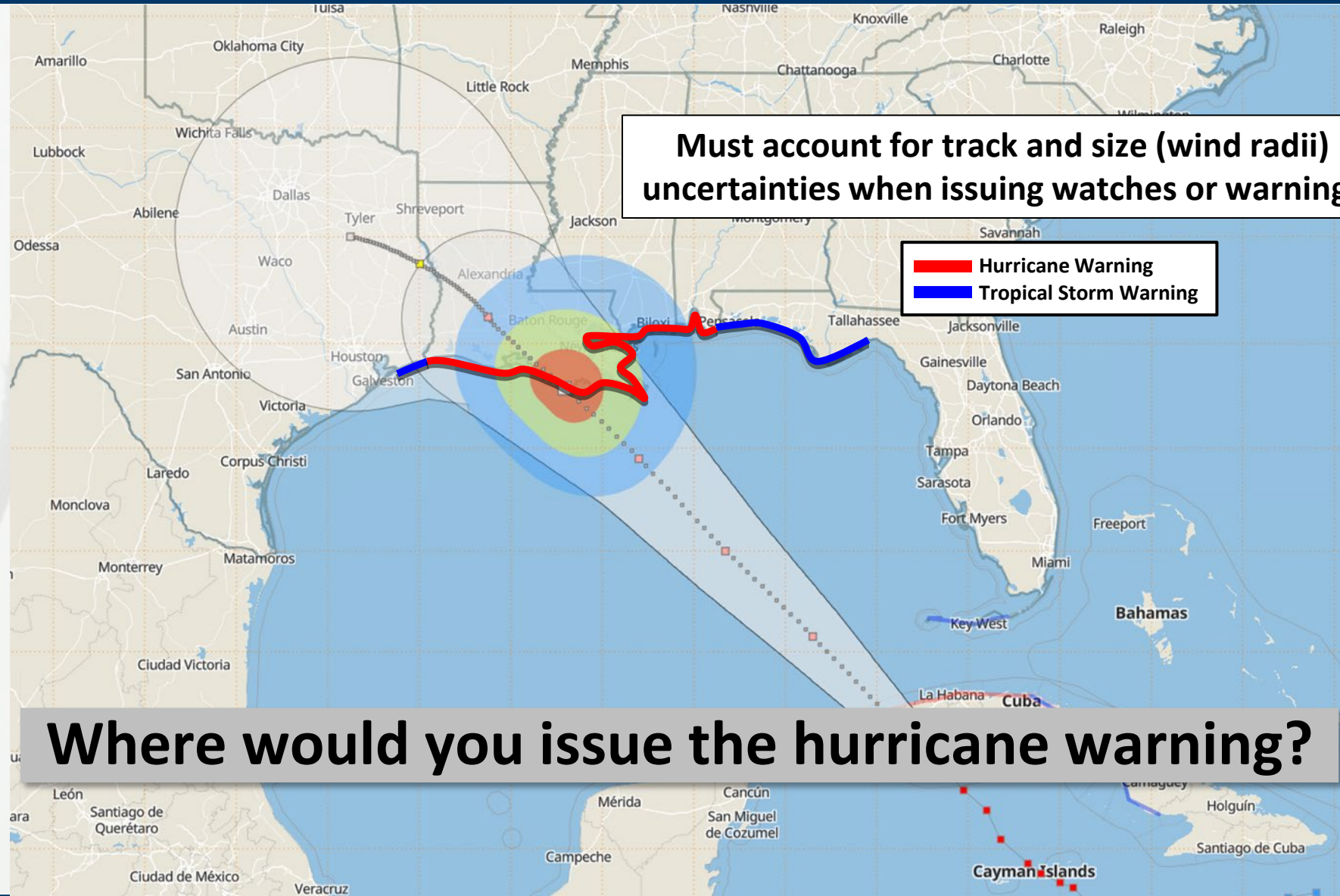
**Where would you issue the hurricane warning?**

# WATCHES & WARNINGS

*Where. When. What. Action.*



FEMA



Where would you issue the hurricane warning?



## QUIZ QUESTION

How often is a new NHC track and intensity forecast routinely issued?

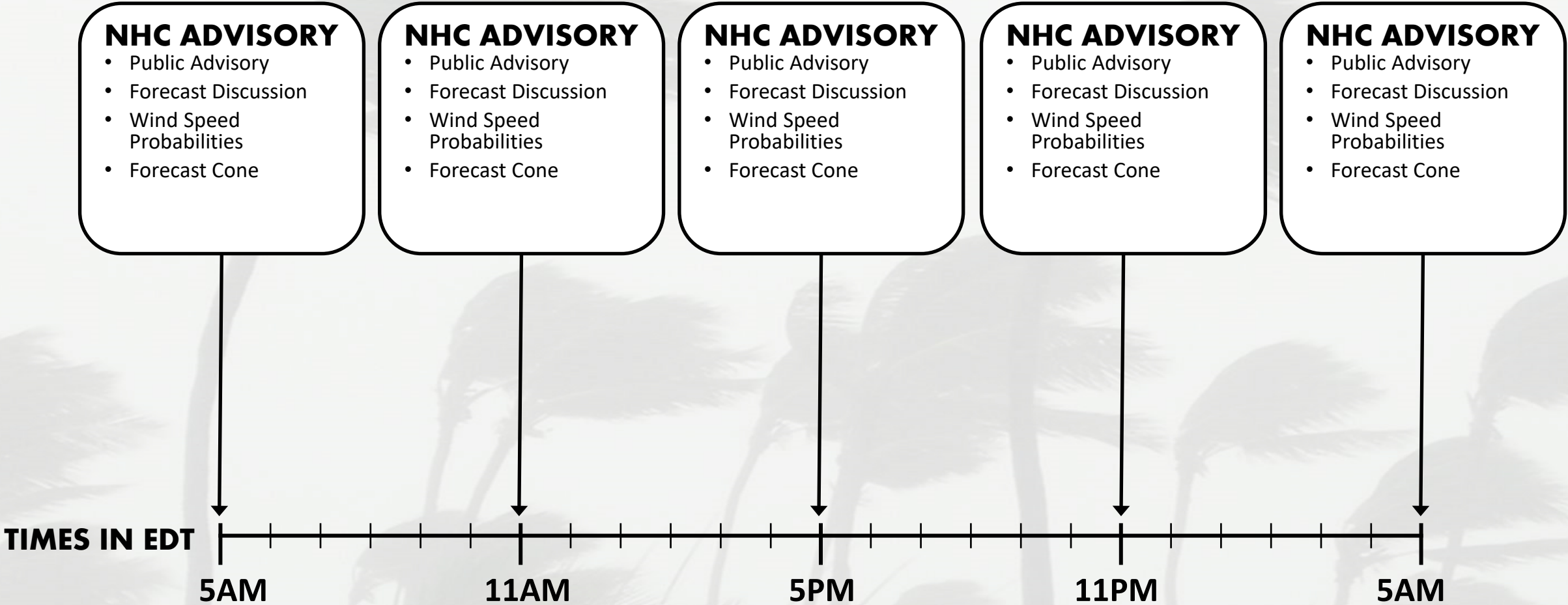
- A. Every 3 hours**
- B. Every 6 hours**
- C. Every 8 hours**
- D. Only when there is a change in the models**

# NHC ADVISORY TIMELINE

*Scheduled Updates*



## NO WATCHES/WARNINGS

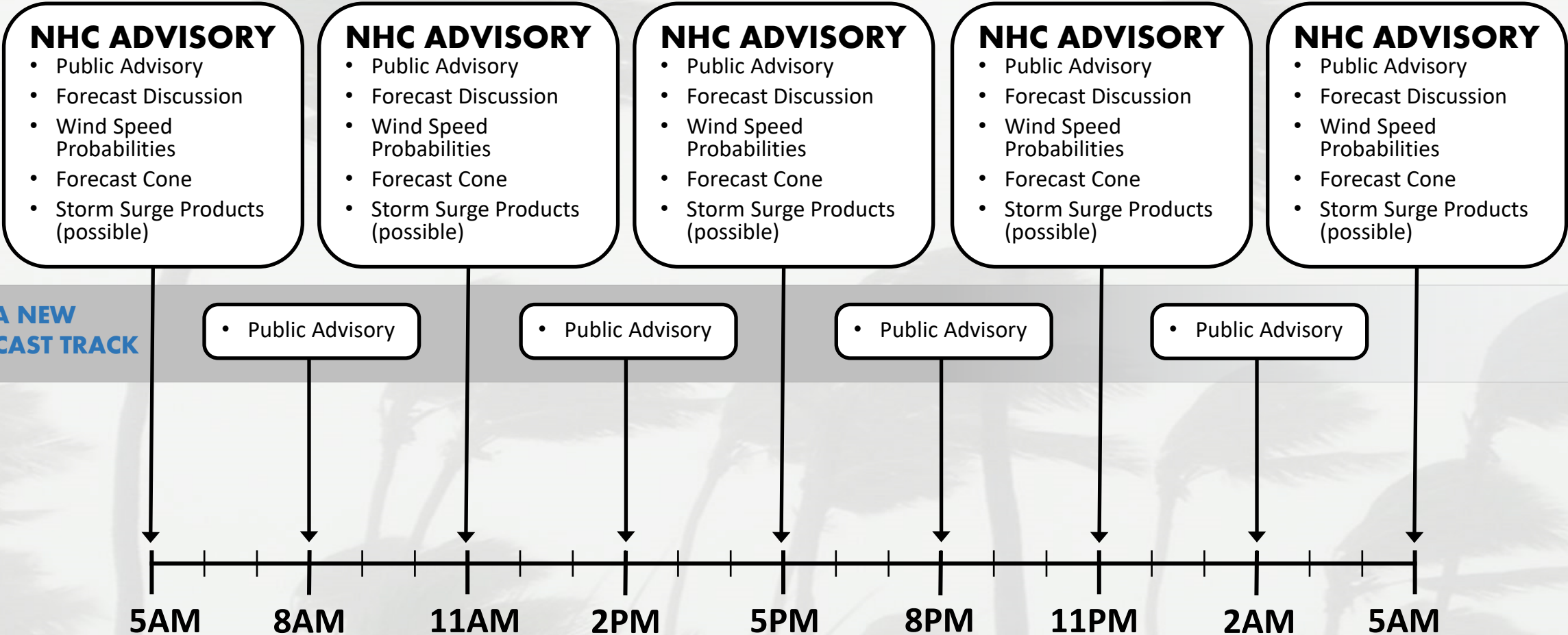


# NHC ADVISORY TIMELINE

*Scheduled Updates*





## WATCHES/WARNINGS *in effect*



# INTERMEDIATE PUBLIC ADVISORY

## *Issued when Watches or Warnings in effect*



**NATIONAL HURRICANE CENTER**  
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Tropical Storm Michael Intermediate Advisory Number 7A  
NWS National Hurricane Center Miami FL AL142018  
700 AM CDT Mon Oct 08 2018

...MICHAEL EXPECTED TO BECOME A HURRICANE VERY SOON...

SUMMARY OF 700 AM CDT...1200 UTC...INFORMATION  
-----

LOCATION...20.9N 85.1W  
ABOUT 70 MI...115 KM S OF THE WESTERN TIP OF CUBA  
MAXIMUM SUSTAINED WINDS...70 MPH...110 KM/H  
PRESENT MOVEMENT...N OR 5 DEGREES AT 7 MPH...11 KM/H  
MINIMUM CENTRAL PRESSURE...982 MB...29.00 INCHES

WATCHES AND WARNINGS  
-----

SUMMARY OF WATCHES AND WARNINGS IN EFFECT:

A Storm Surge Watch is in effect for...

- \* Navarre Florida to Anna Maria Island Florida, including Tampa Bay

A Hurricane Watch is in effect for...

- \* Alabama-Florida border to Suwannee River Florida

A Tropical Storm Watch is in effect for...

- \* Suwannee River to Anna Maria Island Florida, including Tampa Bay
- \* Alabama-Florida border to the Mississippi-Alabama border

**Similar content but issued  
3 hours after complete  
advisory package**

✓ **Watch or Warning in effect**

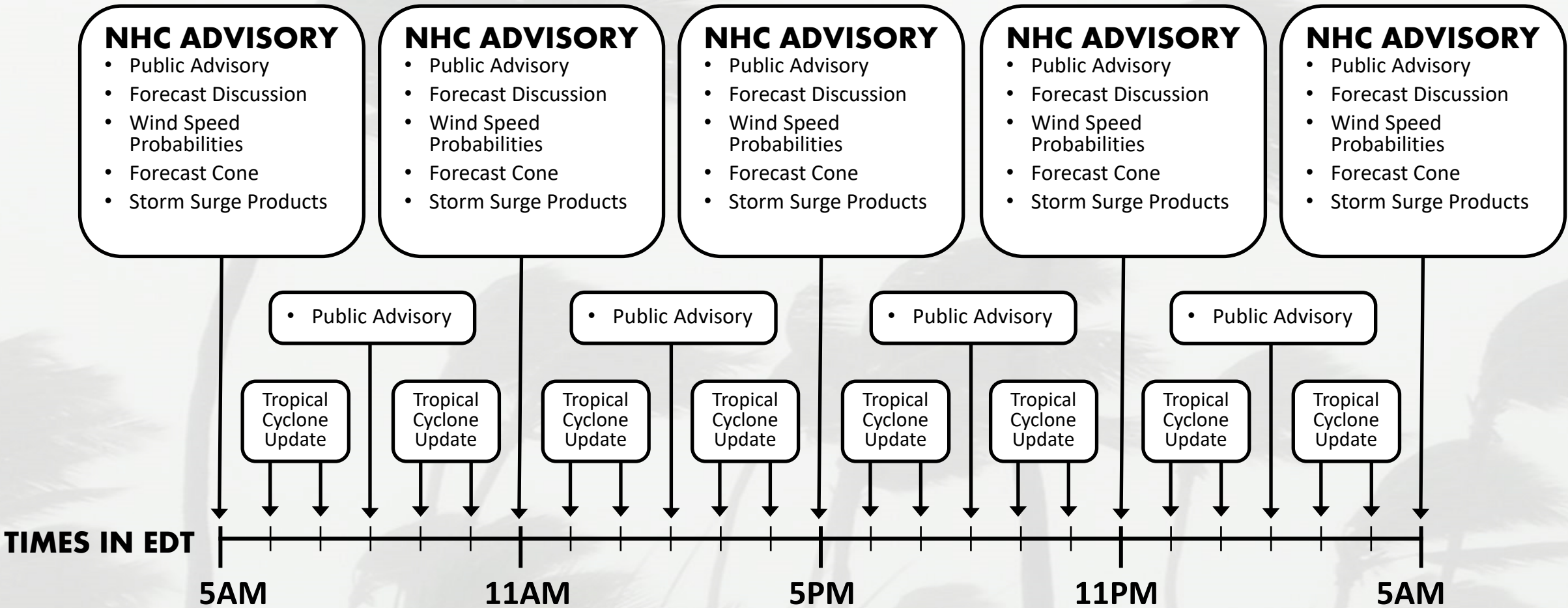


# NHC ADVISORY TIMELINE

*Scheduled Updates*



## WATCHES/WARNINGS *in effect and eye tracked by radar*





# TROPICAL CYCLONE UPDATE

## *Unexpected Changes. Location. Landfall.*



FEMA



### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Hurricane Michael Tropical Cyclone Update  
NWS National Hurricane Center Miami FL AL142018  
1200 PM CDT Wed Oct 10 2018

...EYEWALL OF MICHAEL COMING ASHORE...

With the landfall of Michael's eye imminent, everyone in the landfall area is reminded not to venture out into the relative calm of the eye, hazardous winds will increase quickly as the eye passes!

A weather station at the Gulf County Emergency Operations Center in Port St. Joe recently reported a wind gust of 106 mph (171 km/h). A Weatherflow station in St. Andrew Bay recently reported a sustained wind of 62 mph (100 km/h) and a wind gust of 77 mph (124 km/h). The Apalachicola airport recently reported sustained winds of 63 mph (102 km/h) with a gust of 89 mph (143 km/h).

Water levels continue to rise quickly along the Florida Panhandle coast. A National Ocean Service water level station at Apalachicola recently reported over 6.5 feet of inundation above ground level.

SUMMARY OF 1200 PM CDT...1700 UTC...INFORMATION  
-----  
LOCATION...29.9N 85.7W  
ABOUT 15 MI...25 KM WSW OF MEXICO BEACH FLORIDA  
MAXIMUM SUSTAINED WINDS...150 MPH...240 KM/H  
PRESENT MOVEMENT...NNE OR 15 DEGREES AT 14 MPH...22 KM/H  
MINIMUM CENTRAL PRESSURE...919 MB...27.14 INCHES

\$\$  
Forecaster Brown/Brennan

NNNN

- Unexpected changes occur in the cyclone

- Cyclone landfall

- Issuing international watches and warnings

- 1-hourly position estimates when a cyclone with an eye is nearing land

## **FAQs**

- What areas will flood?
  - How high could the water get?
- **Storm Surge Products**

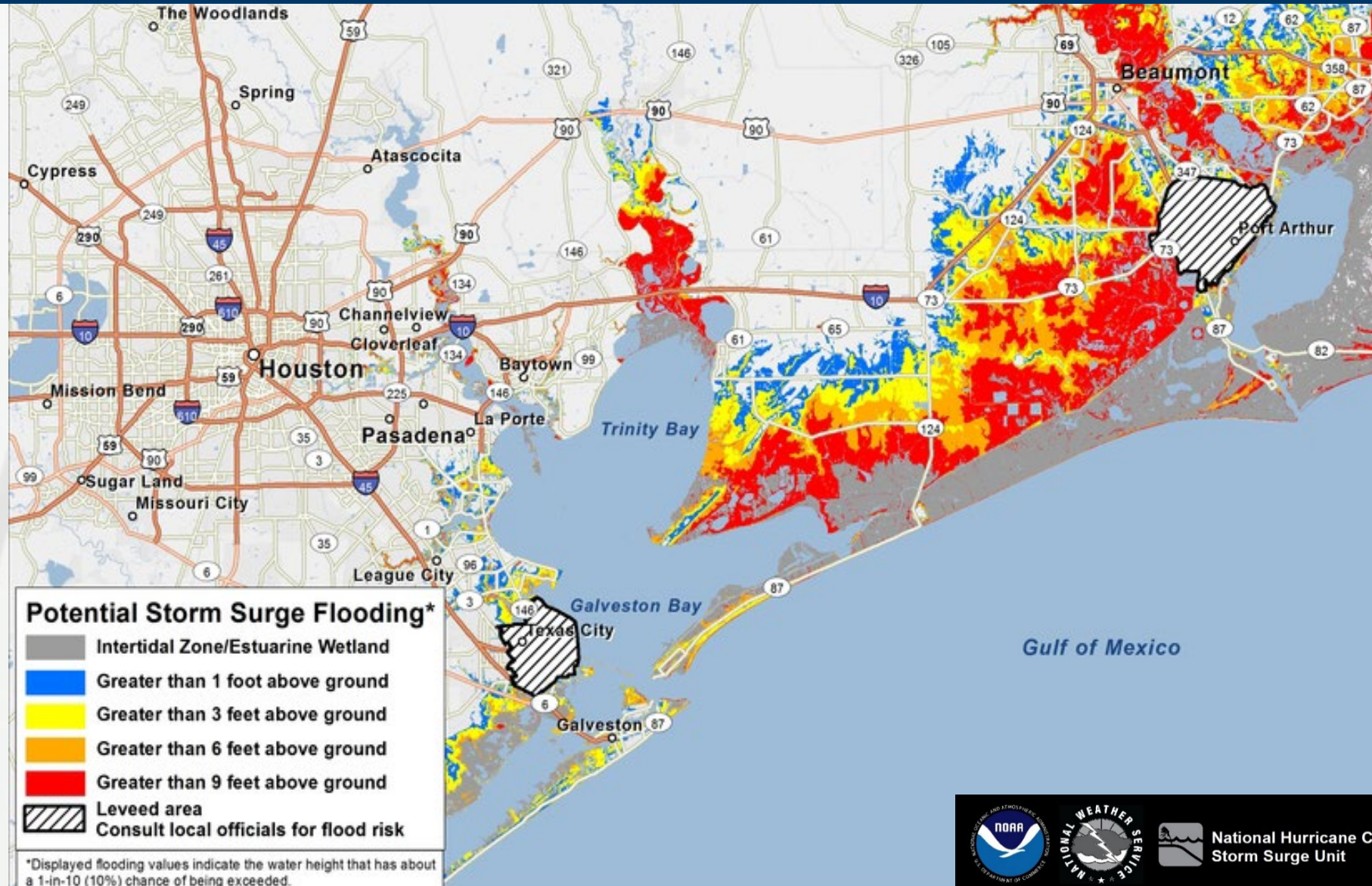


# STORM SURGE

## *Potential Storm Surge Flooding Map*



FEMA



National Hurricane Center  
Storm Surge Unit



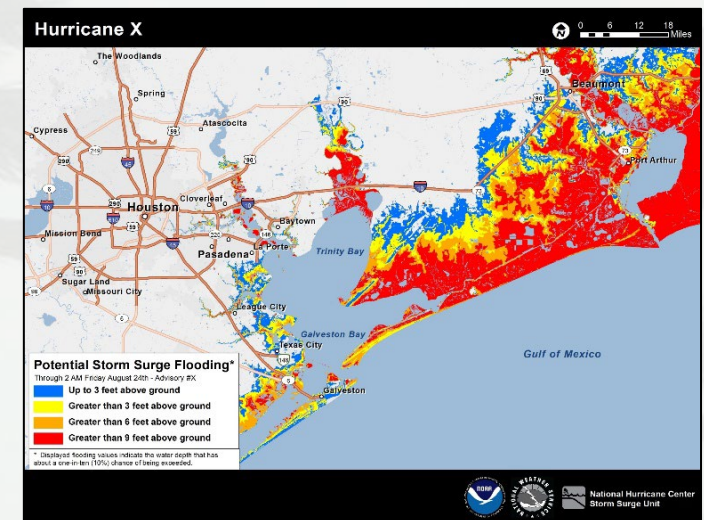
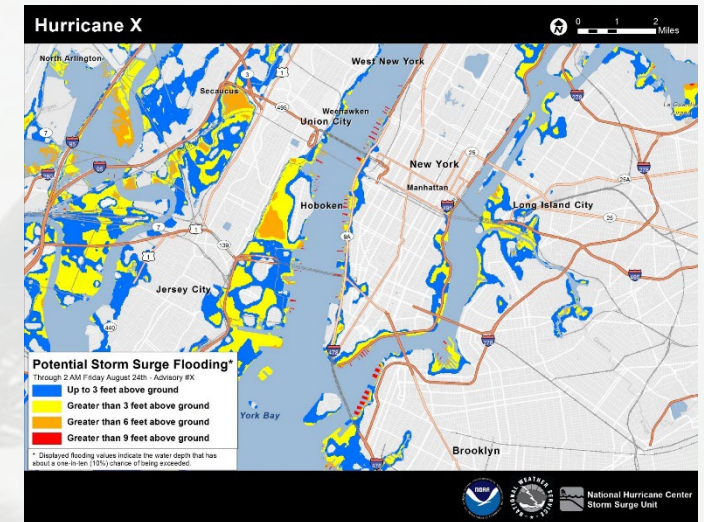
# STORM SURGE

## *Potential Storm Surge Flooding Map*



### INUNDATION MAP

- Height above ground that the water could reach
  - Reasonable worst-case scenario for any individual location
  - Values have a 10% chance of being exceeded
- Issuance with hurricane watch
  - In some cases for a tropical storm watch
- Available 60+ minutes after the advisory release

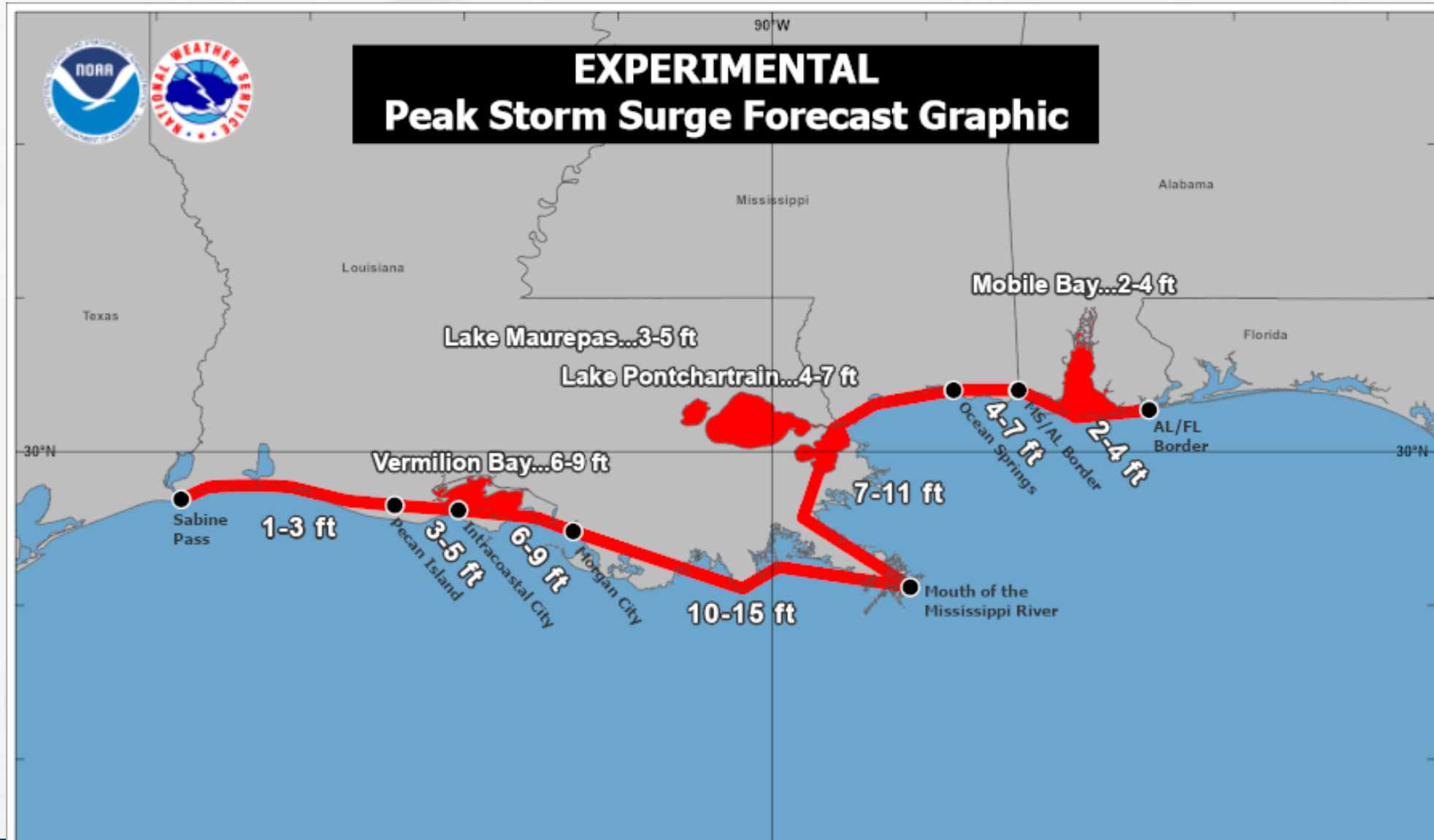


# STORM SURGE

## *Peak Storm Surge Forecast Graphic*



FEMA



## **FAQs**

- What areas will flood?
- How much rain is forecast?

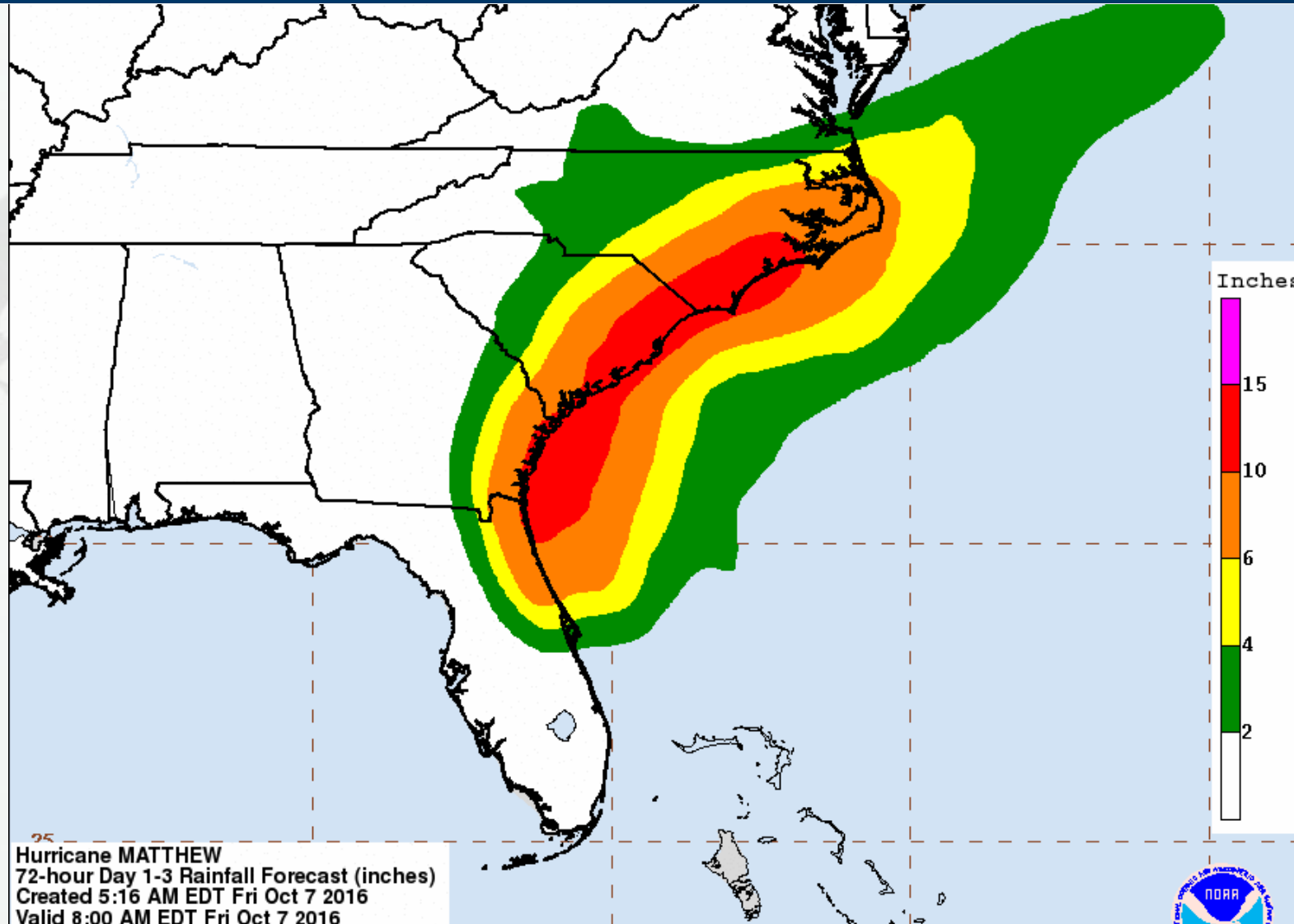
- **Rainfall Products**

# WEATHER PREDICTION CENTER

## *Rainfall Forecast*



FEMA



Hurricane MATTHEW  
72-hour Day 1-3 Rainfall Forecast (inches)  
Created 5:16 AM EDT Fri Oct 7 2016  
Valid 8:00 AM EDT Fri Oct 7 2016  
through 8:00 AM EDT Mon Oct 10 2016  
NOAA/NWS/NCEP/WPC

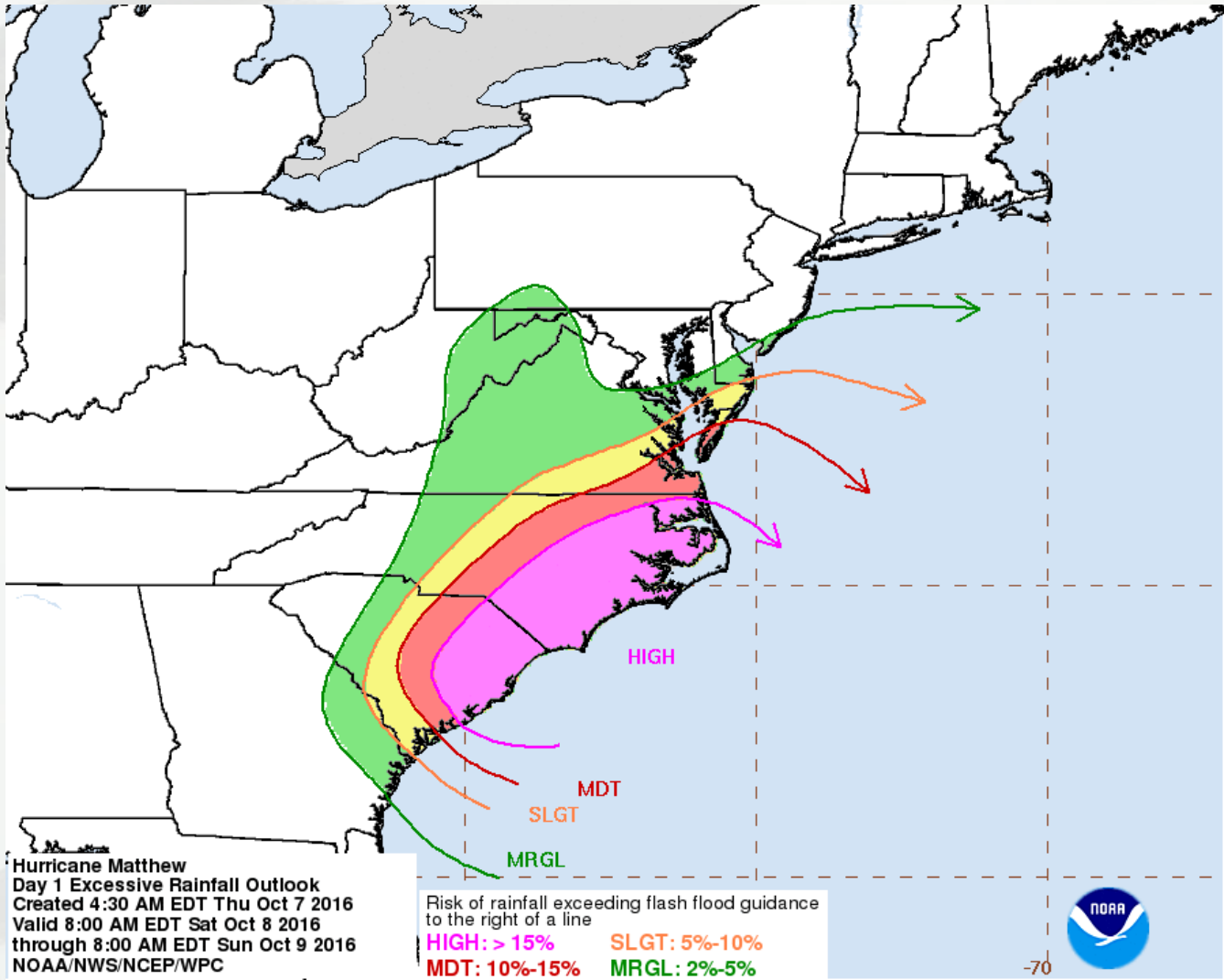
Local point maximum rainfall may be higher than shown.  
See the NHC public advisories for the latest tropical cyclone information.





# WEATHER PREDICTION CENTER

## *Excessive Rainfall Outlook*



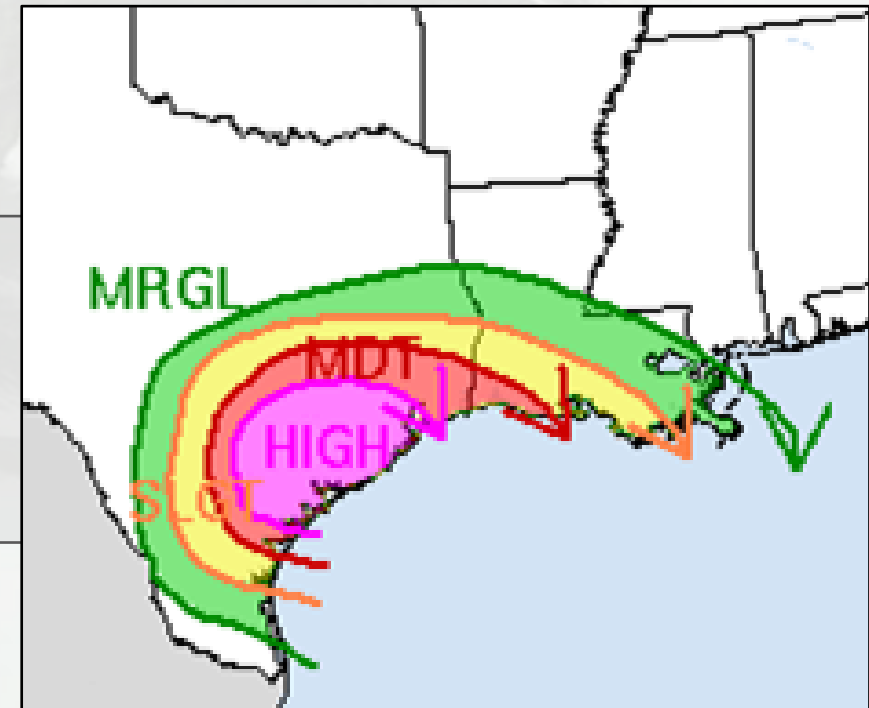
## High Risk Days

- About 4% of days  
(Includes tropical and non-tropical events)

## What happens during High Risk days?

- 46% have at least 1 fatality or injury
- 62% have at least \$1 million in damages

*Stats from 2010 to 2020*



## High Risk Days

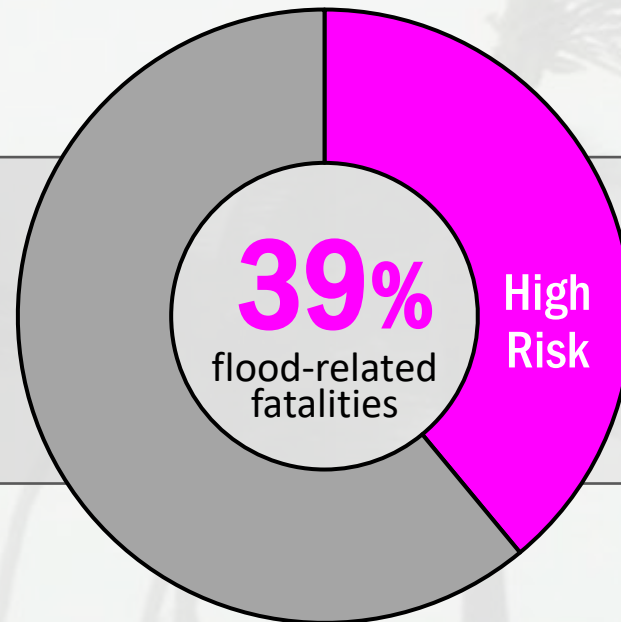
- About 4% of days  
(Includes tropical and non-tropical events)

## High Risk Accounts for:

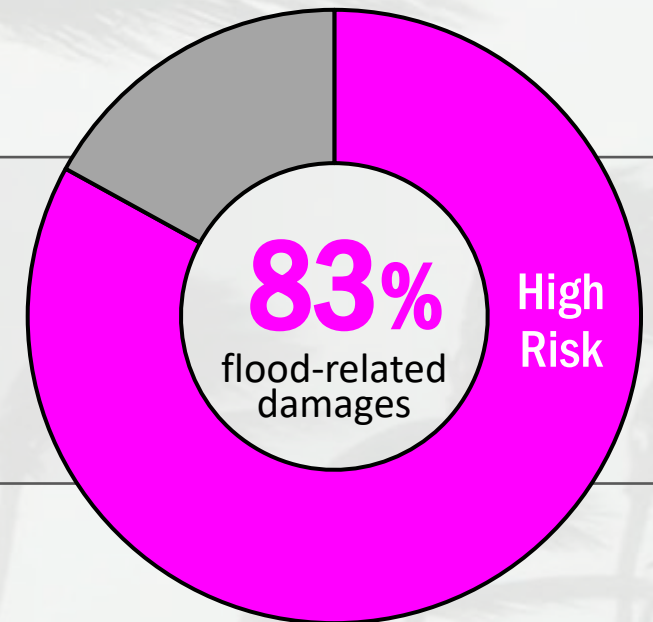
- 39% of Flood Fatalities
- 83% of Flood Damages

*Stats from 2010 to 2020*

## Fatalities



## Damages



## **FAQs**



- Local impacts?
  - Localized forecast information?
  - Inland Watches and Warnings?
- **NWS Forecast Offices**



# NWS FORECAST OFFICES

## *Hurricane Local Statements*





### NATIONAL HURRICANE CENTER

NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

**Hurricane Irma Local Statement** Advisory Number 44  
National Weather Service Miami FL AL112017  
1153 PM EDT Sat Sep 9 2017

This product covers SOUTH FLORIDA

**\*\*MAJOR HURRICANE IRMA CONTINUING TO INCH TOWARD SOUTH FLORIDA\*\***

NEW INFORMATION  
-----

\* CHANGES TO WATCHES AND WARNINGS:  
- The Storm Surge Warning has been cancelled for Coastal Broward, Coastal Palm Beach, and Metro Miami-Dade

\* CURRENT WATCHES AND WARNINGS:  
- A Storm Surge Warning and Hurricane Warning are in effect for Coastal Collier, Coastal Miami-Dade, Far South Miami-Dade, Inland Collier, Inland Miami-Dade, and Mainland Monroe

\* STORM INFORMATION:  
- About 160 miles south-southwest of Miami FL  
- 23.5N 81.0W  
- Storm Intensity 120 mph  
- Movement Northwest or 305 degrees at 6 mph

SITUATION OVERVIEW  
-----

Major Hurricane Irma remains a very dangerous threat for all of South Florida, with a direct major hurricane impact expected over Southwest Florida.

**Issued by local NWS office**

- Hurricane (Tropical Storm) Watch/Warning in effect

**Situation overview**

- Watch/warning information
- Potential impact information
- Preparedness actions

# NWS FORECAST OFFICES

## *Hurricane Local Statements*



FEMA



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#### SITUATION OVERVIEW

-----

Major Hurricane Irma remains a very dangerous threat for all of South Florida, with a direct major hurricane impact expected over Southwest Florida.



**What is the  
affected area?**

# NWS FORECAST OFFICES

## *Hurricane Local Statements*



FEMA



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**SITUATION OVERVIEW**  
-----

Major Hurricane Irma remains a very dangerous threat for all of South Florida, with a direct major hurricane impact expected over Southwest Florida.

**Are there any  
changes since  
the last update?**

# NWS FORECAST OFFICES

## *Hurricane Threats & Impacts (HTI)*



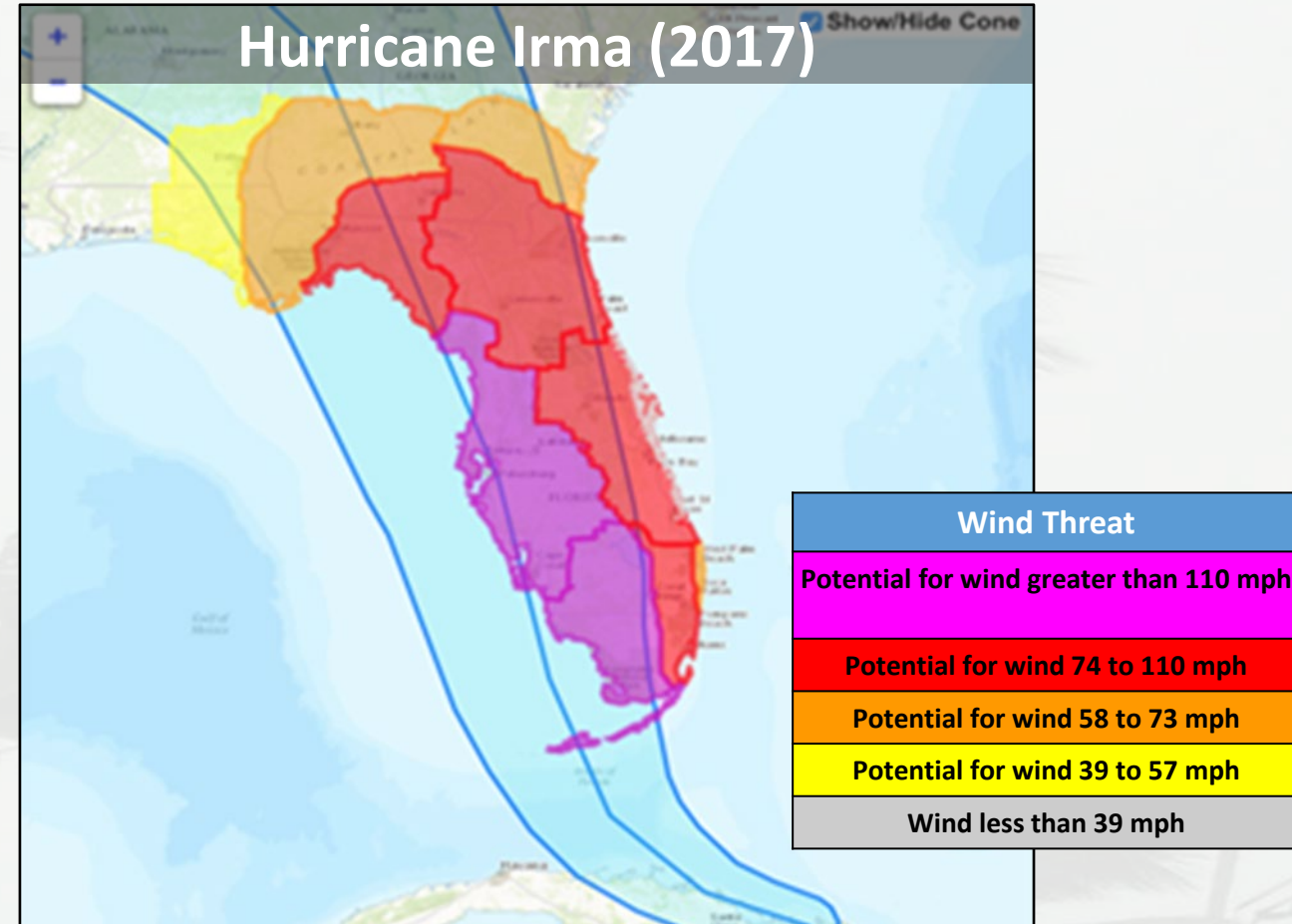
FEMA

## HAZARDS

- Wind
- Storm Surge
- Flooding Rain
- Tornadoes

## THREAT & IMPACTS

- Elevated (yellow)
- Moderate (orange)
- High (red)
- Extreme (magenta)



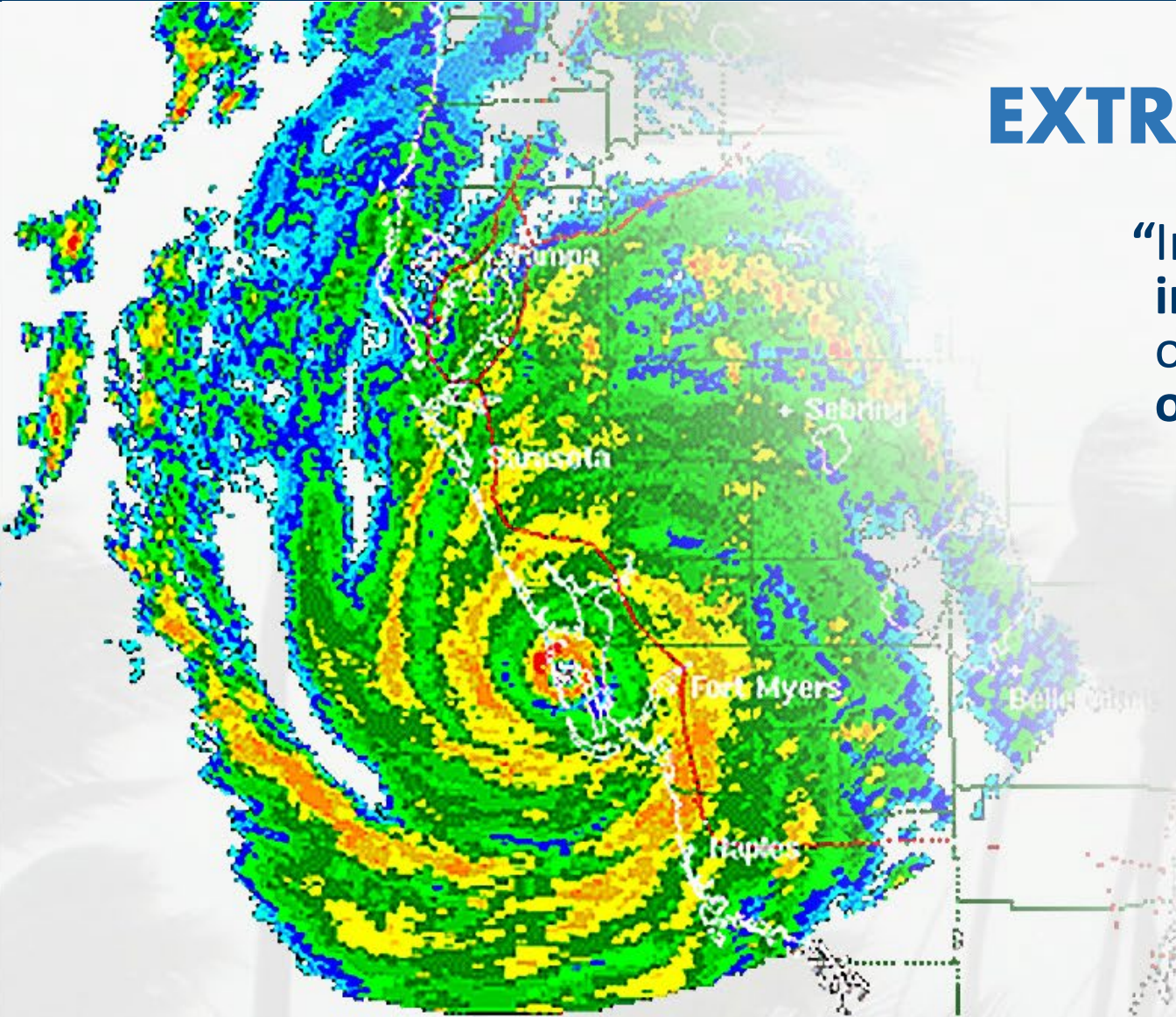


## EXTREME WIND WARNING

“Inform the public of the need to take **immediate shelter** in an interior portion of a well-built structure **due to the onset of extreme tropical cyclone winds.**”

### Issuance criteria:

- Category 3 or greater
- Valid time 2 hours or less



# NWS PRODUCTS

*When is key information available?*



FEMA

Normal Operations	1b Elevated Threat	1c Credible Threat			2a-3a RAHP Activities
Year Round	Hurricane Season 120hr - 72hr	72hr - 48hr	48hr - 36hr	36hr - Landfall (Onset of TS Winds)	Post Landfall

→ TIME →

# NWS PRODUCTS

*When is key information available?*



FEMA

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Hurricane Evacuation Study (HES) products <small>(Surge MOMs, Surge Maps, Evacuation Zones, Clearance times, other planning data)</small>					
Coastal Flood Loss Atlas				HAZUS output	

→ TIME →

# NWS PRODUCTS

*When is key information available?*



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	Tropical Weather Outlook					

→ TIME →

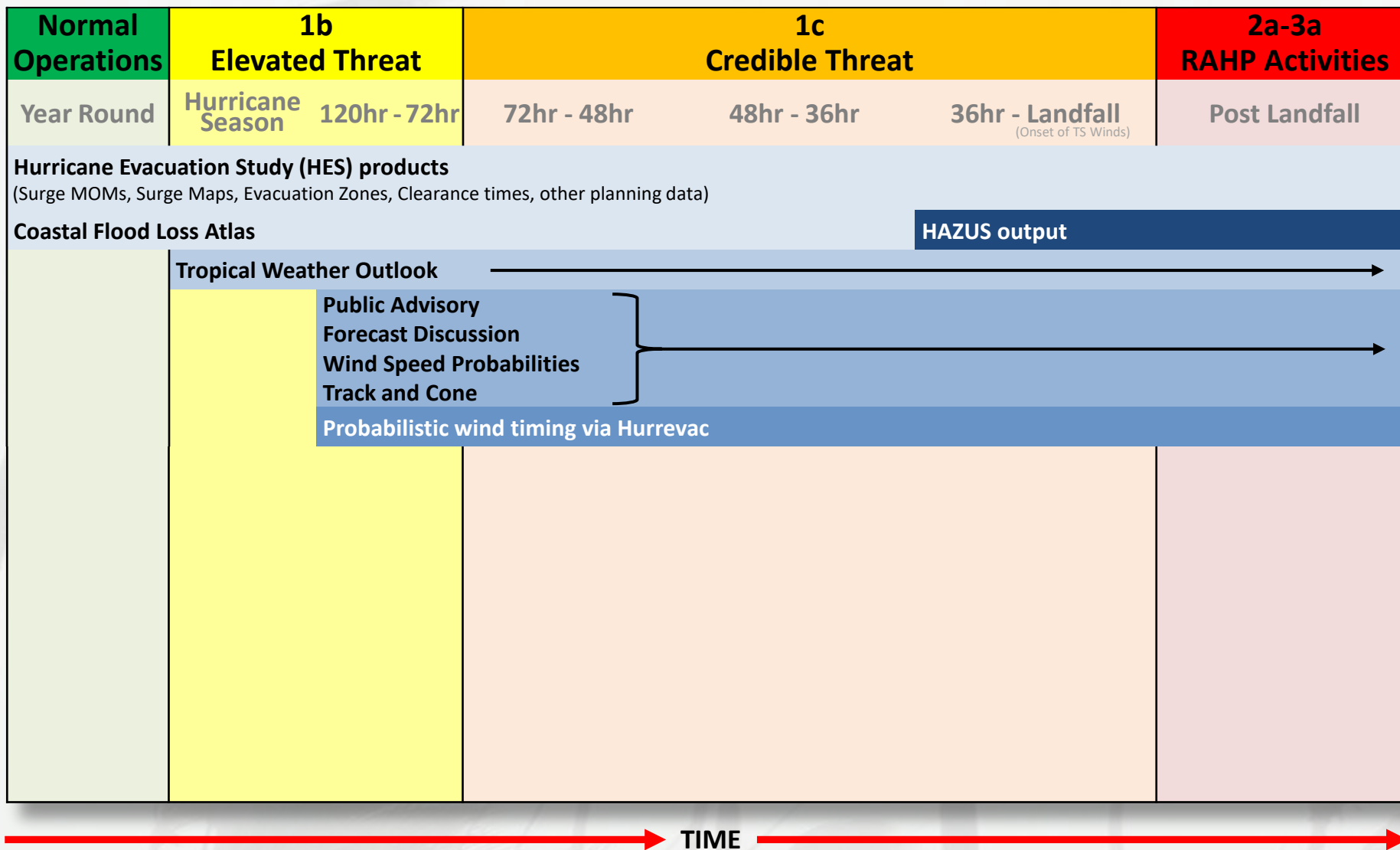


# NWS PRODUCTS

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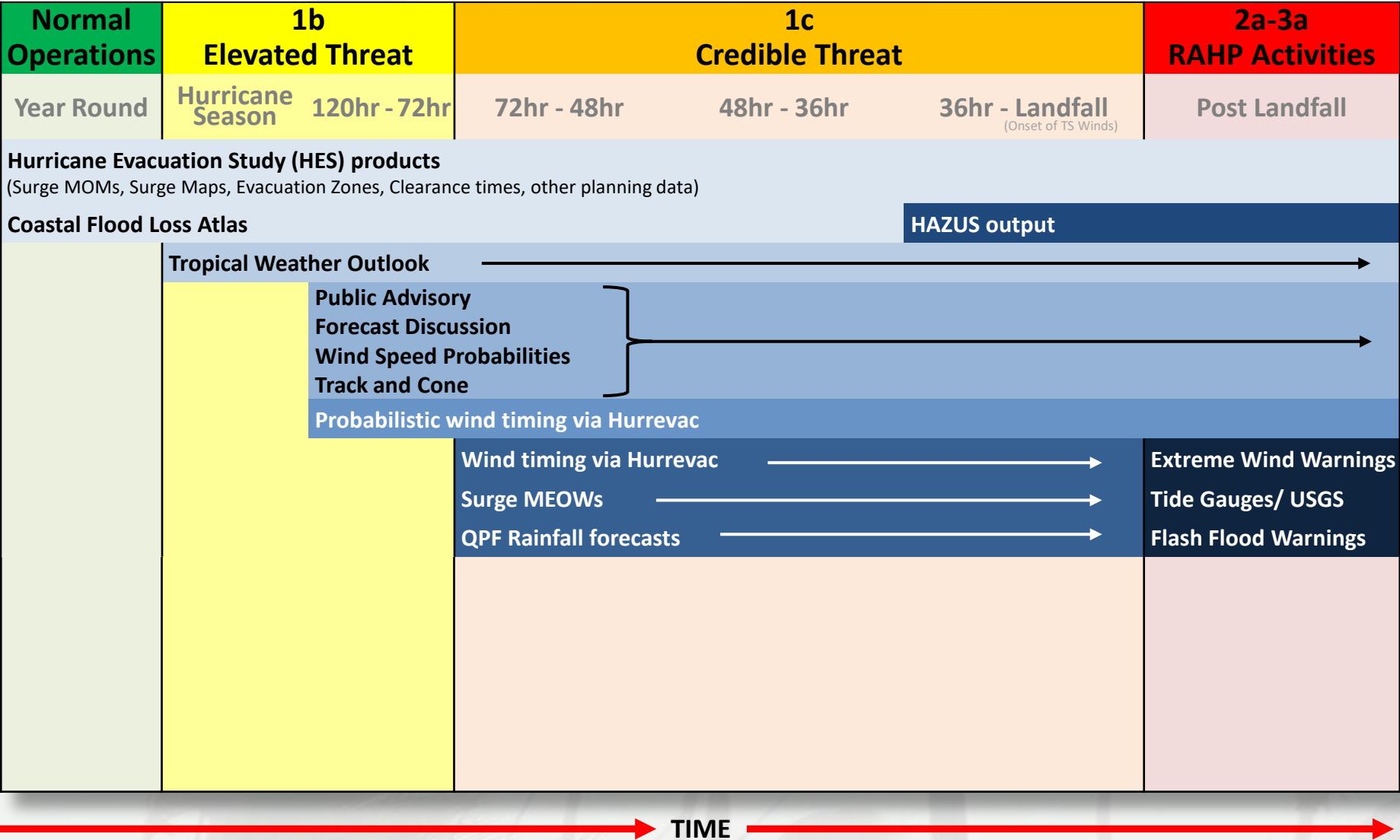


FEMA



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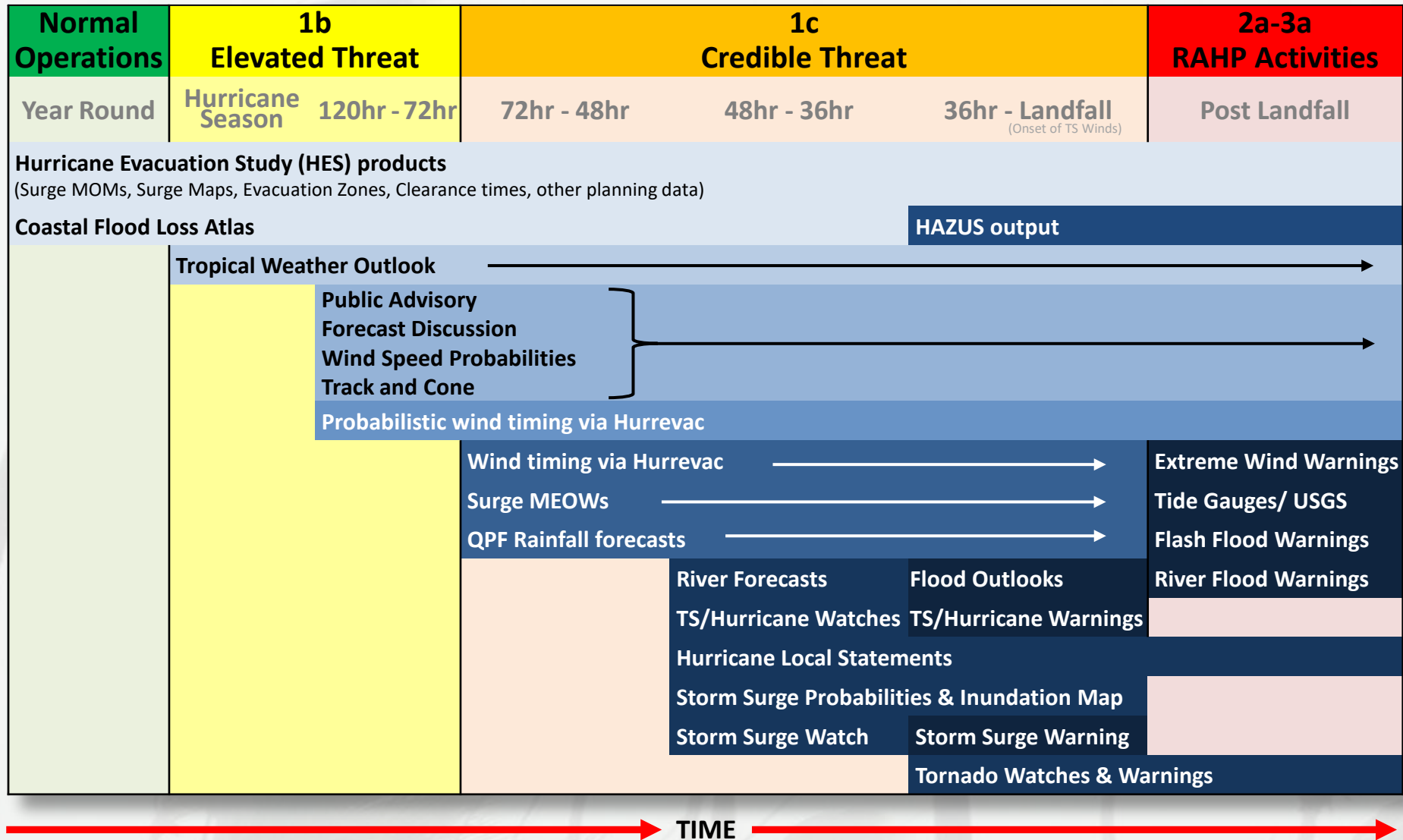


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*When is key information available?*



FEMA

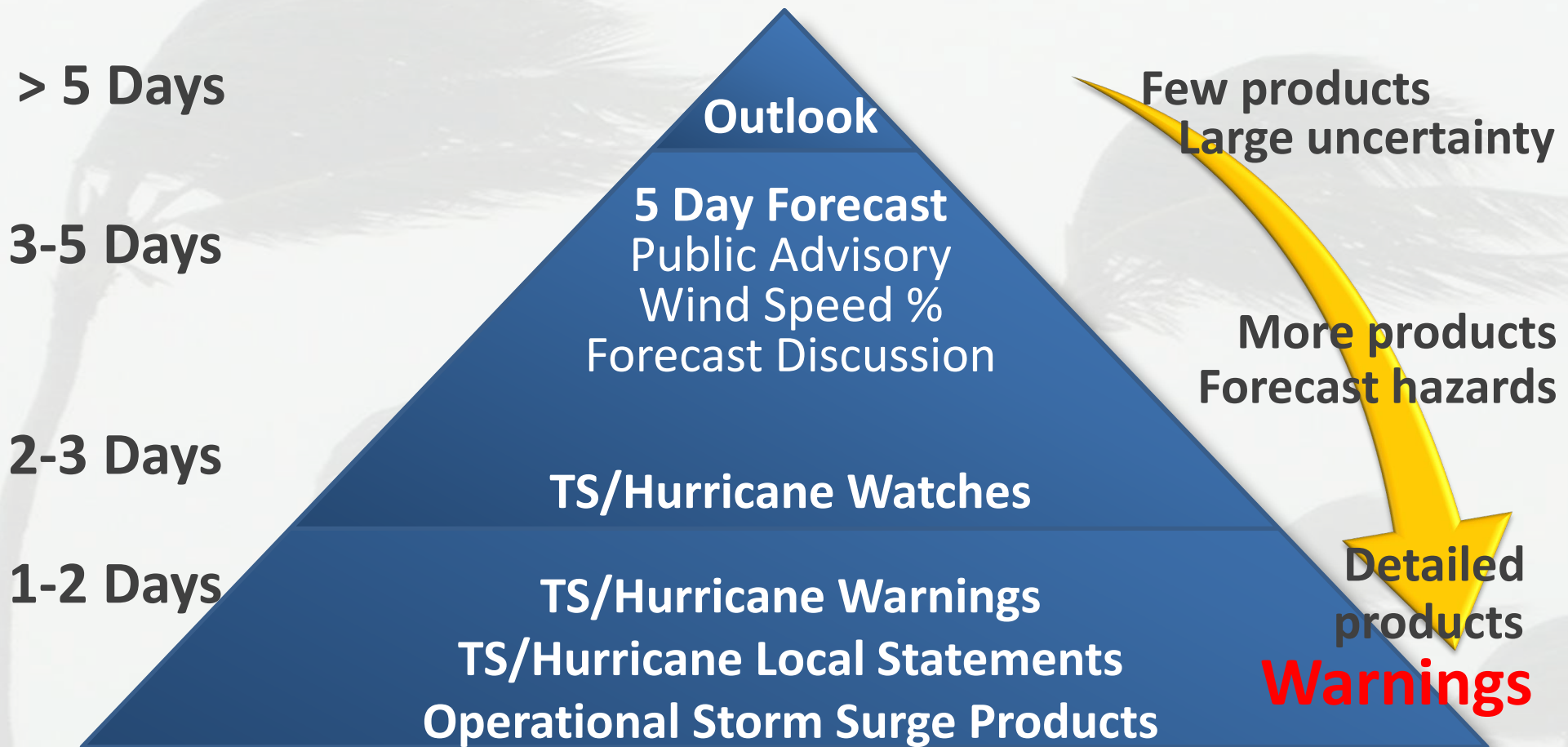


# NATIONAL WEATHER SERVICE

## *Tropical Cyclone Products*



FEMA





# HURRICANE READINESS

## L0311



FEMA

The background of the slide features a large, detailed image of a hurricane's eye and surrounding clouds on the left. On the right, there is a blue circular road sign with a white hurricane symbol and the text "EVACUATION ROUTE" in white capital letters. Below this sign is a rectangular blue sign with a white arrow pointing to the right. The National Weather Service National Hurricane Center website is overlaid in the center.

National Weather Service  
National Hurricane Center

Home News Organization Search [ ] NWS All NOAA Go

Top News of the Day... view past news Last update Fri, 4 Jul 2014 01:21:13 UTC

- **NHC issuing advisories on Hurricane ARTHUR and TD DOUGLAS**
- Inside the Eye: Storm Surge—Plain and Simple (Part 2)
- Five-day Graphical Tropical Weather Outlook introduced (PDF) - video overview
- Update on NHC Products and Services for 2014 (PDF)

Eastern Pacific Atlantic

Atlantic Tropical Cyclone Activity

ARTHUR

3:00 am EDT  
Fri Jul 4 2014

# Questions/Comments?