



Unit 2: National Weather Service Products

Unit 2 Objectives



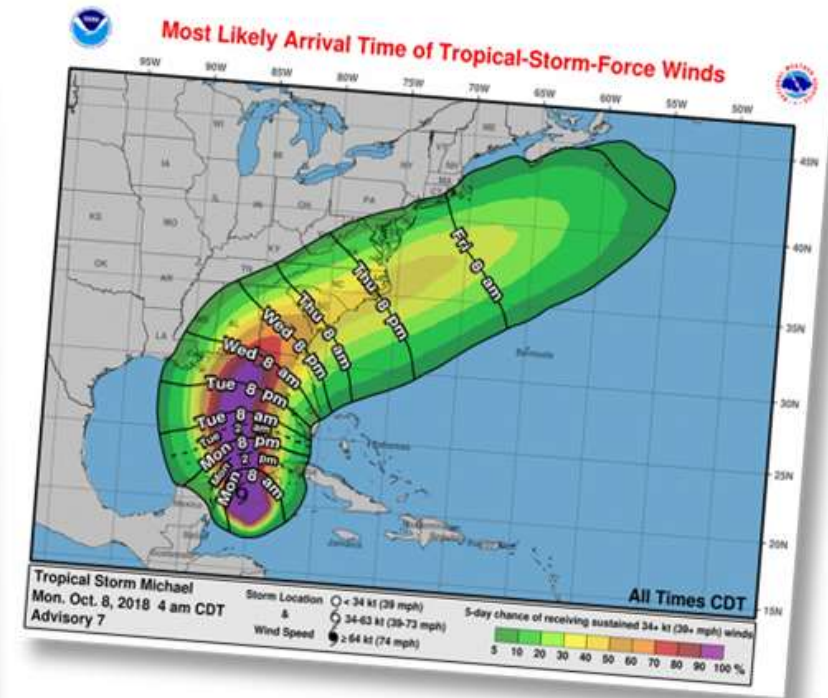
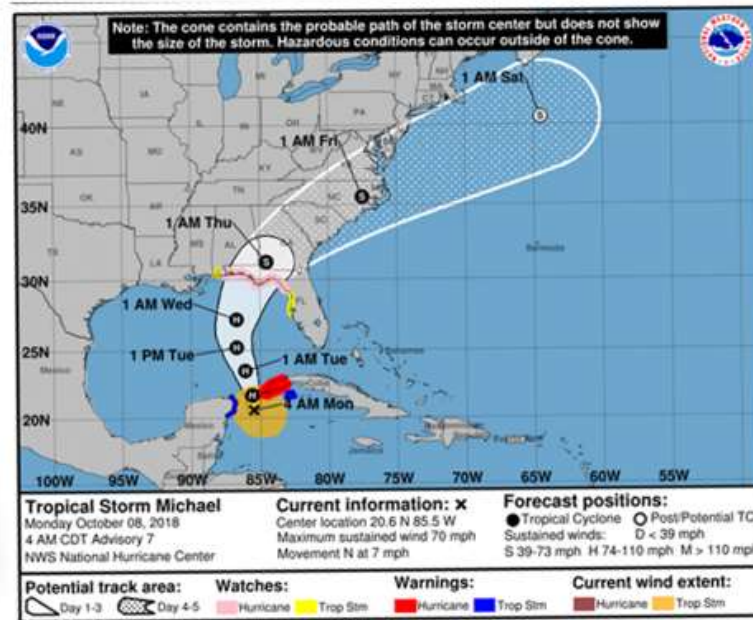
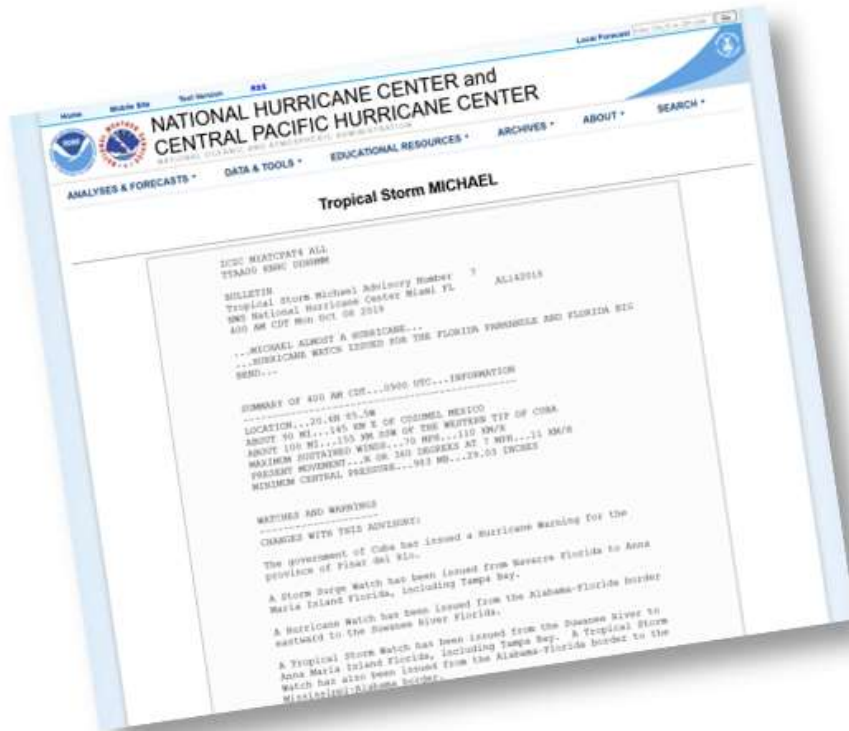
Unit Objectives

- **At the end of Unit 2, you should be able to:**
 - Use NHC text-based and graphical products.
 - Explain when NHC products are available.
 - Explain where to find critical information in NHC products to answer key questions.

Tropical Cyclone Products



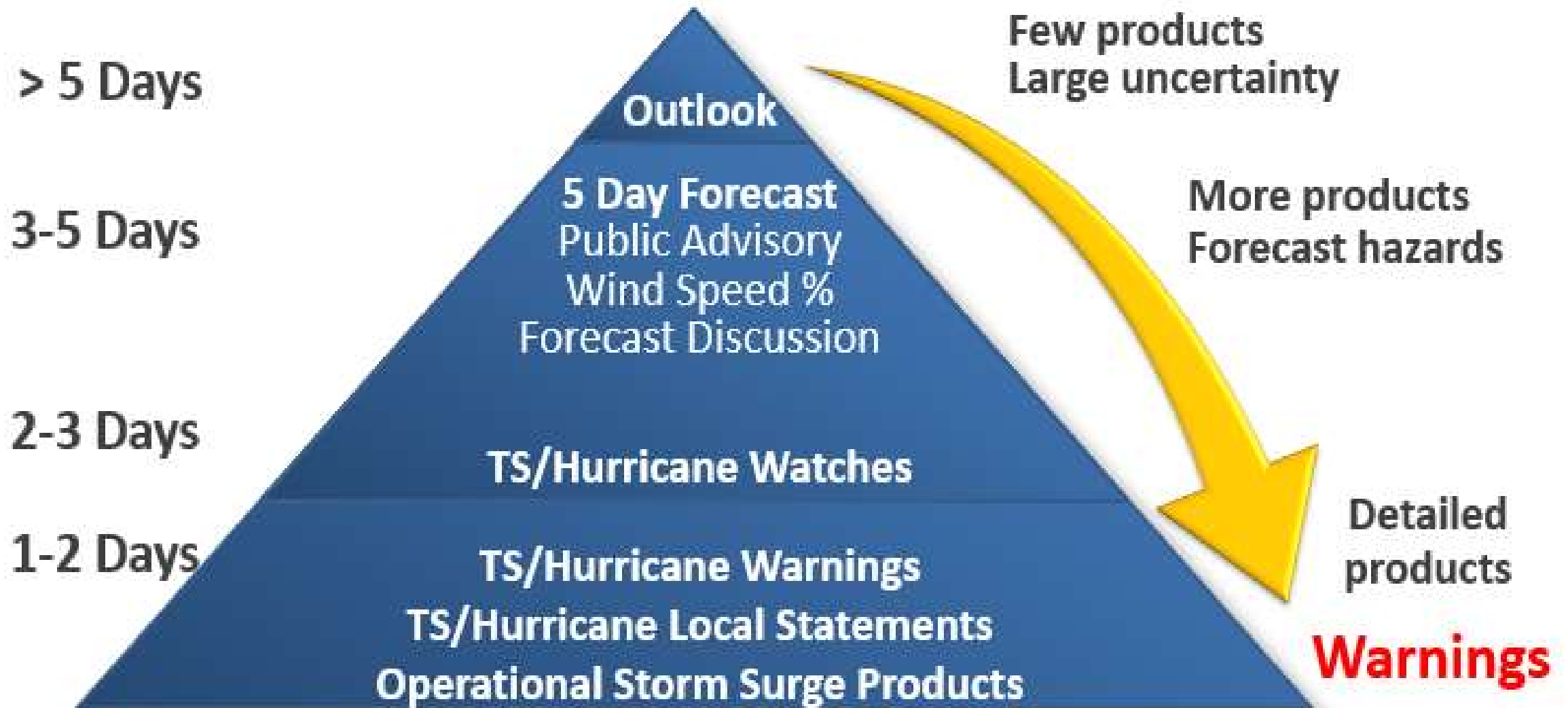
The National Hurricane Center provides the ‘big picture’ that complements and guides local NWS forecast office products.



Tropical Cyclone Products Timeframe



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Frequently Asked Questions 1



FAQs

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

- **Tropical Weather Outlook**

Outlook Schedule



- **Issued May 15 through November 30**
 - 2 a.m. EDT
 - 8 a.m. EDT
 - 2 p.m. EDT
 - 8 p.m. EDT
- **A Special Tropical Outlook can be issued at any time for significant or unexpected changes.**



Tropical Weather Outlook – Text 1



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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

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 7 days...medium...60 percent.

Forecaster Brown

Potential for development?
Headed where?

Tropical Weather Outlook – Text 2



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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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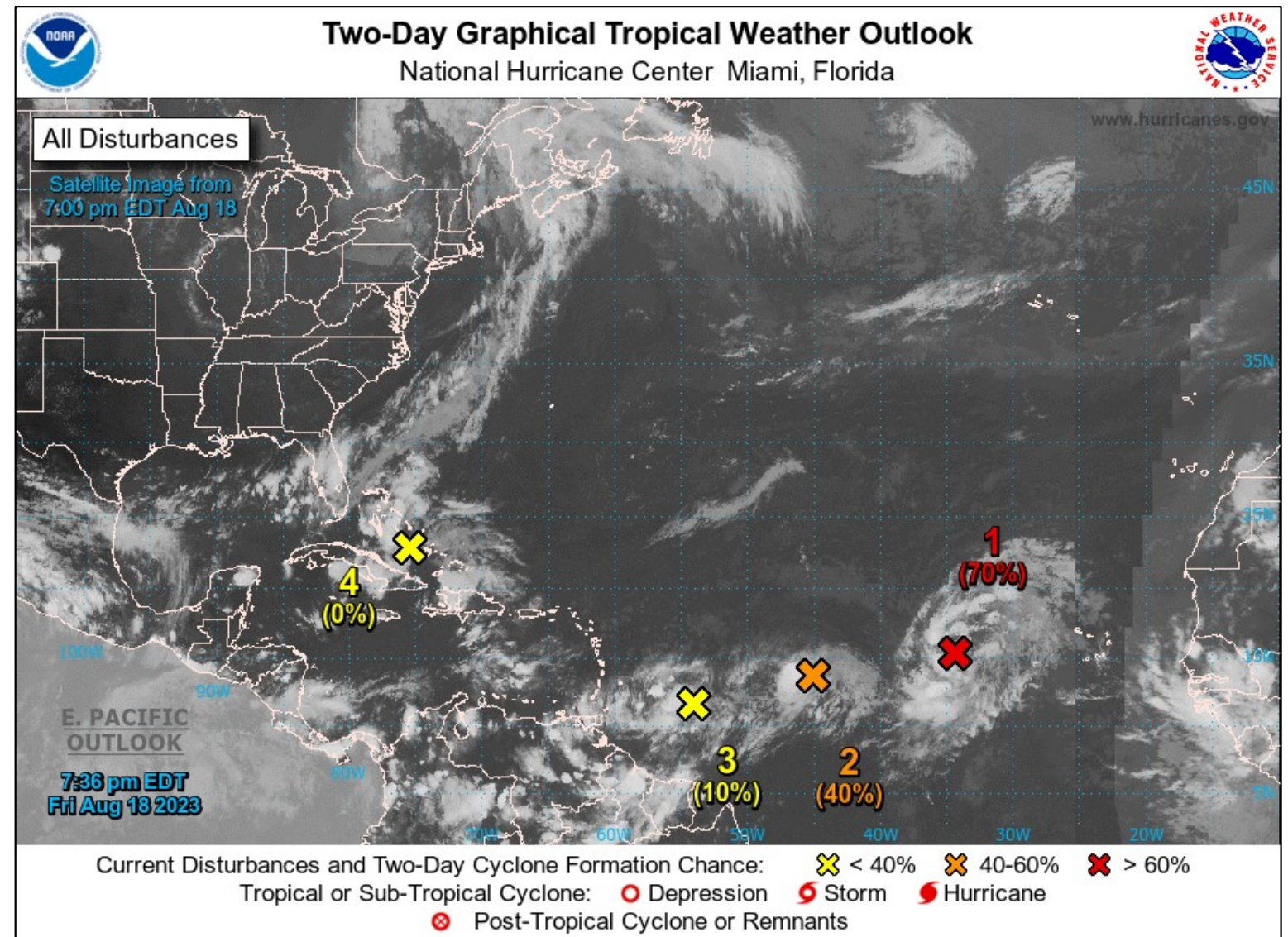
Forecaster Brown

← Sending a plane?

2-Day Formation Potential

Tropical Outlook

- **Current location of disturbances**
- **48-hr formation chance**
 - Categorical (Low–Med–High)
 - Probabilities

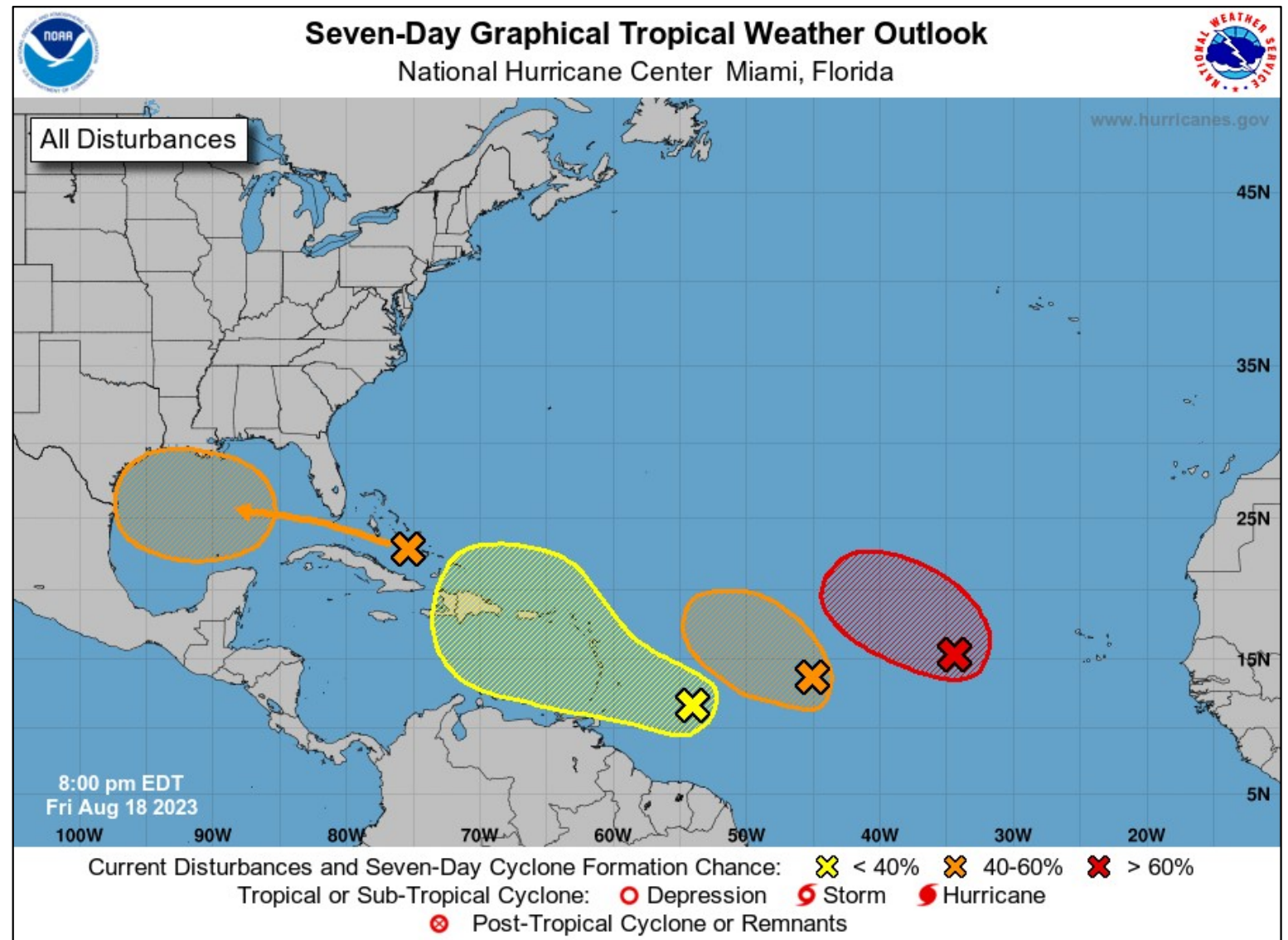


7-Day Formation Potential



Tropical Outlook

- **Initial location of disturbance (x) indicated, if it exists**
- **Formation potential during next 7 days**
 - Shading represents the potential formation area



Tropical Weather Outlook Example 1



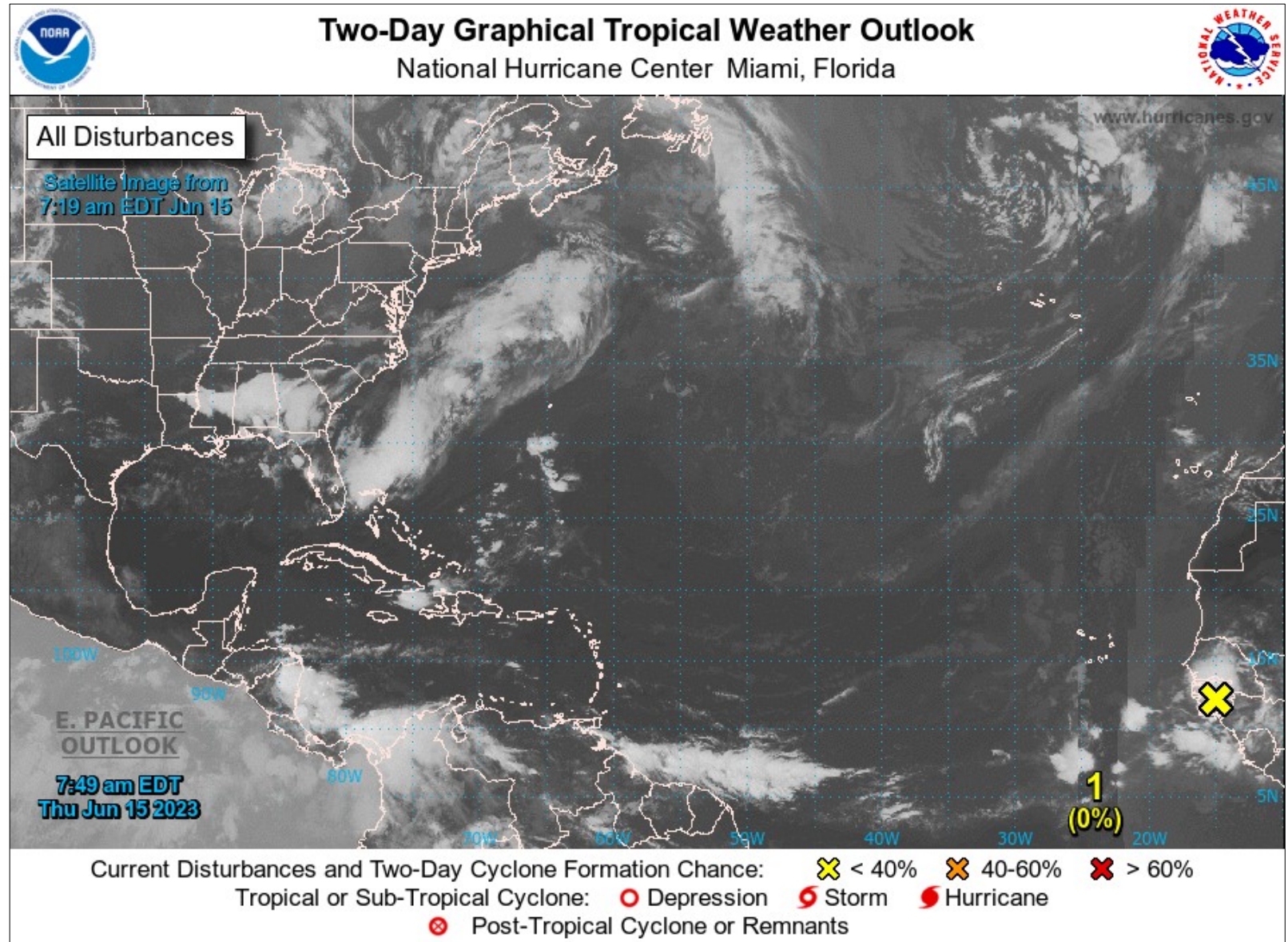
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Tropical Outlook

- **June 15**

2 Day – 0%

7 Day – 20%



Tropical Weather Outlook Example 2



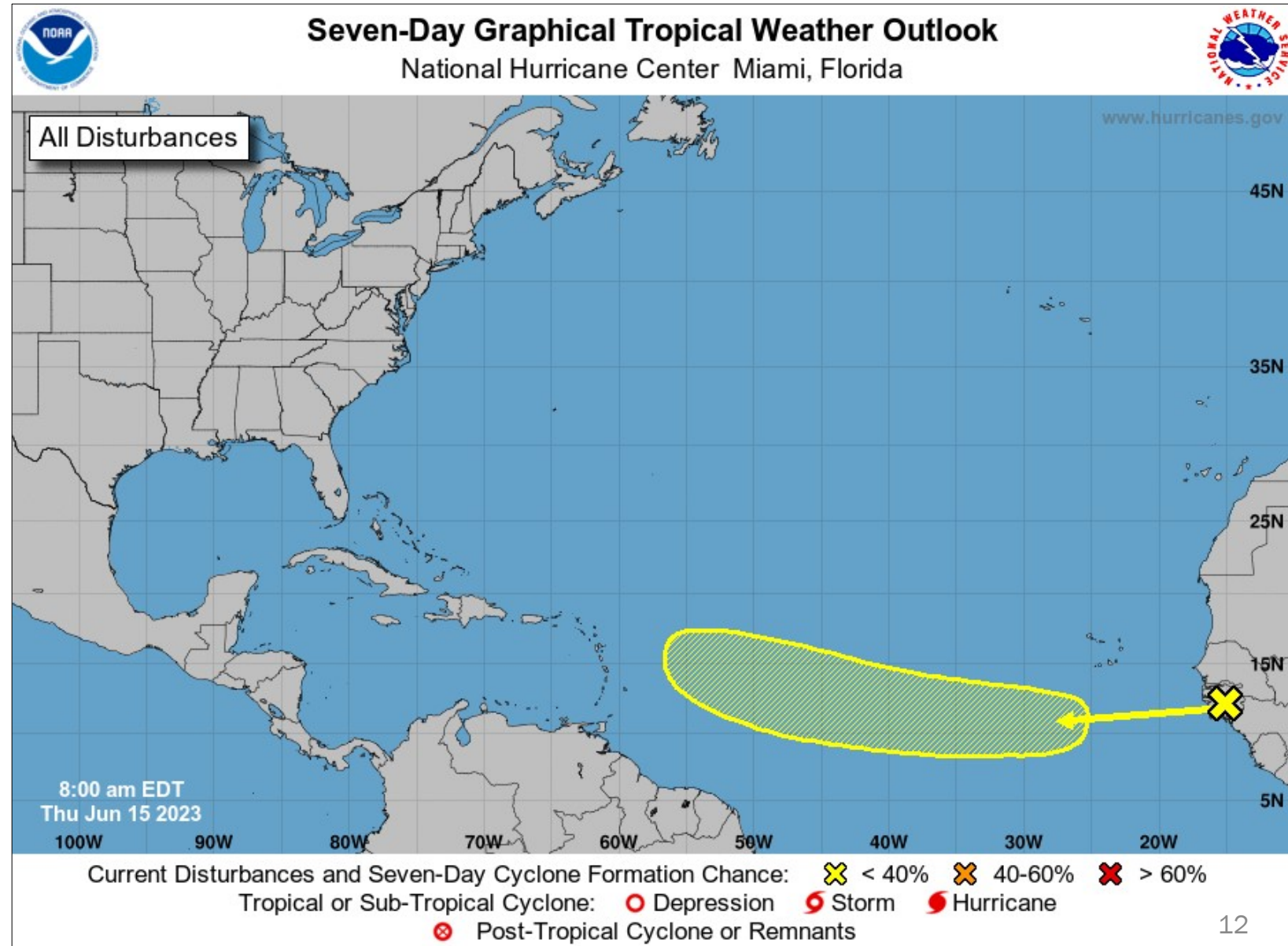
FEMA

Tropical Outlook

- **June 15**

2 Day – 0%

7 Day – 20%



Tropical Weather Outlook Example 3



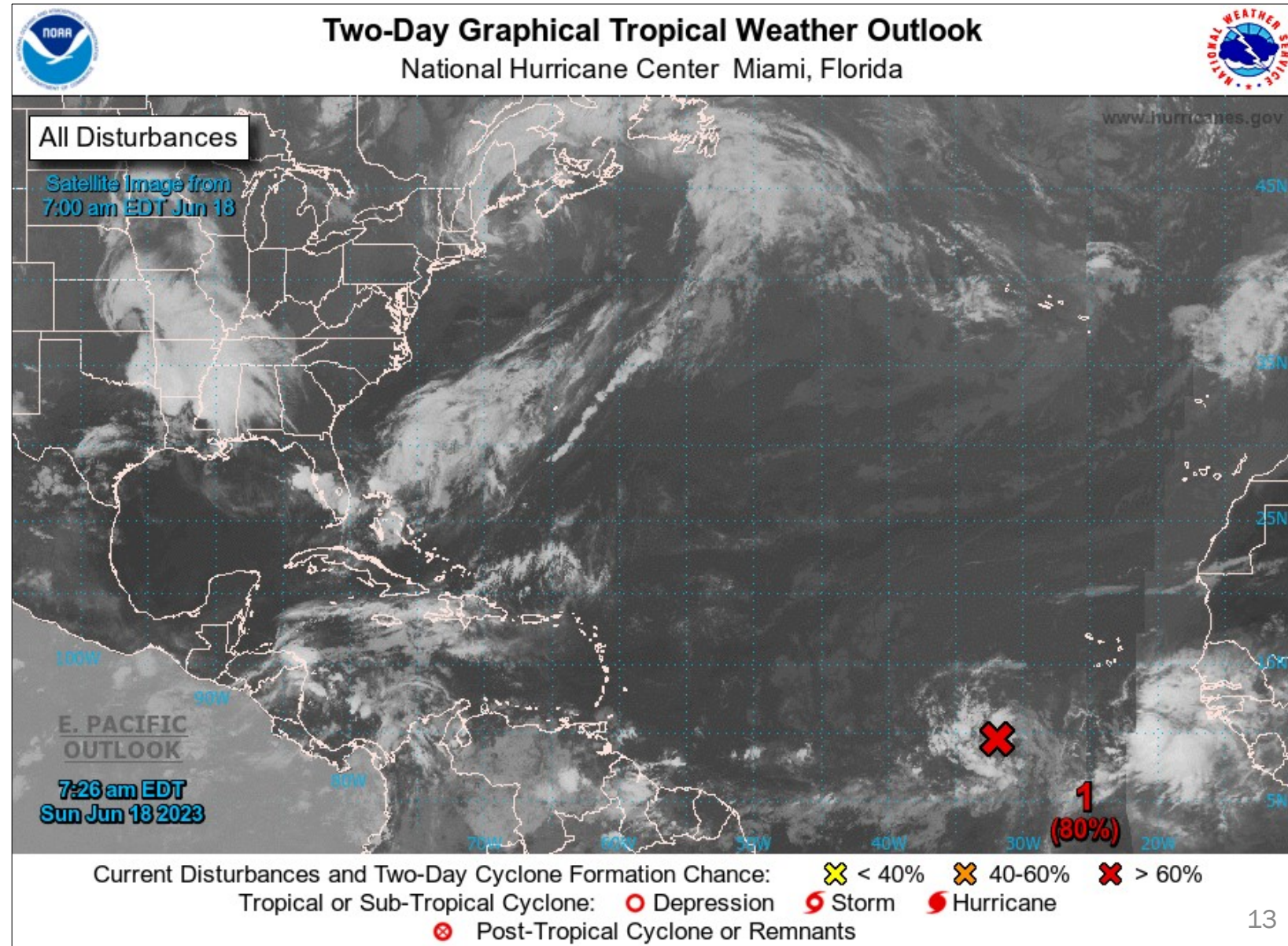
FEMA

Tropical Outlook

- **June 18**

2 Day – 80%

7 Day – 90%



Tropical Weather Outlook Example 4



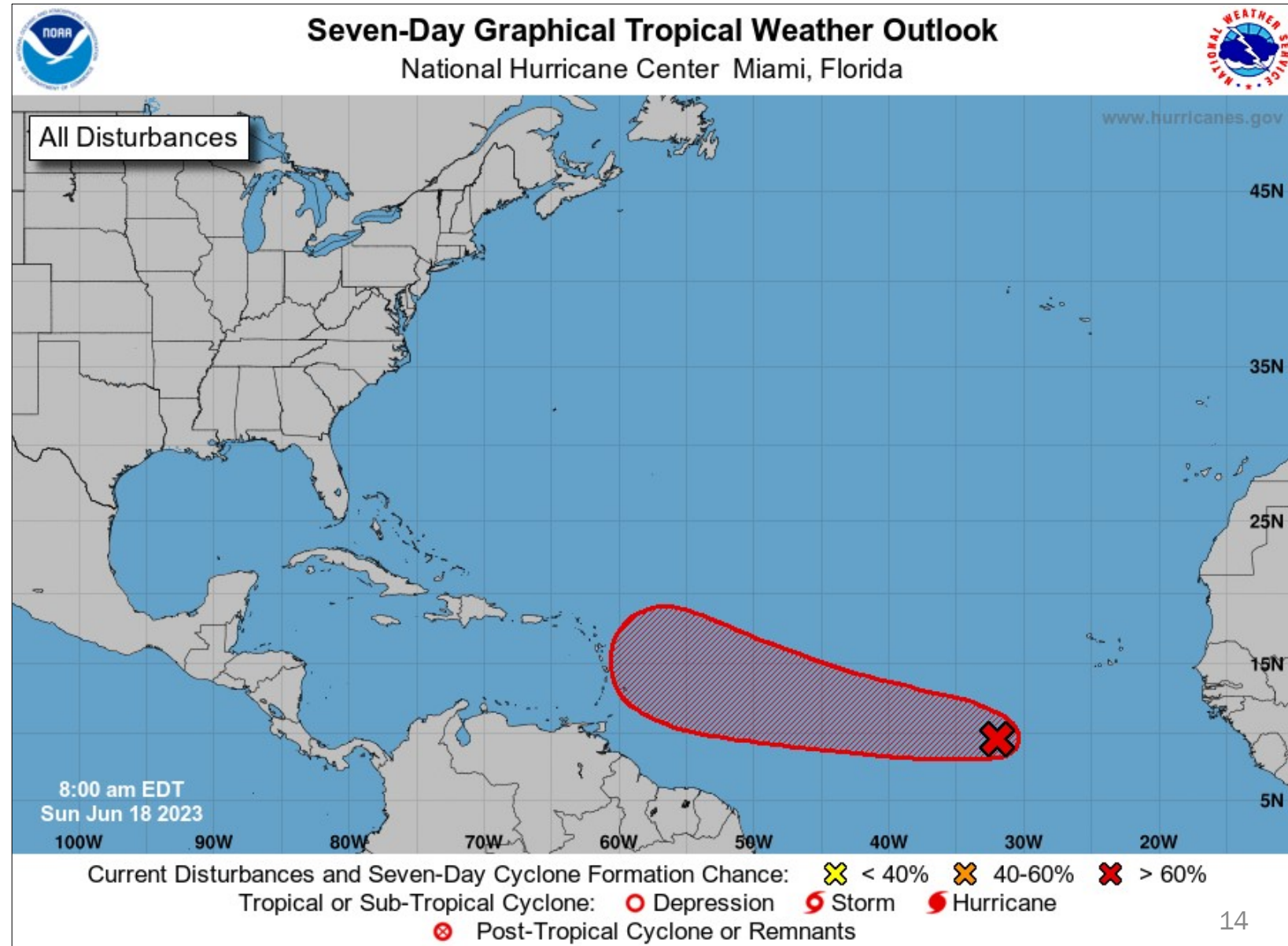
FEMA

Tropical Outlook

- **June 18**

2 Day – 80%

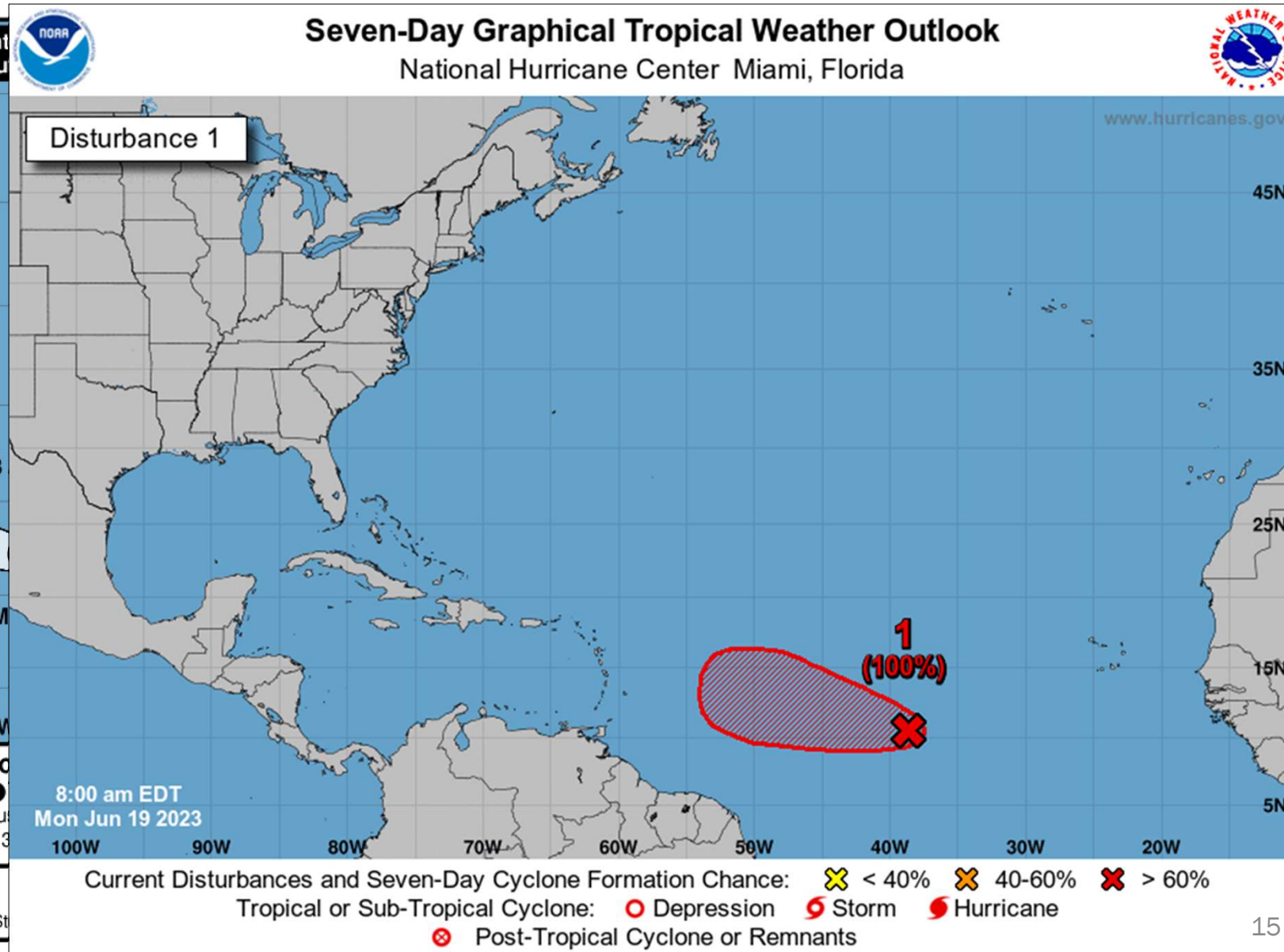
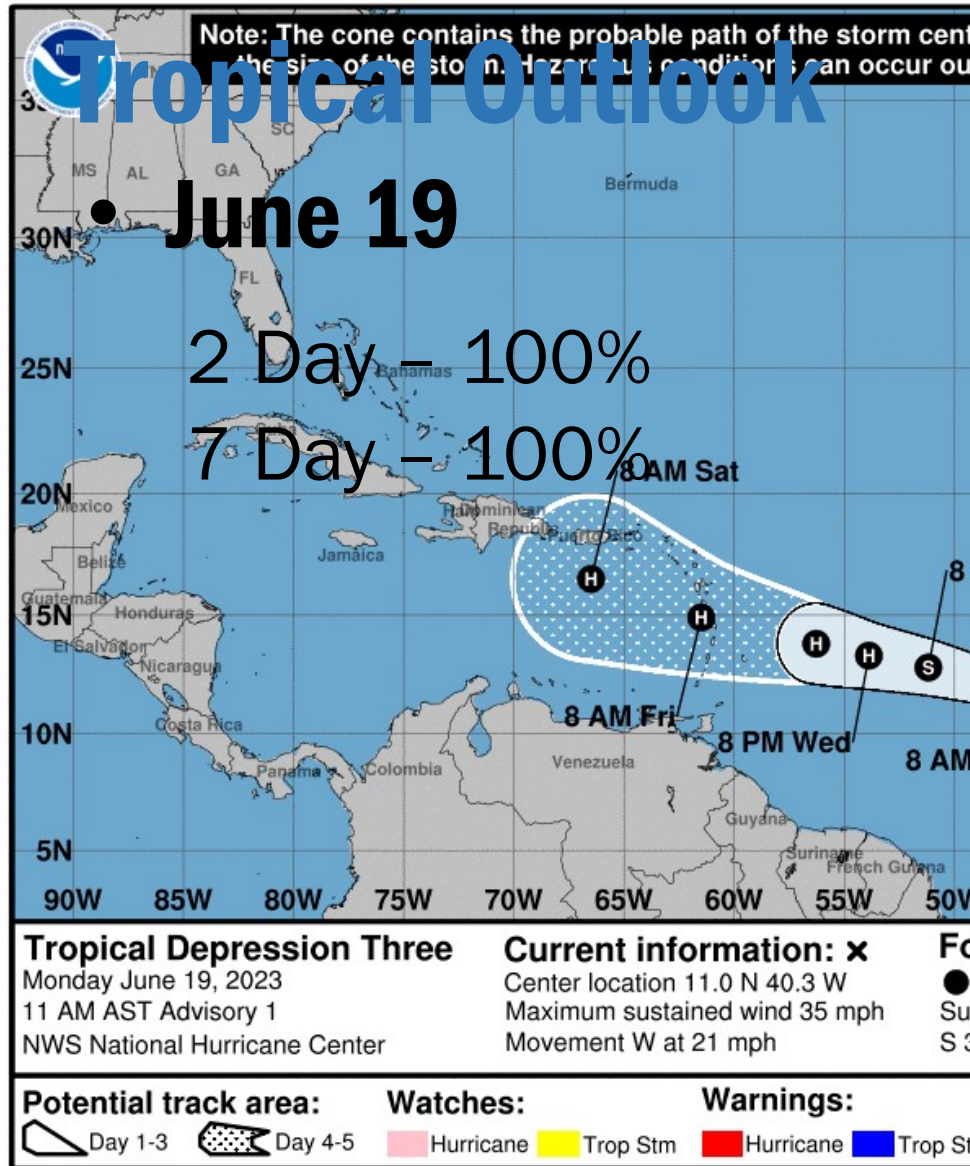
7 Day – 90%



Tropical Weather Outlook Example 5





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Special Tropical Weather Outlook 1



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

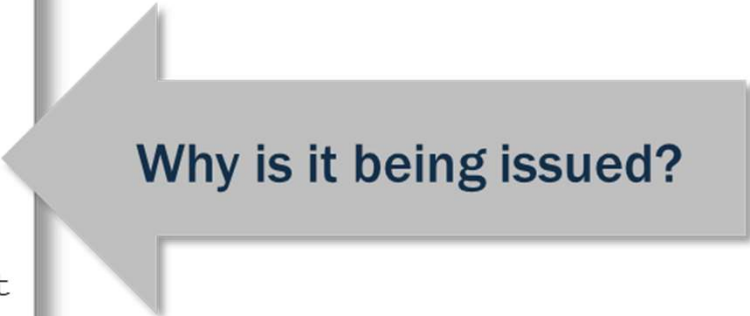
SPECIAL TROPICAL WEATHER OUTLOOK
NWS NATIONAL HURRICANE CENTER MIAMI FL
430 PM EDT MON JUN 30 2014

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.



Special Tropical Weather Outlook 2



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

SPECIAL TROPICAL WEATHER OUTLOOK
NWS NATIONAL HURRICANE CENTER MIAMI FL
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What did the aircraft find?

Special Tropical Weather Outlook 3



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← Watches possible?

How often do you check the Tropical Weather Outlook during hurricane season?

- A. Never
- B. Infrequently
- C. Once a day
- D. Multiple times a day

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



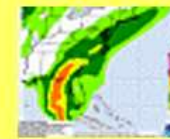
Key Messages



Storm Surge Inundation



Storm Surge Watch/Warning



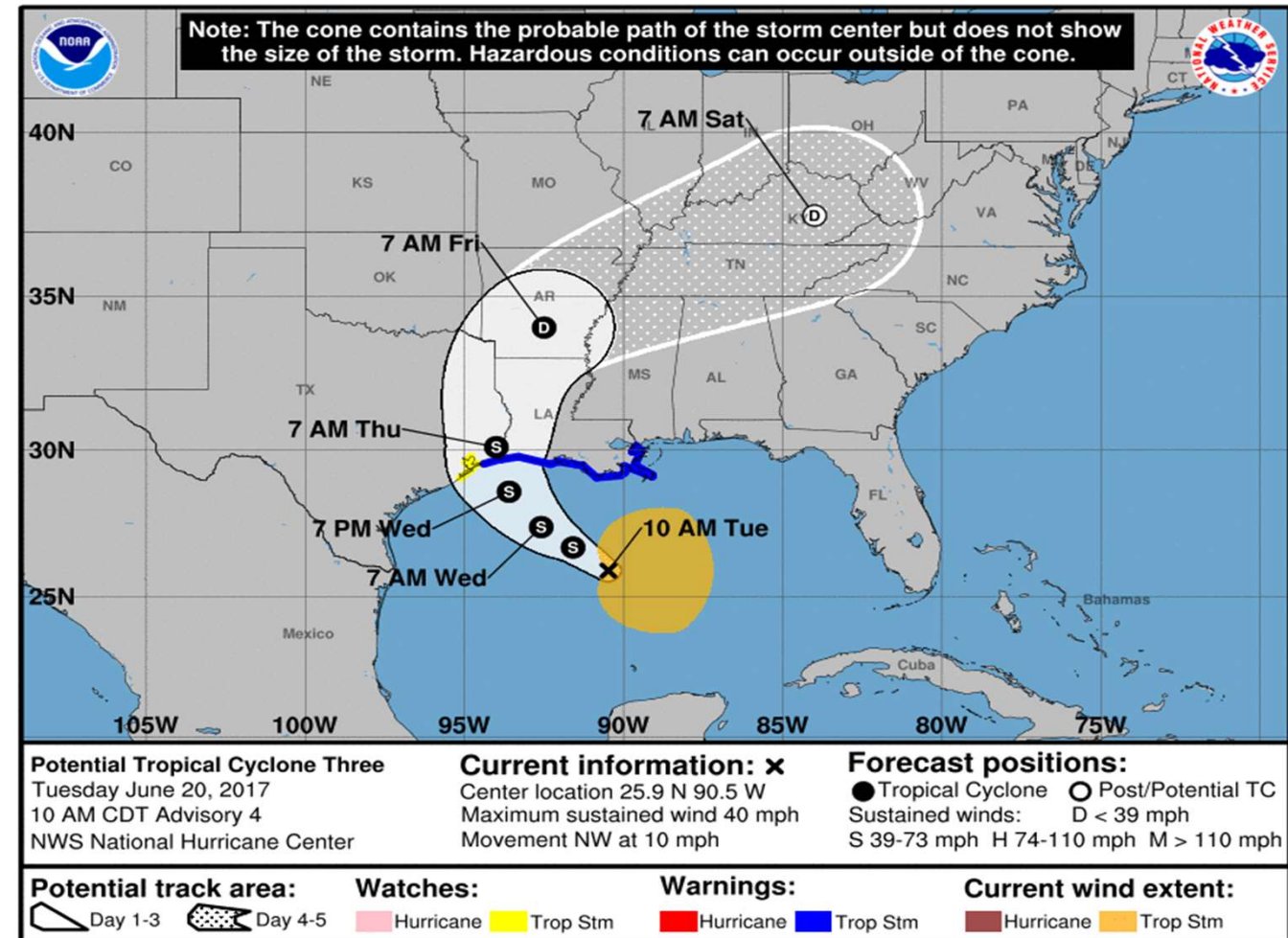
U.S. Rainfall Potential



Flash Flood Potential

NHC Advisories

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



Frequently Asked Questions 2



FAQs

- When is new information available?
- When is a good time for a conference call?
- What's the battle rhythm?

- **NHC Advisory Timeline**

NHC Advisory Timeline



No Watches or Warnings

NHC Forecast

- Public Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Forecast Cone
- Time of Arrival

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TIMES IN EDT

5AM

11AM

5PM

11PM

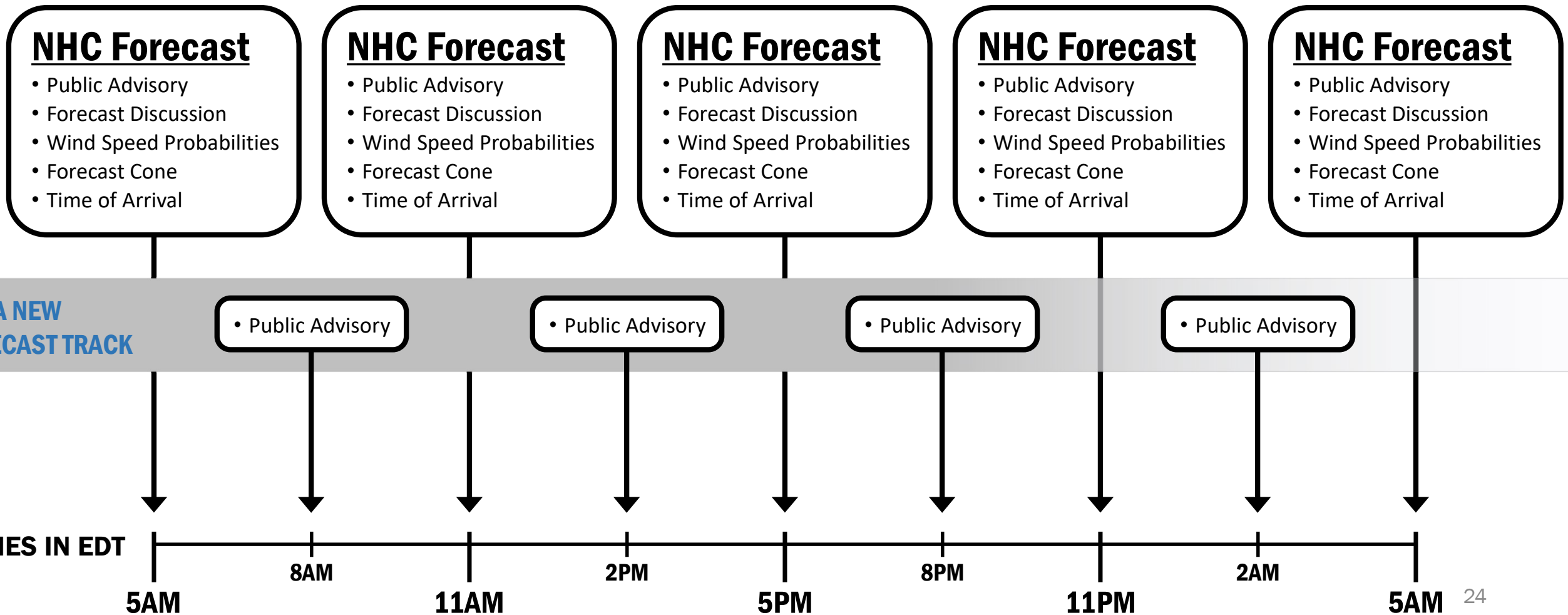
5AM

23

NHC Advisory Timeline – W/W



Watches/Warnings *in effect*





Special Advisories

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

Frequently Asked Questions 3



FAQs



- How strong is the storm?
- What are the hazards?
- Are there any Warnings?

- **Public Advisory**

Public Advisory – Location



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

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



Public Advisory – Strength



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400 AM CDT Mon Oct 08 2018

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WATCHES AND WARNINGS

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* 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

How strong is the storm?

Public Advisory – Watches/Warnings



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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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

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Public Advisory – Track Forecast



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

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).



Public Advisory – Intensity Forecast



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

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

**Forecast to weaken?
Strengthen?**

Public Advisory – Surge Forecast



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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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 – Rain Forecast



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

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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.



Frequently Asked Questions 4



FAQs



- How confident are the forecasters?
- Forecast reasoning?
- What are the key messages?

- **Forecast Discussion**

Forecast Discussion



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

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 - Key Messages



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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



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Key Messages for Tropical Storm Michael

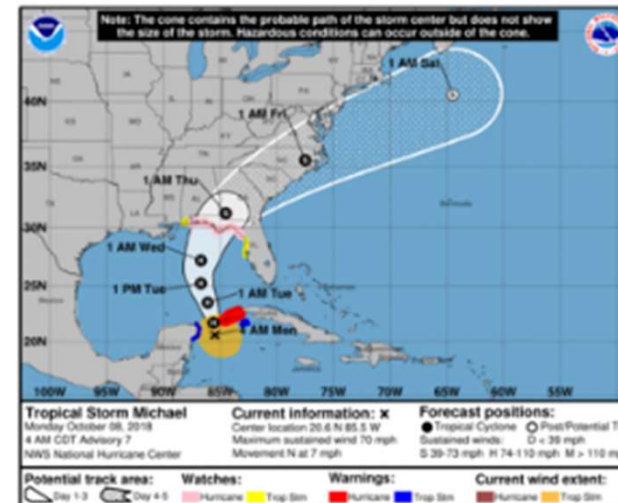
Advisory 7: 4:00 AM CDT Mon Oct 08, 2018



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For more information go to hurricanes.gov

Forecast Discussion - Intensity



FEMA



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.

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

Frequently Asked Questions 5





FAQs

- How large is the storm?
- Where is the storm headed?
- What are the forecast max winds?

- **Forecast Advisory**

Forecast Advisory



  **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

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.

Only source for all
the forecast data

Data is used in
HURREVAC and other
commercial software

Forecast Advisory – Wind Radii 1



  **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

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
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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.

Only source for all the forecast data

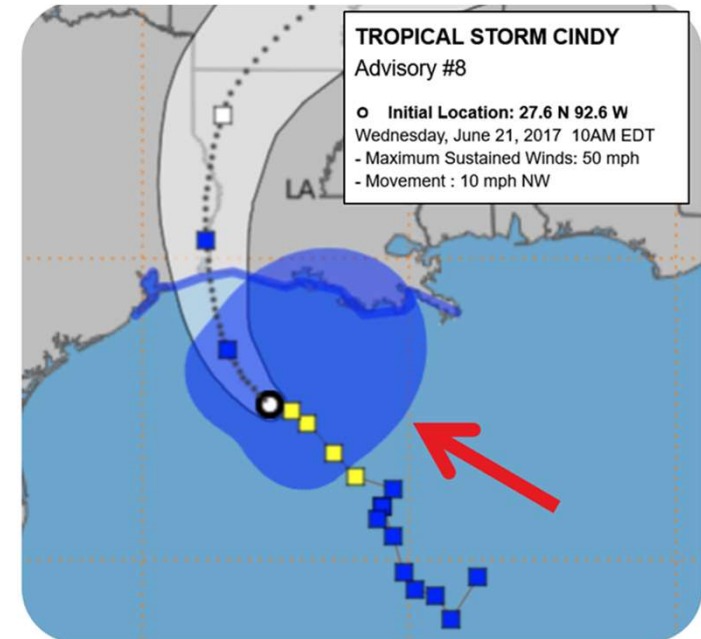
Data is used in HURREVAC and other commercial software

← Current wind radii

← Forecast wind radii

What does the blue area around the center of Cindy represent?

- A. Tropical storm winds are occurring everywhere in the blue area
- B. Area with a 2/3 chance of experiencing tropical storm winds
- C. Maximum extent of tropical storm winds
- D. Area where hurricane winds are occurring

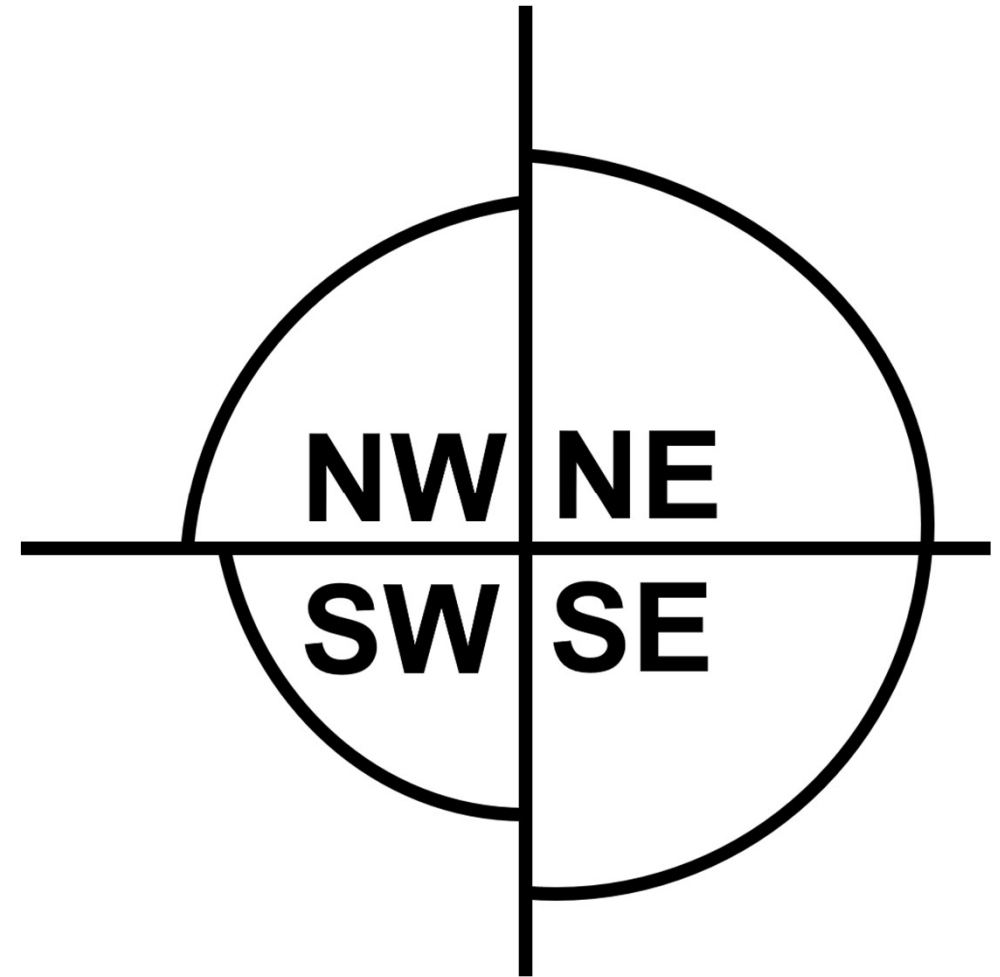


Wind Radii

- **NHC forecasts cyclone size via wind radii in four quadrants**
 - Radii are the largest distance from the center in a quadrant
 - An over-estimate, especially near land

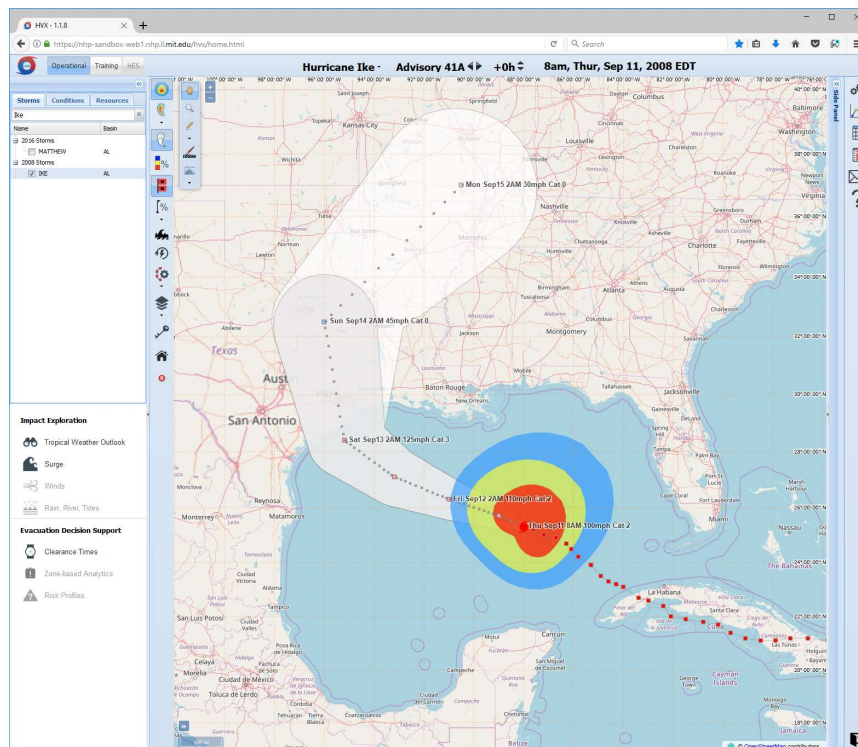
- **Forecast wind radii**

64 KT...	30NE	30SE	0SW	0NW
50 KT...	90NE	90SE	30SW	30NW
34 KT...	130NE	150SE	90SW	120NW



Wind Radii

- NHC forecasts cyclone size via wind radii in four quadrants.

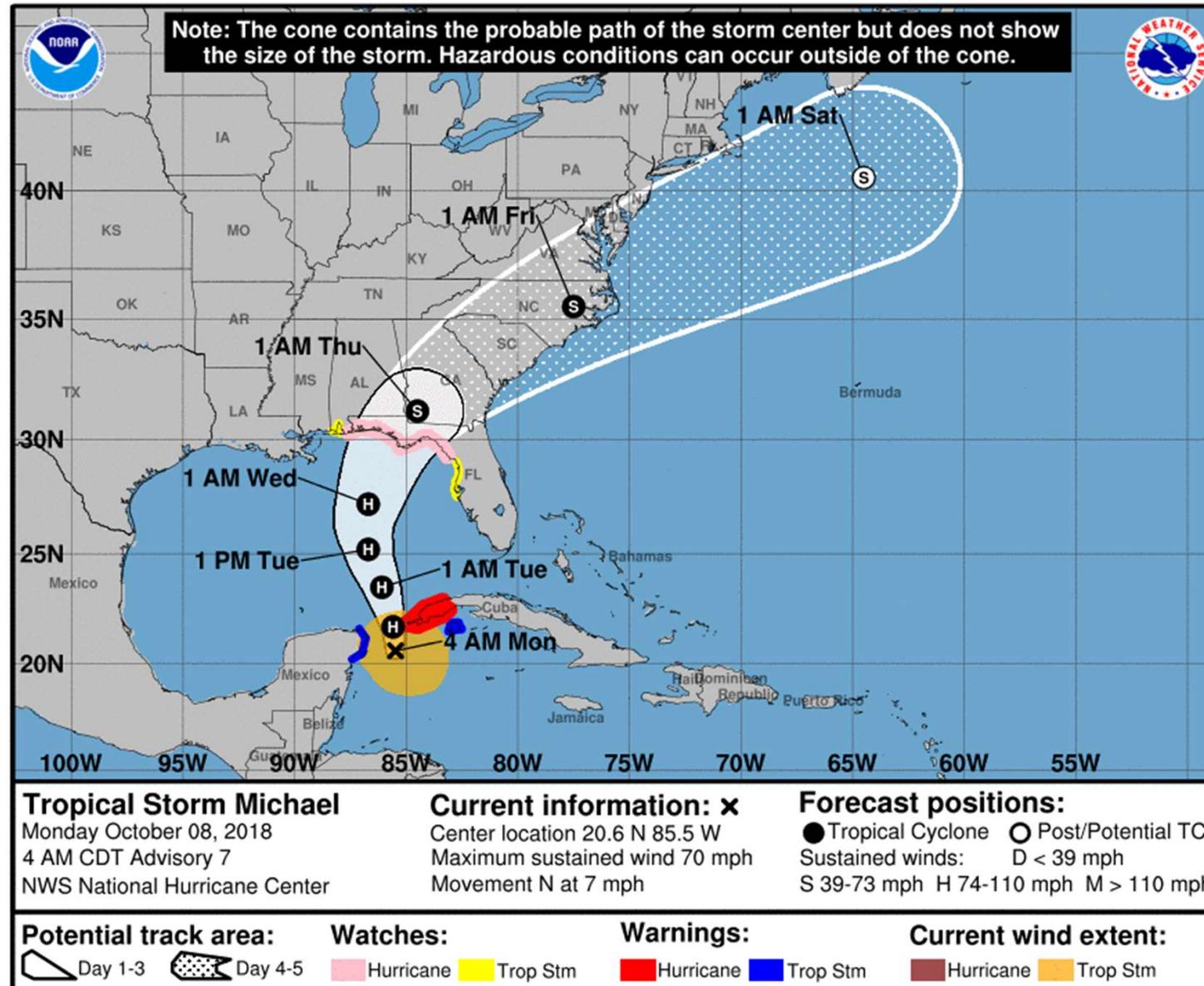


	34 kt (Blue)	50 kt (Yellow)	64 kt (Red)
12 hr	Yes	Yes	Yes
24 hr	Yes	Yes	Yes
36 hr	Yes	Yes	Yes
48 hr	Yes	Yes	Yes
60 hr	Yes	Yes	N/A
72 hr	Yes	Yes	N/A
96 hr	N/A	N/A	N/A
120 hr	N/A	N/A	N/A

Forecast Error Cone

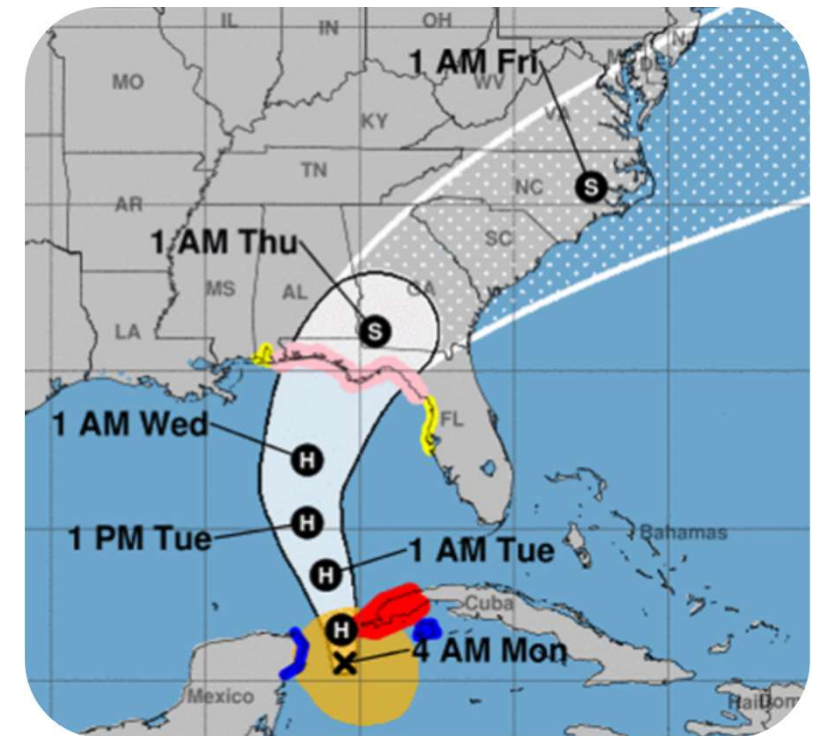


FEMA



What is used to construct the size of the forecast cone?

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



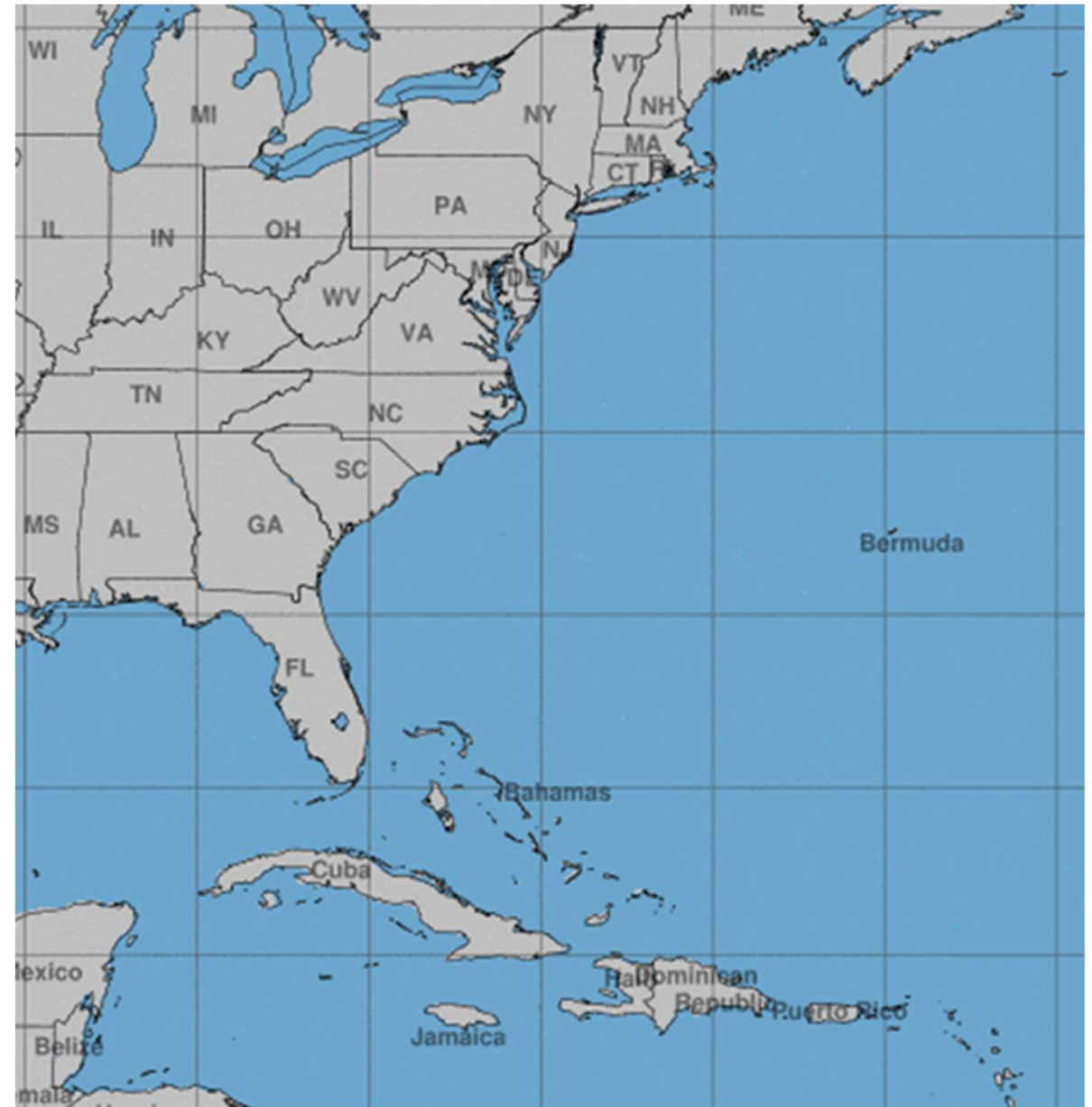
Forecast Error Cone Explained



FEMA

Error Cone

- **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



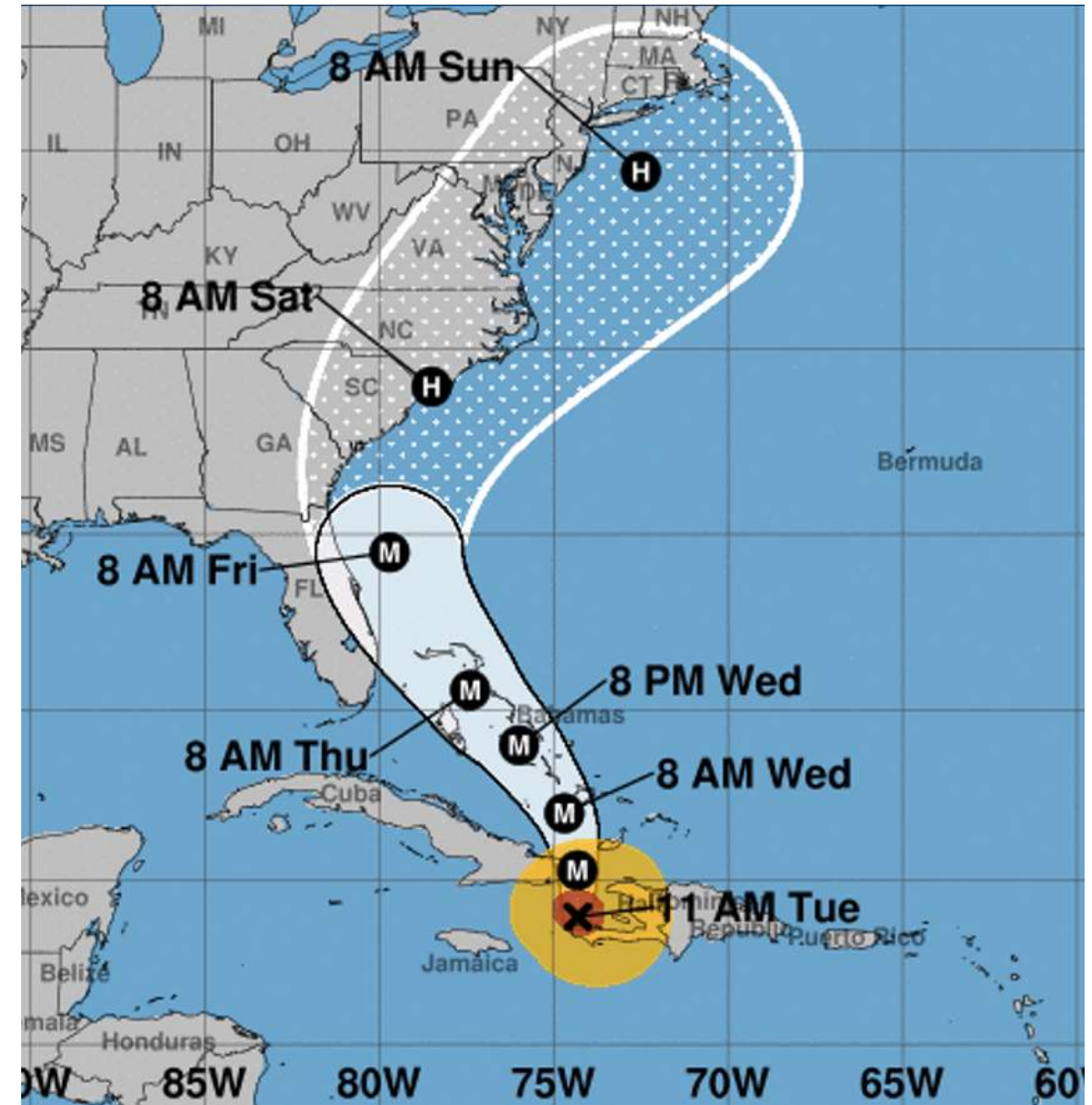
Not In The Cone: No Worries?



FEMA

Error Cone

- **Situational awareness tool**
- **Only displays information about historical track uncertainty**
 - Doesn't communicate information about specific hurricane hazards
- **Impacts can occur well outside the area enclosed by the cone**
 - On average, the center is outside the cone 1/3 of the time



Frequently Asked Questions 6



FAQs

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

- **Wind Speed Probabilities**

Wind Speed Probabilities – Text 1



NATIONAL HURRICANE CENTER		NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION						
TROPICAL STORM MICHAEL WIND SPEED PROBABILITIES NUMBER 7								
NWS NATIONAL HURRICANE CENTER MIAMI FL AL142018								
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 2



NATIONAL HURRICANE CENTER		NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION						
TROPICAL STORM MICHAEL WIND SPEED PROBABILITIES NUMBER 7								
NWS NATIONAL HURRICANE CENTER MIAMI FL AL142018								
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 3



NATIONAL HURRICANE CENTER		NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION						
TROPICAL STORM MICHAEL WIND SPEED PROBABILITIES NUMBER 7								
NWS NATIONAL HURRICANE CENTER MIAMI FL AL142018								
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

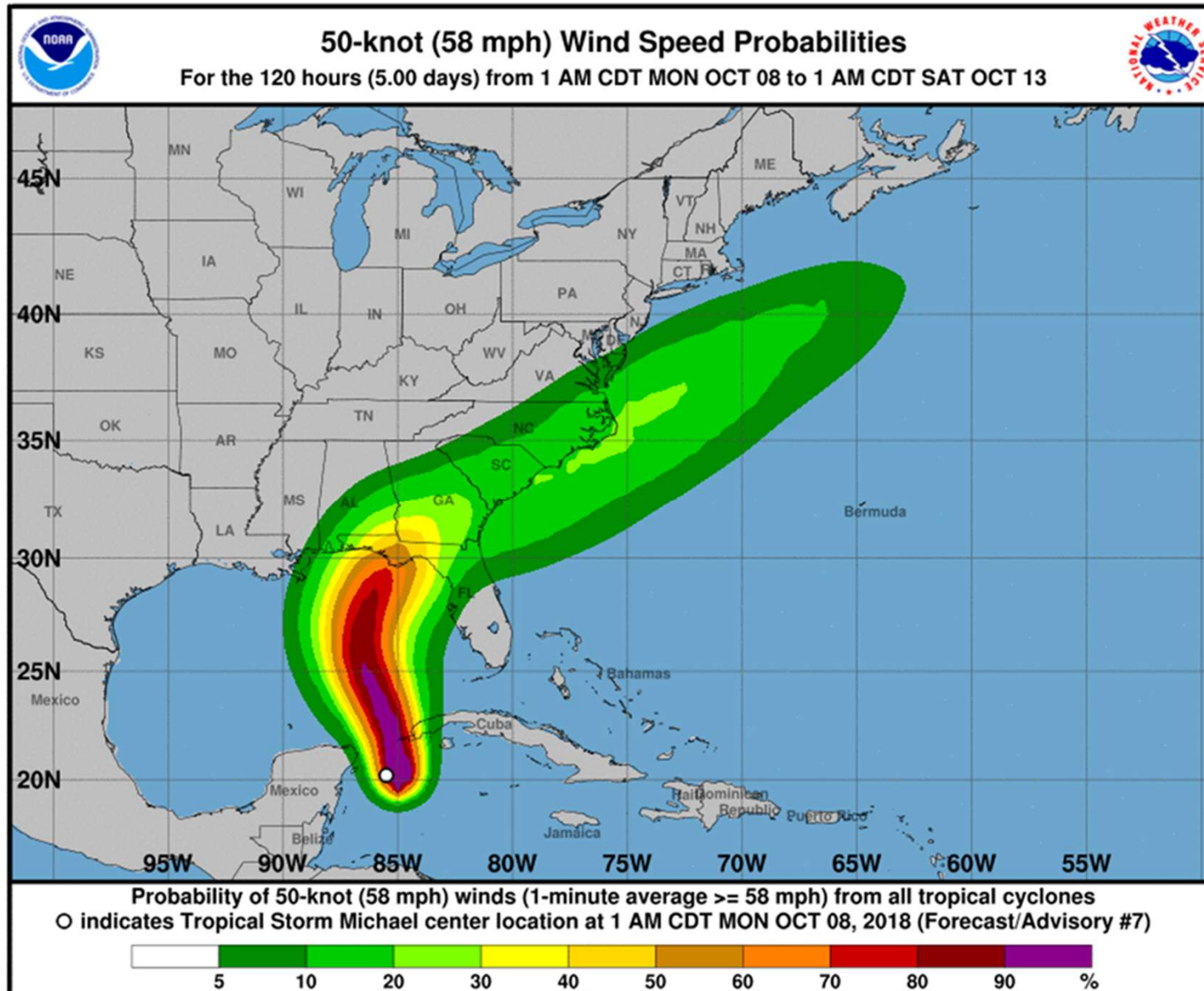
5-Day Cumulative Graphic: TS-Force



Location-Specific Probabilities

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

5-Day Cumulative Graphic: 58 mph



Location-Specific Probabilities

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

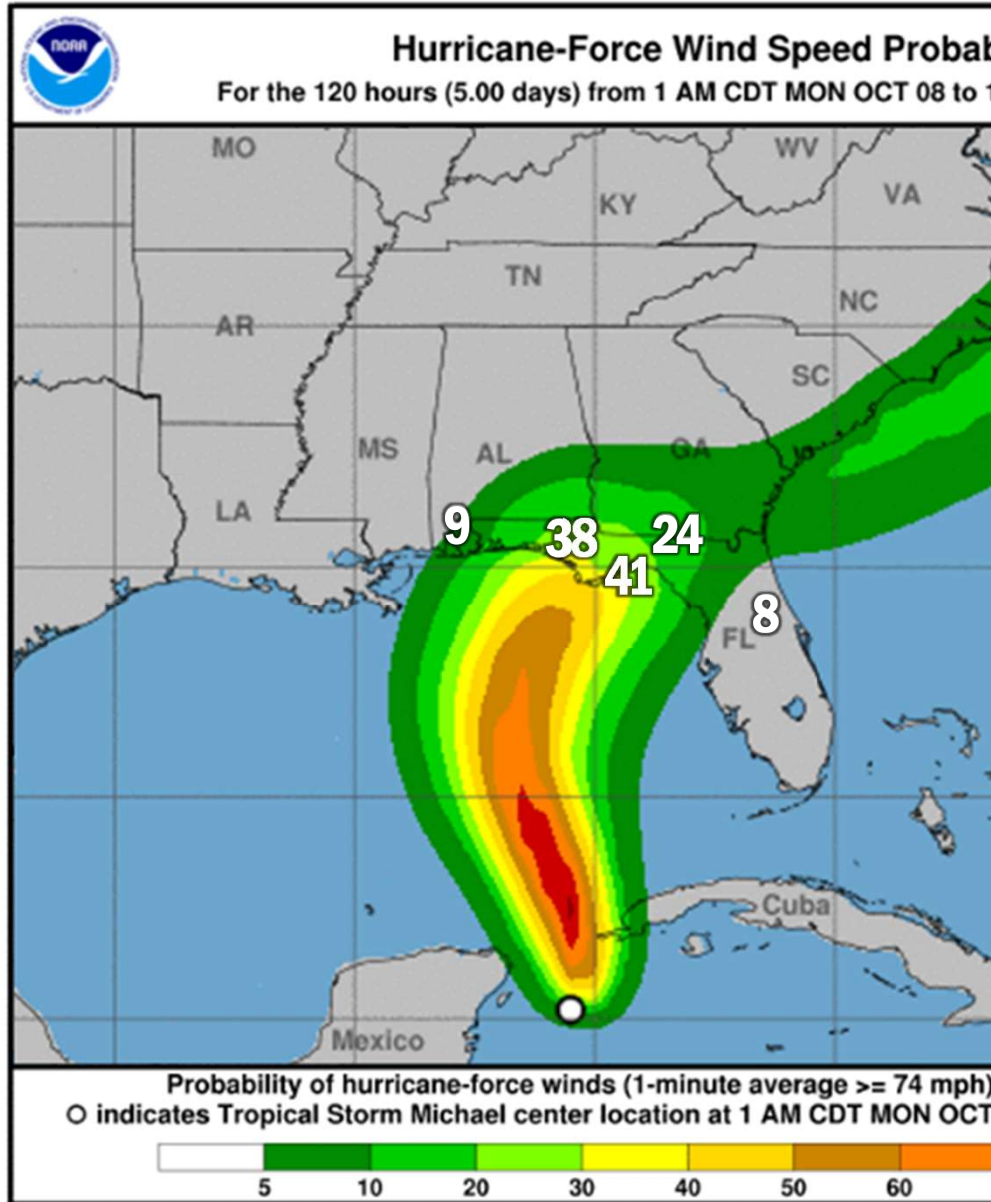
5-Day Cumulative Graphic: Hurricane



Location-Specific Probabilities

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

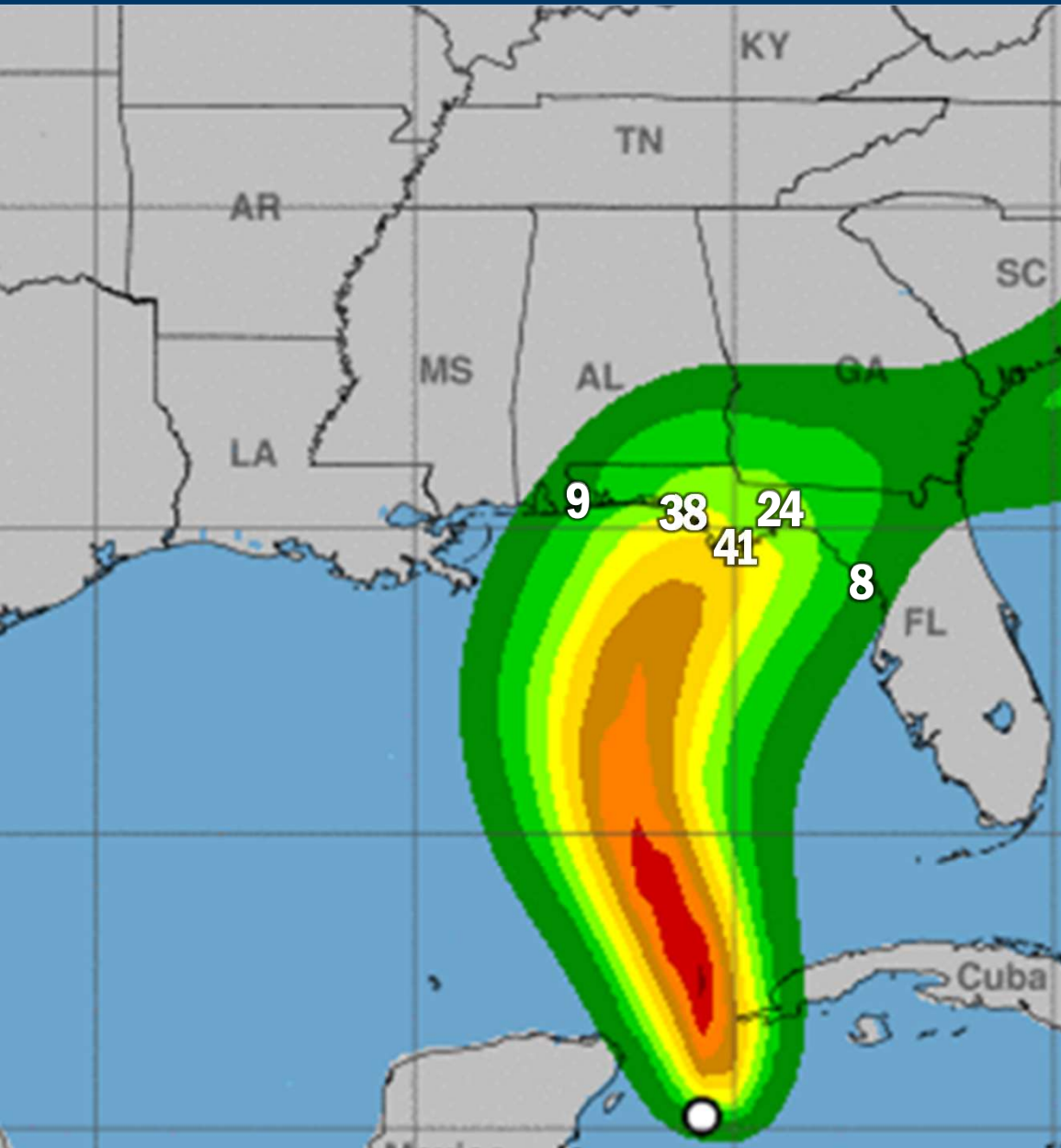
Location-Specific Probabilities 1



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)
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)
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)

Location-Specific Probabilities 2



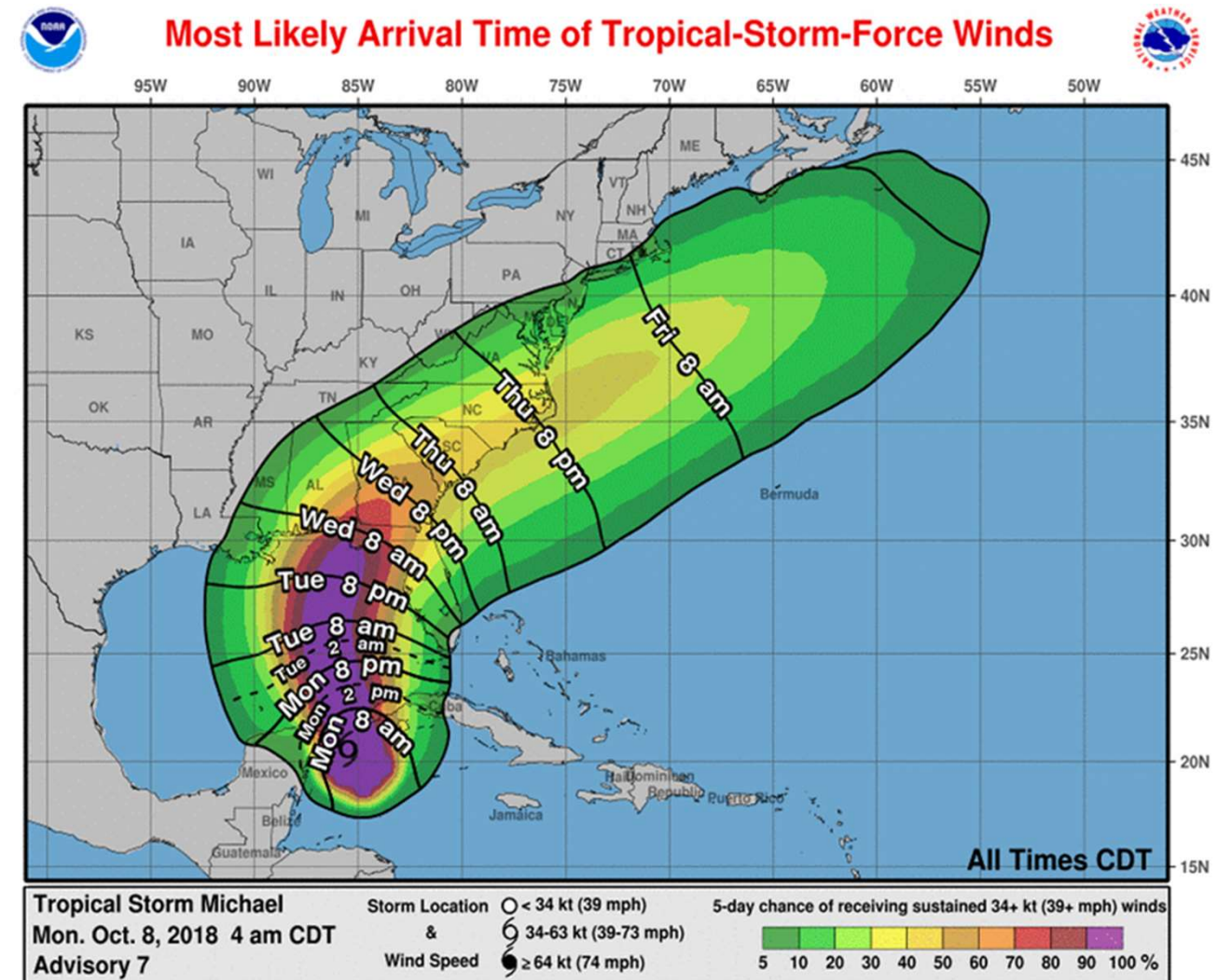
NATIONAL HURRICANE CENTER NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION								
TIME PERIODS	FROM 06Z MON TO 18Z MON	FROM 18Z MON TO 06Z TUE	FROM 06Z TUE TO 18Z TUE	FROM 18Z TUE TO 06Z WED	FROM 06Z WED TO 06Z THU	FROM 06Z THU TO 06Z FRI	FROM 06Z FRI TO 06Z SAT	
FORECAST HOUR	(12)	(24)	(36)	(48)	(72)	(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)	
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)	
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)	

Earliest Reasonable Onset



Earliest Reasonable

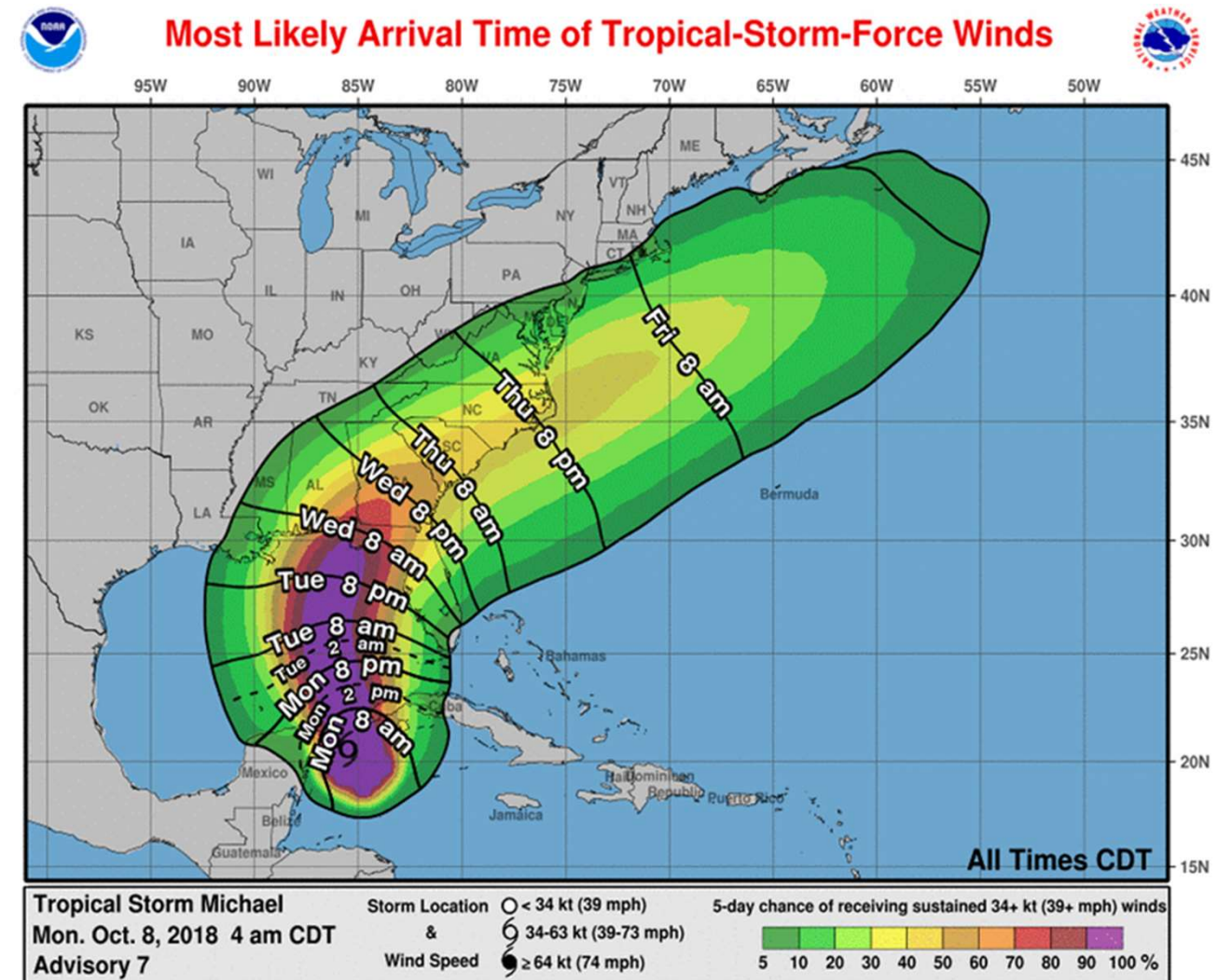
- **10% chance of onset**
 - Most conservative timing
- **Arrival Time of TS winds**
 - Black contours
- **5-day cumulative TS probabilities**
 - Color filled



Most Likely Onset

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 filled



FAQs

- What hazards are a threat?
- Where is the greatest concern?
- When will hurricane hazards begin?

- **Watches and Warnings**

Storm Surge Watches/Warnings



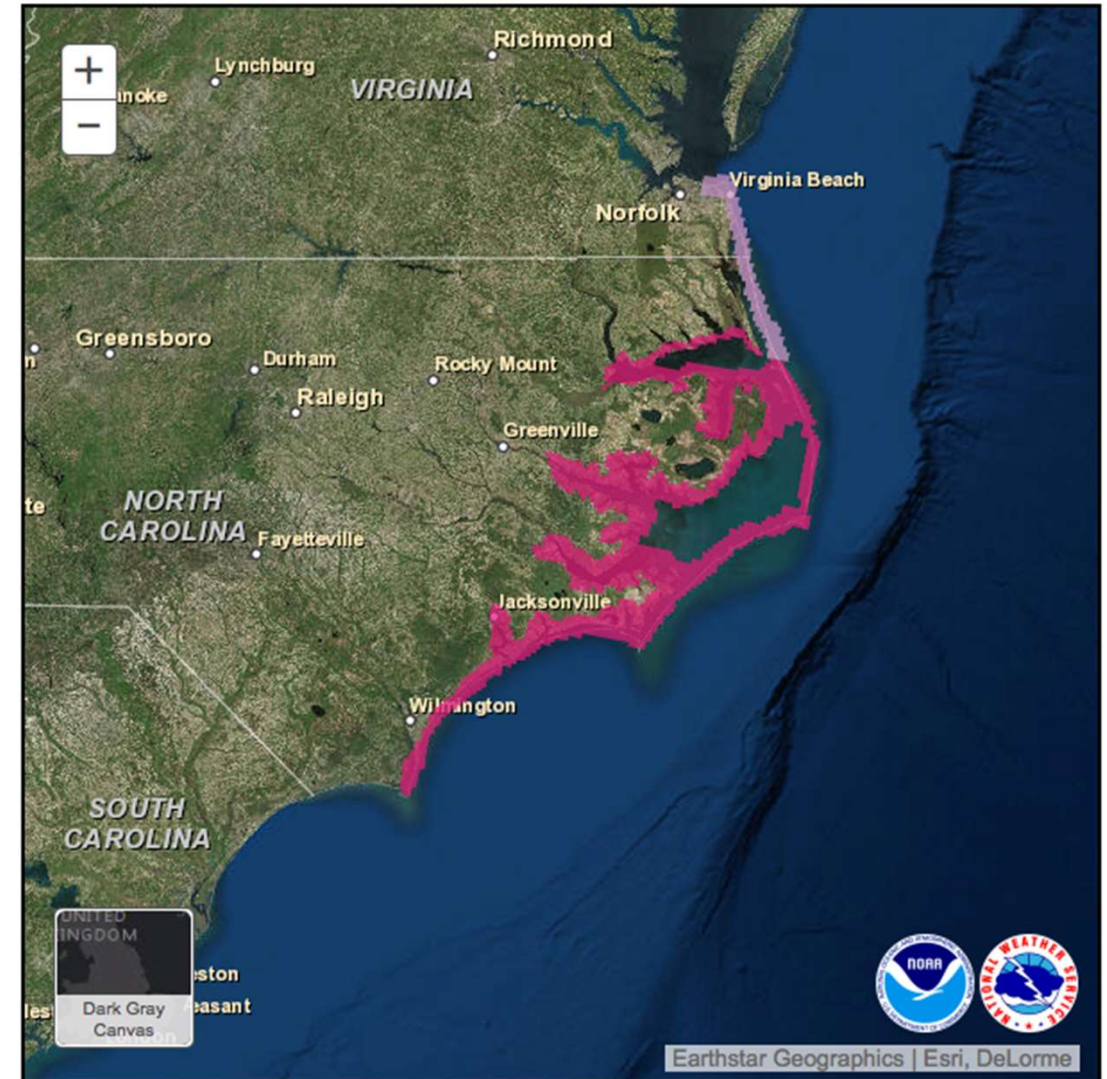
FEMA

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**.
 - Activates WEA.



Hurricane Watch

- Hurricane conditions are **possible** within the Watch area, generally within **48 hours**.

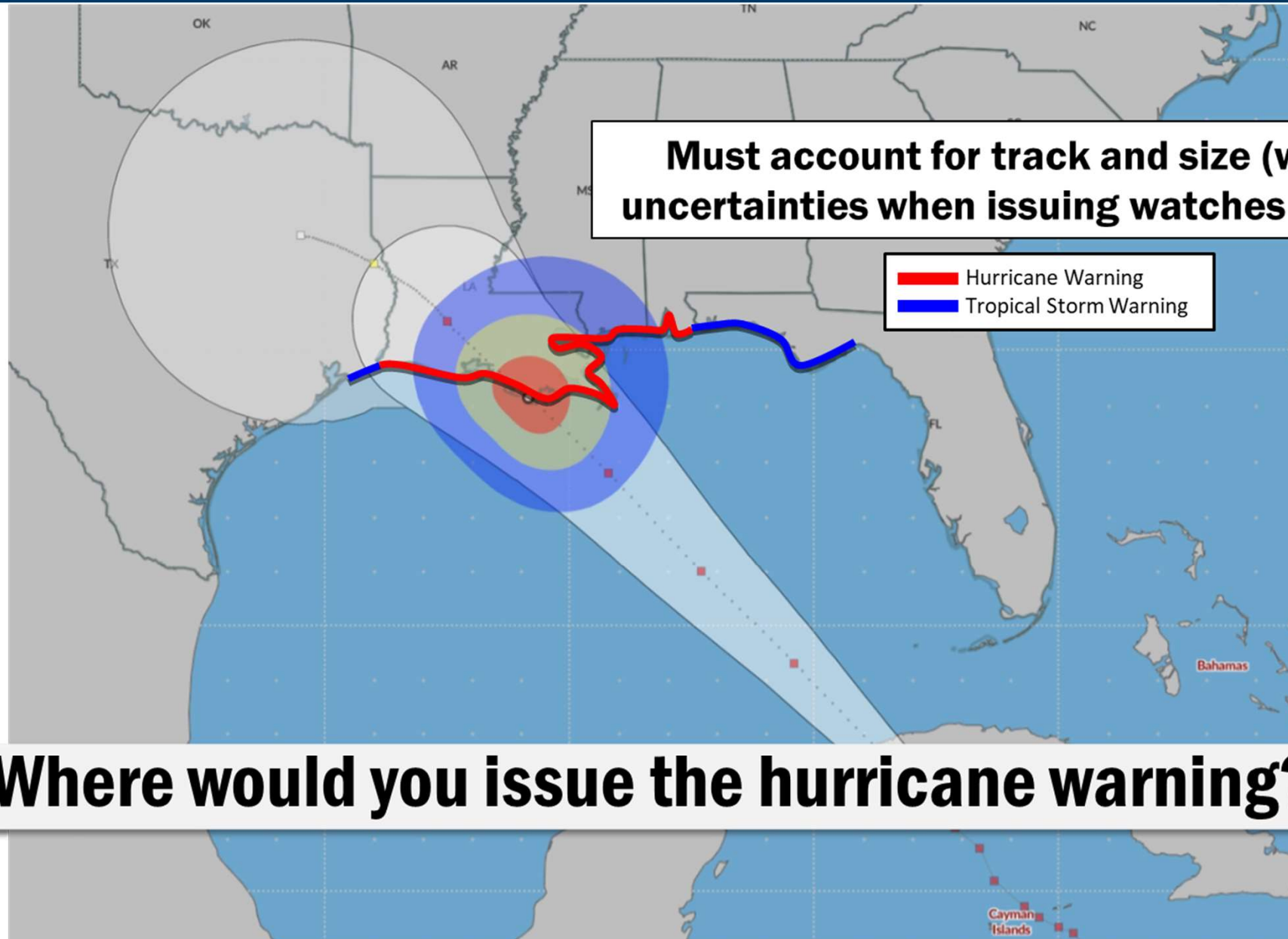
Hurricane Warning

- Hurricane conditions are **expected** within the Warning area, generally within **36 hours**.
 - Activates WEA.



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

Take What Action, Where, & When?



Must account for track and size (wind radii) uncertainties when issuing watches or warnings

Hurricane Warning
Tropical Storm Warning

Where would you issue the hurricane warning?

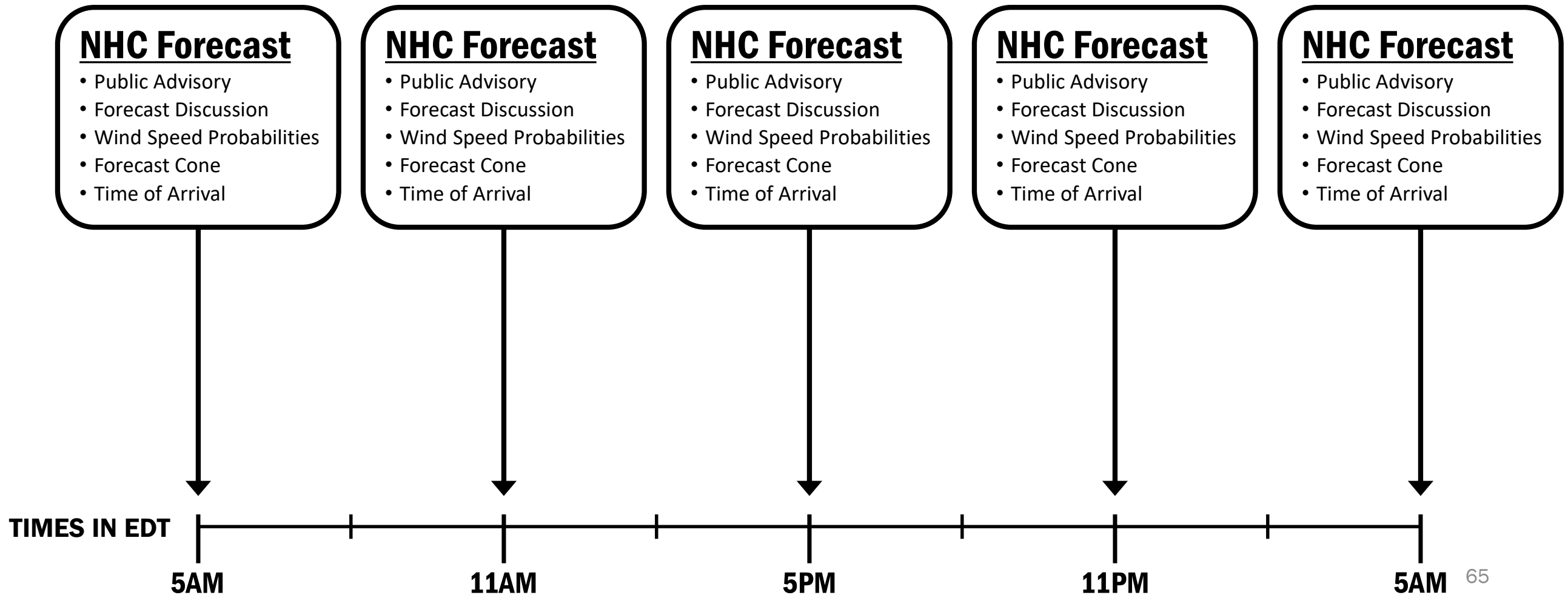
How often is a new NHC track and intensity forecast routinely issued?

- 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



No Watches or Warnings



NHC Advisory Timeline–W/W



Watches/Warnings *in effect*

NHC Forecast

- Public Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Forecast Cone
- Time of Arrival

NHC Forecast

- Public Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Forecast Cone
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NHC Forecast

- Public Advisory
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- Wind Speed Probabilities
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NHC Forecast

- Public Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Forecast Cone
- Time of Arrival

NHC Forecast

- Public Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Forecast Cone
- Time of Arrival

• Public Advisory

• Public Advisory

• Public Advisory

• Public Advisory

NOT A NEW
FORECAST TRACK

TIMES IN EDT

5AM

8AM

11AM

2PM

5PM

8PM


11PM

2AM

5AM

Intermediate Public Advisory



 **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**

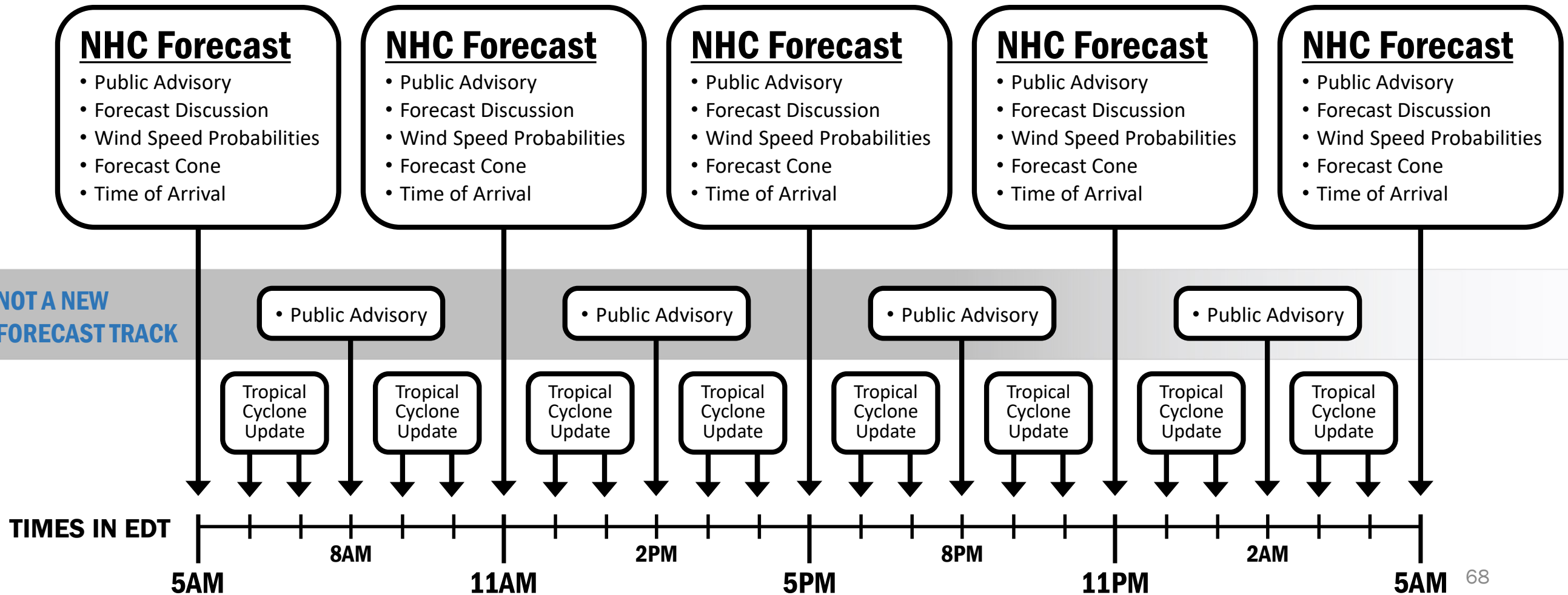
✓ Watch or Warning in effect

NHC Advisory Timeline–Eye



Watches/Warnings *in effect and eye tracked by radar*


NOT A NEW FORECAST TRACK



Tropical Cyclone Update



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

Frequently Asked Questions 8



FAQs

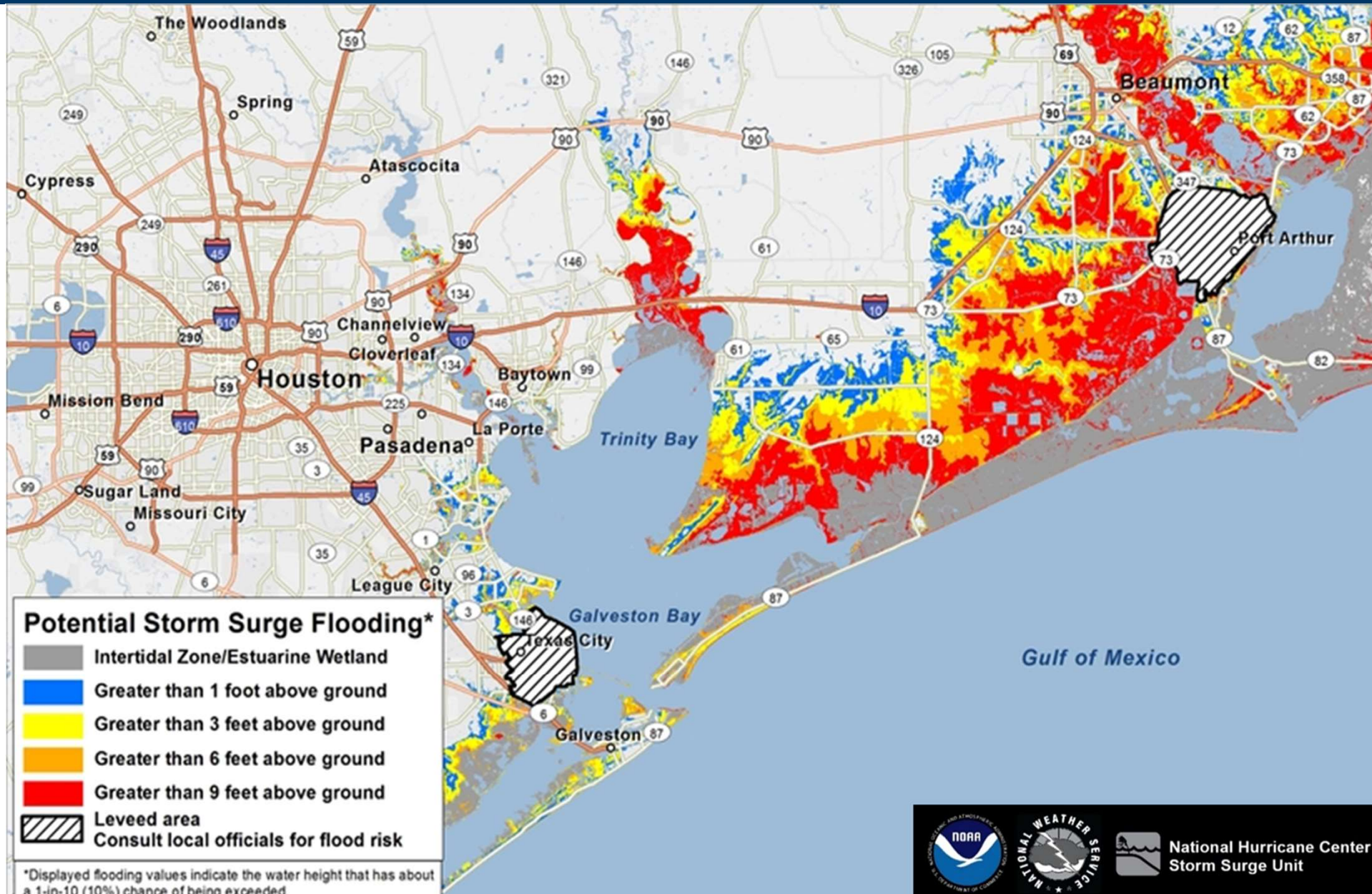
- What areas could flood?
- How high could the water get?
- Reasonable worst-case scenario?

- **Storm Surge Products**

Potential Storm Surge Flooding 1



FEMA

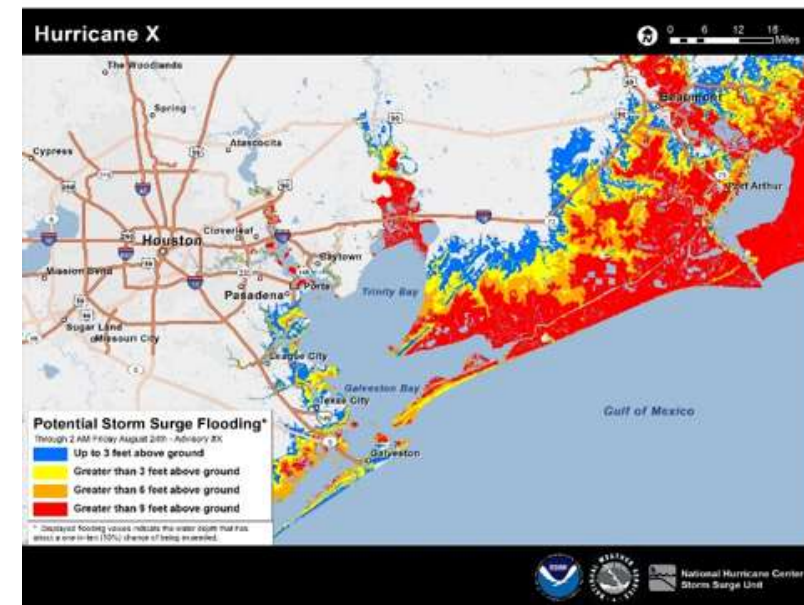


Potential Storm Surge Flooding 2



Inundation Map

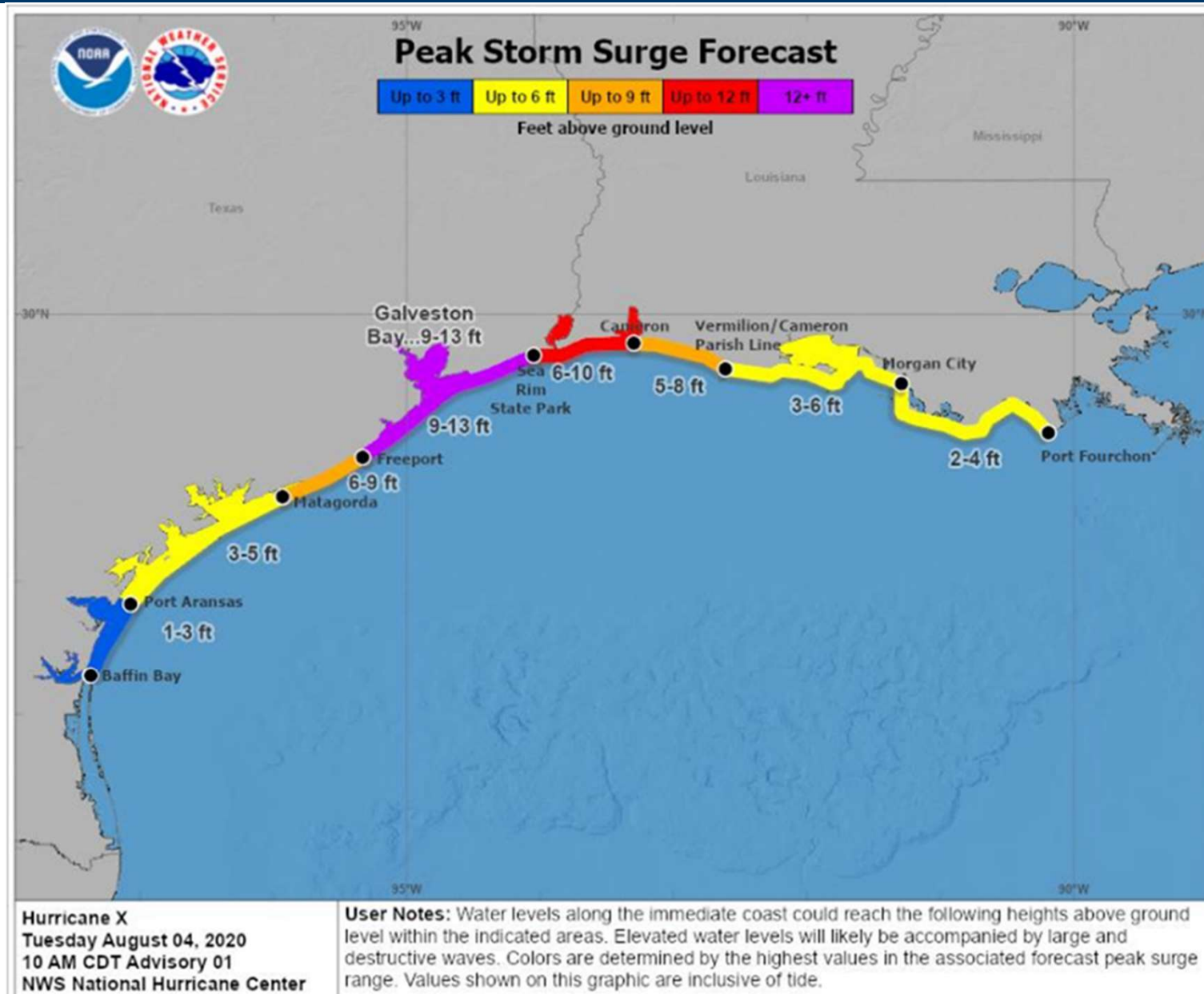
- **Height above ground that the water could reach**
 - Reasonable worst-case scenario for an individual location
 - Values have a 10% chance of being exceeded
- **Issued up to 72 hours before a potential storm surge threat**
- **Available 60+ minutes after the advisory release**



Peak Storm Surge Forecast Graphic



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Frequently Asked Questions 9



FAQs

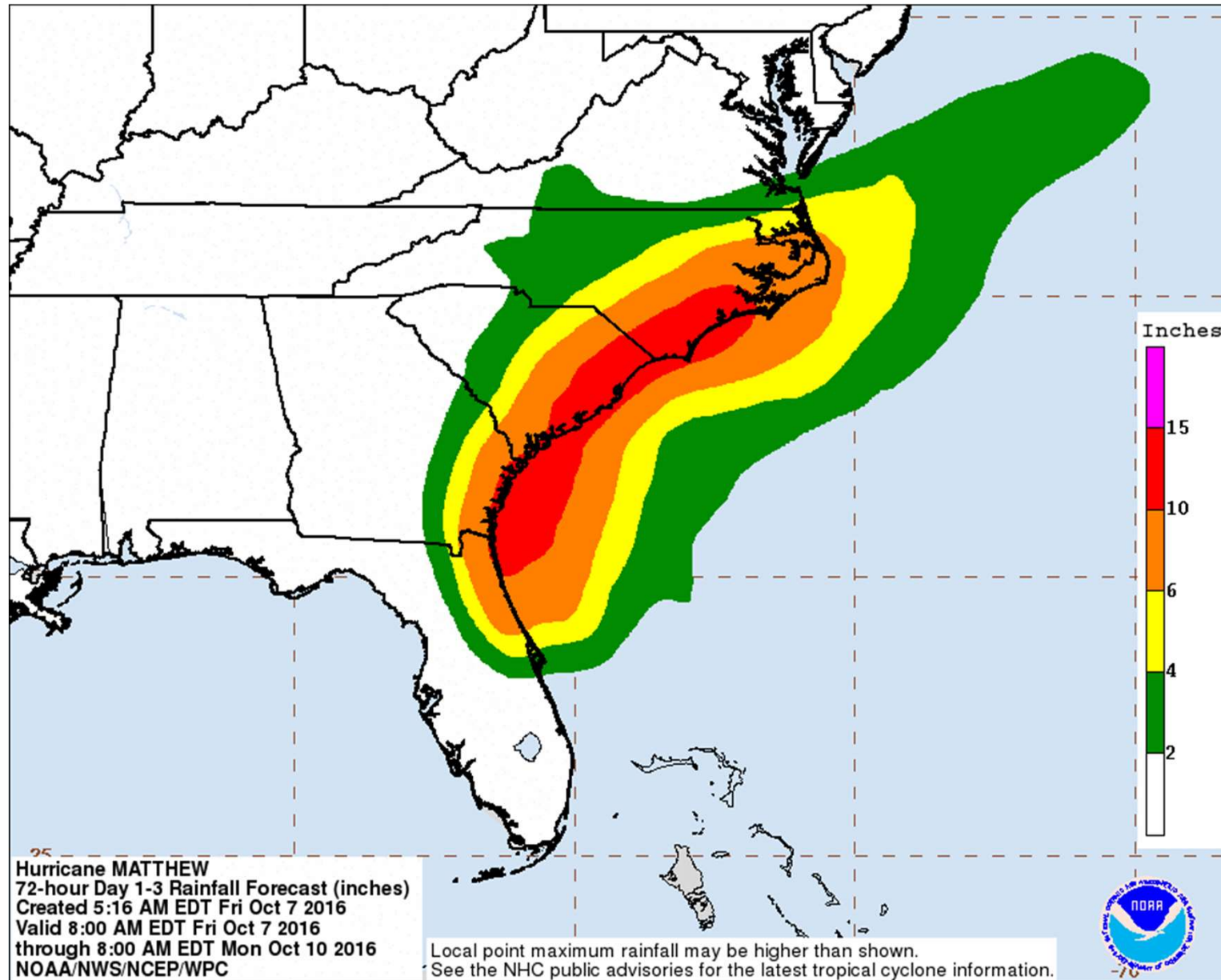
- How much rain is forecast?
- What areas could see flash flooding?
- Which day has the greatest risk?

- **Rainfall Products**

Rainfall Forecast



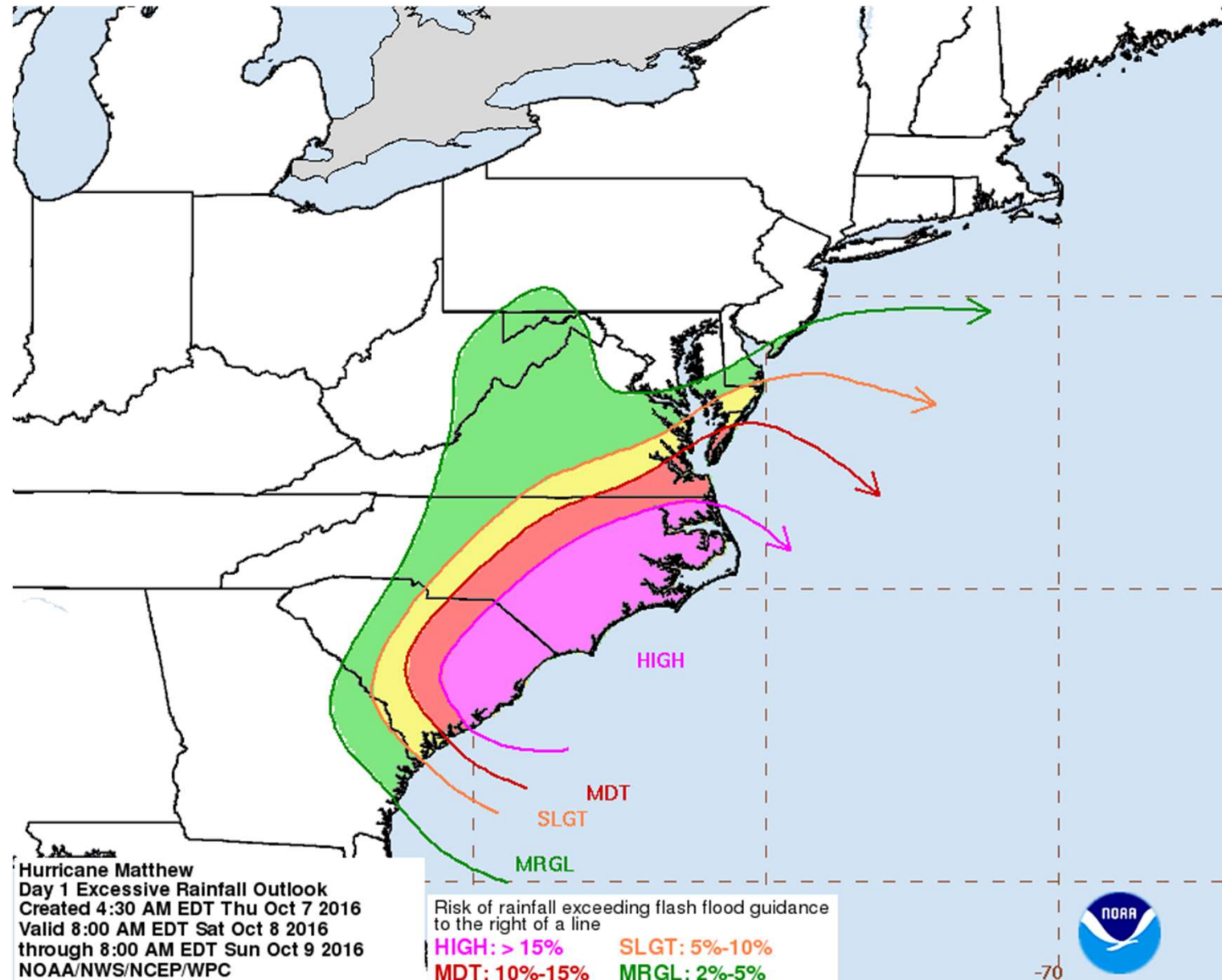
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Excessive Rainfall Outlook (ERO) 1



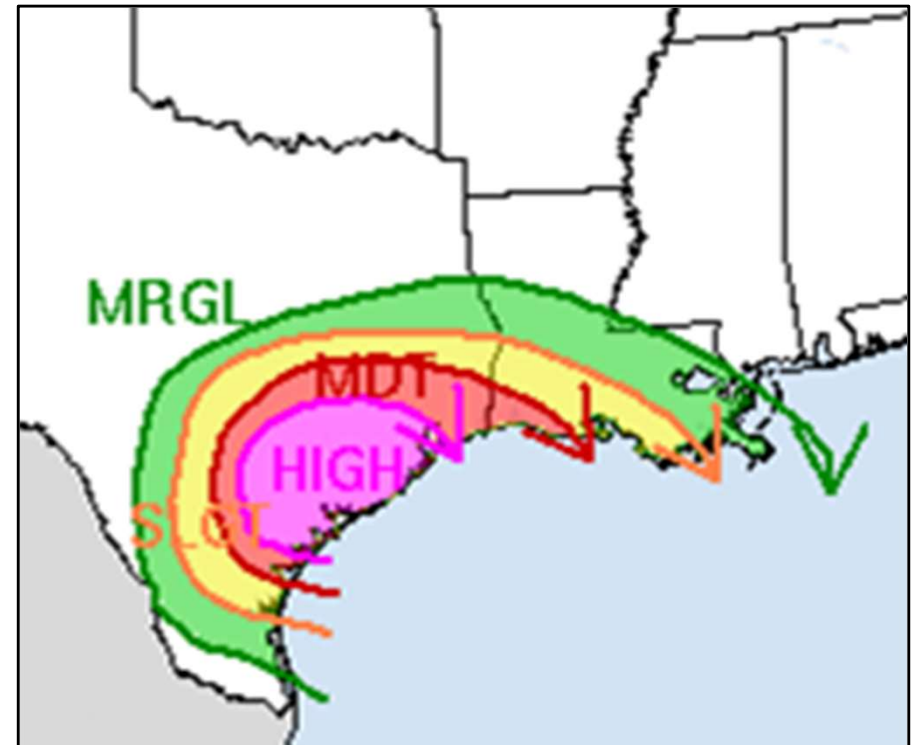
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High Risk Days

- **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
- **High Risk Accounts for:**
 - 39% of flood fatalities
 - 83% of flood damages

(Stats from 2010 to 2020)



FAQs

- Local impacts?
- Localized forecast information?
- Inland Watches and Warnings?

- **NWS Forecast Offices**

Hurricane Local Statements 1



FEMA



HURRICANE WILMA LOCAL STATEMENT ADVISORY NUMBER 32
NATIONAL WEATHER SERVICE MIAMI FL AL242005
530 AM EDT SUN OCT 23 2005

THIS PRODUCT COVERS MAINLAND SOUTH FLORIDA

EXTENSIVE TO DEVASTATING DAMAGE AND LIFE-THREATENING CONDITIONS EXPECTED AS HURRICANE WILMA MOVES NORTHEAST ACROSS SOUTH FLORIDA

NEW INFORMATION

* CHANGES TO WATCHES AND WARNINGS:

- A HURRICANE WATCH HAS BEEN UPGRADED TO A HURRICANE WARNING FOR MIAMI-DADE...BROWARD...PALM BEACH...COLLIER...GLADES AND MONROE COUNTIES

* CURRENT WATCHES AND WARNINGS:

- A HURRICANE WARNING IS IN EFFECT FOR MIAMI -DADE...BROWARD...PALM BEACH...COLLIER...HENDRY...GLADES AND MAINLAND MONROE COUNTIES

* STORM INFORMATION:

- ABOUT 405 MI SW OF NAPLES FL
- 22.1N 86.6W
- STORM INTENSITY 100 MPH WITH HIGHER GUSTS
- MOVING NORTHEAST AT 3 MPH

SITUATION OVERVIEW

EXTREMELY DANGEROUS HURRICANE WILMA IS EXPECTED TO IMPACT SOUTH FLORIDA BEGINNING THIS EVENING. THE MAIN CONCERN IS FOR LIFE-THREATENING INUNDATION IN SURGE-PRONE AREAS OF COLLIER/MAINLAND

Issued by local NWS office


- Hurricane (Tropical Storm) Watch/Warning in effect

Situation overview

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

Hurricane Local Statements 2



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

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Hurricane Local Statements 3



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Are there any changes since the last update?

Hurricane Threats & Impacts (HTI)

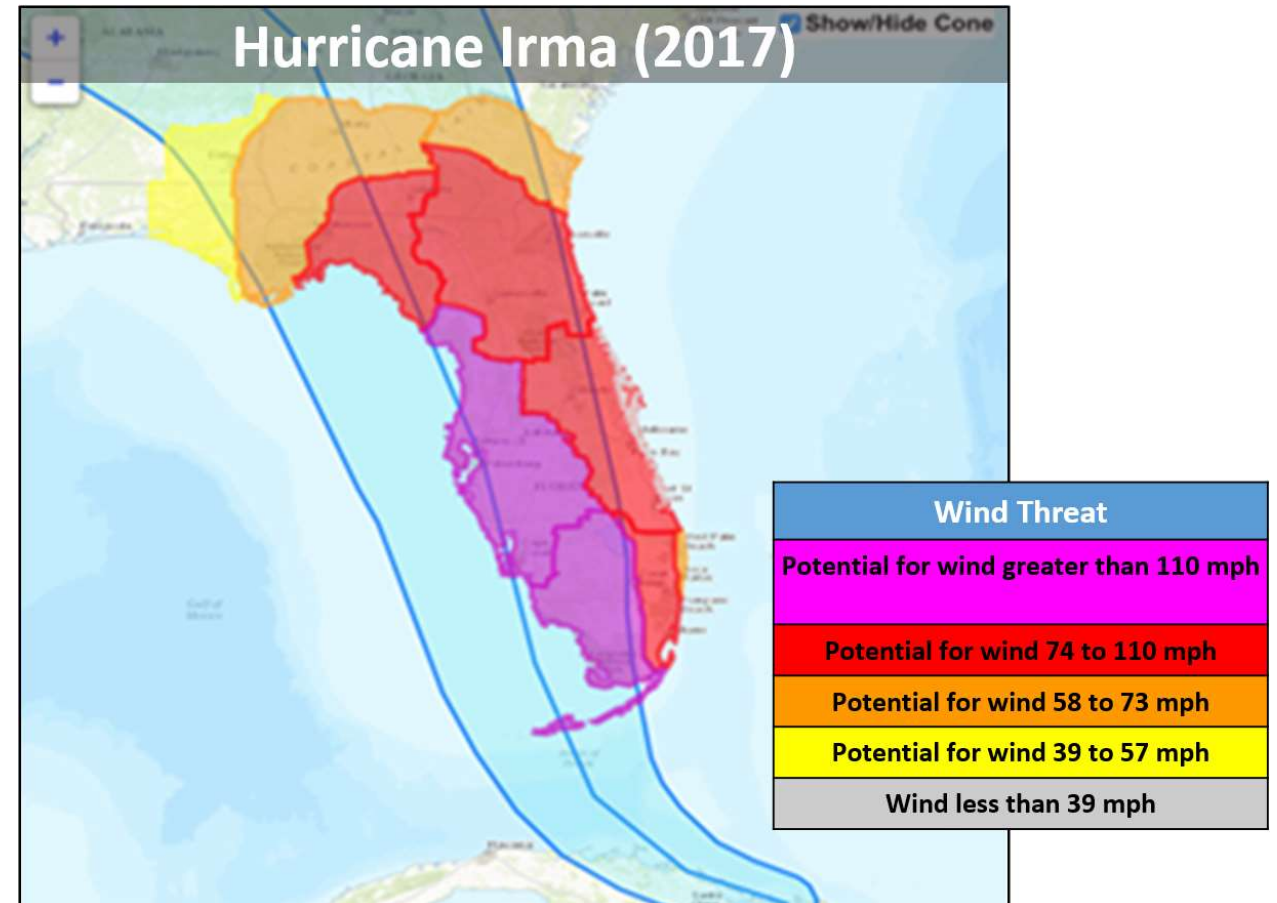


Hazards

- **Wind**
- **Storm Surge Flooding**
- **Inland Flooding**
- **Tornadoes**

Threat & Impacts

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



Extreme Wind Warning

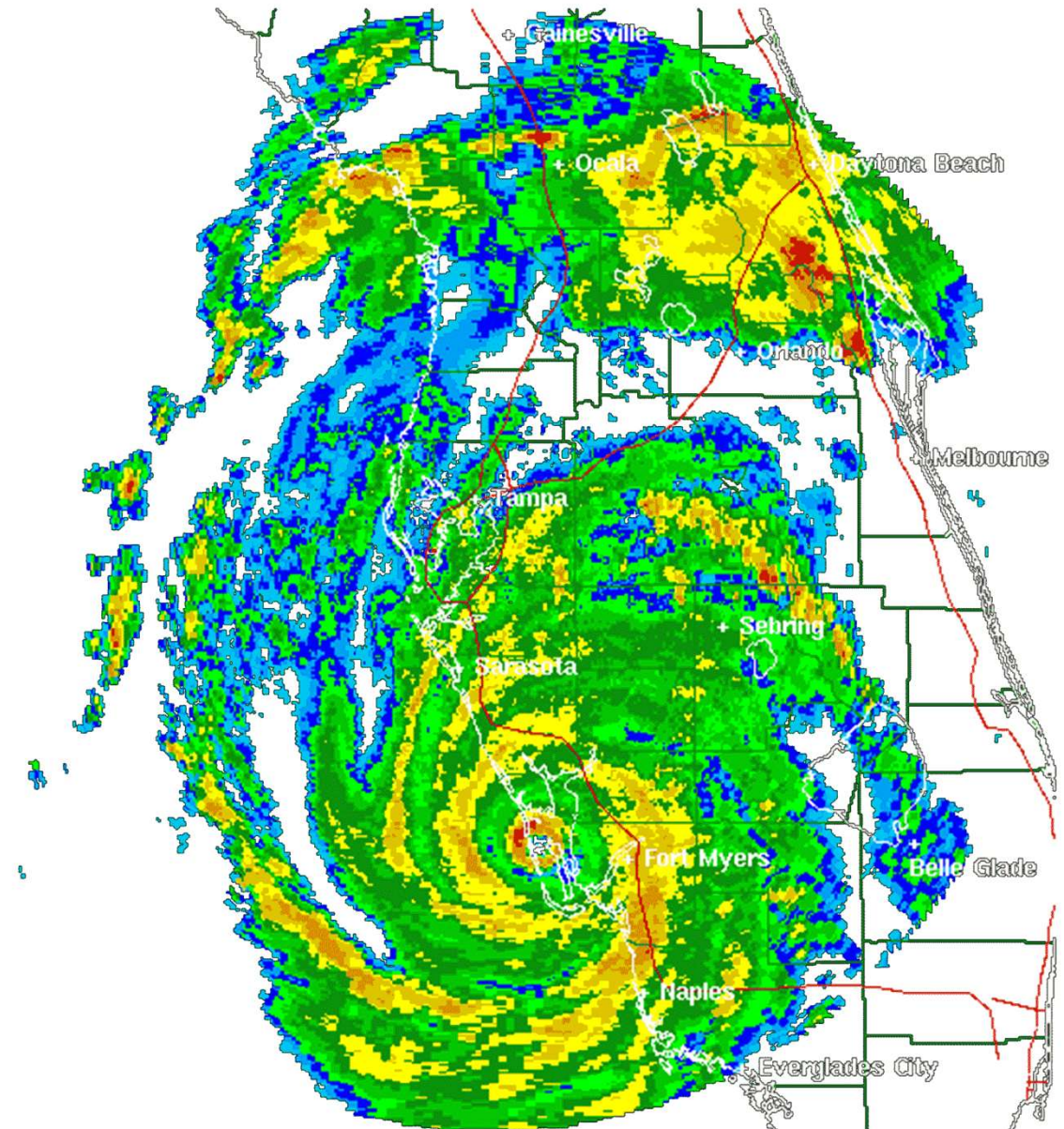


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Extreme Wind Warning

“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.**”

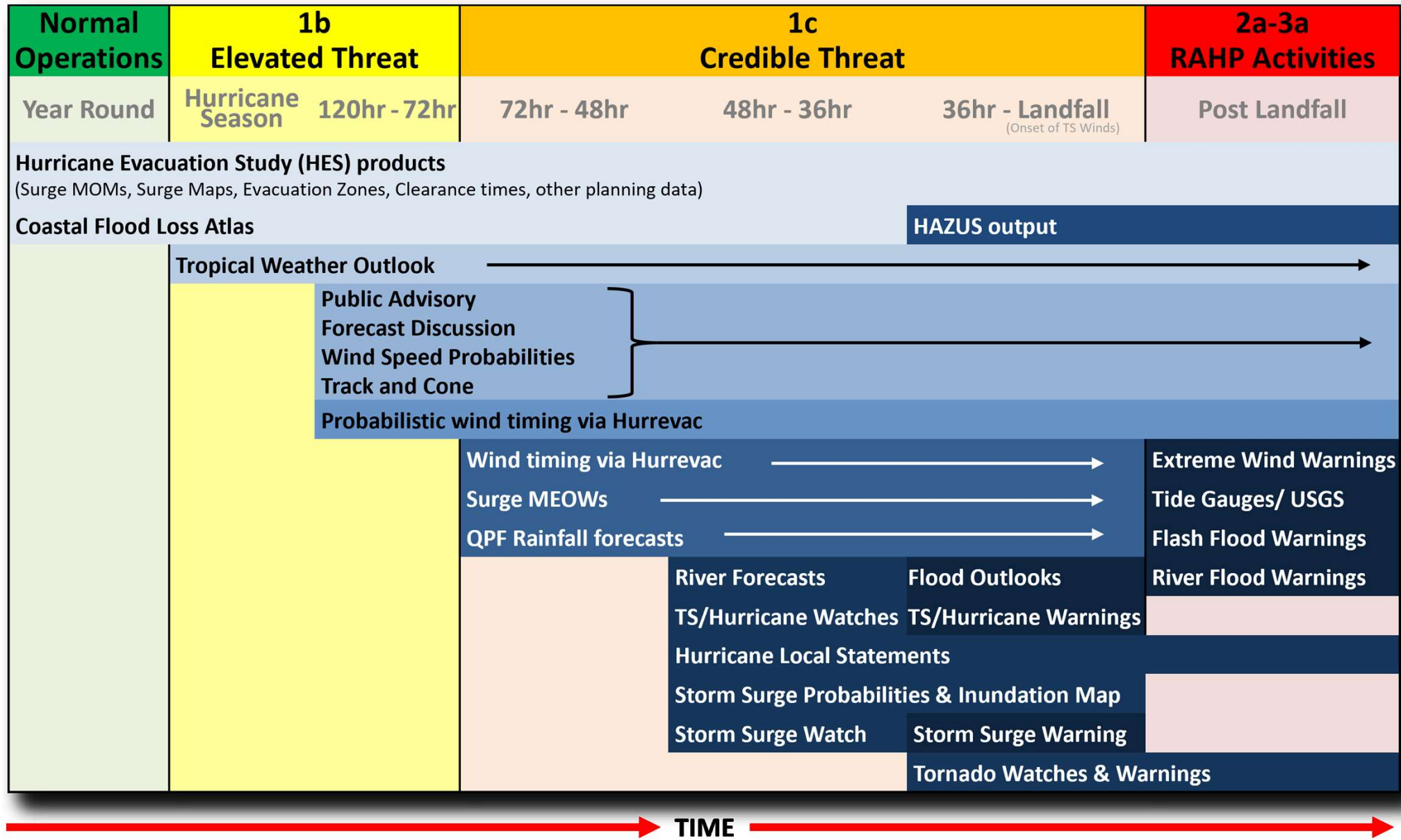
- **Issuance criteria:**
 - Category 3 or greater
 - Valid time 2 hours or less
- **Activates WEA**



NWS Products Timeline



FEMA



Tropical Cyclone Products Timeframe 2



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Questions/Comments?



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What product shows the probable track or path of the center of the tropical cyclone?

- A. Cumulative Wind History
- B. Wind Speed Probability Graphic
- C. Cone Graphic
- D. Graphical Tropical Weather Outlook



Which product gives the chance of tropical cyclone formation?

- A. Tropical Weather Outlook
- B. Tropical Cyclone Discussion
- C. Public Advisory
- D. Wind Speed Probability Graphic

Which product provides wind timing information beyond 72 hours?

- A. Forecast Advisory
- B. Cone Graphic
- C. Public Advisory
- D. Wind Speed Probabilities

Which product shows the current size of the tropical cyclone wind field?

- A. Cone Graphic
- B. Wind Speed Probability Graphic
- C. Tropical Cyclone Cumulative Wind History
- D. Tropical Cyclone Surface Wind Field Graphic

Which product provides the reasoning behind the tropical cyclone forecast?

- A. Public Advisory
- B. Forecast Discussion
- C. Hurricane Local Statement
- D. Forecast Advisory



Which product shows areas of possible tropical cyclone formation?

- A. Cone Graphic
- B. Tropical Weather Outlook
- C. Graphical Tropical Weather Outlook
- D. Wind Speed Probability Graphic

Which product contains forecast position, intensity, and wind radii information?

- A. Public Advisory
- B. Tropical Cyclone Discussion
- C. Tropical Weather Outlook
- D. Forecast Advisory

When are Special Advisories issued?

- A. Upon request
- B. When a tropical cyclone is within radar range
- C. When a significant, unexpected change in the storm occurs
- D. Before an Emergency Management briefing

Provides a continuous flow of information when a tropical cyclone is near land?

- A. Public Advisory and Tropical Weather Outlook
- B. Public Advisory and Forecast Discussion
- C. Public Advisory and Cone Graphic
- D. Public Advisory, Intermediate Advisory, and Tropical Cyclone Update

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

When are NHC intermediate Public Advisories issued?

- A. All the time
- B. When the 5-day forecast reaches land
- C. When ships are crossing the path of the storm
- D. When Coastal Watches and Warnings are in effect



Which warning is issued when a major hurricane is about to make landfall?

- A. Extreme Wind Warning
- B. Hurricane Warning
- C. Tornado Warning
- D. Severe Thunderstorm Warning

The lead time for a Hurricane Watch or Warning is tied to the arrival of _____?

- A. Hurricane force winds
- B. Life-threatening inundation
- C. The eye
- D. Tropical storm-force winds

NHC track forecasts are most accurate for this (strength) of Tropical Cyclones?

- A. Hurricanes
- B. Tropical Storms
- C. Tropical Depressions
- D. All the above

The NHC assigns Saffir-Simpson Hurricane Scale categories based on what?

- A. Size of the hurricane
- B. Maximum sustained winds
- C. Forecast Storm Surge
- D. Minimum pressure

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

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



The NHC's 24- and 48-hour intensity forecasts are on average off by _____ Saffir-Simpson categories?

- A. 1
- B. 2
- C. 3
- D. 4