UNIT 3:
Forecast Uncertainty

Unit 3 Objectives

Unit Objectives

At the end of Unit 3, you should be able to:

- Explain how wind speed probability products are used to predict the chance and timing of hazardous winds.

- Explain uncertainty as it relates to arrival times for TS wind speeds.

- Identify products used to evaluate storm surge risk.

- Identify and discuss coastal surge models.

Forecast Errors

Improving, But Not Perfect

Track Errors

Track Errors

- **Steadily increase each day**

Track Errors

Increasing Error

0   1   2   3   4   5

Forecast Period (Days)

Forecast Track Errors in Miles

Track Errors

- **Increase 35-40 miles (30-35 nm) per day**

37

65

99

142

204

Increasing Error

0   1   2   3   4   5

Forecast Period (Days)

Hurricanes

- **Track errors increase about 25–30 miles per day**

Finally, Signs of Improvement

Forecast Intensity Errors

Intensity Errors

Intensity Errors

- **Increase the first 2–3 days and then level off**

Intensity Errors

Increasing Error

Forecast Period (Days)

0   1   2   3   4   5

Intensity Errors

- **The NHC intensity forecasts are on average off by one Saffir-Simpson category.**

Increasing Error (mph)

9   11   12   14   15

0   1   2   3   4   5

Forecast Period (Days)

Rapid Intensification

- **A forecast challenge**

- **Often results in very large errors**

- **Forecasting the extent and timing of that intensification remains difficult**

Example: Iota Advisory 7 (2020)

Initial Intensity:	65 mph		Initial Intensity:	65 mph
24h Forecast:	105 mph		36h Forecast:	120 mph
Actual Intensity:	105 mph		Actual Intensity:	155 mph
24h Error:	**0 mph**		**36 h Error:**	**35 mph**

Don't Focus on the Skinny Black Line

Hurricane Charley

Hurricane Charley
August 12, 2004 - Advisory 13
11 AM EDT Thursday
Current Location 19.7 N 81.2 W
Max Sustained Wind 90 mph (Cat 1)
Current Movement 17 mph NW

Forecast vs. Observed

Wind Speed Probabilities

NATIONAL HURRICANE CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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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 - - - -

              FROM      FROM      FROM      FROM      FROM      FROM      FROM
 TIME       06Z MON   18Z MON   06Z TUE   18Z TUE   06Z WED   06Z THU   06Z FRI
PERIODS        TO        TO        TO        TO        TO        TO        TO
            18Z MON   06Z TUE   18Z TUE   06Z WED   06Z THU   06Z FRI   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)
```

The chance of hurricane-force winds occurring at Pensacola during the next 5 days is between_____.

A. 1% to 10%
B. 10% to 20%
C. 20% to 30%
D. 30% to 40%
E. 40% to 50%

Generating Probabilities

More Scenarios

- **1,000 realistic alternate scenarios are generated.**
  - Official NHC forecast
  - Historical track and intensity errors

- **Weakening over land**

- **Track model spread**
  - Forecast track errors are correlated to the spread of the model guidance.

Atlantic City, NJ

100 of 1,000 scenarios produce hurricane-force winds at that location

10%

Atlantic City, NJ

100/1,000 = 10%
of hurricane-force winds

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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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0900 UTC MON OCT 08 2018

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

                  FROM      FROM      FROM      FROM      FROM      FROM      FROM
   TIME         06Z MON  18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI
PERIODS            TO       TO       TO       TO       TO       TO       TO
                18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI  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

22

Location-Specific Probabilities 2

NATIONAL HURRICANE CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

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


                   FROM      FROM      FROM      FROM      FROM      FROM      FROM
   TIME         06Z MON  18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI
PERIODS            TO        TO        TO        TO        TO        TO        TO
                 18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI  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

23

Location-Specific Probabilities 3

NATIONAL HURRICANE CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

```
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0900 UTC MON OCT 08 2018

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


                 FROM      FROM      FROM      FROM      FROM      FROM      FROM
   TIME        06Z MON  18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI
 PERIODS         TO       TO       TO       TO       TO       TO       TO
               18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI  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

24

Onset Probabilities

NATIONAL HURRICANE CENTER
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

```
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NWS NATIONAL HURRICANE CENTER MIAMI FL         AL142018
0900 UTC MON OCT 08 2018

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


              FROM      FROM      FROM      FROM      FROM      FROM      FROM
  TIME       06Z MON  18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI
PERIODS        TO       TO       TO       TO       TO       TO       TO
             18Z MON  06Z TUE  18Z TUE  06Z WED  06Z THU  06Z FRI  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)
```

Onset Probabilities
- Timing information

25

Cumulative Probabilities

TROPICAL STORM MICHAEL WIND SPEED PROBABILITIES NUMBER   7
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0900 UTC MON OCT 08 2018

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

		FROM	FROM	FROM	FROM	FROM	FROM	FROM
TIME		06Z MON	18Z MON	06Z TUE	18Z TUE	06Z WED	06Z THU	06Z FRI
PERIODS		TO	TO	TO	TO	TO	TO	TO
		18Z MON	06Z TUE	18Z TUE	06Z WED	06Z THU	06Z FRI	06Z SAT
FORECAST HOUR		(12)	(24)	(36)	(48)	(72)	(96)	(120)

LOCATION   KT

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)

Cumulative Probabilities
- Total chance through the time period

5-Day Cumulative Graphic: TS-Force

Tropical-Storm-Force Wind Speed Probabilities
For the 120 hours (5.00 days) from 1 AM CDT MON OCT 08 to 1 AM CDT SAT OCT 13

Probability of tropical-storm-force winds (1-minute average >= 39 mph) from all tropical cyclones
○ indicates Tropical Storm Michael center location at 1 AM CDT MON OCT 08, 2018 (Forecast/Advisory #7)

5 10 20 30 40 50 60 70 80 90 %

Location-Specific Probabilities
- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

27

50-knot (58 mph) Wind Speed Probabilities
For the 120 hours (5.00 days) from 1 AM CDT MON OCT 08 to 1 AM CDT SAT OCT 13

Probability of 50-knot (58 mph) winds (1-minute average >= 58 mph) from all tropical cyclones
O indicates Tropical Storm Michael center location at 1 AM CDT MON OCT 08, 2018 (Forecast/Advisory #7)

Location-Specific Probabilities
- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

28

Hurricane-Force Wind Speed Probabilities
For the 120 hours (5.00 days) from 1 AM CDT MON OCT 08 to 1 AM CDT SAT OCT 13

Probability of hurricane-force winds (1-minute average >= 74 mph) from all tropical cyclones
O indicates Tropical Storm Michael center location at 1 AM CDT MON OCT 08, 2018 (Forecast/Advisory #7)

5   10   20   30   40   50   60   70   80   90   %

Location-Specific Probabilities
- Tropical-Storm-Force
- 58 mph
- Hurricane-Force

29

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)

9 38 24 41 8

Chances of hurricane-force winds at Tampa and Port Charlotte are both around 30%

WSP – Knowledge Check Revisit

The chance of hurricane-force winds occurring at Pensacola during the next 5 days is between_____.

A. 1% to 10%
B. 10% to 20%
C. 20% to 30%
D. 30% to 40%
E. 40% to 50%

Wind Timing Importance and Causes

Uncertainty in Wind Timing

- **Track**
  - Forward speed, direction of motion, and location of center relative to given location

- **Storm Size**
  - How far will TS winds extend from the center? Difficult to forecast and highly variable

Time of Arrival Graphics
Designed to account for uncertainty in arrival of TS-force winds and provide timing information

83% increase in 3 days!

Generating Time of Arrival Graphics

More Scenarios

- **1,000 realistic alternate scenarios are generated.**
    - Official NHC forecast and historical errors
    - Weakening over land
    - Track model spread

- **Produces information about:**
    - Chance of wind occurring
    - Probabilistic onset timing

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

Earliest Reasonable Arrival Time of Tropical-Storm-Force Winds

Tropical Storm Michael
Mon. Oct. 8, 2018 4 am CDT
Advisory 7

Storm Location & Wind Speed: ○ < 34 kt (39 mph), ◐ 34-63 kt (39-73 mph), ◑ ≥ 64 kt (74 mph)

5-day chance of receiving sustained 34+ kt (39+ mph) winds: 5 10 20 30 40 50 60 70 80 90 100%

All Times CDT

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

Most Likely Arrival Time of Tropical-Storm-Force Winds

Tropical Storm Michael
Mon. Oct. 8, 2018 4 am CDT
Advisory 7

Storm Location & Wind Speed
○ < 34 kt (39 mph)
◉ 34-63 kt (39-73 mph)
◉ ≥ 64 kt (74 mph)

5-day chance of receiving sustained 34+ kt (39+ mph) winds
5 10 20 30 40 50 60 70 80 90 100 %

All Times CDT

Timing Uncertainty

- **Earliest Reasonable**
  - Absolutely must be there by 5 p.m.
  - Leave by 4:10 p.m. (50 min)

- **Most Likely**
  - Some wiggle room
  - Can afford to be a little late if traffic
  - Leave by 4:34 p.m. (26 min)

- **Window to leave: 24 min**
  - 4:10 p.m. to 4:34 p.m.

Wind Timing - Tallahassee FL

Timing Uncertainty

- **Earliest Reasonable**
  - 10% chance of onset
  - Most conservative timing
  - Tuesday 8 p.m.

- **Most Likely**
  - 50% chance of onset
  - Equally likely before as after
  - Wednesday 8 a.m.

- **Range of wind arrival: 12 h**
  - Tue 8 p.m. to Wed 8 a.m.

Most Likely Arrival Time of Tropical-Storm-Force Winds

Tropical Storm Michael
Mon. Oct. 8, 2018 4 am CDT
Advisory 7

Storm Location & Wind Speed: ○ < 34 kt (39 mph) ◎ 34-63 kt (39-73 mph) ● ≥ 64 kt (74 mph)

5-day chance of receiving sustained 34+ kt (39+ mph) winds: 5 10 20 30 40 50 60 70 80 90 100 %

All Times CDT

Wind Timing Uncertainty

TOA Product Limitations

- **Storm Size**
  - Unusually large or small storms may not be handled well, especially beyond the first 24–36 hours.

- **Slow Forward Speed**
  - Storms that stall or move slowly can have much earlier onset times than what is conveyed in the official forecast.

Hurricane Dorian (2019)

Wilmington, NC

Hurricane Nate (2017)

Gulfport, MS

Summary

- **NHC's forecasts are improving but errors remain.**
  - Error cone is not the cure for the skinny black line.

- **Wind Speed Probabilities.**
  - Likelihood of Tropical Storm and Hurricane Winds
  - Onset timing of wind hazards

- **Incorporates track, intensity, and size uncertainty.**
  - Includes weakening due to land
  - Provides an assessment of wind timing and threat that accounts for NHC forecast errors.

Unit 3 Objectives Revisited

Unit Objectives

At the end of Unit 3, you should be able to:

- Explain how wind speed probability products are used to predict the chance and timing of hazardous winds.

- Explain uncertainty as it relates to arrival times for TS wind speeds.

- Identify products used to evaluate storm surge risk.

- Identify and discuss coastal surge models.

Hurricane Sally

HURRICANE SALLY

Advisory #14

⊙ **Initial Location: 28.8 N 87.4 W**
Monday, September 14, 2020 5PM EDT
- Maximum Sustained Winds: 100 mph (Cat 2)
- Movement : 6 mph WNW

What a Difference a Bay Makes

Storm Surge – SLOSH Model

Sea,
Lake, and
Overland
Surges from
Hurricanes

A numerical model used to estimate storm surge heights for historical, hypothetical, or predicted hurricanes

Operational Storm Surge Basins
for the Sea, Lake, and Overland Surges from Hurricanes
(SLOSH) Model
Updated: January 2022

Storm Surge Risk Tools

Maximum of the MEOWs (MOMs)

Maximum Envelopes of Water (MEOWs)

Probabilistic Storm Surge (P-Surge)

Potential Storm Surge Flooding Map

Storm Surge Watch/Warning

Planning/More Forecast Uncertainty → More Forecast Certainty

Maximum Envelope of Water

MEOWS

- **Composite of maximum storm surge for a given set of parameters (by basin)**
- **Used as guidance for planning and operations**

MEOW Example

13.8 ft

User selects:
- Category (Cat 3)
- Landfall direction (wnw)
- Forward speed (15 mph)
- Initial tide (High)

59

Maximum of Maximums (MOMs)

MOMs

- **Worst-case for a particular category storm**

- **Combination of many scenarios**
  - Forward speed
  - Angle of approach
  - Size (Radius of maximum wind)
  - Initial tide level

- **No single hurricane will produce the regional flooding depicted in a Maximum of Maximums (MOMs)**

Maximum of Maximums (MOMs) 2

Probabilistic Storm Surge (P-Surge)

P-Surge

- **Based on NHC official advisory**
  - Uncertainties based on historical errors

- **Accounts for uncertainty in:**
  - Track (landfall location)
  - Forward speed
  - Size (Radius of maximum wind)
  - Intensity

- **Accounts for tide**

- **Heights above ground level**

10% Exceedance (feet above ground)

Probabilistic Storm Surge

HURRICANE IRENE

Advisory #22

— Forecast Track

- - Alternate P-surge Tracks

Sizes, Intensities, Forward Speeds

Size (RMW):   Small, Medium, Large

Forward Speed: Fast, Medium, Slow

Intensity: Strong, Medium, Weak

P-Surge

- **Typically issued with a Hurricane or Storm Surge Watch/Warning**
  - But can be provided up to 72 hours prior to arrival of TS winds when forecaster confidence is high

- **Available about 1 hour after advisory**

- **Output used to generate NHC's Potential Storm Surge Flooding Map**
  - Also used to create local NWS storm surge products (i.e., Hurricane Threats and Impacts Graphics, etc.)

ADV TIME	P-SURGE
• 0500	**0600 EDT**
• 1100	**1200 EDT**
• 1700	**1800 EDT**
• 2300	**0000 EDT**

Deterministic vs. Probabilistic

FEMA

Probabilistic Surge (P-surge) shows larger surge threat to Pensacola area

Surge based on NHC 24 hr forecast

Mobile ★

Pensacola ★

Pascagoula

Mobile Bay

Dauphin Island

Gulf Shores

Perdido Key

Santa Rosa Island

🟦	Greater than 1 feet
🟨	Greater than 3 feet
🟧	Greater than 6 feet
🟥	Greater than 9 feet

In general, NHC operational storm surge products provide water levels above which reference level?

A. Mean Sea Level (MSL)

B. Ground Level (AGL)

C. NAVD88

D. Normal Tidal Levels

Vertical Datums

Potential Storm Surge Flooding Map

Potential Inundation Map

- **Height above ground that the water <u>could</u> reach**
  - Reasonable worst-cast scenario for any individual location
  - Storm surge heights at any individual location have a **10% chance of being exceeded**

- **Not a flooding footprint**

- **Issuance and availability are the same as P-Surge**

Intertidal/Wetlands

Tidal (Estuarine) Wetlands

Estuarine Forested Wetland
Mangroves
Everglades National Park, Florida

Estuarine Scrub/Shrub Wetland
Tidal Shrub Swamp
Virginia

Estuarine Emergent Wetland
Salt Marsh
Brigantine, New Jersey

Non-Tidal (Palustrine) Wetlands

Palustrine Forested Wetland
Cypress Swamp
Bayou Corne, Louisiana

Palustrine Scrub/Shrub Wetland
Short Pocosin
Pocosin Lakes National Wildlife Refuge, North Carolina

Palustrine Emergent Wetland
Sawgrass Prairie
Everglades National Park, Florida

Intertidal/Wetlands Mask

Current Wetlands Mask

Intertidal/Wetlands Mask 2

With Wetlands Mask

Without Wetlands Mask

Hurricane Florence (2018) – Advisory 50

Messaging P-Surge

NHC Potential Storm Surge Flooding Map
Hurricane LAURA (2020) Advisory 27
From 10 AM CDT Wednesday August 26 to 01 PM CDT Sunday August 30

Imagery with Labels

Lafayette

Beaumont

30km
20mi

Esri, HERE, NPS | Esri, HERE, NPS

Potential Storm Surge Flooding*

- Intertidal Zone/Estuarine Wetland
- Greater than 1 foot above ground
- Greater than 3 feet above ground
- Greater than 6 feet above ground
- Greater than 9 feet above ground
- Leveed area
  Consult local officials for flood risk

Map Layer Options:

Inundation Layer Only | Inundation with Intertidal Layer

Map Opacity Slider

Download GIS data *(Instructions)* | Inundation Layer Only | Inundation with Intertidal Layer

Potential Storm Surge Flooding
The NWS's potential storm surge flooding map indicates the **height** above ground that the **water could reach.**

LAND

D C B A

COASTLINE

"Above Ground Level" describes the water level of the flooding that moves inland due to the combined effect of storm surge and tide.

WATER

weather.gov
hurricanes.gov

A Greater than 9 feet above ground

B 6-9 feet above ground

C 3-6 feet above ground

D 1-3 feet above ground

73

Questions/Comments?