Hurricane Awareness

Participant Guide

Version 1.0

FEMA

NATIONAL DISASTER PREPAREDNESS TRAINING CENTER

Copyright Information

Hurricane Awareness

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FEMA's National Training and Education Division (NTED) offers a full catalog of courses at no-cost to help build critical skills that responders need to function effectively in mass consequence events. Course subjects range from Weapons of Mass Destruction (WMD) terrorism, cybersecurity, and agro-terrorism to citizen preparedness and public works. NTED courses include multiple delivery methods: instructor led (direct deliveries), train-the-trainers (indirect deliveries), customized (conferences and seminars) and web-based. Instructor led courses are offered in residence (i.e. at a training facility) or through mobile programs in which courses are brought to state and local jurisdictions that request the training. A full list of NTED courses can be found at www.firstrespondertraining.gov.

Table of Contents

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Hurricane Awareness

Module 1: Welcome, Introduction, and Administration

Version 1.0

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Module 1: Welcome, Introduction, and Administration

Slide 1-1. Welcome, Introduction, and Administration

Duration

50 minutes

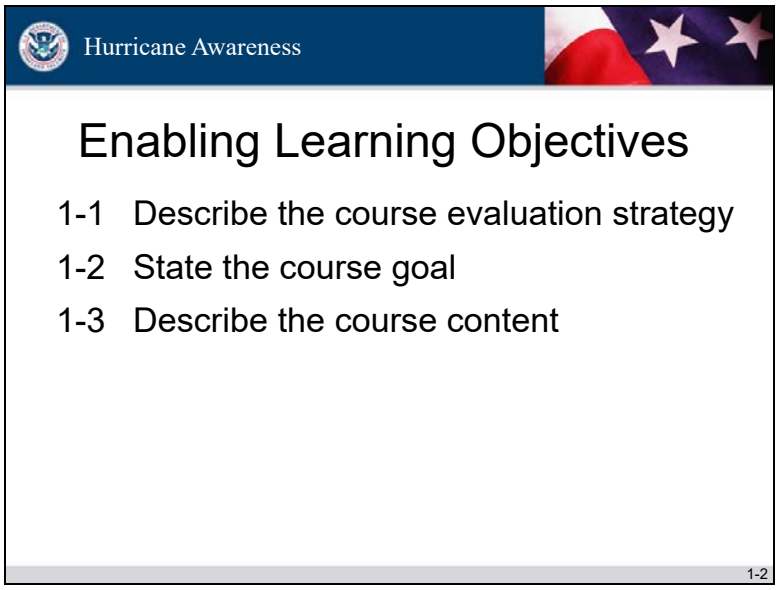
Scope Statement

In this module, the instructor will welcome participants to the course and explain course administration, goal, and content. The instructor will introduce himself or herself and ask participants to introduce themselves one at a time. Finally, the instructor will assess the participants' existing comprehension of hurricane science, forecasting, warning, and preparedness by conducting a pre-test.

Terminal Learning Objective (TLO)

Participants will explain course content, objectives, and administration.

Enabling Learning Objectives (ELOs)



Slide 1-2. Enabling Learning Objectives

At the conclusion of this module, participants will be able to:

1-1 Describe the course evaluation strategy;
1-2 State the course goal; and
1-3 Describe the course content.

Resources

- Instructor Guide (IG)
- Class roster
- Module 1 presentation slides
- Laptop with presentation software installed and CD-ROM capability
- Audio-visual (A/V projection unit)
- Projector screen
- Chalkboard (and chalk), whiteboard (and dry erase markers), or easel and easel paper (and permanent markers)
- Letter-size manila envelopes (four; one each for the course registration forms, pre-tests, post-tests, and Level 1 evaluations)
- Pre-Test Key
- One of each of the following items per participant:
  - Participant Guide (PG) available for download from http://ndptc.hawaii.edu/
  - Pre-Test
  - Answer Sheet
  - Notepad and pen

Instructor-to-Participant Ratio

2:40

Reference List

Not applicable

Practical Exercise Statement

Not applicable

Assessment Strategy

- Instructor observation of participant involvement in classroom discussion
- Instructor-led discussion to gauge participant grasp of the subject matter to ensure that the participant understands both how performance will be evaluated and how evaluation will impact participant outcomes
- Instructor administration of objectives-based pre-test to assess the knowledge and experience participants bring to the class

Hurricane Awareness

Icon Map

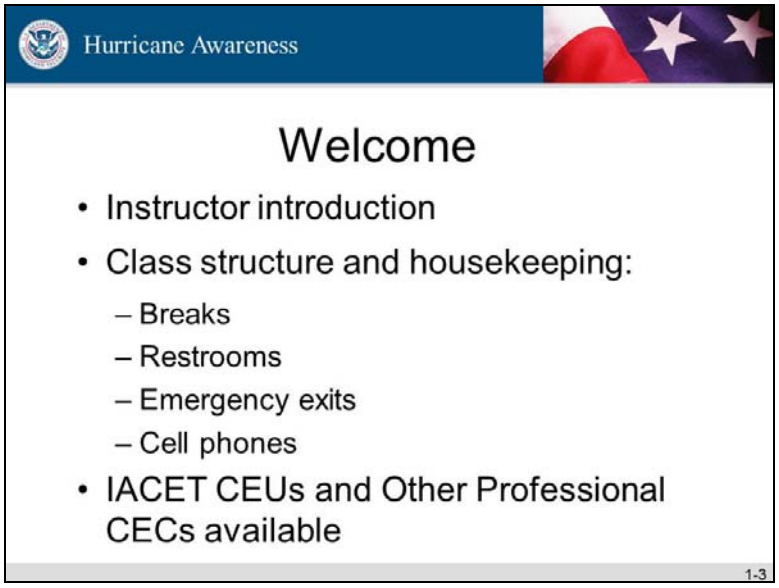
Knowledge Check: Used when it is time to assess participant understanding.

Example: Used when there is a descriptive illustration to show or explain.

Key Points: Used to convey essential learning concepts, discussions and introduction of supplemental material.

Participant Note: Used to indicate text that has been included as additional information for the participant. The text may not be directly addressed in the slide presentation or during class discussion.

Participant Notes:

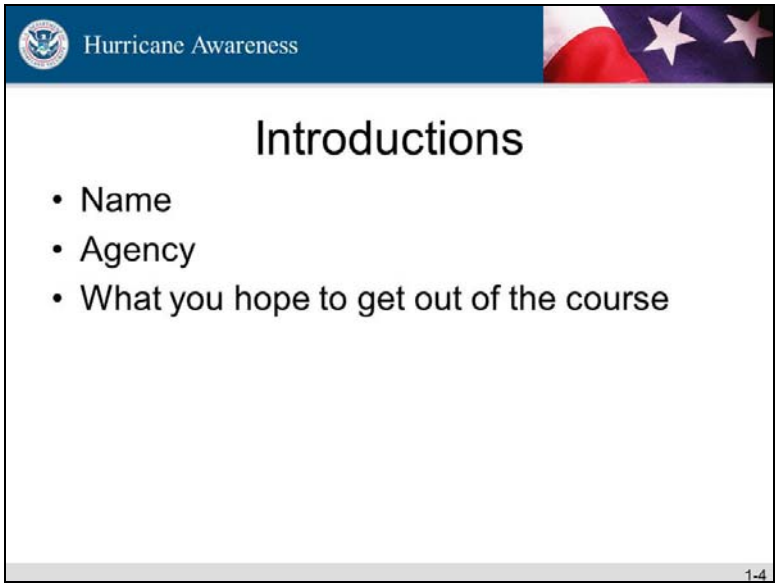


Slide 1-3. Welcome

The lead instructor will begin by welcoming participants and introducing the instructional team. The instructor will then review classroom protocols and standard classroom policies, such as breaks, restroom facilities, emergency exits, cell phone and Internet use.

Key Point: The National Disaster Preparedness Training Center (NDPTC) mission is as follows: Uniquely positioned geographically and culturally, the NDPTC works collaboratively to develop and deliver training and education in the areas of disaster preparedness, response, and recovery to governmental, private, tribal, and non-profit entities, and under-represented/under-served communities. It incorporates urban planning and environmental management, emphasizing community preparedness and addressing the needs of vulnerable at-risk populations.

Participant Notes:



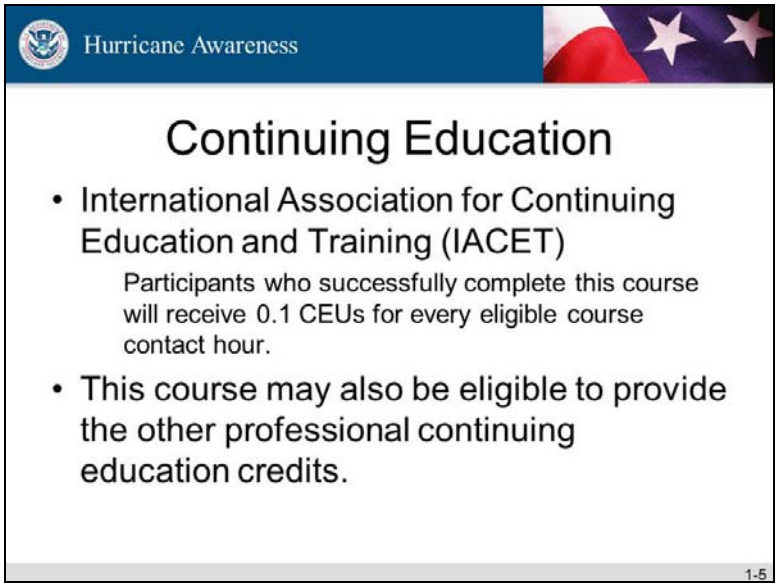
Slide 1-4. Introductions

The instructor will lead a round of participant self-introductions. Participants are asked to provide information designed to help the instructor learn names and understand the participants' backgrounds and motivations:

- Name
- Organization or agency
- Experience with disasters and leadership
- Reasons for taking this course
- Expectations for the course

Participants are encouraged to take an active role in the class discussions and group activities to demonstrate comprehension. Participant Guides are provided for participants to follow along with the course and to take any notes as needed.

Participant Notes:



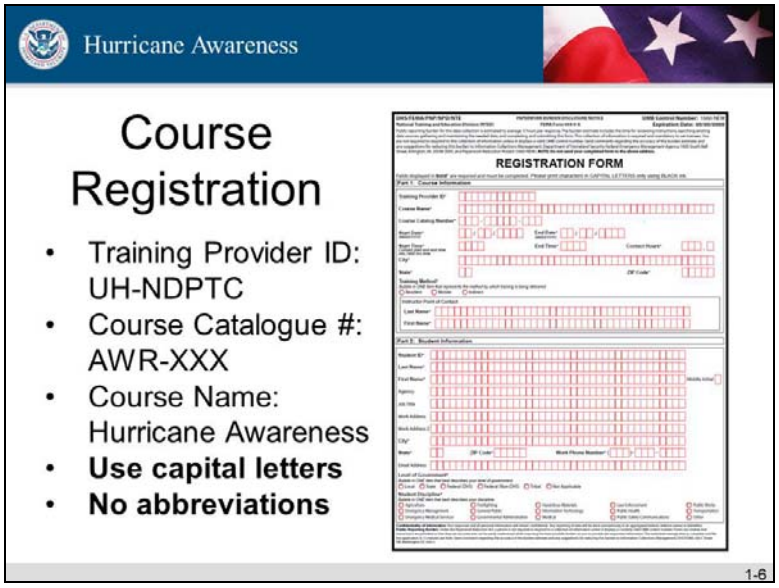
Slide 1-5. Continuing Education

This course may also be eligible to provide the following professional continuing education credits:

1. International Association of Emergency Managers (IAEM)- Training hours
2. Association of State Floodplain Managers (ASFPM)- Continuing Education Credits (CEC)
3. American Planning Association (APA)- Certification Maintenance (CM)
4. American Institute of Architects (AIA)- Continuing Education System (CES) Learning Units (LU)

Eligibility to receive credits from the designated professional organizations is dependent on the specific membership and/or qualification requirements as enforced by each individual organization. Submission processes enforced by each organization should be followed to successfully receive credits. For more information, visit the NDPTC website or contact NDPTC at 808-725-5220/ ndptc-training@lists.hawaii.edu.

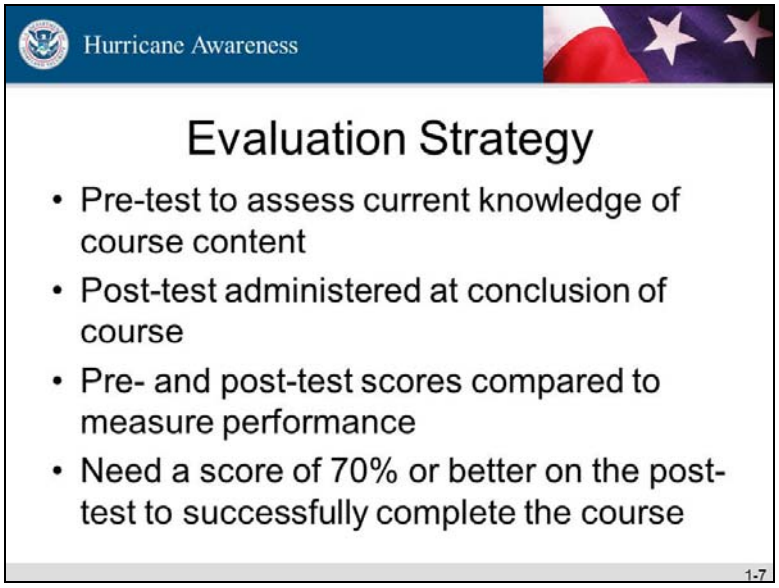
Participant Notes:



Slide 1-6. Course Registration

The instructor will distribute the course registration forms for those participants who have not already completed the online registration. The instructor will then collect the registration forms.

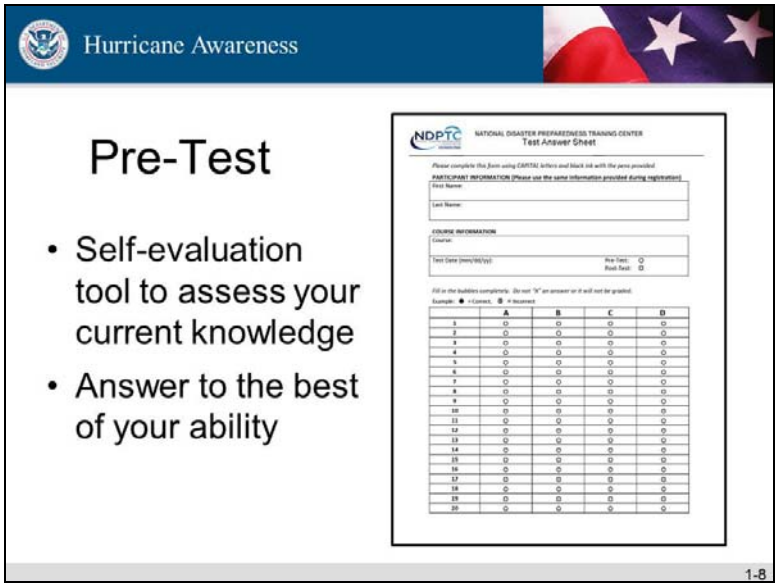
Participant Notes:



Slide 1-7. Evaluation Strategy

The evaluation strategy for this course follows FEMA's Responder Training Development Center (RTDC) guidance and uses resources, templates, and best practices that provide for instructional development and evaluation. Participants will be given two tests – a pre-test administered next, and a post-test at the end of the course. Each test includes one or more items designed to assess mastery of the module enabling learning objectives. Successful performance on the post-test (i.e., scoring 70% or better) will be recognized by issuance of a Certificate of Achievement. During the course, knowledge checks will offer participants an opportunity to reinforce new knowledge and get corrective feedback prior to the post-test.

Participant Notes:



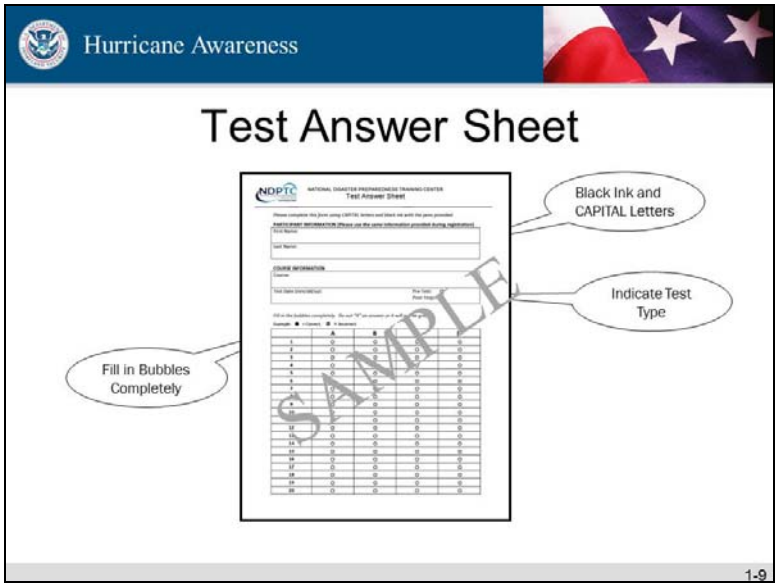
Slide 1-8. Pre-test

The instructor will inform the participants that, working independently, they will have 10 minutes to complete the pre-test.

Participants should follow these instructions as they take the pre-test and indicate their answers on the test answer sheet:

- Write legibly using uppercase letters.
- Use the same first name, last name, and date of birth provided on the participant registration form. This information is used to generate a unique participant identification number.
- Complete the Test Date field in the upper right-hand portion of the sheet by writing the day the test is actually administered.
- Write the test document ID number in the Test Doc ID field. The ID number is located in the test handout footer.
    - The instructor should confirm that all participants are using the same test version.
- Fill-in the Pre-test answer bubble.
- Completely fill-in each bubble making certain the darkened bubble is correctly aligned to the selected answer letter on the test answer sheet.

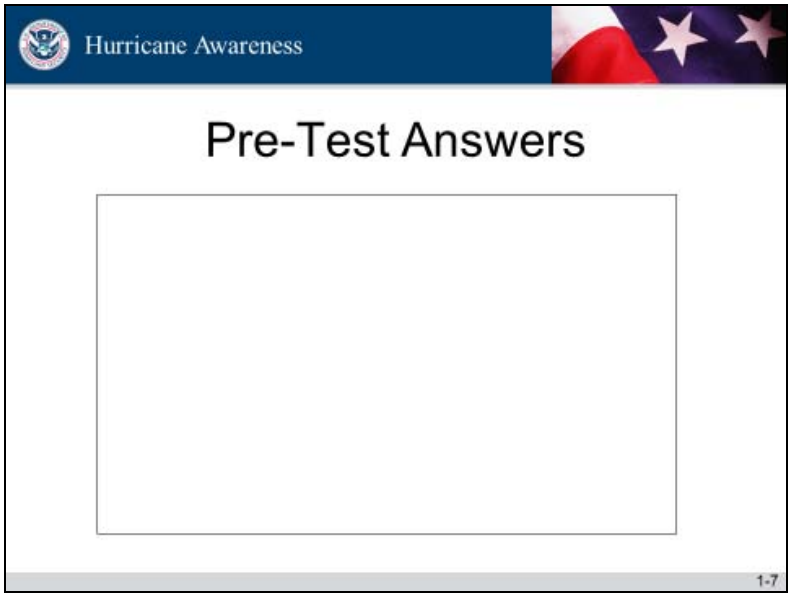
Participant Notes:



Slide 1-9. Test Answer Sheet

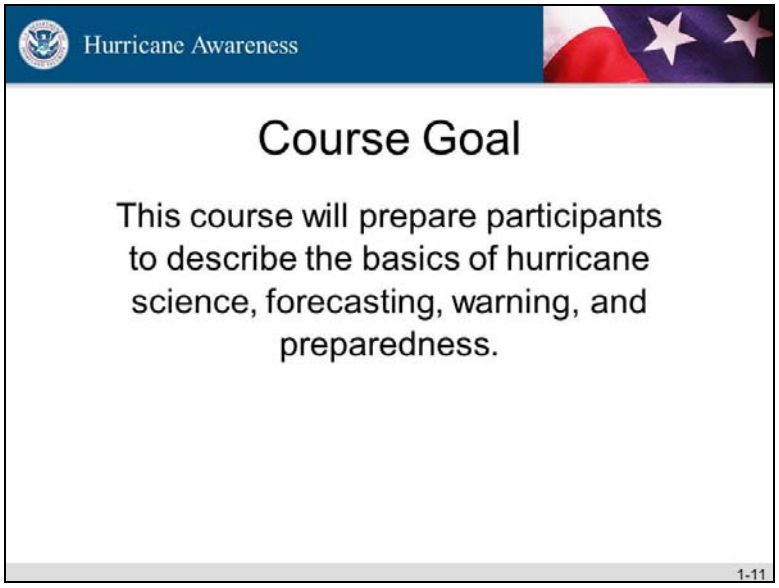
Participants will grade their own tests, taking care not to make grading marks in answer columns A through D. Participants may write the correct answer in the margins of the test answer sheet. On a separate piece of paper participants may also write down test scores for personal reference, and take any notes as needed.

Participant Notes:



Slide 1-7. Pre-Test Answers

Participant Notes:



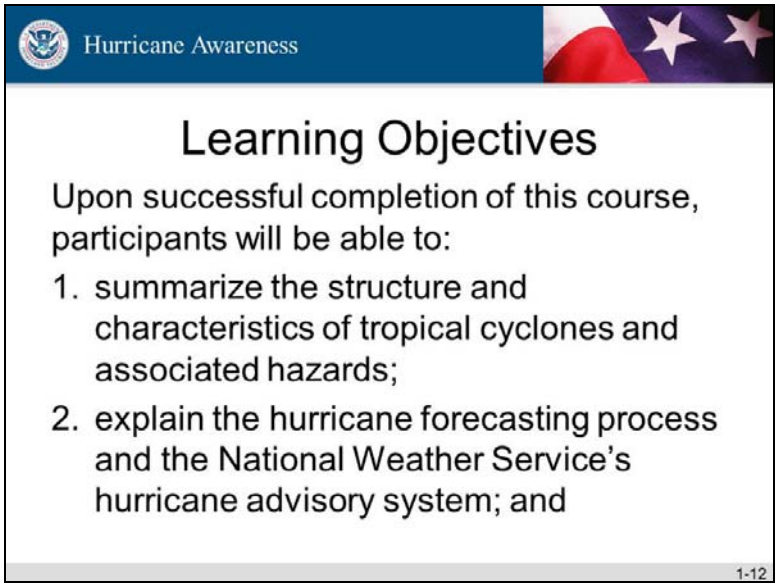
Slide 1-11. Course Goal

This course will prepare participants to understand the basics of hurricane science, forecasting, warning, and preparedness.

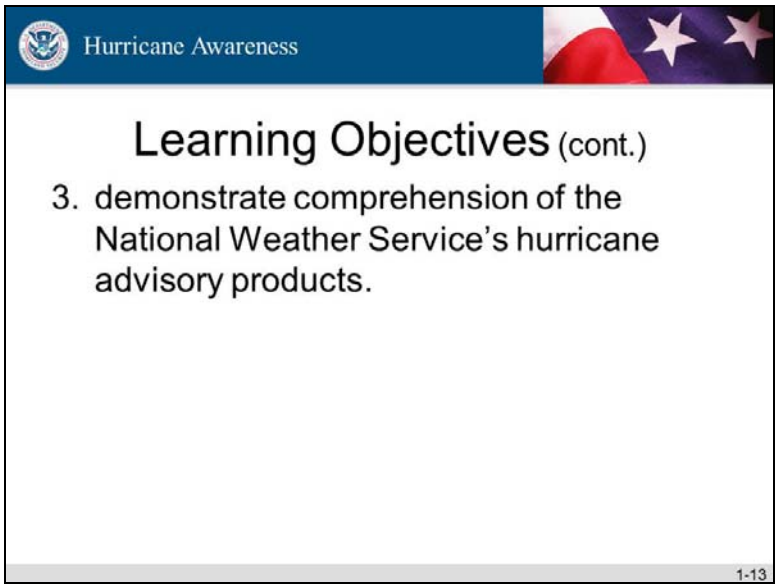
This course does not require any previous subject matter knowledge, so participants should not be concerned about having a background in the topics noted above. All of the knowledge required to answer intra-module and end-of-course assessment questions can be found in the course materials presented in the lectures.

This awareness-level course is targeted at participants across a broad spectrum of the community who need to be aware of the threat of hurricanes. In particular, this information should be of interest to the following: emergency managers, first responders, small businesses, corporations, federal/state/tribal governments, non-government organizations, community organizations, and typical households who need to prepare for and respond to hazards associated with hurricanes.

Participant Notes:



Slide 1-12. Learning Objectives

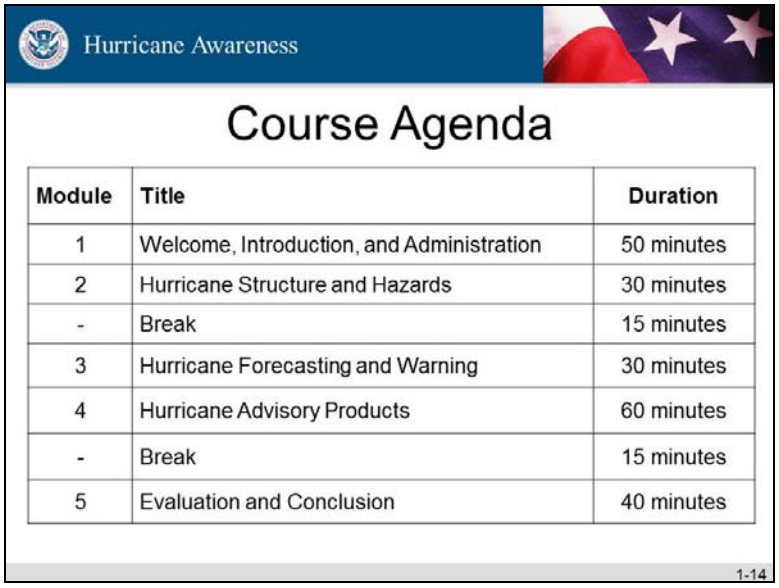


Slide 1-13. Learning Objectives (continued)

Upon successful completion of this course, participants will be able to:

1. summarize the structure and characteristics of tropical cyclones and associated hazards;
2. explain the hurricane forecasting process and the National Weather Service's hurricane advisory system; and
3. demonstrate comprehension of the National Weather Service's hurricane advisory products.

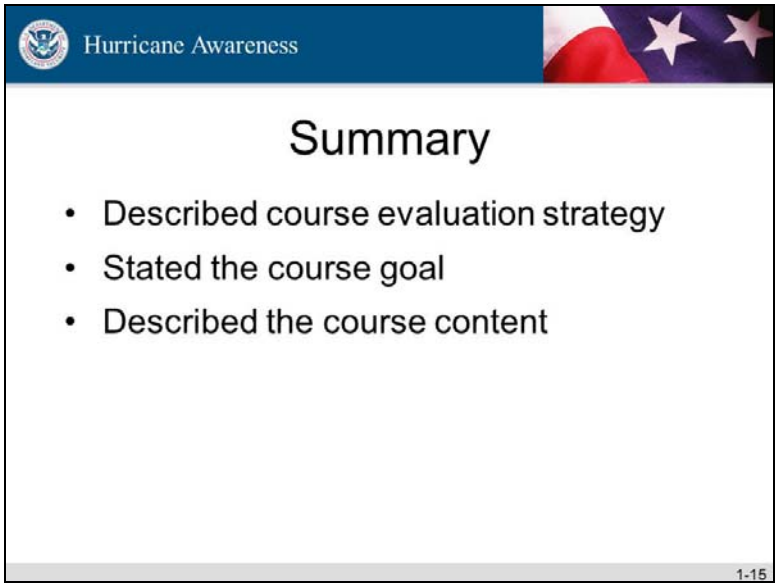
Participant Notes:



Slide 1-14. Course Agenda

This course is composed of five distinct modules designed to address various topics as well as to satisfy administrative requirements. Each session includes an introduction, lecture content, and class discussions, which expand upon the topics or ideas that are presented.

Participant Notes:



Slide 1-15. Summary

In this module, participants:

- Described the course evaluation strategy;
- Stated the course goal; and
- Described the course content.

Hurricane Awareness

Module 2: Hurricane Structure and Hazards

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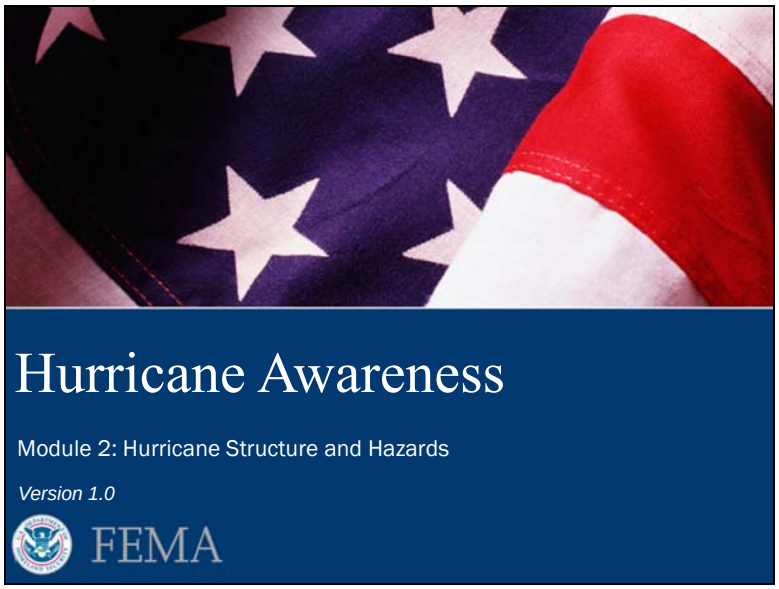
Module 2: Hurricane Structure and Hazards



Slide 2-1. Hurricane Structure and Hazards

Duration

30 minutes

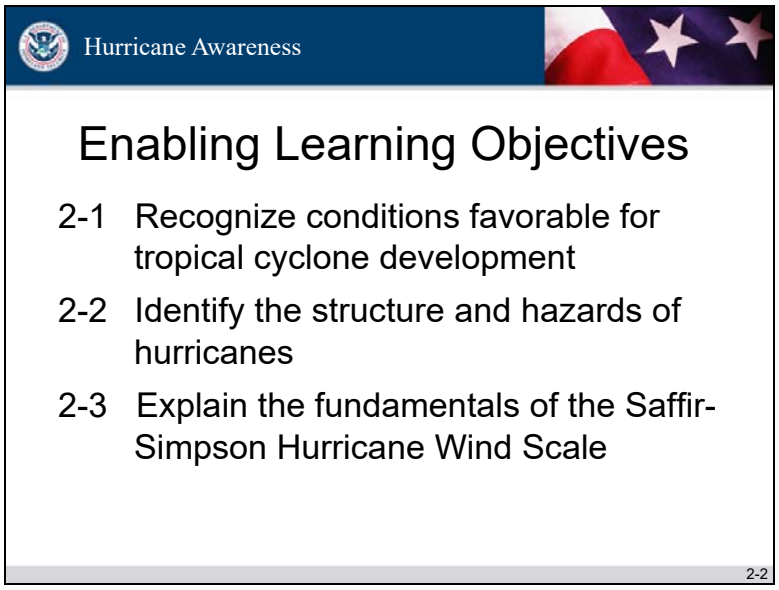
Scope Statement

This module will familiarize participants with an overview of the structure and characteristics of tropical storms and hurricanes. A survey of hurricane-related hazards will be presented, including high winds, storms surge, heavy rain, inland flooding, and tornadoes. This module will help participants understand the environmental conditions that support hurricane development and will provide an overview of the Saffir-Simpson Hurricane Wind Scale, which is used to quantify the intensity of tropical cyclones in the Atlantic Ocean, Eastern Pacific, and Central Pacific Ocean basins.

Terminal Learning Objective (TLO)

Participants will summarize the structure and characteristics of tropical cyclones and associated hazards.

Enabling Learning Objectives (ELOs)



Slide 2-2. Enabling Learning Objectives

At the conclusion of this module, participants will be able to:

2-1 Recognize conditions favorable for tropical cyclone development;
2-2 Identify the structure and hazards of hurricanes; and
2-3 Explain the Saffir-Simpson Hurricane Wind Scale.

Resources

- Instructor Guide (IG)
- Module 2 presentation slides
- Laptop with presentation software installed and CD-ROM capability
- Audio-visual (A/V projection unit)
- Projector screen
- Chalkboard (and chalk), whiteboard (and dry erase markers), or easel and easel paper (and permanent markers)
- One of each of the following items per participant:
  - Notepad and pen
  - Participant Guide (PG) available for download from http://ndptc.hawaii.edu/

Instructor-to-Participant Ratio

2:40

Reference List

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Practical Exercise Statement

Not applicable

Assessment Strategy

- Instructor observation of participant involvement in classroom discussion
- Instructor-led discussion to gauge participant grasp of the subject matter

Hurricane Awareness

Icon Map

Knowledge Check: Used when it is time to assess participant understanding.

Example: Used when there is a descriptive illustration to show or explain.

Key Points: Used to convey essential learning concepts, discussions and introduction of supplemental material.

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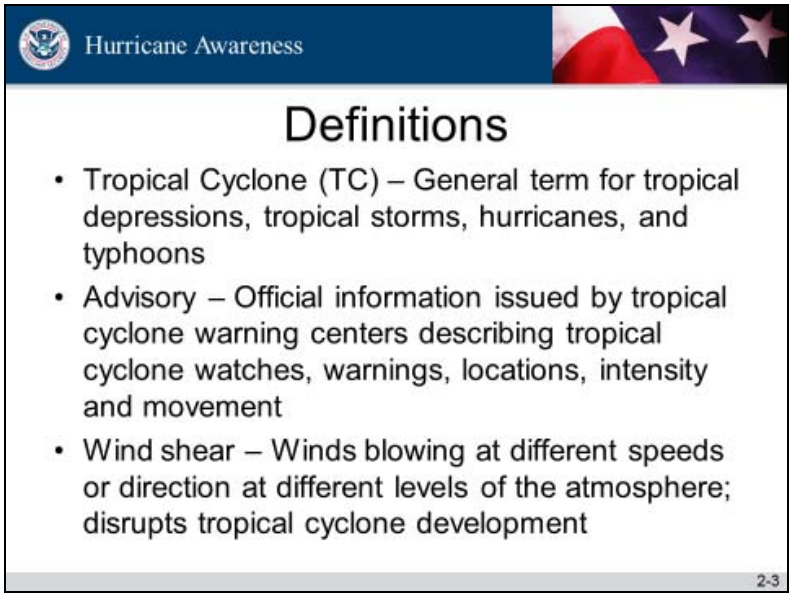
Participant Notes:



Slide 2-3. Definitions

Tropical Cyclone (TC):
A tropical cyclone is a defined low-pressure system with organized thunderstorm activity not connected to a frontal system that forms over tropical or subtropical waters. The winds of a tropical cyclone rotate counterclockwise around low-pressure systems in the northern hemisphere and clockwise around low pressure systems in the southern hemisphere.

Tropical cyclone is a generic term used for all of the following:

- Hurricane/Typhoon
- Cyclone (in the Indian Ocean and South Pacific)
- Tropical Storm
- Tropical Depression

Key Point: A hurricane is a type of tropical cyclone.

Advisory:
In reference to hurricanes, an advisory describes official information issued by tropical cyclone warning centers such as the National Hurricane Center or Central Pacific Hurricane Center. These bulletins describe all tropical cyclone watches and warnings in effect along with the details of tropical cyclone locations, intensity, and movement.

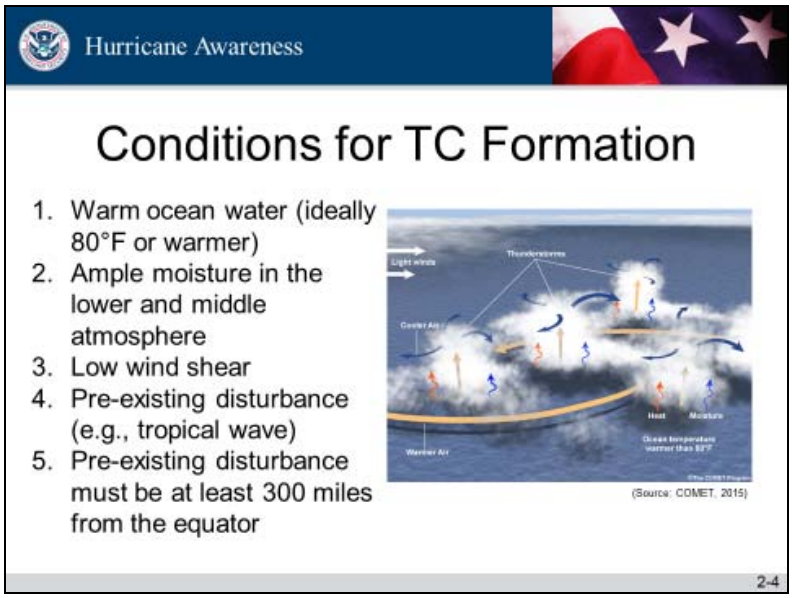
Participant Notes:

Wind Shear:

One of the biggest obstacles to the development of tropical cyclones is wind shear. Wind shear is the difference in wind speeds or direction at different levels of the atmosphere. Like garden shears to a hedge, shear in the atmosphere has the tendency to stunt or disrupt development by lopping off the tops of thunderstorms before they can grow high up in the atmosphere.

Participant Note: Some low-pressure systems do not fit the mold of a tropical cyclone or a mid-latitude cyclone and actually have characteristics of both. These hybrid systems can occur when a tropical cyclone transitions into a mid-latitude, sometimes referred to as post-tropical cyclones. Like a hybrid vehicle, transitioning post-tropical cyclones derive their energy from multiple power sources – both the atmosphere and the ocean. Their wind fields tend to be broader and less circular than pure tropical cyclones. Although their maximum winds are usually weaker than hurricane strength, the bigger wind field can make them just as impactful. Sandy in 2012 is an example of a hurricane that transitioned into a post-tropical cyclone prior to landfall, but still wrought over $60 billion in damage to the Northeast United States.

Participant Notes:



Slide 2-4. Conditions for TC Formation

Tropical cyclones need certain conditions in order to form. Although these conditions must be present, they do not guarantee development.

1. **Warm ocean water (ideally 80 degrees or warmer).** Warm ocean water is the power source for tropical cyclones. Water from the ocean evaporates from the surface and eventually cools and condenses as it rises, forming clouds. This releases stored energy from the ocean into the atmosphere and helps to heat and power the system.

2. **Ample moisture in the lower and middle atmosphere.** Tropical cyclones thrive off moisture between the surface of the ocean and about 15,000 feet. Dry air introduced into a tropical cyclone can eat away at thunderstorms that are helping to warm the atmosphere and drive the circulation.

3. **Low wind shear.** The difference in wind speed and direction between the upper and lower atmosphere needs to be minimal in order for a tropical cyclone to form. In other words, the wind shear must be light. The culprit for high wind shear is typically strong winds up at about 20,000 to 30,000 feet. Strong winds aloft tilt thunderstorms as they try to grow taller, which spreads out the heat that they produce. Without a concentrated area of heat, disturbances have trouble organizing.

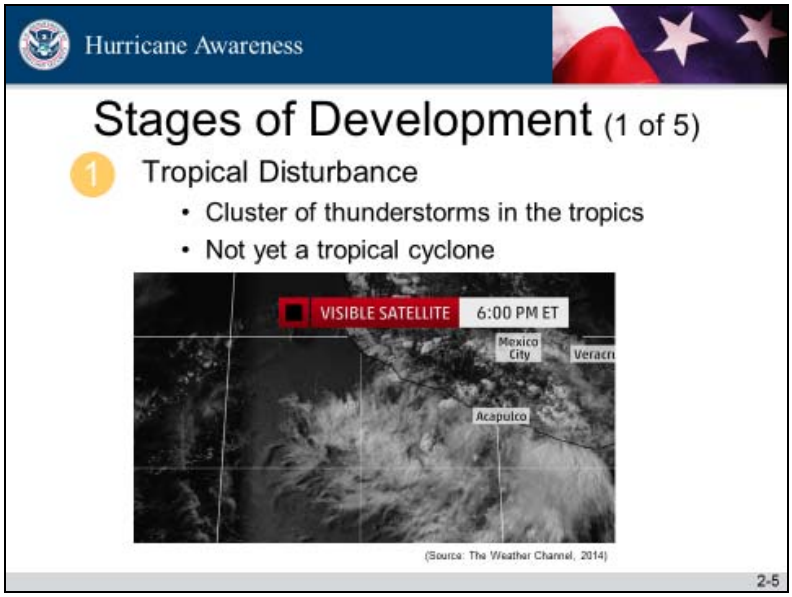
Participant Notes:

4. **Pre-existing disturbance.** Tropical cyclones do not form out of thin air. A pre-existing disturbance, usually in the form of thunderstorm clusters, must first exist. The most common type of disturbance in the Atlantic Ocean originates over Africa and rolls westward into the Atlantic every three to five days. These thunderstorm clusters, known as “tropical waves,” are often the seedlings for tropical depressions, tropical storms, and hurricanes. Approximately 70% of tropical cyclones in the Atlantic originate as tropical waves.

5. **Pre-existing disturbance must be at least 300 miles from the equator.** Thunderstorm clusters must spin in order to organize. They acquire this spin from the rotation of the earth. At the equator, the influence of the earth’s spin is zero but it increases as you move in either direction toward the poles. This is something known as the Coriolis Effect. While there is nothing magical about 300 miles, enough spin exists beyond 300 miles from the equator to commonly produce tropical cyclones.

Key Point: Warm ocean water, low wind shear, and a pre-existing disturbance are the three primary criteria required to form a hurricane.

Participant Notes:

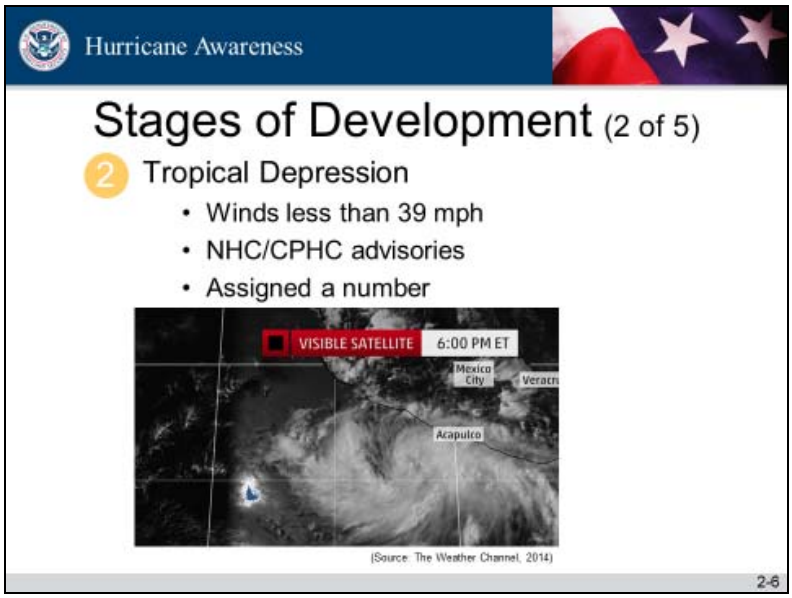


Slide 2-5.Stages of Development (Slide 1 of 5)

Tropical cyclones do not just form spontaneously. Like the spark that ignites a campfire, there must first be a preexisting tropical disturbance. In the Atlantic Ocean, this is sometimes a cluster of thunderstorms that rolls off the African continent. In other instances, it is a low-pressure area along a stalled frontal boundary or a disturbance in the upper atmosphere that works down to the ocean surface.

A tropical disturbance is simply a clustering of thunderstorms in the tropics. The circulation, however, is not yet defined nor the thunderstorms organized sufficiently to classify it as a tropical cyclone.

Participant Notes:



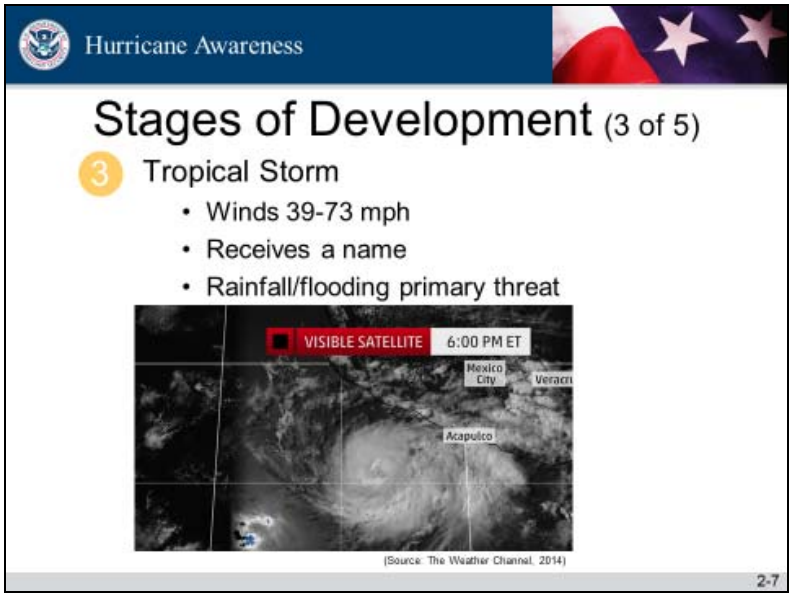
Slide 2-6. Stages of Development (Slide 2 of 5)

When a tropical disturbance has a defined area of low pressure with organized thunderstorm activity, it is designated a tropical depression. A tropical depression must have maximum sustained surface winds of less than 39 mph.

At this stage, the National Hurricane Center or the Central Pacific Hurricane Center will initiate advisories, and the tropical cyclone is assigned a number based on previous tropical depressions in the season (e.g., the first tropical depression of the season is designated Tropical Depression One).

✔ **Knowledge Check**: What are the three primary criteria required to form a tropical cyclone?

Participant Notes:



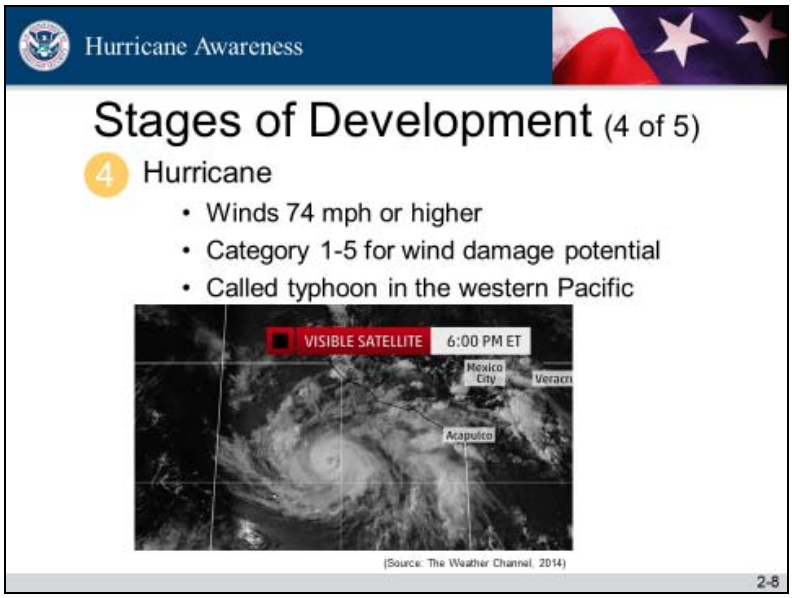
Slide 2-7. Stages of Development (Slide 3 of 5)

Once the winds of a tropical cyclone reach 39 mph, it is designated a tropical storm. The storm is assigned a name from six rotating lists.

Although the phrase “only a tropical storm” is commonly (and wrongly) applied, tropical storms pose a very real threat to life and property, primarily through heavy rainfall and flooding. Since 1994, tropical storms have been responsible for two of the five deadliest tropical cyclone strikes in the United States.

Participant Note: The practice of assigning names to tropical storms began in 1953. Each ocean (Atlantic, eastern Pacific, and central Pacific) is given six rotating lists by the World Meteorological Organization (WMO), an arm of the United Nations headquartered in Geneva, Switzerland. The WMO retires the names of the deadliest and costliest storms at the end of each season, and the names are replaced by the country or countries impacted by the retired storms. After every six years, the lists repeat (e.g., the list used in 2015 will be used again in 2021). Names alternate between male and female.

Participant Notes:

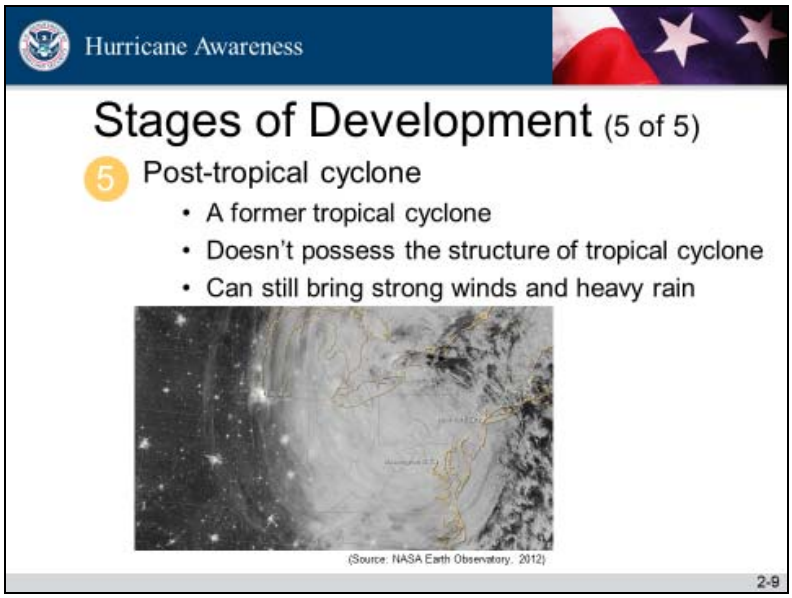


Slide 2-8. Stages of Development (Slide 4 of 5)

When the winds of a tropical cyclone reach 74 mph or higher, it is designated a hurricane if located in the Atlantic Ocean or Pacific Ocean east of 180 degrees. West of 180 degrees longitude, these tropical cyclones are called typhoons. Hurricanes and typhoons are structurally no different; because both are found in the northern hemisphere, they both spin in the same direction.

When a tropical cyclone becomes a hurricane, a category number is assigned to the system based on the maximum sustained surface winds only. This scale, known as the Saffir-Simpson Hurricane Wind Scale in the United States, varies by country. Forecast agencies outside of the U.S., such as the Japan Meteorological Agency, have developed their own tropical cyclone classification scales.

Participant Notes:



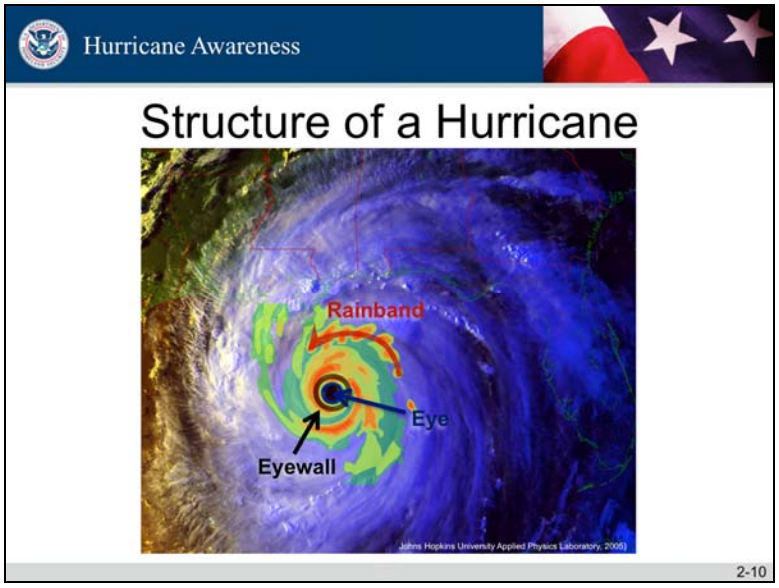
Slide 2-9. Stages of Development (Slide 5 of 5)

Once a tropical cyclone loses its tropical characteristics, it becomes post-tropical. Although this generally represents the dying or decaying stage of the tropical cyclone life cycle, post-tropical cyclones can continue to carry the threat of heavy rainfall and strong winds. Sandy in 2012 produced significant impacts to the Northeast U.S. even though it lost its tropical characteristics right before landfall.

Post-tropical cyclones can possess well-defined circulations; they usually lack organized thunderstorm activity near their circulation centers.

Key Point: Although they have a different appearance from a hurricane, post-tropical cyclones may contain the same type and severity of hazards as hurricanes.

Participant Notes:



Slide 2-10. Structure of a Hurricane

A hurricane is comprised of three main features: rainbands, the eyewall, and the eye.

Rainbands are long, curved bands of clouds and thunderstorms that spiral inward toward the center of a hurricane. Heavy bursts of rain and wind are usually embedded within these rainbands. Spiral rainbands can extend to the outer fringes of a hurricane and will often feed over the same areas. Therefore, rainfall flooding associated with these rainbands can occur well away from the center of a hurricane. Tornadoes are also a common threat associated with rainbands moving onshore.

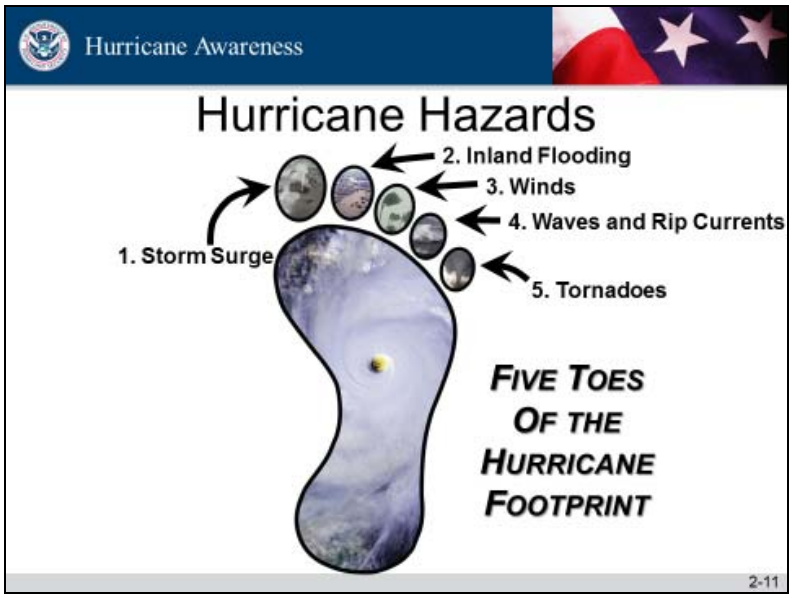
Example: The outer rainbands of Isaac in 2012 dropped 18 to 20 inches of rain in parts of Florida, flooding Palm Beach County over 200 miles away from Isaac's center.

The eyewall is the most violent part of a hurricane. The strongest winds and heaviest rains are found in the eyewall, making it also the most dangerous part of the hurricane. The eyewall is made up of intense thunderstorms, which form a complete ring around the relatively calm eye. Contraction or expansion of the eyewall can cause changes in wind speed and storm strength. As a tropical cyclone grows and changes, it can form multiple eyewalls that replace the original eyewall. Changes in eyewall size and eyewall replacement are very difficult to predict and pose the greatest challenges to hurricane forecasters.

Participant Notes:

The eye is the center of the hurricane. It is the proverbial calm of the hurricane since there are few clouds or even clear conditions with light winds inside. The eye is typically 20 to 40 miles across, but have been observed as small as 2 miles across or as big as 60-80 miles across. In extreme cases, the eye can be as large as 100-200 miles across. Eyes typically do not develop until winds have reached hurricane strength (at least 74 mph) and are a good indicator of a strong, organized tropical cyclone. Those sheltering in place during a hurricane landfall should never go outside during an eye passage. The worst, most dangerous weather is within the eyewall, which immediately precedes and follows the passage of the hurricane eye.

Participant Notes:



Slide 2-11. Hurricane Hazards

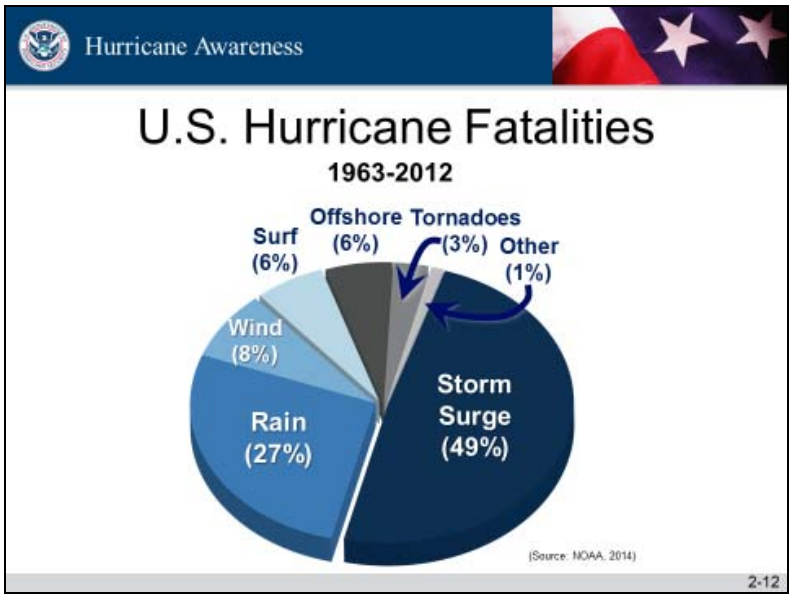
A hurricane is a multi-hazard weather system. Every hurricane landfall brings a different set of hazards and leaves a unique footprint along its path inland. Some hazards are near the storm center while others are found hundreds of miles away from the hurricane's circulation. While the severity of the hazards may differ from storm to storm, all hurricanes bring the following hazards:

- Storm surge;
- Inland flooding;
- Strong winds;
- Waves and rip currents; and
- Tornadoes.

Storm surge is historically the biggest killer in hurricanes. Storm surge also has the greatest potential for loss of life; it is the primary reason we evacuate from hurricanes. It can be thought of as the big toe of the hurricane footprint. Inland flooding from rainfall is second to storm surge in number of fatalities over the past 50 years, followed by strong winds, waves and rip currents, and tornadoes.

Participant Note: Although storm surge is responsible for the greatest number of deaths in hurricanes over the past 50 years, drowning from rainfall occurs more frequently than any other hurricane hazard. Always remember: turn around, don't drown.

Participant Notes:



Slide 2-12. U.S. Hurricane Fatalities

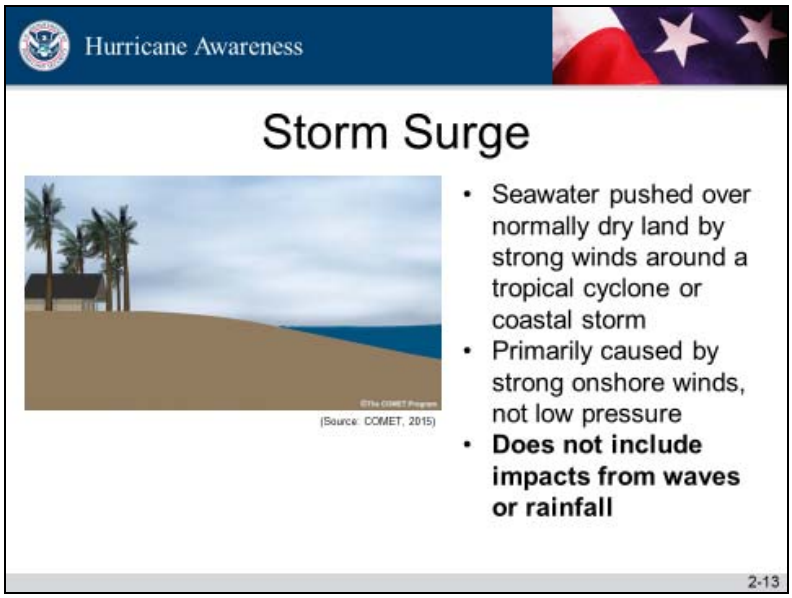
From 1963 to 2012, hurricanes were responsible for an estimated 2,544 deaths in the United States. This is an average of 50 deaths per year, but the number of deaths in the U.S per year is highly variable, from only a few to several thousand.

Roughly nine in 10 deaths in hurricanes occurred in water-related incidents, mostly from drowning. Storm surge was responsible for about half of all fatalities (49 percent) while rainfall-induced inland flooding and mudslides accounted for about one in four deaths (27 percent). Between five and 10 percent of people drowned in strong rip currents and high waves produced by tropical cyclones over the past 50 years. Strong non-tornadic winds only accounted for five to ten percent of all hurricane fatalities, while tornadoes were responsible for the smallest number of identified hurricane fatalities (three percent).

e.g.

Example: The deadliest six storms (or about one percent of all storms) were responsible for about two out of three deaths. Hurricane Katrina in 2005 in one day took around 1,100 lives, accounting for 40 percent of the past 50 years of hurricane fatalities.

Participant Notes:



Slide 2-13. Storm Surge

Storm surge is seawater "piling up" and pushed over normally dry land by the strong winds around a tropical cyclone or coastal storm. It is caused primarily by strong onshore winds, not low pressure. The low pressure of a coastal storm only contributes a small fraction (five to ten percent) to the total storm surge flooding.

e.g. **Example**: 18 to 19 feet of a 20-foot storm surge would be caused by the winds, while only one to two feet would be caused by the low pressure.

Storm surge should not be confused with a giant wave or a tsunami, which is created by an underwater earthquake. Rather, storm surge is a rise in water, generally over the course of several hours, which builds up within 50 to 100 miles of the coast. Storm surge pushes ashore at only four to five mph, but because water is 800 times denser than air, the force is equivalent to winds blowing at near Category 3 intensity. Storm surge does not include impacts from waves, which can add to the flooding and destruction along the immediate coastline.

Participant Note: The highest storm surge ever measured in the United States was 27.8 feet at Pass Christian, Mississippi, in August 2005 during Hurricane Katrina.

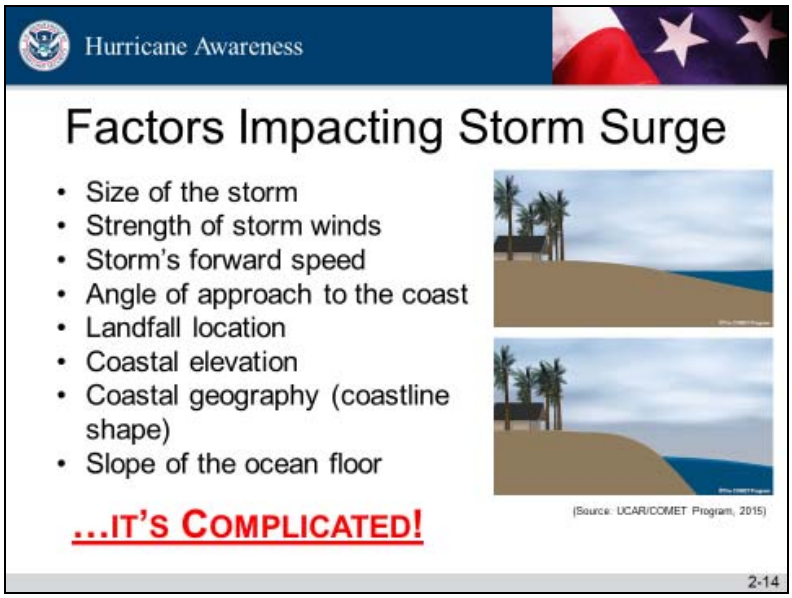
The surface winds rotating around a tropical cyclone or strong coastal storm induce a vertical circulation that can extend down into the ocean for hundreds of feet. These underwater currents gradually weaken as they spiral downward until the vertical circulation disappears entirely.

Participant Notes:

When a coastal storm is over a deep sea or open ocean, this circulation (known as the Ekman spiral) can run its course unobstructed. However, when a tropical cyclone approaches shallow water or the continental shelf, its underwater circulation begins to “feel” the seafloor. The vertical circulation is disrupted sending the water up and over the land. This is the storm surge.

✔ **Knowledge Check**: Does storm surge occur over the open ocean?

Participant Notes:



Slide 2-14. Factors Impacting Storm Surge

Storm surge forecasts are dependent on the ocean, land, and atmosphere. Many factors can impact the magnitude of storm surge flooding. The size of the storm plays a significant role in the extent and height of the storm surge. Even for tropical cyclones without hurricane force winds, a broad wind field can create a life-threatening storm surge. Using your arm while pushing water toward the lip of a pool will displace a greater amount of water than using your finger. Likewise, a bigger storm will produce a bigger storm surge due to the broader wind field.

Stronger maximum surface winds will also generate a higher storm surge. The forward speed of the storm and the angle at which it approaches the shoreline have substantial implications on where the worst storm surge will occur. Higher spots along the coast and those coastlines that jut outward rather than curve inward will be less prone to storm surge flooding.

As shown in the two animations on this slide, the seabed is a key player in storm surge impacts. Ocean floors that drop off quickly, such as those found along the east coast of Florida or surrounding islands like Puerto Rico and Hawaii, tend to be less at risk to storm surge and more susceptible to powerful waves. On the other hand, coastlines with gently sloping seafloors like those found along the U.S. Gulf Coast are more vulnerable to storm surges.

Participant Notes:

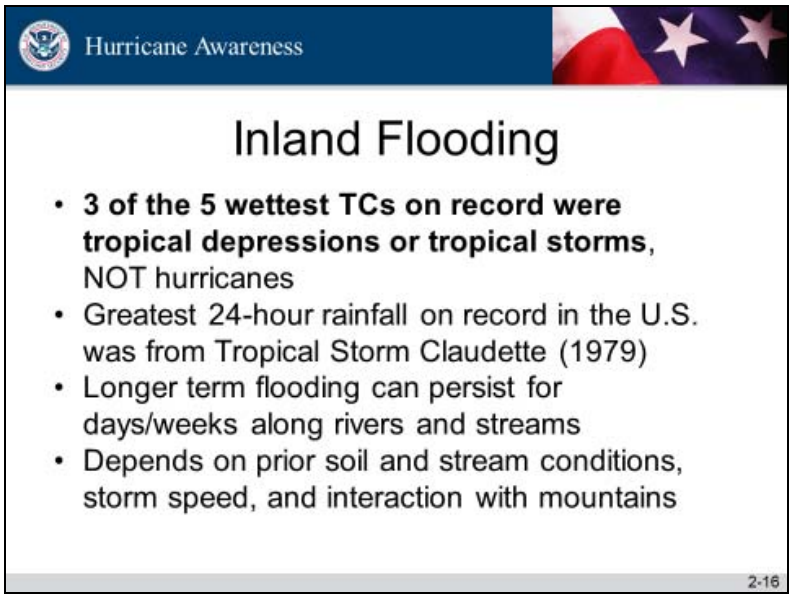
Slide 2-15. What does storm surge look like?

Storm surge comes in different flavors and is sometimes difficult to distinguish from rainfall flooding and high waves. The time lapse above is from Everglades City on the southwest coast of Florida during Hurricane Wilma in October of 2005. Wilma approached from the southwest and the strong onshore flow on the right side of the counterclockwise circulation pushed a storm surge of seven feet into this part of coastal Florida.

Notice that the storm surge comes in over a period of several hours and is slow to recede. This part of Everglades City is not along the immediate coastline where waves will add to the total water rise. Although in extreme cases the storm surge can rise several feet in a matter of a few minutes (such as in sounds and bays with a sharp wind shift), traditional storm surge resembles the time lapse shown here.

Participant Note: Modeling waves is difficult and computationally expensive. It can take hours to produce one wave forecast, but a storm surge model can run in a matter of seconds. Waves are modeled and forecast apart from storm surge, so hurricane forecasters can issue timely forecasts. As computing power improves, storm surge models will be combined with real-time wave models to forecast a combined storm surge and wave total water rise along the coast.

Participant Notes:



Slide 2-16. Inland Flooding

Although the heaviest rainfall associated with tropical cyclones usually falls along or to the right of the track, heavy rainfall within outer rainbands can bring the flood threat hundreds of miles away from the storm center. Small rivers, creeks, and streams can become quickly engorged from excessive rainfall and are susceptible to flash flooding. Torrential rains associated with decaying tropical cyclones can leave rivers at or near flood stage for weeks.

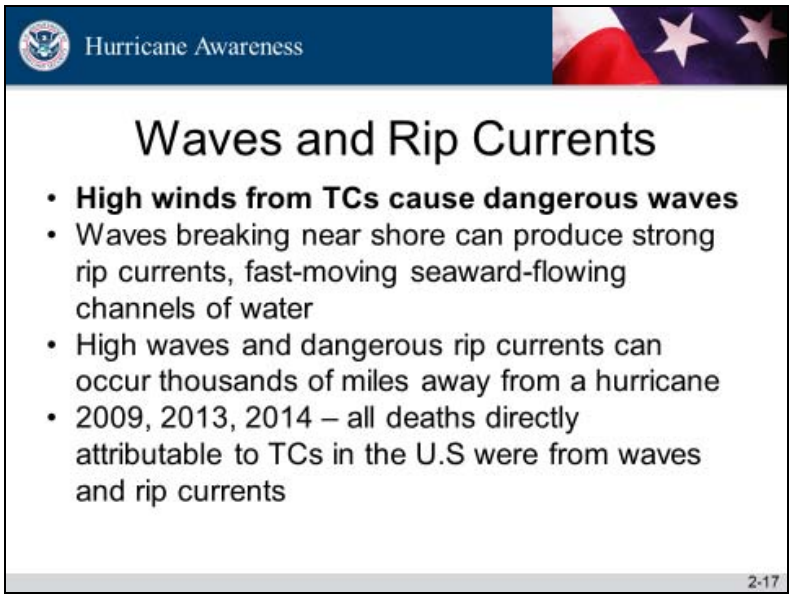
Rainfall amounts are not directly related to the strength of tropical cyclones but rather to the speed and size of the storm, as well as the geography of the area. Slower moving and larger storms produce more rainfall. In addition, mountainous terrain enhances rainfall from a tropical cyclone.

In many cases, weaker tropical cyclones bring as much or more rainfall than stronger storms. Three of the five wettest tropical cyclones on record in the United States were not hurricanes, but rather tropical depressions or tropical storms.

e.g.

Example: In 1979, Tropical Storm Claudette was responsible for the greatest 24-hour rainfall on record in the United States. In Alvin, Texas, 42 inches (or 3.5 feet) of rainfall fell in a single day as the tropical storm moved inland.

Participant Notes:



Slide 2-17. Waves and Rip Currents

The strong winds of a tropical cyclone can cause dangerous waves that pose a significant hazard to mariners, coastal residents, and visitors. When the waves break along the coast, they can produce deadly rip currents, even hundreds of miles away from a storm.

Rip currents are fast moving channels of water flowing away from shore, usually extending past the line of breaking waves, which can pull even the strongest swimmers away from shore.

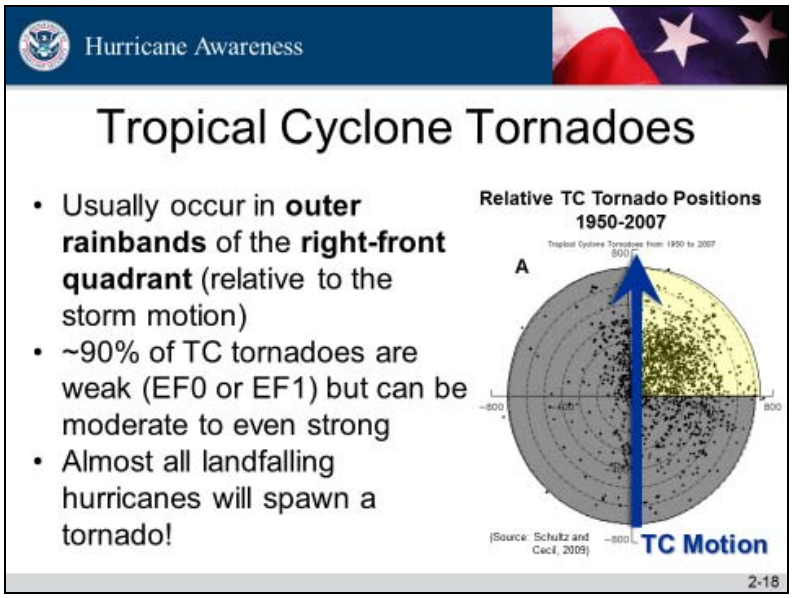
e.g.

Example: In 2008, despite the fact that Hurricane Bertha was more than a 1,000 miles offshore, the storm resulted in rip currents that killed three people along the New Jersey coast and required 1,500 lifeguard rescues in Ocean City, Maryland, over a one-week period.

In 2009, 2013, and 2014, all deaths in the United States directly attributable to tropical cyclones occurred as the result of drowning from large waves or strong rip currents.

Participant Note: If rip currents are present, beachgoers should avoid going in the water. However, if caught in a rip current, swimmers should not try to fight the current or swim directly into shore. Swim parallel to the shoreline until you escape the current's pull. When free from the pull of the current, swim at an angle away from the current toward shore. Remember: a rip current pulls you out, not under.

Participant Notes:



Slide 2-18. Tropical Cyclone Tornadoes

Nearly all tropical cyclones making landfall in the United States spawn at least one tornado. Tropical cyclone-spawned tornadoes most often occur in thunderstorms embedded in rainbands well away from the storm center but they can also occur near the eyewall.

Tornadoes produced by tropical cyclones are usually weak and short-lived, but they still pose a significant threat. Hurricane Ivan in 2004 holds the United States record for the most tornadoes spawned by a tropical cyclone, producing 118 total tornadoes. On average, 14 tornadoes were spawned per United States tropical cyclone landfall between 1990 and 2009.

Participant Note: Sheltering strategies for tropical cyclones typically involve large crowds in a building with a lot of space. However, a tornado requires the opposite strategy of sheltering in a small space. This could pose a challenge to emergency managers and decision-makers and should be considered when making plans in an area that could be vulnerable to tropical cyclone tornadoes. Thankfully, the vast majority of tropical cyclone tornadoes are not as intense as tornadoes that are spawned by supercell thunderstorms.

Wind shear, which works against tropical cyclone development, is a requirement for the development of thunderstorms that can produce tornadoes. Tornadoes most often occur over land. As a tropical cyclone makes landfall, the greater friction induced by the wind blowing over land increases the low-level vertical wind shear, which can enhance the conditions for tornado formation.

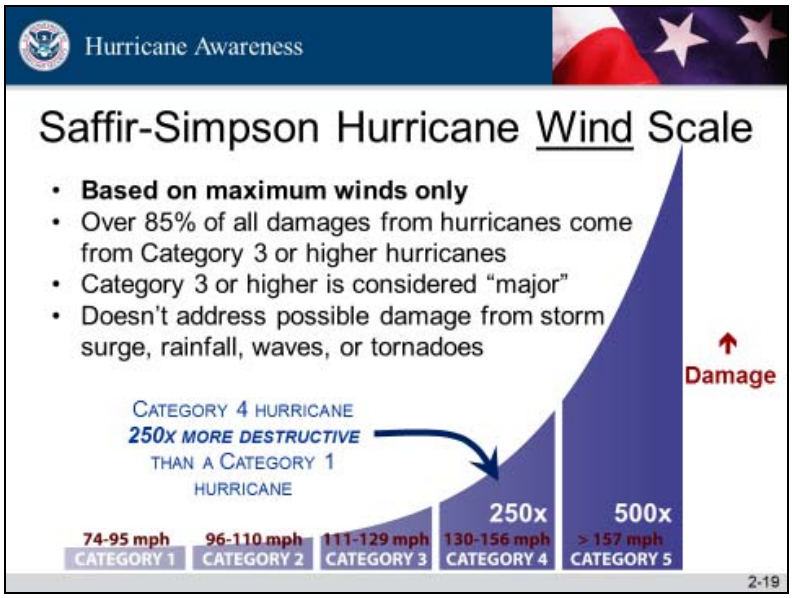
Participant Notes:

The graphic on this slide shows the location (relative to tropical cyclone motion) of all tropical cyclone-spawned tornadoes in the United States from 1950 through 2007. In the northern hemisphere, most tornadoes occur in the right-front quadrant of the storm.

Tropical cyclones can spawn tornadoes from a day or two prior to landfall to up to three days after landfall. Although statistically the largest number of tropical cyclone tornadoes occurs on the day of landfall, some of the biggest and most damaging outbreaks have taken place one or two days after landfall, as with Beulah in 1967, Danny in 1985, and Beryl in 1994.

Because of Florida's peninsular shape, many of the tornadoes there occur in outer rainbands and often from tropical cyclones that do not make landfall in Florida. In general, tropical cyclone tornadoes are most common within 125 miles to 375 miles of the coast.

Participant Notes:



Slide 2-19. Saffir-Simpson Hurricane Wind Scale

The Saffir-Simpson Hurricane Wind Scale is a 1 to 5 rating based on a hurricane's maximum one-minute averaged sustained wind speed. This scale estimates potential property damage. Hurricanes reaching Category 3 and higher are considered major hurricanes because of their potential for significant loss of life and damage. Over 85 percent of all damages from hurricanes come from Category 3 or higher hurricanes. Category 1 and 2 storms are still dangerous, however, and require preventative measures.

In the western North Pacific, the term "super typhoon" is used for tropical cyclones with sustained winds exceeding 150 mph.

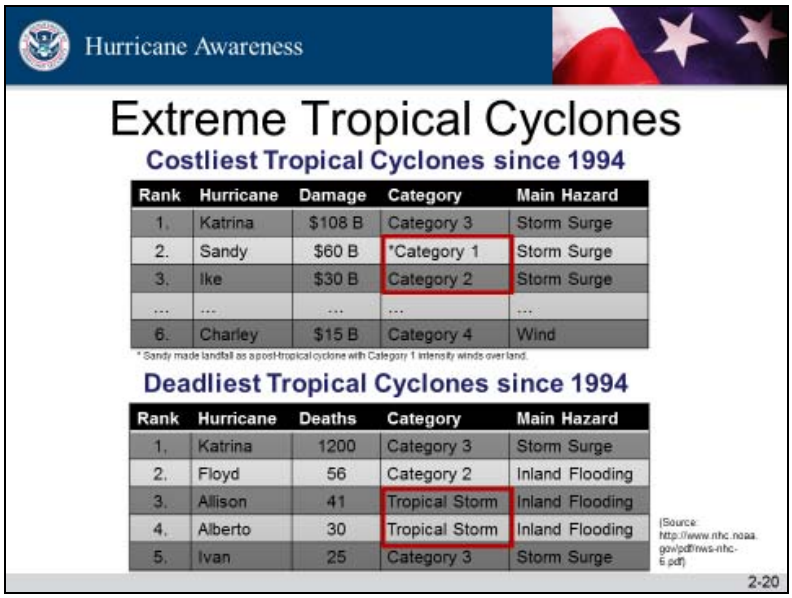
The Saffir-Simpson Hurricane Wind Scale does not address damage from storm surge, rainfall, waves, or tornadoes. The Category has little to no bearing on any of these other hazards. For example, Category 4 Hurricane Charley in 2004 produced a six to seven foot storm surge while Category 2 Hurricane Ike in 2008 produced a 15 to 20 foot storm surge.

Participant Notes:

Below are the winds associated with each Category and the types of damage which can be expected.

Category	Sustained Winds	Types of Damage Due to Hurricane Winds
1	74-95 mph 64-82 kt 119-153 km/h	**Very dangerous winds will produce some damage:** Well-constructed frame homes could have damage to roof, shingles, vinyl siding, and gutters. Large branches of trees will snap and shallowly rooted trees may be toppled. Extensive damage to power lines and poles likely will result in power outages that could last a few to several days.
2	96-110 mph 83-95 kt 154-177 km/h	**Extremely dangerous winds will cause extensive damage:** Well-constructed frame homes could sustain major roof and siding damage. Many shallowly rooted trees will be snapped or uprooted and block numerous roads. Near-total power loss is expected with outages that could last from several days to weeks.
3 (major)	111-129 mph 96-112 kt 178-208 km/h	**Devastating damage will occur:** Well-built framed homes may incur major damage or removal of roof decking and gable ends. Many trees will be snapped or uprooted, blocking numerous roads. Electricity and water will be unavailable for several days to weeks after the storm passes.
4 (major)	130-156 mph 113-136 kt 209-251 km/h	**Catastrophic damage will occur:** Well-built framed homes can sustain severe damage with loss of most of the roof structure and/or some exterior walls. Most trees will be snapped or uprooted and power poles downed. Fallen trees and power poles will isolate residential areas. Power outages will last weeks to possibly months. Most of the area will be uninhabitable for weeks or months.
5 (major)	157 mph or higher 137 kt or higher 252 km/h or higher	**Catastrophic damage will occur:** A high percentage of framed homes will be destroyed, with total roof failure and wall collapse. Fallen trees and power poles will isolate residential areas. Power outages will last for weeks to possibly months. Most of the area will be uninhabitable for weeks or months.

Participant Notes:



Slide 2-20. Extreme Tropical Cyclones

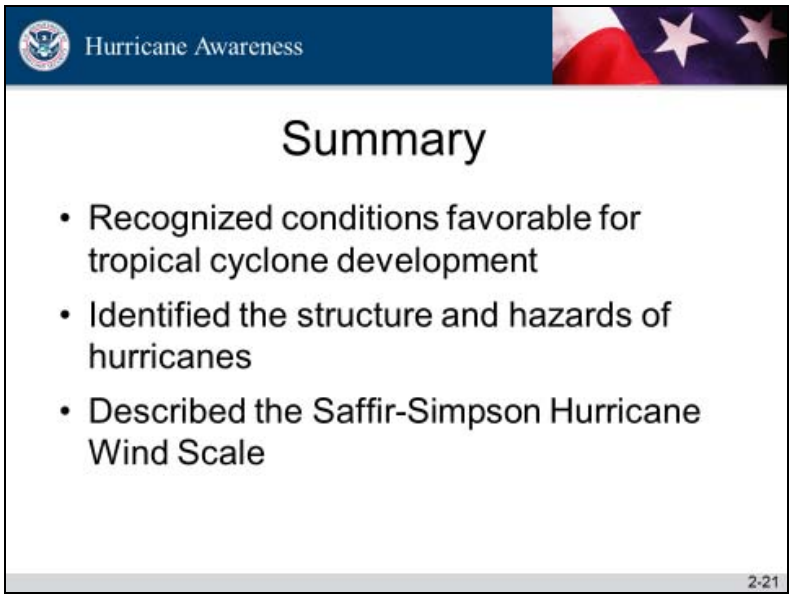
The Saffir-Simpson Hurricane Wind Scale only tells one story: the story of the wind. For some hurricanes like Andrew in 1992, the winds were the primary hazard. For other hurricanes like Katrina in 2005, it was the storm surge. Still, for others like Floyd in 1999, it was the inland flooding from heavy rainfall.

The tables on this slide show the costliest and deadliest United States hurricanes since 1994 by Category and primary hazard. Two of the top three costliest hurricanes were non-"major" hurricanes as defined by the Saffir-Simpson Hurricane Wind Scale. The tremendous storm surge of these hurricanes, however, produced more damage than some Category 5 hurricanes.

Likewise, two of the five deadliest tropical cyclones since 1994 were not hurricanes at all but tropical storms. Tropical Storm Allison in 2001 inundated the Houston area with nearly 37 inches of rain, producing catastrophic flooding that destroyed nearly 3,000 homes and took 41 lives across the United States.

The location and population of the areas near landfall also contribute to the extent and amount of damage. The growth of coastal populations and coastal cities has increased the vulnerability of coastal communities to high-cost disasters resulting from tropical cyclone impacts.

Participant Notes:



Slide 2-21. Summary

In this module, participants:

- Recognized conditions favorable for tropical cyclone development;
- Identified the structure and hazards of hurricanes; and
- Described the Saffir-Simpson Hurricane Wind Scale.

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Hurricane Awareness

Module 3: Hurricane Forecasting and Warning

Version 1.0

FEMA

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Module 3: Hurricane Forecasting and Warning

Slide 3-1. Hurricane Forecasting and Warning

Duration

30 minutes

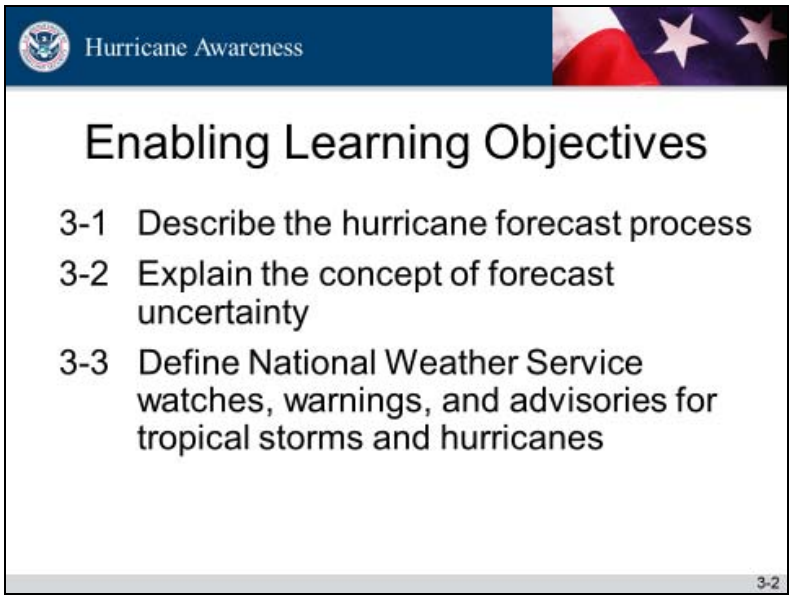
Scope Statement

This module introduces participants to the fundamentals of the hurricane forecast and advisory process, with an emphasis on the uncertainty associated with forecasting track and intensity. The instructor will lead participants through the hurricane forecast process while highlighting the uncertainty associated with each step. Participants will then learn about the National Weather Service's advisory process, consisting of watches, warnings, and advisories associated with tropical storms and hurricanes.

Terminal Learning Objective (TLO)

Participants will explain the hurricane forecasting process and the National Weather Service's hurricane advisory system.

Enabling Learning Objectives (ELOs)



Slide 3-2. Enabling Learning Objectives

At the end of this module, participants will be able to:

3-1 Describe the hurricane forecast process;

3-2 Explain the concept of forecast uncertainty; and

3-3 Define National Weather Service watches, warnings, and advisories for tropical storms and hurricanes.

Resources

- Instructor Guide (IG)
- Module 3 presentation slides
- Laptop with presentation software installed and CD-ROM capability
- Audio-visual (A/V projection unit)
- Projector screen
- Chalkboard (and chalk), whiteboard (and dry erase markers), or easel and easel paper (and permanent markers)
- One of each of the following items per participant:
    - Notepad and pen
    - Participant Guide (PG) available for download from http://ndptc.hawaii.edu/

Instructor-to-Participant Ratio

2:40

Reference List

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Practical Exercise Statement

Not applicable

Assessment Strategy

- Instructor observation of participant involvement in classroom discussion
- Instructor-led discussion to gauge participant grasp of the subject matter

Hurricane Awareness

Icon Map

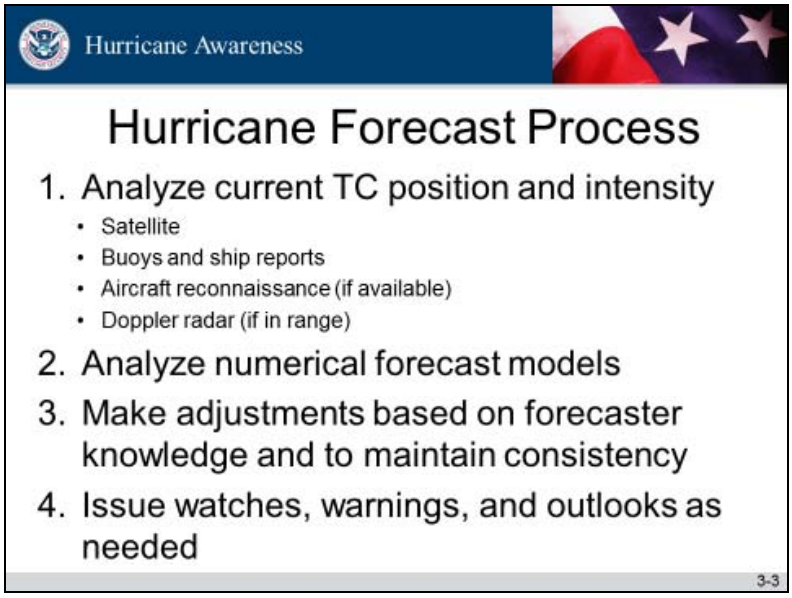
Knowledge Check: Used when it is time to assess participant understanding.

Example: Used when there is a descriptive illustration to show or explain.

Key Points: Used to convey essential learning concepts, discussions and introduction of supplemental material.

Participant Note: Used to indicate text that has been included as additional information for the participant. The text may not be directly addressed in the slide presentation or during class discussion.

Participant Notes:



Slide 3-3. Hurricane Forecast Process

The hurricane forecast process begins with analyzing the current position and intensity of the tropical system using a mixture of:

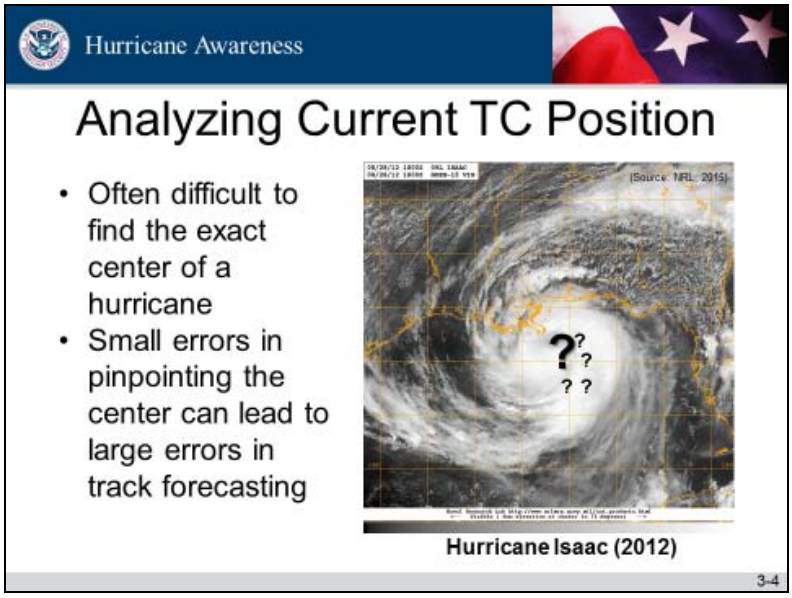
- Satellite data;
- Buoys and ship reports;
- Aircraft reconnaissance (if available); and
- Doppler radar (if in range).

Once the approximate position and intensity of the system are determined, the information is sent to numerical weather forecast models. These models are run with all available meteorological data to project future track and intensity. Meteorologists use these results as guidance to their forecast (more details about numerical weather models will be covered in the following slides).

Using their knowledge of the atmosphere and the biases of each computer projection, hurricane forecasters adjust and blend the numerical weather models to provide a more accurate and consistent forecast. While forecasts from individual computer models may vary wildly from run to run, hurricane forecasters aim to avoid the “pendulum” or “windshield wiper” effect. That is, individual computer models often move a forecast track left or right only to bring it back in the opposite direction six hours later. Hurricane forecasters smooth out this variability.

All of this information is incorporated into a hurricane forecast and, if necessary, alerts are issued for current and future weather conditions.

Participant Notes:

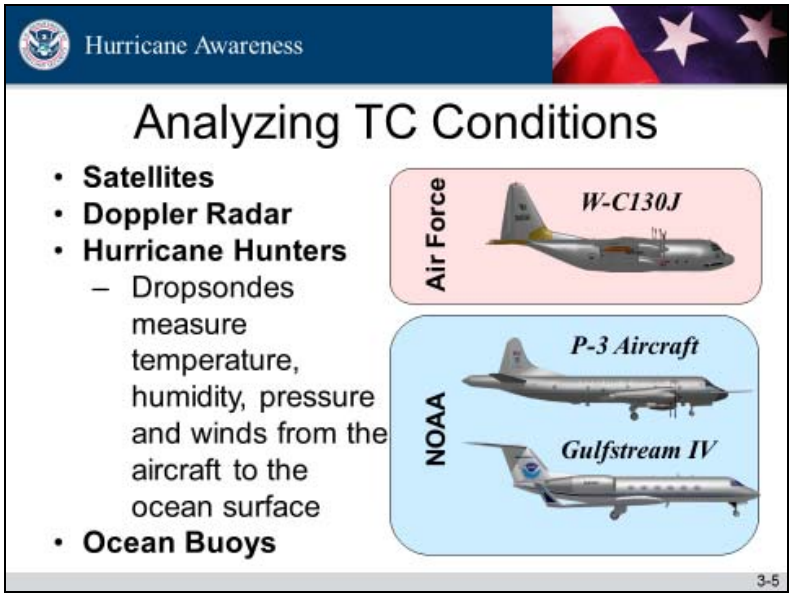


Slide 3-4. Analyzing Current TC Position

The current position of a tropical cyclone is not always easy to determine. Tropical cyclones spend most of their existence over water, where few observation stations exist. Forecasters must rely primarily on remote observations from satellites, which cannot always "see" the tropical cyclone center. Circulations of weak or organizing systems are not as defined or circular as developed hurricanes, which can make it difficult to pinpoint a center.

Not all hurricanes are created equal. Hurricane eyes can be large and ragged or veiled in thin, high clouds as shown in the satellite picture of Hurricane Isaac in 2012. Forecasters carefully analyze data from aircraft reconnaissance and ocean buoys to find the location of lowest pressure in order to fix the center of the hurricane.

Participant Notes:



Slide 3-5. Analyzing TC Conditions

Hurricane forecasters have a variety of tools at their disposal to create forecasts for tropical weather events. The most important of the tools are detailed below.

Satellites

Geostationary and polar orbiting satellites provide data that are used to determine different weather features. Examples include visible, infrared, water vapor, microwave, and scatterometer. Each imagery type gives meteorologists different insights about weather conditions or the structure of a tropical cyclone itself.

Doppler Radar

The NEXt generation RADar network was established in the early to mid-1990s. There are now 160 government-operated radars across the United States and its territories. These radars are called WSR-88Ds. The acronym WSR-88D stands for Weather Surveillance Radar, created in 1988, with Doppler capability.

NEXRAD Radar is only useful for forecasters when a tropical cyclone is within range of a NEXRAD site (generally 150-250 miles of the coast). Radar is a powerful tool used not only for tracking the tropical cyclone center but also for estimating winds, determining rainfall rates, and identifying embedded tornadoes.

Participant Notes:

Hurricane Hunters

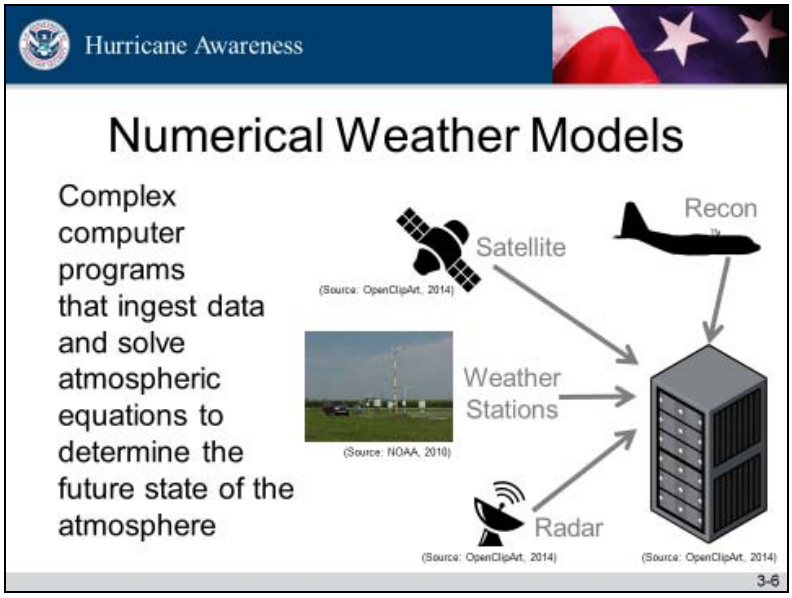
The Hurricane Hunters are a fleet of airplanes that fly into hurricanes to collect data for forecasters and researchers. The United States Air Force Reserve supplies ten C-130J military planes to the fleet while NOAA, the parent organization of the National Weather Service, supplies two additional P-3 propeller planes and one Gulfstream jet.

Hurricane Hunters are very important for hurricane forecasting. By flying aircraft in and around tropical cyclones, the Hurricane Hunters are able to fill in gaps of data over water. Through utilizing meteorological instruments, onboard radar, and dropsondes, forecasters are able to produce a more accurate picture of each storm.

Ocean Buoys

NOAA's National Data Buoy Center, or NDBC, maintains an international system of buoys that produce invaluable data to hurricane forecasters. Buoys take automatic observations of wind direction, wind speed, wind gusts, atmospheric pressure, air temperature, water temperature, and wind speed at 10 and 20 meters above the surface. This data is reviewed by hurricane forecasters and input into numerical weather models, discussed in the next two slides, to produce more accurate tropical weather forecasts.

Participant Notes:



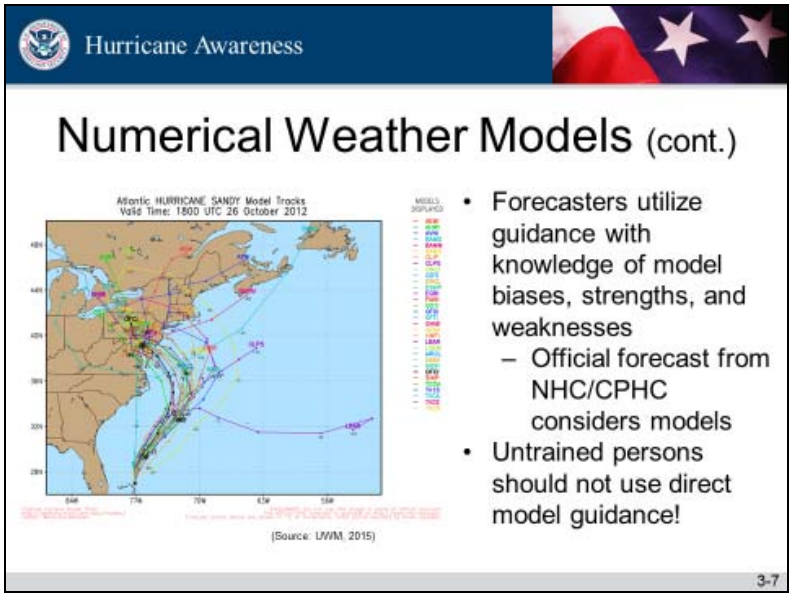
Slide 3-6. Numerical Weather Models

Numerical weather prediction models, simply referred to as “computer models,” are supercomputers that use advanced chemical, physical, and atmospheric equations to turn weather observations into weather forecasts.

The first model was produced in April of 1950 using an ENIAC computer that filled a 30-foot by 50-foot room. This first forecast of 24-hour weather conditions took more than 24 hours to be produced. While the forecast itself was not useful, it did prove that computer-based weather prediction was feasible.

Computer modeling of the atmosphere became more efficient as computer power increased and allowed the models to forecast both with more detail and in less time.

Participant Notes:



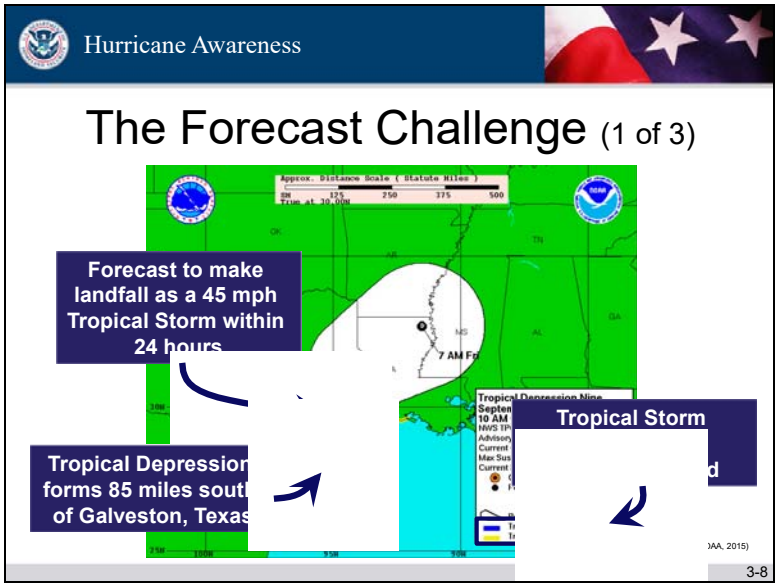
Slide 3-7. Numerical Weather Models (continued)

An important concept when discussing numerical weather modeling is the time of issuance. Weather modeling is a global endeavor and so the meteorological community uses the global time standard of Greenwich Mean Time, named after the city of its namesake in England. This time is also referred to as “GMT,” “Zulu,” “Z”, or “UTC.” Greenwich Mean Time is four hours ahead of Eastern Daylight Time (EDT) and five hours ahead of Eastern Standard Time (EST).

Most global models ingest data twice daily at 00z and 12z. This means that the models pull in the most current observations at this time. When all of the current observations are assimilated into the model to provide the most accurate snapshot of what the atmosphere looks like at that time, the model then begins to “run” by processing the equations and generating a forecast.

Participant Note: The official forecasts from all operational forecast centers (e.g., the National Hurricane Center, the Central Pacific Hurricane Center, and the Joint Typhoon Warning Center) include all information from these computer models, so the official forecast is the best guidance available to decision-makers. Hurricane forecasters are most familiar with the strengths, weaknesses, and biases of each model and consider this when making their forecasts. Non-meteorologists should never analyze the models themselves, but rather, reply on the expertise of the forecasters at each of the above forecast centers.

Participant Notes:



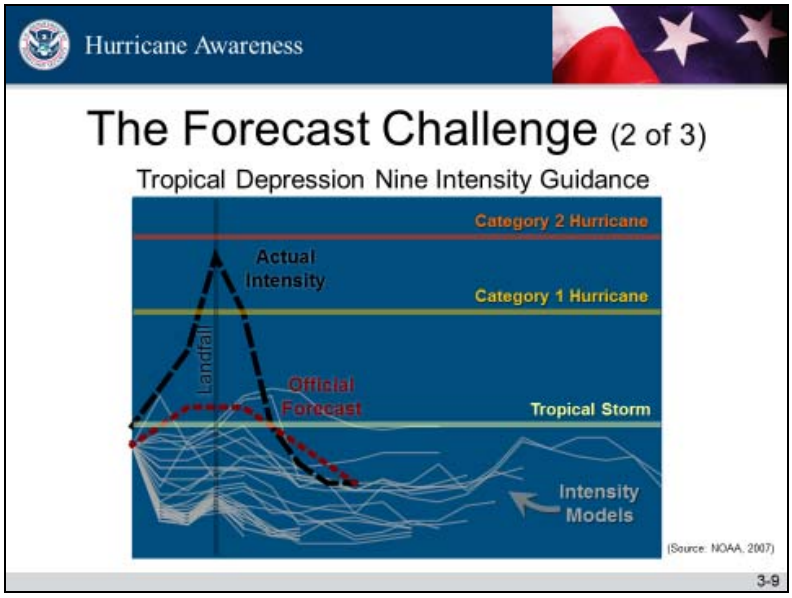
Slide 3-8. The Forecast Challenge (1 of 3)

The great challenge to hurricane forecasters is predicting rapid intensification of storms. Storms that gather a lot of strength in a little amount of time can pose a serious threat to those living along the coast, especially for systems that are nearing landfall. Decisions are based on the best available forecast however when a storm defies the odds, it gives emergency managers and the public little time to prepare.

In 2007, the ninth tropical depression of the season formed less than 100 miles south of Galveston, Texas. The system was forecast to only slowly strengthen into a 45 mph tropical storm before making landfall along the Texas coast the following day.

Tropical storm watches and warnings were issued from Port O'Connor, Texas, to Intracoastal, Louisiana.

Participant Notes:

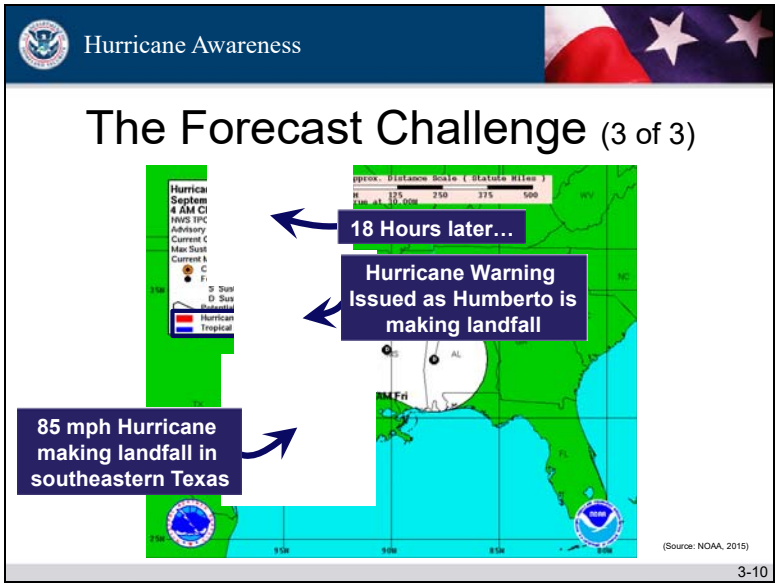


Slide 3-9. The Forecast Challenge (2 of 3)

The vast majority of the computer models at the time suggested the tropical depression would remain a tropical depression through landfall. A few outliers suggested the depression could strengthen into a low-end tropical storm before landfall, but none forecasted an intensity close to hurricane strength.

Despite the best available guidance, Tropical Depression Nine rapidly strengthened over the subsequent 24-hour period into an 85 mph, near-Category 2 hurricane. Hurricane Humberto defied even the best and most bullish computer forecast models.

Participant Notes:



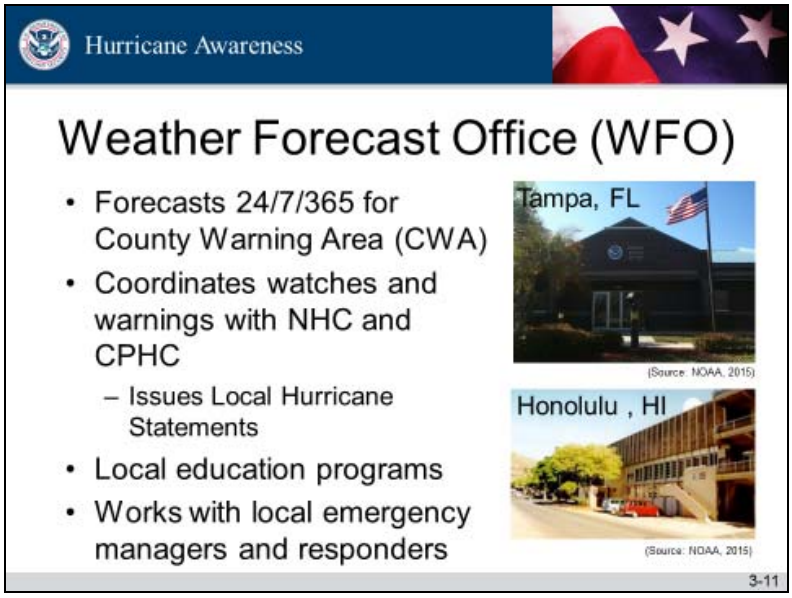
Slide 3-10. The Forecast Challenge (3 of 3)

A short 18 hours later, Tropical Depression Nine was making landfall just east of High Island, Texas, as an 85 mph, near-Category 2 hurricane. Hurricane Warnings were issued less than two hours before landfall during the overnight hours when most residents were asleep.

Thankfully, the worst of the hurricane struck a relatively unpopulated area east of the booming Houston metro, though one death and 12 injuries were still reported from the storm. Over 130,000 customers lost power from Humberto's powerful winds.

Key Point: A forecast is based on the best available information at the time. Rapidly intensifying storms cannot be confidently forecast, so tropical cyclones near landfall should be closely monitored for sudden changes. *However*, the official forecast originating from the official forecast center (in this case, NHC) is always the best guidance available to decision-makers! This example is merely to show that sometimes, even the best forecast cannot capture the uncertainties of rapid intensity changes, which any decision-maker should always keep in mind.

Participant Notes:

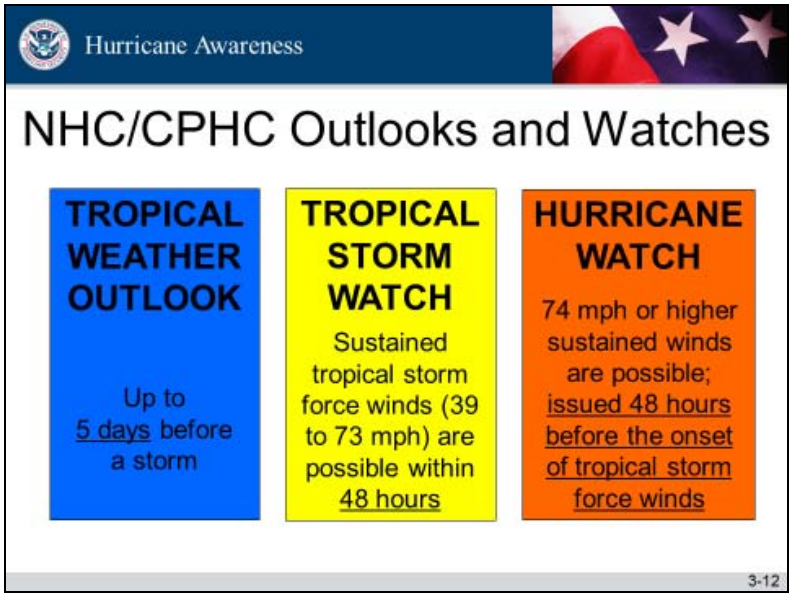


Slide 3-11. Weather Forecast Office (WFO)

NWS WFOs are usually, but not always, located in buildings near a Doppler weather radar site. Inside the office there are workstations with advanced meteorological software to help the forecasters view and interpret large amounts of data and graphics.

Participant Note: Each office is staffed with a MIC (Meteorologist-in-Charge) who is in charge of the office, a WCM (Warning Coordination Meteorologist) who conducts product evaluations and preparedness programs, and multiple Senior Forecasters and General Forecasters who produce the routine forecast and alert products.

Participant Notes:



Slide 3-12. NHC/CPHC Outlooks and Watches

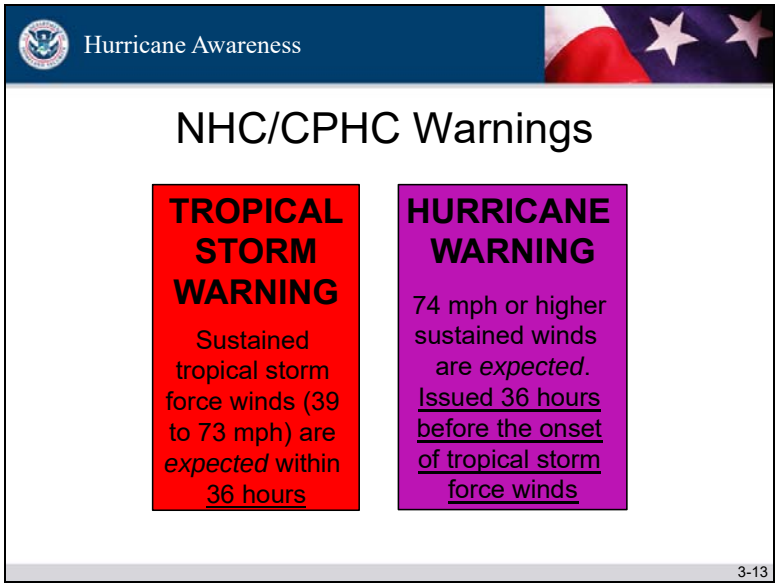
The NWS Glossary provides the following definitions:

"The Tropical Weather Outlook is a discussion of significant areas of disturbed weather and their potential for development out to five days. It includes (when possible) a nontechnical explanation of the meteorology behind the outlook. The Outlook also provides the chance of development (in percent, from 0 to 100 in ten percent increments) of each disturbance discussed in the outlook."

"A Tropical Storm Watch is an announcement that sustained winds of 39 to 73 mph are possible within the specified area within 48 hours in association with a tropical, subtropical, or post-tropical cyclone."

"A Hurricane Watch is an announcement that sustained winds of 74 mph or higher are possible within the specified area in association with a tropical, subtropical, or post-tropical cyclone. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the hurricane watch is issued 48 hours in advance of the anticipated onset of tropical storm force winds."

Participant Notes:

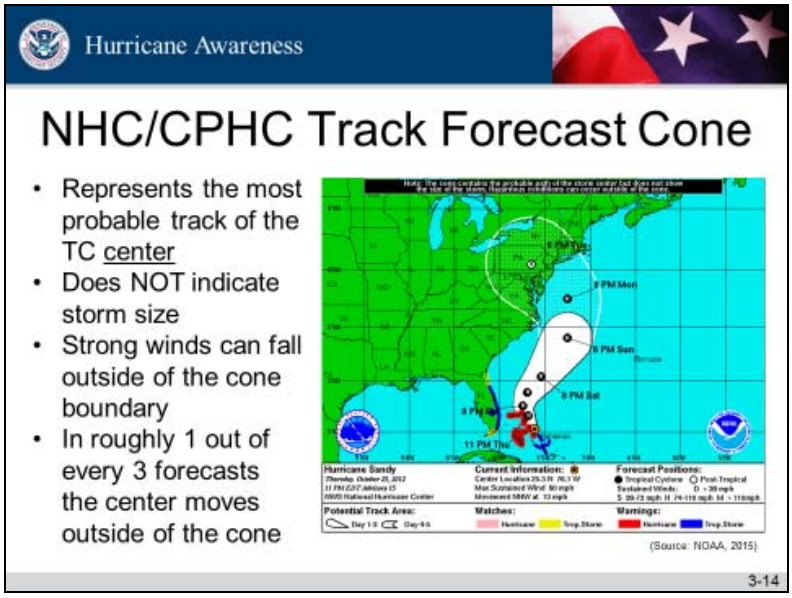


Slide 3-13. NHC/CPHC Warnings

"A Tropical Storm Warning is an announcement that sustained winds of 39 to 73 mph are expected somewhere within the specified area within 36 hours in association with a tropical, subtropical, or post-tropical cyclone."

"A Hurricane Warning is an announcement that sustained winds of 74 mph or higher are expected somewhere within the specified area in association with a tropical, subtropical, or post-tropical cyclone. Because hurricane preparedness activities become difficult once winds reach tropical storm force, the warning is issued 36 hours in advance of the anticipated onset of tropical-storm-force winds. The warning can remain in effect when dangerously high water or a combination of dangerously high water and waves continue, even though winds may be less than hurricane force."

Participant Notes:



Slide 3-14. NHC/CPHC Track Forecast Cone

The solid white area in the track forecast cone depicts the track forecast uncertainty for days one to three of the forecast, while the stippled area depicts the uncertainty on days four and five. Historical data indicate that the entire five-day path of the center of the tropical cyclone will remain within the cone about 60 to 70 percent of the time. This also means that in roughly one of every three forecasts the center moves *outside* of the cone.

It is also important to realize that a tropical cyclone is not a point. Their effects can span many hundreds of miles from the center. The area experiencing hurricane force (one-minute average wind speeds of at least 74 mph) and tropical storm force (one-minute average wind speeds of 39 to 73 mph) winds can extend well beyond the white areas shown enclosing the most likely track area of the center.

This graphic also shows an approximate representation of coastal areas under a hurricane warning (red), hurricane watch (pink), tropical storm warning (blue) and tropical storm watch (yellow). The orange circle indicates the current position of the center of the tropical cyclone. The dot indicating the forecast center location will be black if the cyclone is forecast to be tropical and will be white with a black outline if the cyclone is forecast to be post-tropical.

Participant Notes:

The letter inside the dot indicates the NHC's forecast intensity for that time:

D: Tropical Depression – wind speed less than 39 MPH

S: Tropical Storm – wind speed between 39 MPH and 73 MPH

H: Hurricane – wind speed between 74 MPH and 110 MPH

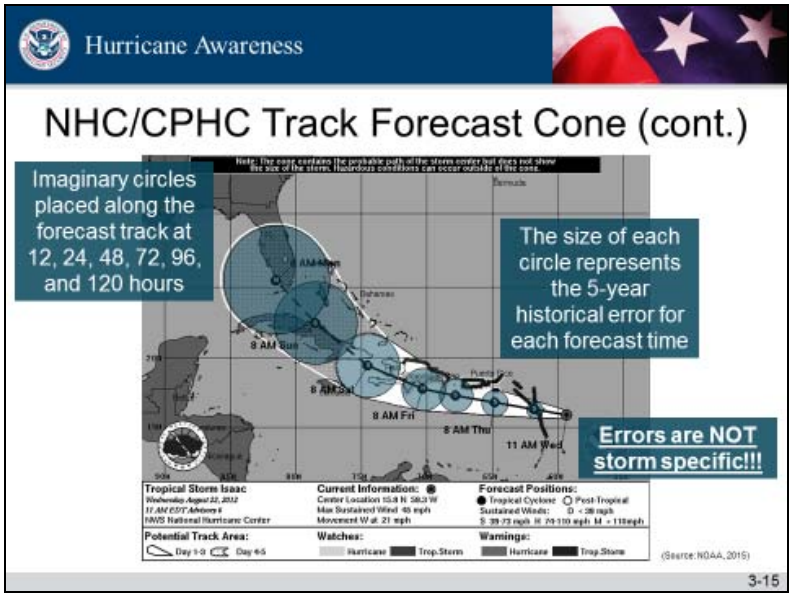
M: Major Hurricane – wind speed greater than 110 MPH

Graphics for Atlantic and central Pacific tropical cyclones are normally issued every six hours coincident with the advisory at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time and Hawaiian Standard Time (or 4 AM, 10 AM, 4 PM, and 10 PM Eastern Standard Time).

Graphics for eastern Pacific tropical cyclones are normally issued every six hours at 2 AM, 8 AM, 2 PM, and 8 PM Pacific Daylight Time (or 1 AM, 7 AM, 1 PM, and 7 PM Pacific Standard Time).

The graphics are updated when intermediate public advisories are issued, and special graphics may be issued at any time due to significant changes in warnings or in the cyclone.

Participant Notes:

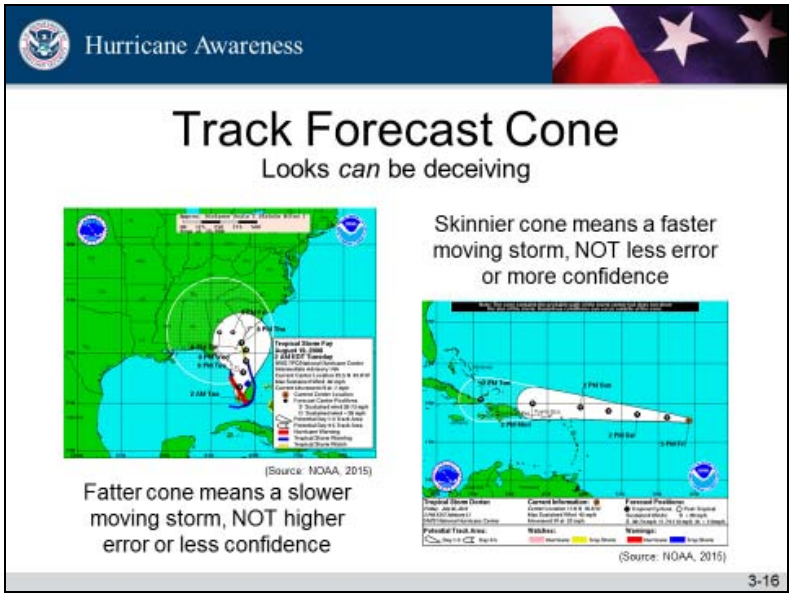


Slide 3-15. NHC/CPHC Track Forecast Cone (continued)

The track forecast cone is formed by placing a set of imaginary circles along the forecast track at the 12, 24, 36, 48, 72, 96, and 120 hour positions. The size of each circle is set so that it encloses 67 percent of the previous five years of official forecast errors. The cone is then formed by smoothly connecting the area swept out by the set of circles.

Participant Note: The track forecast cone is based on historical errors from previous tropical cyclone forecasts. The errors are not specific to the current storm and do not consider the spread or uncertainty in the computer forecast models for the current system.

Participant Notes:



Slide 3-16. Track Forecast Cone

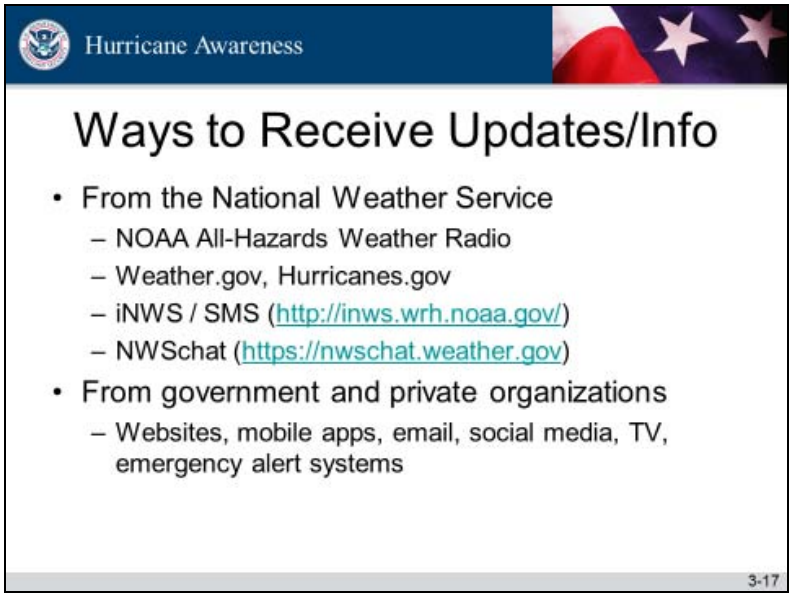
The track forecast cone can vary in size and shape from forecast to forecast. A skinnier cone does not necessarily imply a more confident forecast and a fatter cone does not imply a more uncertain forecast.

The shape of the cone is most directly tied to the movement of the system. A slower moving system means the imaginary circles representing the historical error are drawn very close to or on top of one another. This gives the cone a larger, rounder appearance. The size of the circles that define the cone remains the same for the entire season and do not change between advisories. The only factor that changes the cone's appearance with regard to width is the faster vs. slower forward speed.

On the other hand, a faster moving system means the imaginary circles representing the historical error are drawn farther away from one another. This gives the cone a narrow, straight appearance.

Participant Note: A rounder cone over land often suggests an increased threat for heavy rainfall and flooding due to the slow movement of the system.

Participant Notes:



Slide 3-17. Ways to Receive Updates/Info

Stakeholders can receive products, updates, and special weather statements directly from the NWS or from private companies. Many people receive alerts via smartphone apps or local television.

NOAA weather radio (NWR) and Interactive NWS (iNWS) are also useful and lesser-known ways to receive alerts.

From the NWS: “Under a January 1975 White House policy statement, NOAA Weather Radio was designated the sole Government-operated radio system to provide direct warning into private homes for both natural disasters and nuclear attack.” NOAA Weather Radio All-Hazards (the official name) is known as the “voice of the NWS” and can be accessed through a variety of VHF public service bands by utilizing a specific receiver that can be purchased at a number of retailers. NWR operates outside the standard AM or FM broadcast bands.

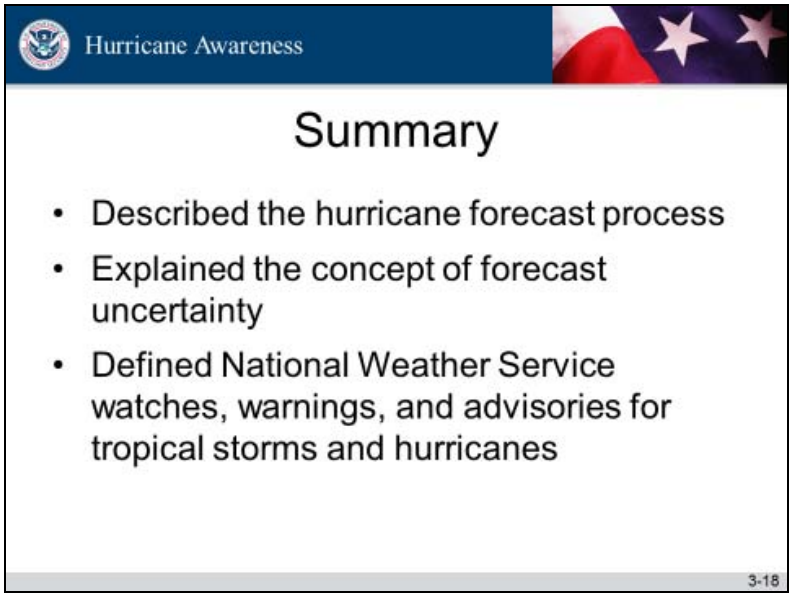
The Interactive NWS (iNWS) is a service that allows emergency management professionals and responders to set preferences about which alerts they want, for which locations, and they will then receive text messages with those alerts.

Many people see official NWS watches, warnings, and advisories on TV, their smartphone, and on social media; they may not realize that the NWS is the source for all official public safety alerts and that these public safety alerts are simply being distributed via other channels.

Participant Notes:

In addition, social media and bloggers have become increasingly visible when large storms are in the forecast. Some individuals associated with these outlets may use language that contradicts official alerts issued by the NWS. It is reasonable that forecasters outside of the NWS may have different opinions about an upcoming storm compared to NWS forecasts, but it is important to remember that the only organization that can issue official public safety alerts is the NWS.

Participant Notes:



Slide 3-18. Summary

In this module, participants:

- Described the hurricane forecast process;
- Explained the concept of forecast uncertainty; and
- Defined National Weather Service watches, warnings, and advisories for tropical storms and hurricanes.

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Hurricane Awareness

Module 4: Hurricane Advisory Products

Version 1.0

FEMA

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Module 4: Hurricane Advisory Products

Slide 4-1. Hurricane Advisory Products

Duration

60 minutes

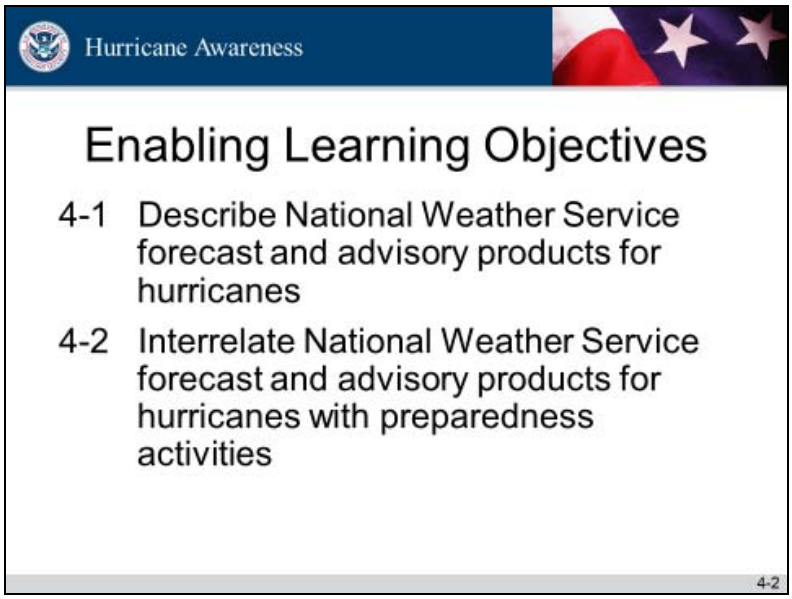
Scope Statement

This module introduces specific hurricane advisory products to participants. Products from the National Hurricane Center and Central Pacific Hurricane Center will be analyzed and described to participants. The instructor will then lead participants through a guided activity that will challenge them to correctly read and utilize National Hurricane Center advisory products during an activity.

Terminal Learning Objective (TLO)

Participants will demonstrate comprehension of the National Weather Service's hurricane advisory products.

Enabling Learning Objectives (ELOs)



Slide 4-2. Enabling Learning Objectives

At the end of this module, participants will be able to:

4-1 Describe National Weather Service forecast and advisory products for hurricanes; and

4-2 Interrelate National Weather Service forecast and advisory products for hurricanes with preparedness activities.

Resources

- Instructor Guide (IG)
- Module 4 presentation slides
- Laptop with presentation software installed and CD-ROM capability
- Audio-visual (A/V projection unit)
- Projector screen
- Chalkboard (and chalk), whiteboard (and dry erase markers), or easel and easel paper (and permanent markers)
- Group Handouts
- One of each of the following items per participant:
  - Notepad and pen
  - Participant Guide (PG) available for download from http://ndptc.hawaii.edu/

Instructor-to-Participant Ratio

2:40

Reference List

Federal Emergency Management Agency (FEMA). 2015. "How to Prepare for a Hurricane." Accessed 2015. http://www.fema.gov/media-library-data/1409003345844-0e142725ea3984938c8c6748dd1598cb/ How_To_Prepare_Guide_Hurricane.pdf

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University of Wisconsin-Milwaukee (UWM). 2012. "Archived Real-Time Tropical Cyclone Forecast Charts." Accessed 2015. http://derecho.math.uwm.edu/models/archive/

Wikipedia. 2015. "Wakulla County, Florida." Accessed 2015. http://en.wikipedia.org/wiki/Wakulla_County,_Florida

Practical Exercise Statement

A tropical storm activity is presented and each group is expected to properly read, analyze, and utilize National Hurricane Center advisory products provided to them. The instructor will ask groups specific questions about the advisory products and lead a class discussion. The activity will challenge participants to demonstrate comprehension of hurricane science, forecasting, and warning.

Assessment Strategy

- Instructor observation of participant involvement in classroom discussion
- Instructor-led discussion to gauge participant grasp of the subject matter
- Instructor observation of individual participation during group activity

Hurricane Awareness

Icon Map

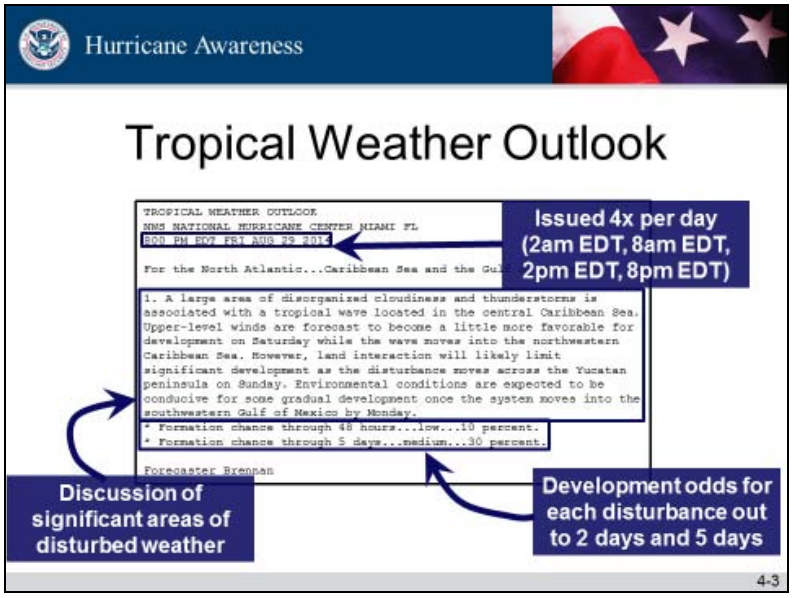
Knowledge Check: Used when it is time to assess participant understanding.

Example: Used when there is a descriptive illustration to show or explain.

Key Points: Used to convey essential learning concepts, discussions and introduction of supplemental material.

Participant Note: Used to indicate text that has been included as additional information for the participant. The text may not be directly addressed in the slide presentation or during class discussion.

Participant Notes:



Slide 4-3. Tropical Weather Outlook

The Tropical Weather Outlook (TWO) is a general assessment of activity in the tropics relevant to tropical cyclone formation for the Atlantic, eastern Pacific, and central Pacific Oceans. The text bulletin discusses areas of disturbed weather and their potential for formation into a tropical cyclone during the next five days or the next two days for the Central Pacific basin. This product is routinely issued and written in plain English.

For the Atlantic and Central Pacific basins, the 48-hour chance of tropical cyclone formation with categorical odds (low, medium, high) is listed in tabular form below the last paragraph describing each disturbance; the entire five-day period development odds are listed thereafter.

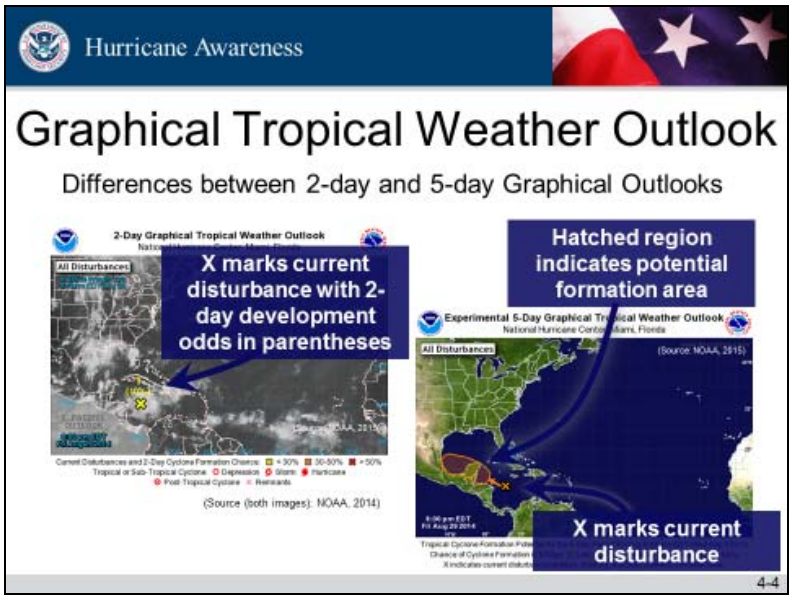
Category Label	Range
Low	0-30%
Medium	40%-60%
High	70%-100%

The Tropical Weather Outlook is issued at 2 AM, 8 AM, 2 PM, and 8 PM Eastern Daylight Time. Once Daylight Saving Time ends, issuance times become 1 AM, 7 AM, 1 PM, and 7 PM Eastern Standard Time. A special outlook may be issued at any time when important changes in areas of disturbed weather need to be conveyed before the next scheduled release of the Tropical Weather Outlook.

Participant Notes:

For the Atlantic and central Pacific, the Tropical Weather Outlook is issued from June 1 to November 30. For the eastern Pacific, it is issued from May 15 to November 30.

Participant Notes:



Slide 4-4. Graphical Tropical Weather Outlook

The Graphical Tropical Weather Outlook (GTWO) is a web display intended to be a visual companion product to the text Tropical Weather Outlook.

Like the Tropical Weather Outlook, the Graphical Tropical Weather Outlook is updated four times daily at 2 AM, 8 AM, 2 PM, and 8 PM Eastern Daylight Time (1 AM, 7 AM, 1 PM, and 7 PM Eastern Standard Time). It is issued from June 1 to November 30 for the Atlantic and central Pacific and from May 15 to November 30 for the eastern Pacific.

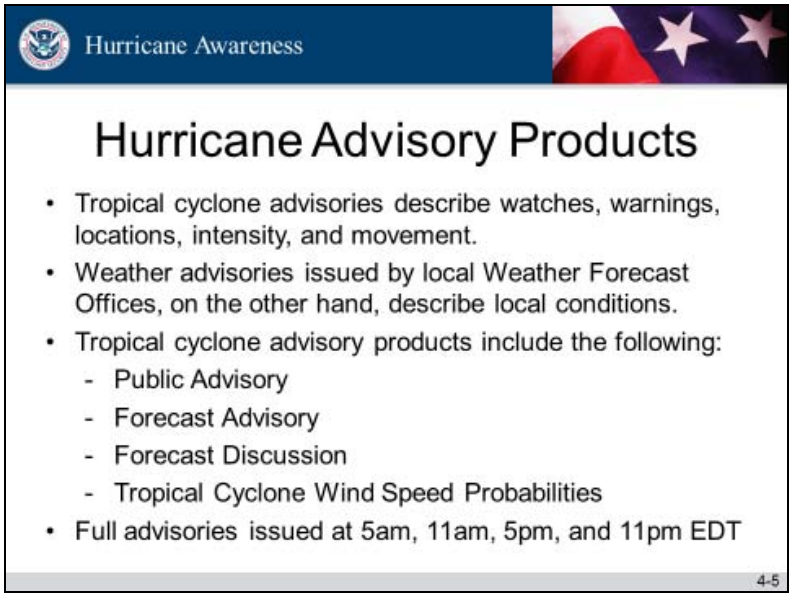
The Graphical Tropical Weather Outlook comes in two flavors – a 48-hour graphic and a five-day graphic. It is important to note that the five-day graphic is not available in the Central Pacific basin. The graphic for the 48-hour Tropical Weather Outlook shows the *current* disturbance (numbered and denoted by an "X"), with the 48-hour development odds in parentheses. The disturbance number, current position, and percentages are colored by the categorical odds for formation (low, medium, high).

The five-day Graphical Tropical Weather Outlook marks the current disturbance with an "X" (if it exists at issuance time). A color-coded hatched region shows the potential formation area by categorical odds (low, medium, high). An arrow pointing from the "X" toward the hatched region indicates the direction in which the disturbance is expected to move, however, the five-day odds are not valid until it moves into the hatched region.

Participant Notes:

Participant Note: The location of current storms is not shown on either Graphical Tropical Weather Outlook. This outlook should only be utilized to understand where storm development may occur.

Participant Notes:



Slide 4-5. Hurricane Advisory Products

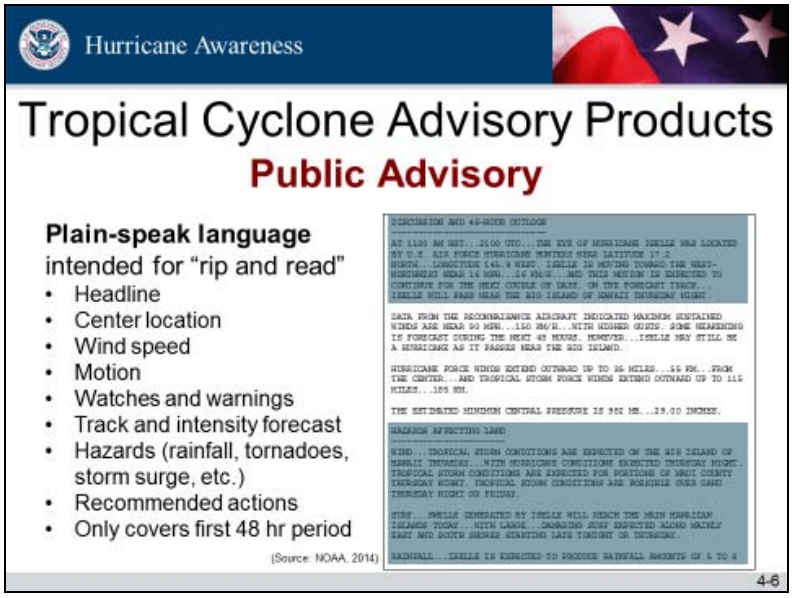
A tropical cyclone advisory is official information issued by the National Hurricane Center or Central Pacific Hurricane Center describing all tropical cyclone watches and warnings in effect along with details concerning tropical cyclone locations, intensity, and movement, and precautions that should be taken. A tropical cyclone advisory should not be confused with other National Weather Service advisories (like winter weather advisories) that are issued by local Weather Forecast Offices. While tropical cyclone advisories provide overall information about a tropical cyclone, WFO-issued *advisories* describe local conditions that are imminent but generally less severe than a *warning*.

A tropical cyclone advisory package includes the following content:

- Public Advisory
- Forecast Advisory
- Forecast Discussion
- Tropical Cyclone Wind Speed Probabilities

Complete advisory packages containing all content listed above are issued at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time (4 AM, 10 AM, 4 PM, and 10 PM Eastern Standard Time).

Participant Notes:



Slide 4-6. Tropical Cyclone Advisory Products: Public Advisory

The Tropical Cyclone Public Advisory is intended to be a "rip and read" text bulletin with all pertinent current tropical cyclone information.

A headline of the event or lead statement is followed by a summary of the most current information on the tropical cyclone. The center position in terms of latitude and longitude coordinates and distance from a selected land point or island is listed, as well as the current motion. The advisory includes the maximum sustained winds in miles per hour and the estimated or measured minimum central pressure in millibars and inches.

A section for watches and warnings includes any new or updated tropical storm or hurricane watch/warnings.

The discussion section reviews information listed in the summary section and discusses general forecast information, such as storm motion, potential landfall, and future intensity, over the next 48 hours.

The final section summarizes hazards affecting land. This includes information on wind timing, potential storm surge, rainfall, tornadoes, or high surf associated with the cyclone, as well as any pertinent weather observations.

Participant Notes:

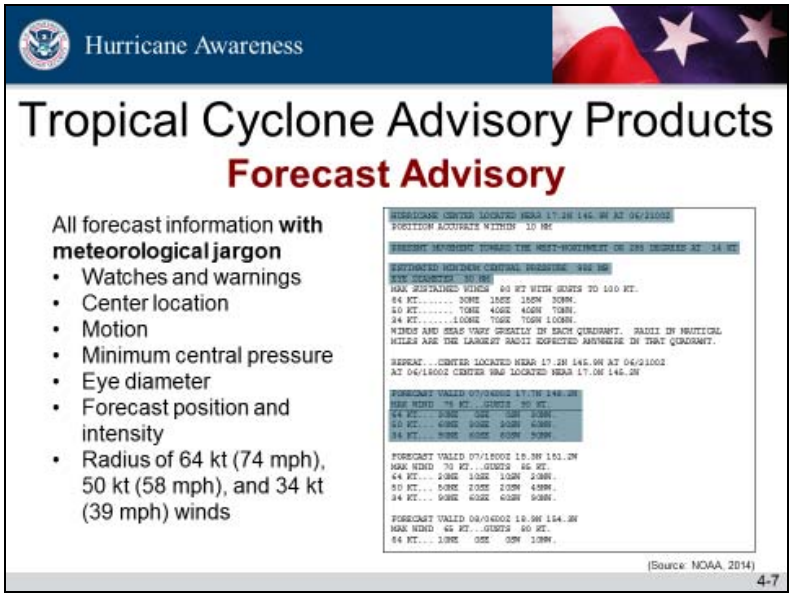
Complete public advisories are issued at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time (4 AM, 10 AM, 4 PM, and 10 PM Eastern Standard Time).

Intermediate public advisories are issued every three hours when coastal watches or warnings are in effect or a tropical cyclone is over land at tropical storm intensity or greater. Tropical Cyclone Updates (TCUs) are issued at hourly intervals whenever the center can be easily tracked on radar and coastal watches/warnings are in effect. The TCU contains all key storm parameters, and allows the inclusion of additional statements of interest as appropriate. Additionally, special public advisories may be issued at any time due to significant changes in warnings or in the cyclone.

The schedule for the next intermediate and complete advisories is contained at the end of the public advisory.

Participant Note: Watches and warnings for the United States and Puerto Rico are only announced in a complete advisory package or special advisory package. Watches and warnings may be discontinued using a regular public advisory, special public advisory, intermediate public advisory or tropical cyclone update. Changes to international watches and warnings can be conveyed in a public advisory, intermediate advisory, special public advisory, or tropical cyclone update.

Participant Notes:



Slide 4-7. Tropical Cyclone Advisory Products: Forecast Advisory

The Tropical Cyclone Forecast Advisory is the only source for all forecast information. Unlike the Public Advisory, it is formatted for computers so that commercial tracking software (such as weather graphics systems or decision-support tools) can easily read and process the forecast information.

Changes to existing watches and warnings are summarized, followed by any new tropical cyclone watches and warnings. The current latitude and longitude coordinates, intensity, and system motion are also listed.

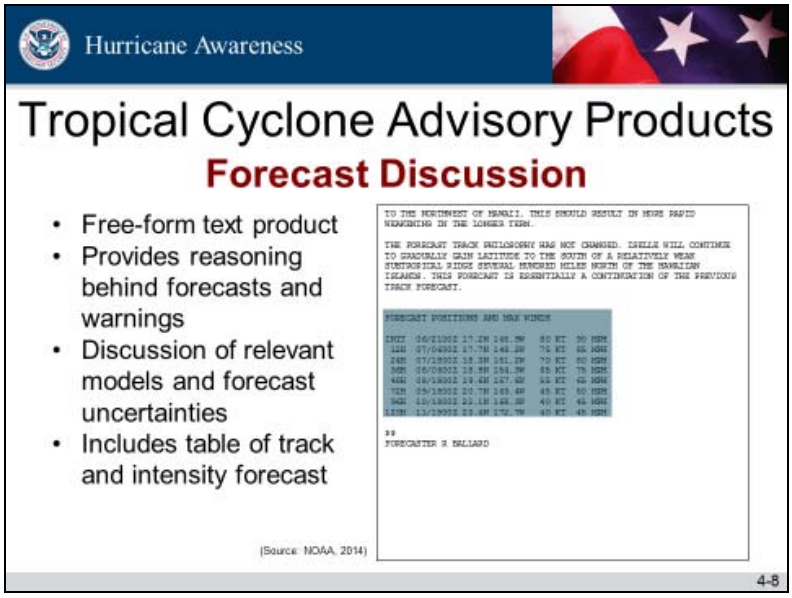
The advisory contains forecasts of the cyclone positions, intensities, and wind fields for 12, 24, 36, 48, and 72 hours from the current synoptic time (2 AM, 8 AM, 2 PM, or 8 PM Eastern Daylight Time).

Forecast advisories are issued every six hours at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time (4 AM, 10 AM, 4 PM, and 10 PM Eastern Standard Time). The forecast advisory includes the current tropical cyclone position, minimum central pressure, and wind radii. A mention of the cyclone position at the synoptic time (about three hours prior to issuance) is included, and forecast information is provided at 12-hour intervals beyond that.

Participant Notes:

Participant Note: All wind speeds in the forecast advisory are given in knots rather than in miles per hour. Size and distance estimates are measured in nautical miles rather than statute miles commonly used by the public. This wind information, as depicted both here and in the Wind Speed Probabilities product, can help with evacuation decision making.

Participant Notes:

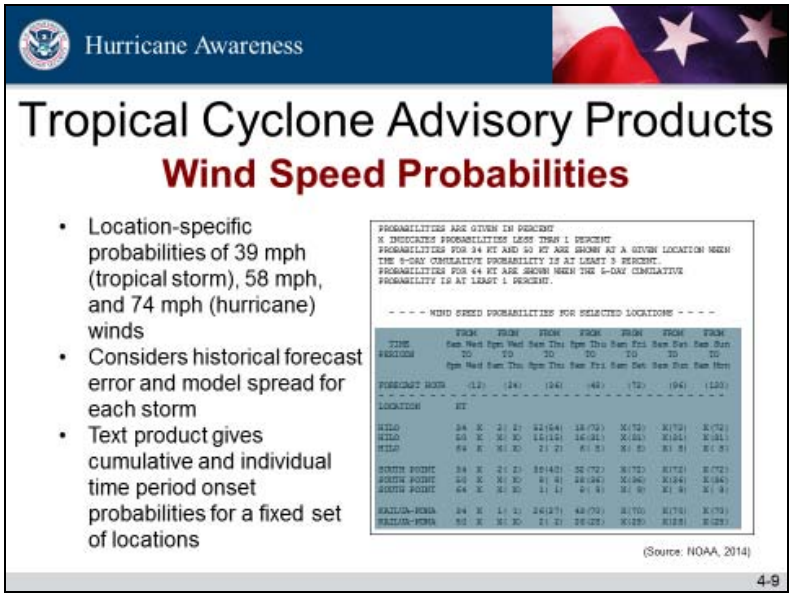


Slide 4-8. Tropical Cyclone Advisory Products: Forecast Discussion

The Tropical Cyclone Discussion explains the reasoning for the analysis and forecast of a tropical or subtropical cyclone. It is a free-form text product so it includes more "personality" than the Public or Forecast Advisories. A table at the bottom lists the forecast track and intensity at 12, 24, 36, 48, 72, 96, and 120 hours.

Similar to the Forecast Advisory, Tropical Cyclone Forecast Discussions are issued every six hours at 5 AM, 11 AM, 5 PM, and 11 PM Eastern Daylight Time (4 AM, 10 AM, 4 PM, and 10 PM Eastern Standard Time). Special tropical cyclone discussions may be issued at any time due to significant changes in warnings or in the cyclone.

Participant Notes:



Slide 4-9. Tropical Cyclone Advisory Products: Wind Speed Probabilities

The text wind speed probability product contains wind speed probabilities for selected coastal and inland cities, as well as selected island and ocean locations for each tropical cyclone forecast issued by the NHC. Each wind speed probability text product provides probabilities (in percent) for wind speeds of at least 39 mph (tropical storm force), 58 mph, or 74 mph (hurricane force) at each listed location. Probabilities are based on errors during recent years in the official track and intensity forecasts issued by the NHC and CPHC. Variability in tropical cyclone size (wind radii) is also incorporated into the probabilities.

Two types of probability values are provided in the text product:

- Cumulative probabilities of occurrence, and
- Onset probabilities.

Cumulative probabilities are provided in the text product for the following time periods: 0-12 hours, 0-24 hours, 0-36 hours, 0-48 hours, 0-72 hours, 0-96 hours, and 0-120 hours (0-5 days). These cumulative probabilities (shown in parentheses beyond 12 hours) indicate the overall chances that the stated wind speed will occur at each location during the period between hour 0 (the beginning of the forecast) and each listed forecast hour.

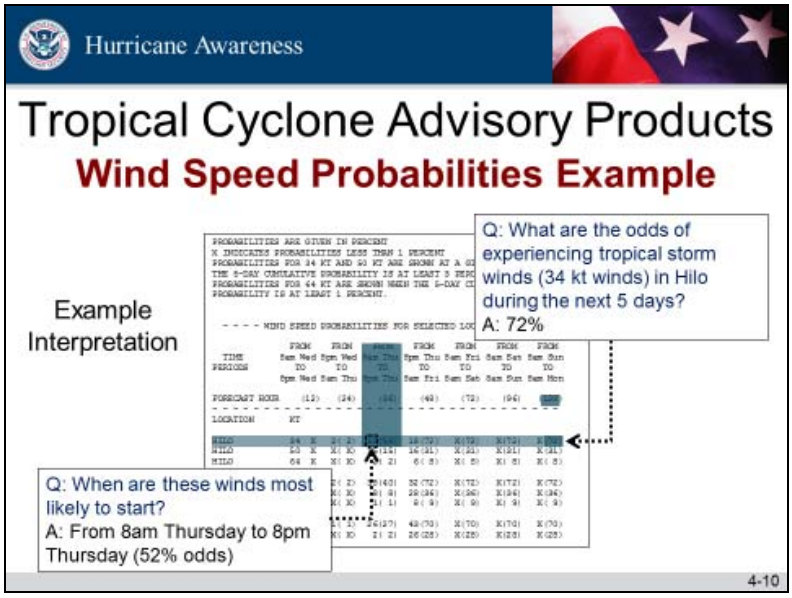
Participant Notes:

Onset probabilities are provided for each of the following time intervals: 0-12 hours, 12-24 hours, 24-36 hours, 36-48 hours, 48-72 hours, 72-96 hours, and 96-120 hours. These onset probabilities indicate the chances that the stated wind speed will start during each individual period at each location. Cumulative probabilities (in parentheses) through each forecast time period represent the sum of the onset probabilities up to that time.

In other words, cumulative probabilities tell decision-makers the chances that the event will happen at all. The onset probabilities tell decision-makers when the event is most likely to start.

Probabilities for a particular location and speed are provided only when the 120-hour (five-day) cumulative probability of sustained tropical storm and 58 mph winds is at least three percent. Hurricane force probabilities are provided when the 120-hour (five-day) cumulative probability is at least one percent. Locations are listed in geographic order, and data for all wind speeds (with high enough probabilities) at one location are grouped together.

Participant Notes:



Slide 4-10. Tropical Cyclone Advisory Products: Wind Speed Probabilities Example

The Wind Speed Probabilities text product includes seven forecast periods for each location listed. These 12, 24, 36, 48, 72, 96, and 120 hour periods are represented by each column. Each location can have up to three rows that indicate the chance of 39 mph (tropical storm), 58 mph, and 74 mph (hurricane) for each forecast time period (or column). The individual or onset probability is the first number in each column (percent outside of parentheses). The cumulative or overall chance is the second number in each column (percent inside of parentheses).

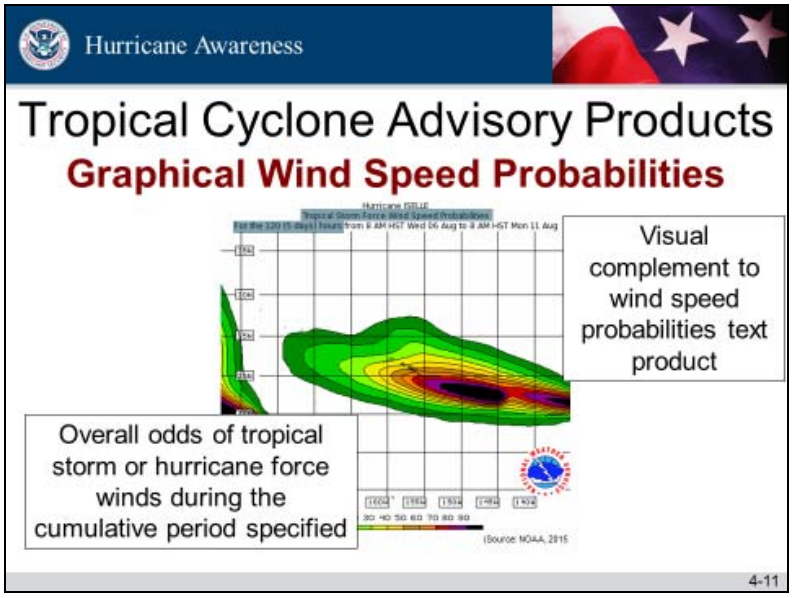
For example, the first row of the wind speed probabilities shown on this slide give the percent chance of tropical storm (39 mph or higher) winds in Hilo, Hawaii, for each forecast period. In order to find the overall five-day odds of tropical storm winds at Hilo, look for the 120-hour forecast time, or the last column of the first row. The number in the parentheses indicates that the chance of experiencing tropical storm winds in Hilo over the entire five-day period is 72 percent. The individual odds in this column are marked by an “X,” meaning the odds of sustained tropical storm winds are less than three percent for the individual time period (from 8 AM Sunday to 8 AM Monday).

Participant Notes:

But when are the odds greatest for experiencing tropical storm winds in Hilo? In order to find this, look at the individual odds for each forecast period, which is the first percent value (or "X" if the percent value is less than three percent) for each of the seven forecast time periods. The forecast time period with the highest individual odds gives the time period during which tropical storm winds will most likely begin. For Hilo, this is from 8 AM Thursday to 8 PM Thursday, or during the 36-48 hour time period.

Participant Note: Individual probabilities may be low relative to what one might expect when looking at daily rainfall forecast. However, hurricanes are extreme events. The occurence of hurricane force winds can be life threatening, so do not be fooled by low probabilities. A 1 in 5 chance, or 20 percent chance, of a potentially life threatening event warrants action!

Participant Notes:



Slide 4-11. Tropical Cyclone Advisory Products: Graphical Wind Speed Probabilities

A graphic version of the wind speed probabilities complements the wind speed probabilities text product. Each wind speed probabilities graphic provides probabilities (in percent) that wind speeds of at least 39 mph (tropical storm force), 58 mph, or 74 mph (hurricane force) will occur during cumulative time periods at each specific point on the map.

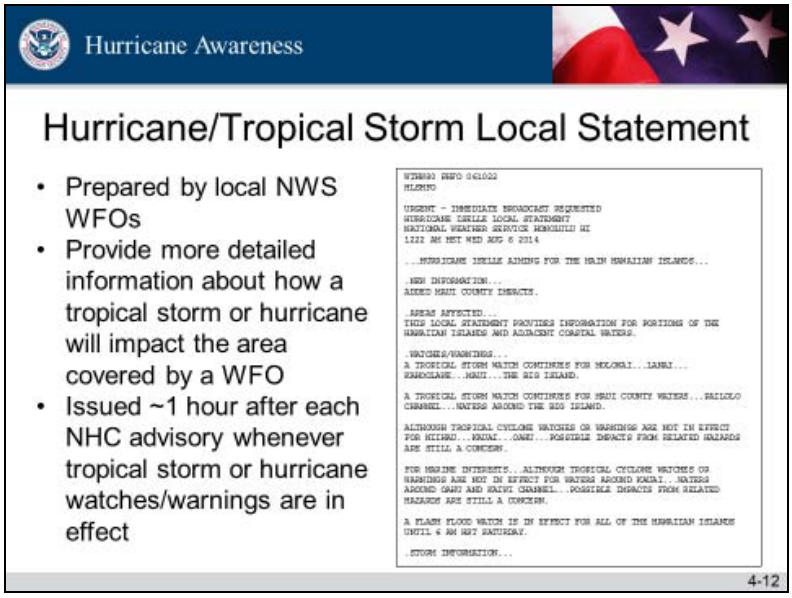
The capability to animate through the periods is also provided. These cumulative probabilities indicate the overall chances that the indicated wind speed will occur at any specific location on the map during the period between hour 0 and the indicated forecast hour. In other words, these cumulative probabilities tell decision-makers the chances that the event will happen at any point on the map within the time period stated on each graphic.

Participant Note: Wind speed probabilities consider computer forecast model spread or uncertainty specific to each storm. So unlike the track forecast cone, wind speed probabilities can help users understand forecast uncertainties, so that they are not surprised by small changes in the forecast track. It is important to note, however, that the probabilities are *point specific* and not to be used for geographical areas. Actual areal probabilities will be different.

Participant Notes:

Example: This example graphic shows the tropical storm force (39 mph or higher) wind speed probabilities for Hurricane Iselle (2014), for the five-day period from 8 AM Wednesday, August 6, through 8 AM Monday August 11. The cumulative 0-120 hour values are shown here to indicate the overall chances of experiencing tropical storm force winds *at any specific point on the map*. It is clear from this graphic that the greatest chances of experiencing tropical storm force winds are at individual locations around the Big Island.

Participant Notes:



Slide 4-12. Hurricane/Tropical Storm Local Statement

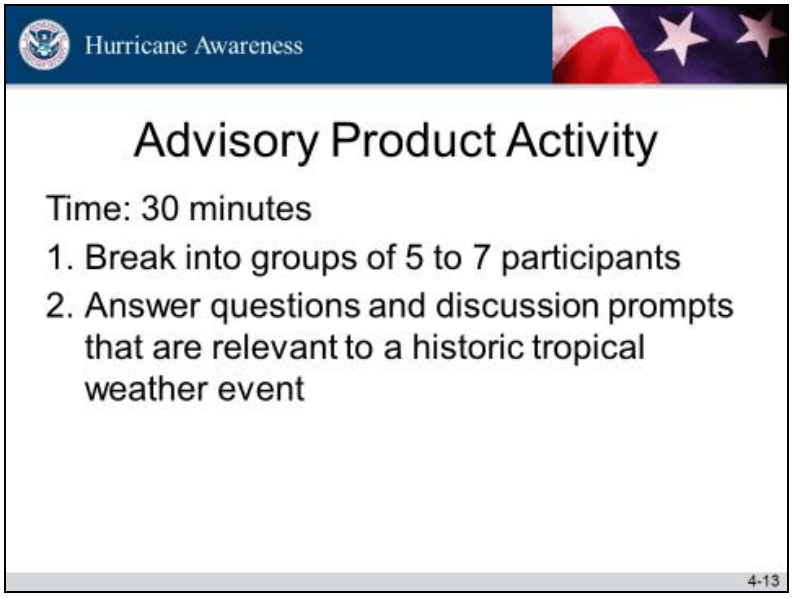
Local National Weather Service Weather Forecast Offices produce Hurricane Local Statements to keep their decision-makers, public, and media current on present and anticipated storm effects specific to their area. These statements contain essential, detailed hurricane or tropical storm information, expanding on the storm's potential impacts to the local area and on any recommended actions from local emergency managers.

Although the first few lines of the header are codes that identify the product, it's a good idea to check the date and time within the last line of the header to make sure you have the most recent local statement.

The statement begins by summarizing the key point of the forecast discussion that follows. After the discussion, the counties/parishes/areas affected are summarized, followed by the most recent information since the last update and a more detailed description of the affected areas. Next are the watches and warnings, followed by precautionary and preparedness actions statements based on the threat posed by each hazard. A sub-section for each hazard (which may include storm surge, timing and force of winds, inland flooding, tornadoes, and local marine impacts) lists the potential impacts of that threat. The last section tells when the next update for this product will be issued.

Hurricane local statements are usually issued about an hour after each advisory whenever tropical storm or hurricane watches and warnings are in effect.

Participant Notes:

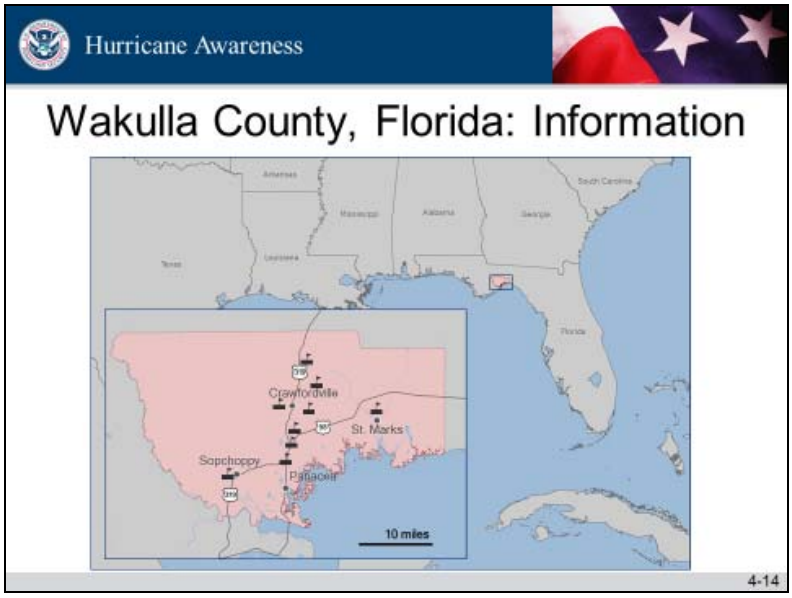


Slide 4-13. Advisory Product Activity

A tropical weather event is presented. Each group is expected to properly read, analyze, and utilize National Hurricane Center advisory products provided to them. The instructor will ask groups specific questions about the advisory products and lead a class discussion. The activity will challenge participants to demonstrate comprehension of hurricane science, forecasting, and warning.

Participants will work in groups to answer questions and respond to discussion prompts during the following activity.

Participant Notes:



Slide 4-14. Wakulla County, Florida: Information

For the following activity, participants should answer questions and respond to discussion prompts as if they were in Wakulla County, Florida.

The above map shows the location of Wakulla County, Florida, which is located along the panhandle of Florida about 20 miles south of the capital of Tallahassee.

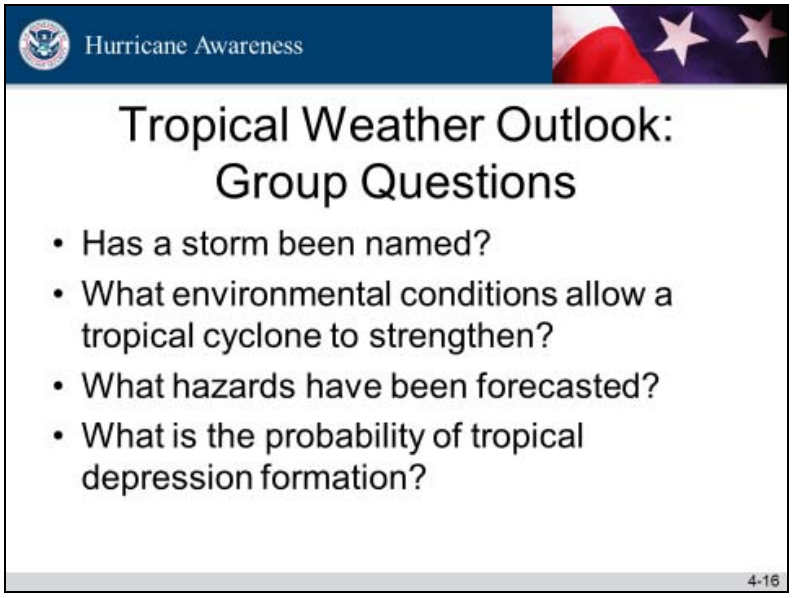
There is a local NWS office located in Tallahassee; this WFO is responsible for the central Florida panhandle, southeast Alabama, and southwest Georgia.

Participant Notes:

Slide 4-15. Tropical Weather Outlook

Participants should refer to the corresponding page in the Group Handout.

Participant Notes:

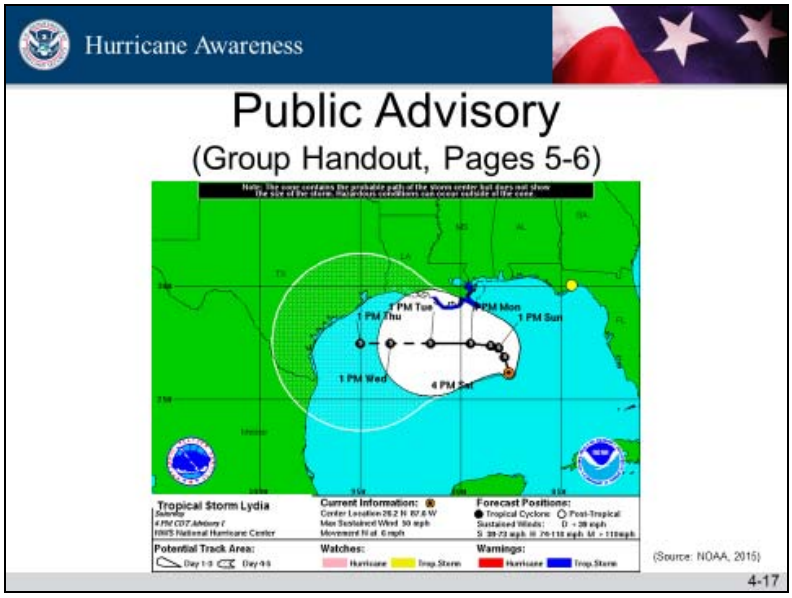


Slide 4-16. Tropical Weather Outlook: Group Questions

Participants should answer the following questions in their groups:

- Has a storm been named?
- What environmental conditions allow a tropical storm to strengthen?
- What hazards have been forecasted?
- What is the probability of tropical depression formation?

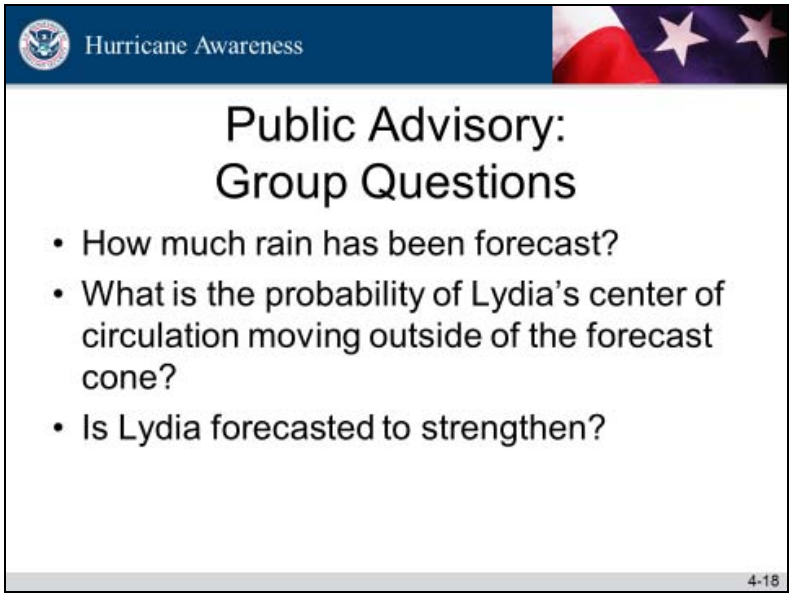
Participant Notes:



Slide 4-17. Public Advisory

Participants should refer to the corresponding page in the Group Handout.

Participant Notes:



Slide 4-18. Public Advisory: Group Questions

Participants should answer the following questions in their groups:

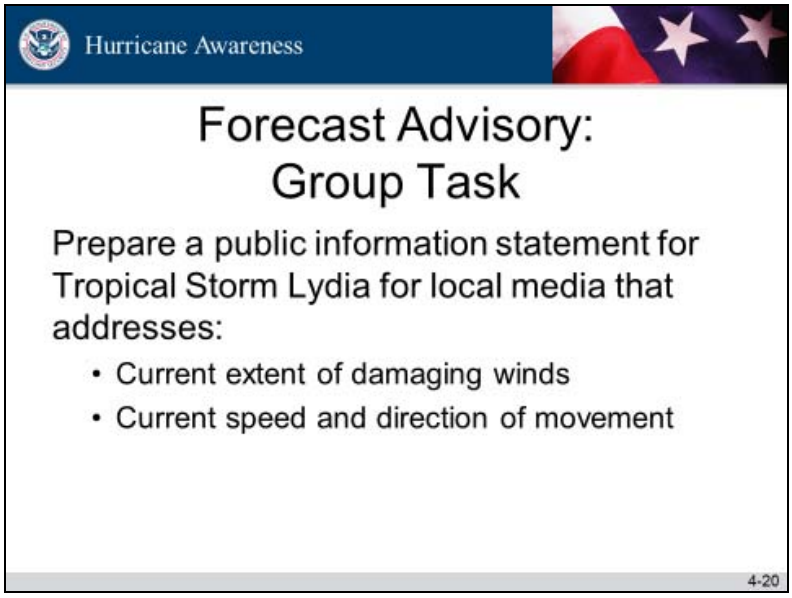
- How much rain has been forecasted?
- What is the probability of Lydia's center of circulation moving outside of the forecast cone?
- Is Lydia forecasted to strengthen?

Participant Notes:

Slide 4-19. Forecast Advisory

Participants should refer to the corresponding page in the Group Handout.

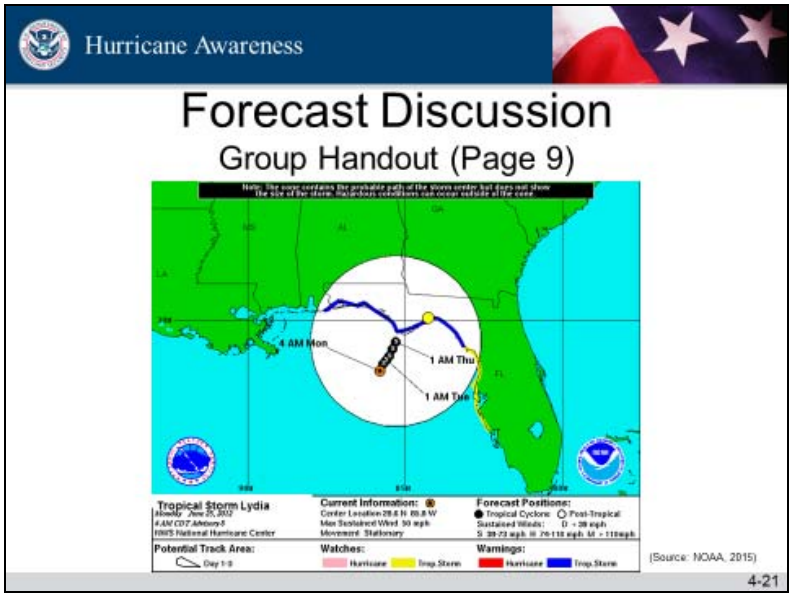
Participant Notes:



Slide 4-20. Forecast Advisory: Group Task

Participants should prepare a public information statement for Tropical Storm Lydia for local media that addresses the extent of damaging winds, anticipated hazards, and the forecasted path.

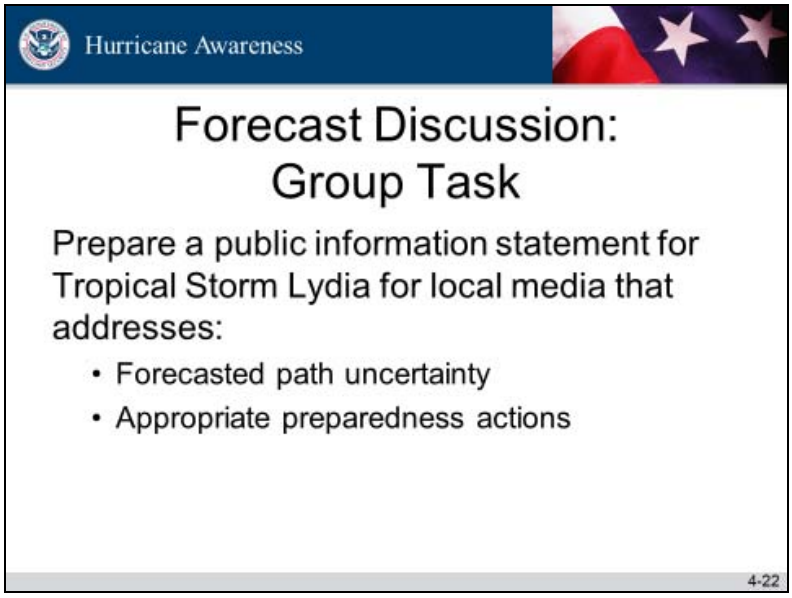
Participant Notes:



Slide 4-21. Forecast Discussion

Participants should refer to the corresponding page in the Group Handout.

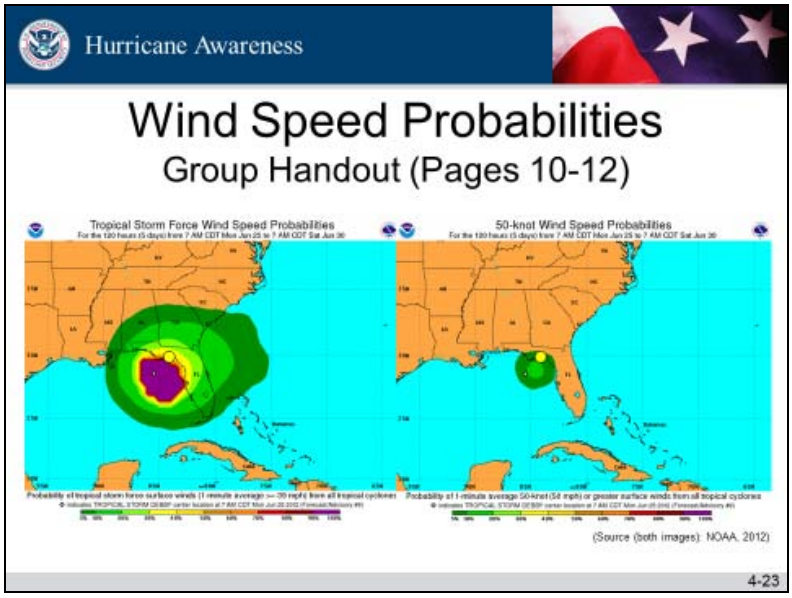
Participant Notes:



Slide 4-22. Forecast Discussion: Group Task

Participants should prepare a public information statement for Tropical Storm Lydia for local media that addresses forecasted path uncertainty and appropriate preparedness actions.

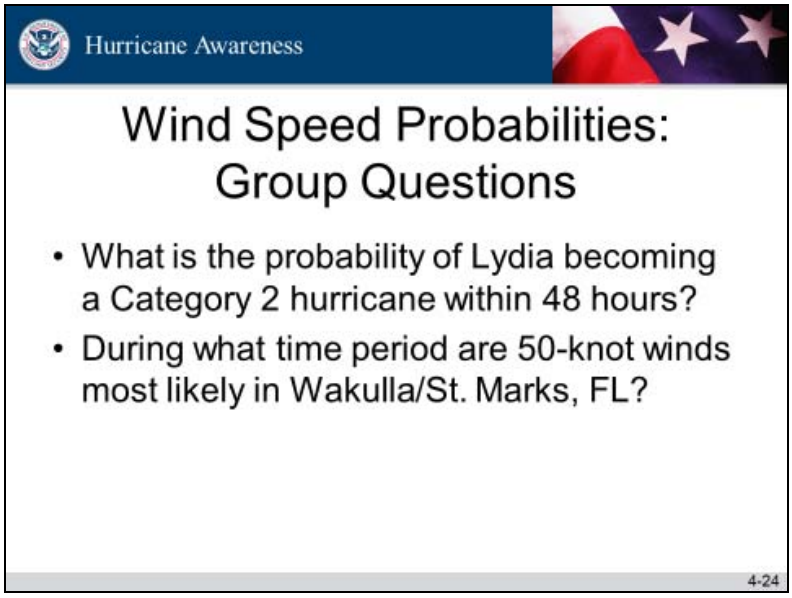
Participant Notes:



Slide 4-23. Wind Speed Probabilities

Participants should refer to the corresponding page in the Group Handout.

Participant Notes:

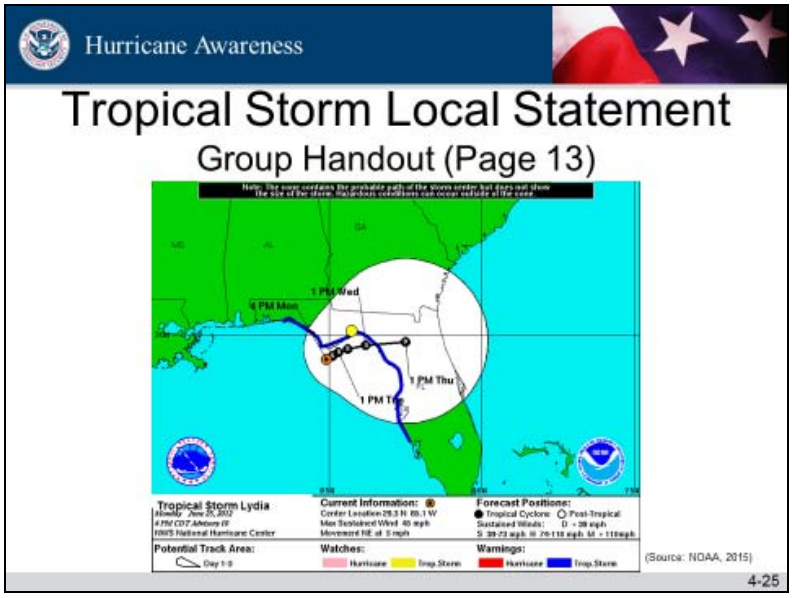


Slide 4-24. Wind Speed Probabilities: Group Questions

Participants should answer the following questions in their groups:

- What is the probability of Lydia becoming a Category 2 hurricane within 48 hours?
- During what time period are 50-knot winds most likely in Wakulla/St. Marks, FL?

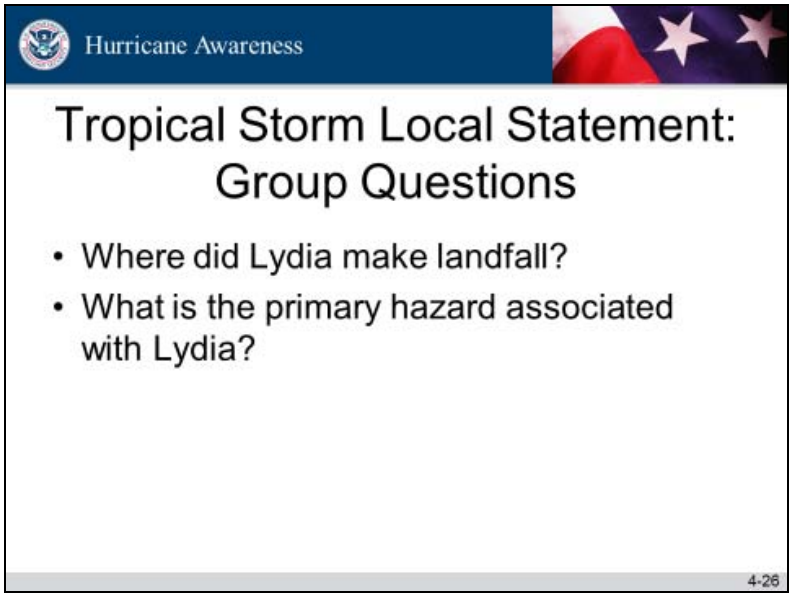
Participant Notes:



Slide 4-25. Tropical Storm Local Statement

Participants should refer to the corresponding page in the Group Handout.

Participant Notes:

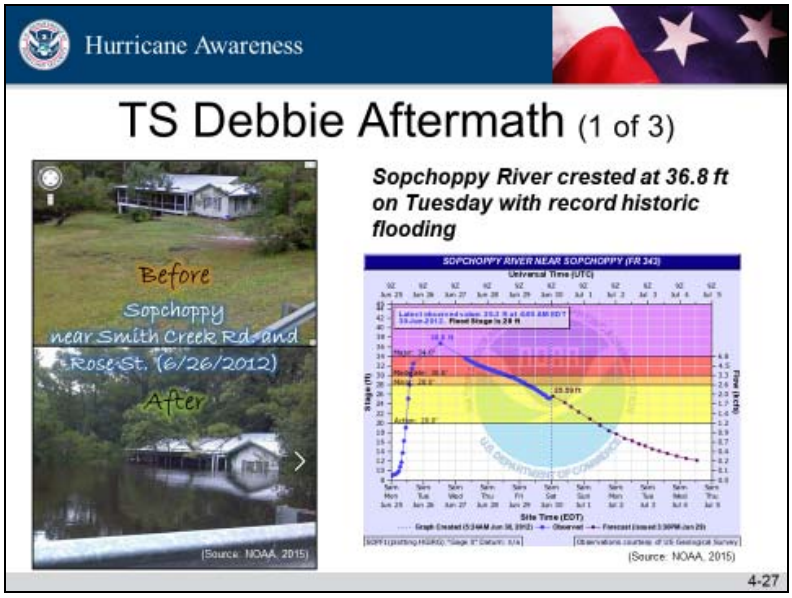


Slide 4-26. Tropical Storm Local Statement: Group Questions

Participants should answer the following questions in their groups:

- Where did Lydia make landfall?
- What is the primary hazard associated with Lydia?

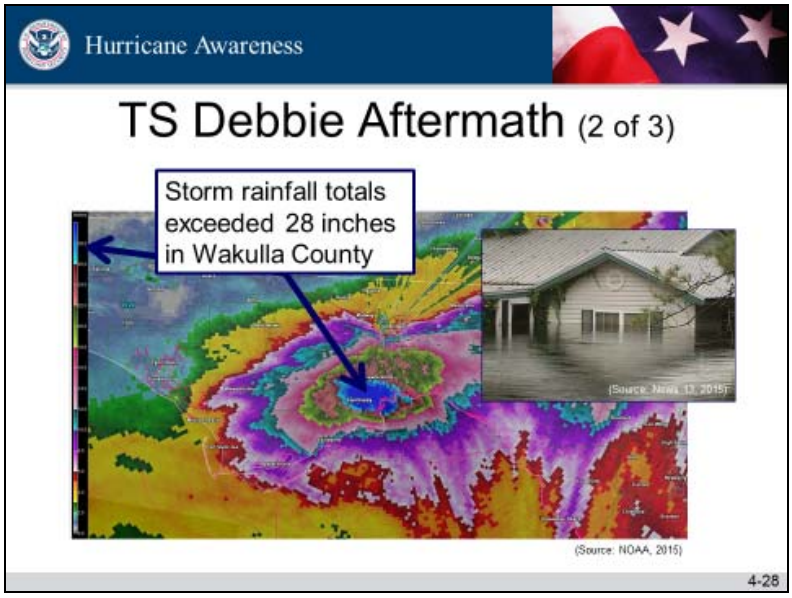
Participant Notes:



Slide 4-27. TS Debbie Aftermath (1 of 3)

The Sopchoppy River crested at 36.8 feet on Tuesday, with record historic flooding. The before and after photos to the left show the extent of the flooding. Numerous homes and businesses were impacted by this event, with 271 homes in total flooded to some degree across Wakulla County. Two bridges were damaged by the floodwaters and numerous roads were washed out.

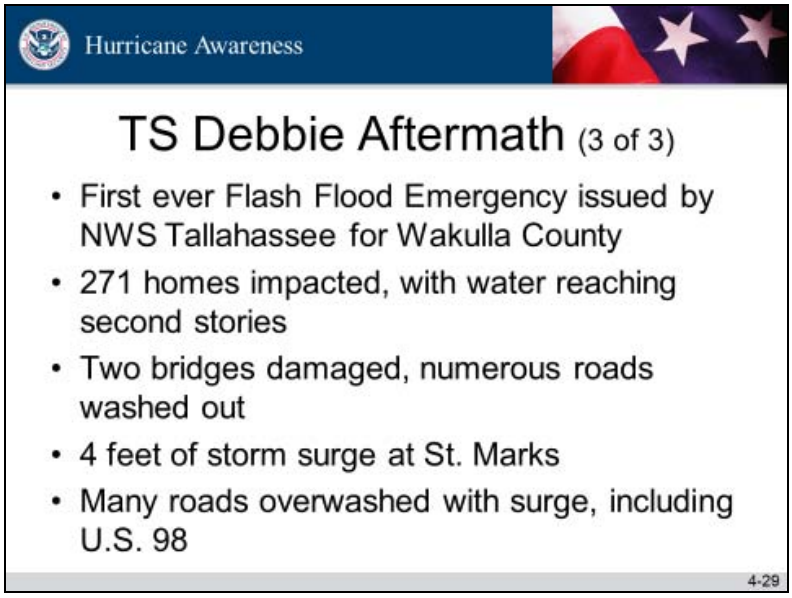
Participant Notes:



Slide 4-28. TS Debbie Aftermath (2 of 3)

The NWS Weather Forecast Office in Tallahassee estimated rainfall totals from radar of greater than 28 inches in Wakulla County, as indicated by the dark blue shading near Sopchoppy. Reports received from local rain gauge networks and storm spotters verified these estimates. An observer in Wakulla County recorded 28.78 inches of rain during the event. Much of the Florida Big Bend from Tallahassee south saw over a foot of rain (pink shading) from the Tropical Storm, resulting in the catastrophic flooding of many homes.

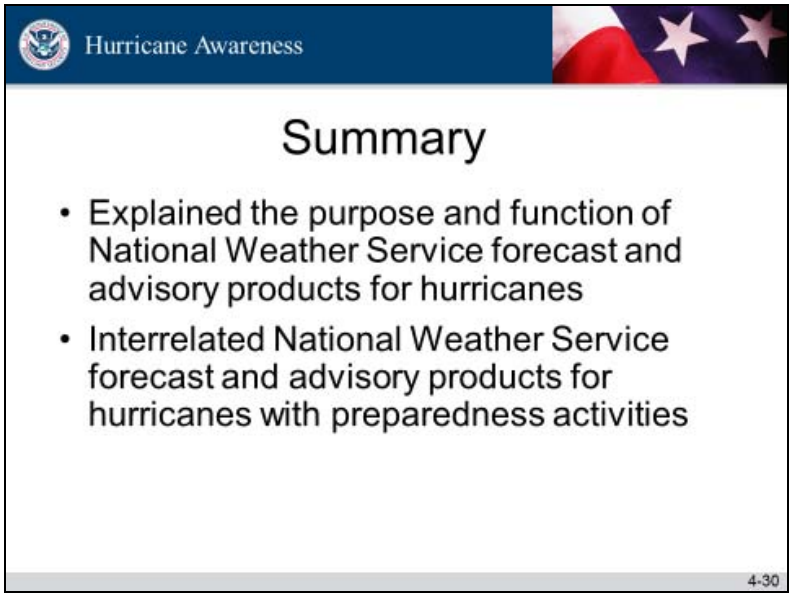
Participant Notes:



Slide 4-29. TS Debbie Aftermath (3 of 3)

The impact to Wakulla County was severe. More than 271 structures were affected, with multiple bridges and roads washed out from the floodwaters. In St. Marks, a four-foot storm surge was reported, overwashing coastal roads, including U.S. 98. The preliminary damage total across the state was estimated at over a quarter billion dollars.

Participant Notes:



Slide 4-30. Summary

In this module, participants:

- Explained the purpose and function of National Weather Service forecast and advisory products for hurricanes; and
- Interrelated National Weather Service forecast and advisory products for hurricanes with preparedness activities.

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Hurricane Awareness

Module 5: Evaluation and Conclusion

Version 1.0

FEMA

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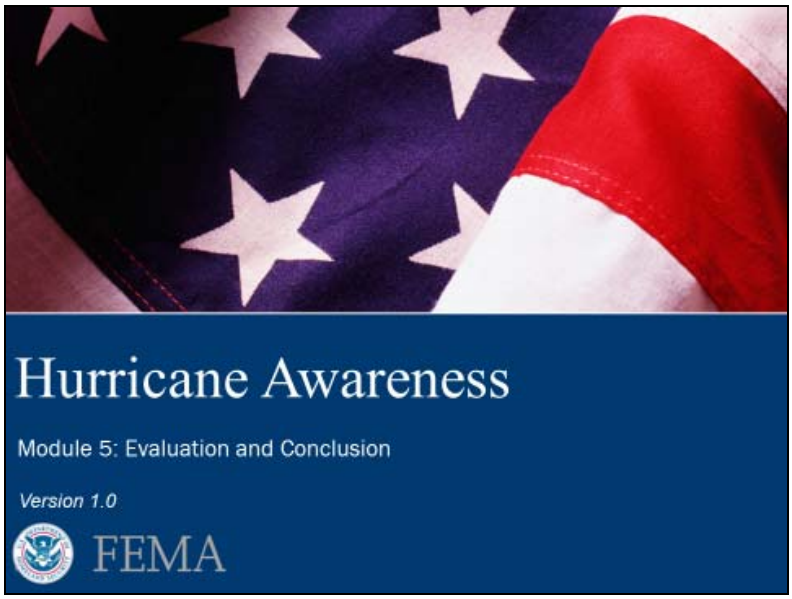
Module 5: Evaluation and Conclusion



Slide 5-1. Evaluation and Conclusion

Duration

40 minutes

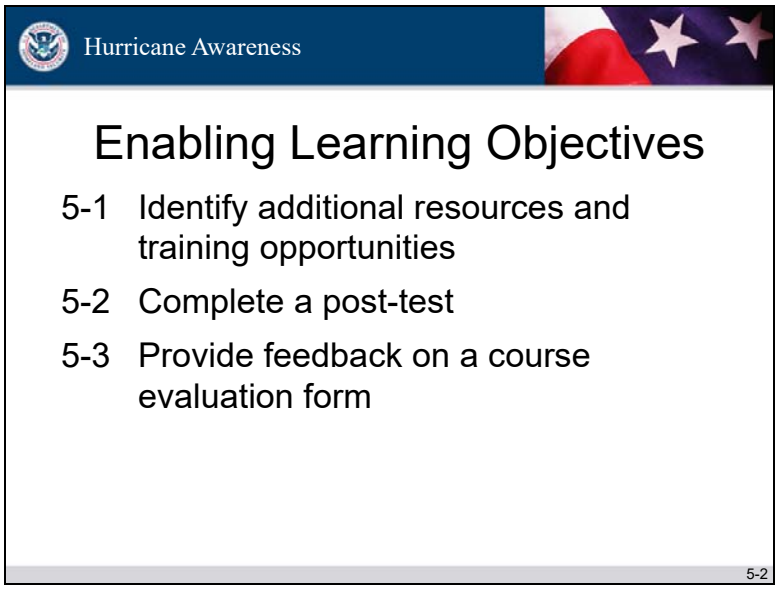
Scope Statement

In this module, participants will review lessons learned from previous modules, be advised of additional resources and training opportunities, complete a post-test and course evaluation form, and provide feedback on the course instructions, content, and materials.

Terminal Learning Objective (TLO)

Participants will complete a post-test and course evaluation.

Enabling Learning Objectives (ELOs)



Slide 5-2. Enabling Learning Objectives

At the end of this module, participants will be able to:

5-1 Identify additional resources and training opportunities;
5-2 Complete a post-test; and
5-3 Provide feedback on a course evaluation form.

Resources

- Instructor Guide (IG)
- Module 5 presentation slides
- Laptop with presentation software installed and CD-ROM capability
- Audio-visual (A/V projection unit)
- Projector screen
- Chalkboard (and chalk), whiteboard (and dry erase markers), or easel and easel paper (and permanent markers)
- Post-Test Key with ELO Mapping
- One of each of the following items per participant:
  - Participant Guide (PG) available for download from http://ndptc.hawaii.edu/
  - Notepad and pen
  - Course Evaluation Form
  - Answer Sheet
  - Post-Test

Instructor-to-Participant Ratio

2:40

Reference List

National Domestic Preparedness Consortium (NDPC). 2012. NDPC Website. https://www.ndpc.us

Practical Exercise Statement

Not applicable

Assessment Strategy

- Instructor observation of participant involvement in classroom discussion
- Instructor administration of objectives-based post-test to assess the knowledge participants have gained in each module

Hurricane Awareness

Icon Map

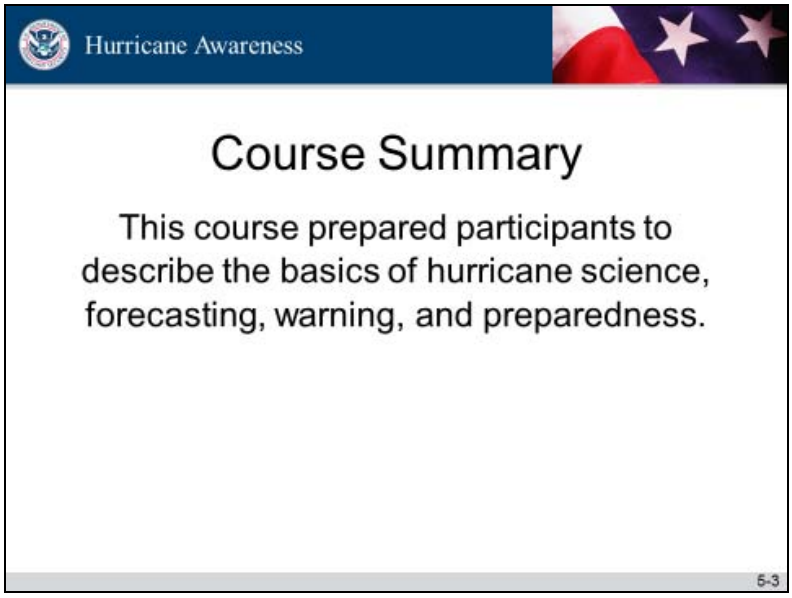
Knowledge Check: Used when it is time to assess participant understanding.

Example: Used when there is a descriptive illustration to show or explain.

Key Points: Used to convey essential learning concepts, discussions and introduction of supplemental material.

Participant Note: Used to indicate text that has been included as additional information for the participant. The text may not be directly addressed in the slide presentation or during class discussion.

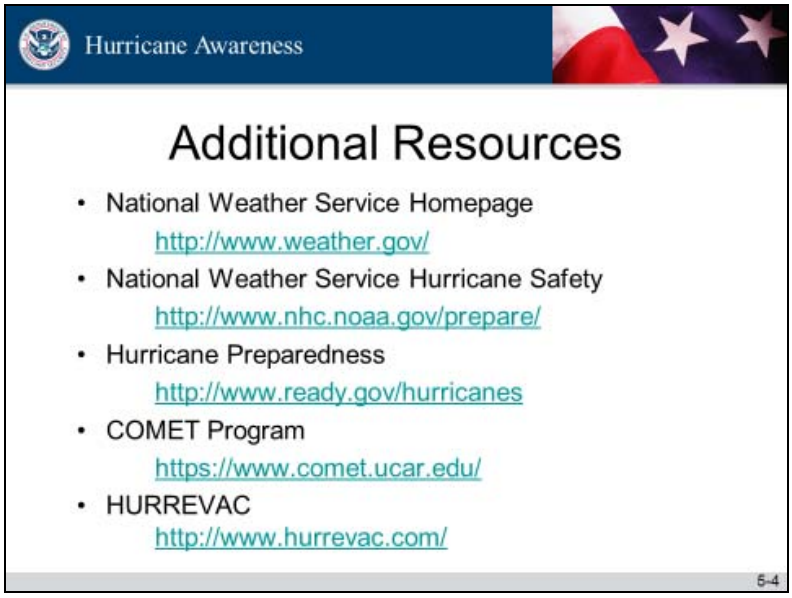
Participant Notes:



Slide 5-3. Course Summary

This course prepared participants to understand the basics of hurricane science, forecasting, warning, and preparedness.

Participant Notes:

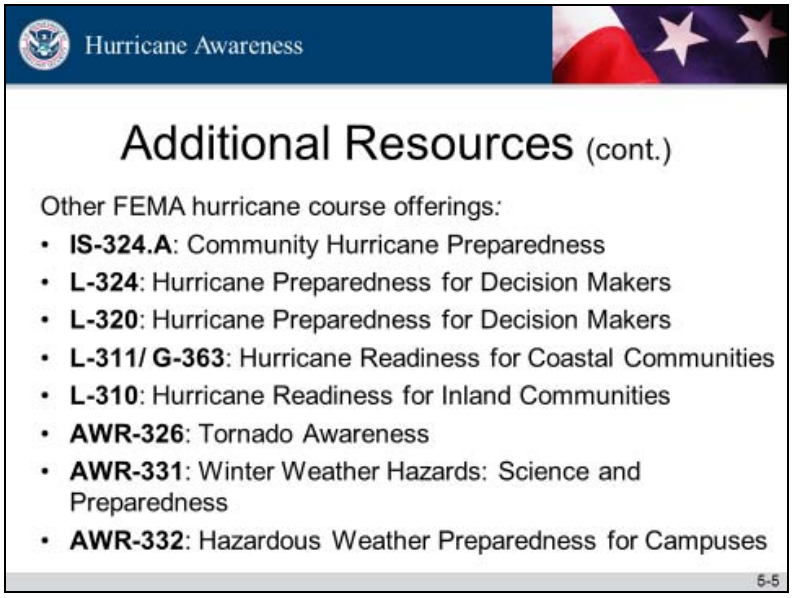


Slide 5-4. Additional Resources

Participants who are interested in learning more may look up the following references:

- National Weather Service homepage
  http://www.weather.gov/
- National Weather Service Hurricane Safety
  http://www.nhc.noaa.gov/prepare/
- Hurricane Preparedness
  http://www.ready.gov/hurricanes
- COMET Program
  http://www.comet.ucar.edu/
- HURREVAC
  http://www.hurrevac.com/

Participant Notes:

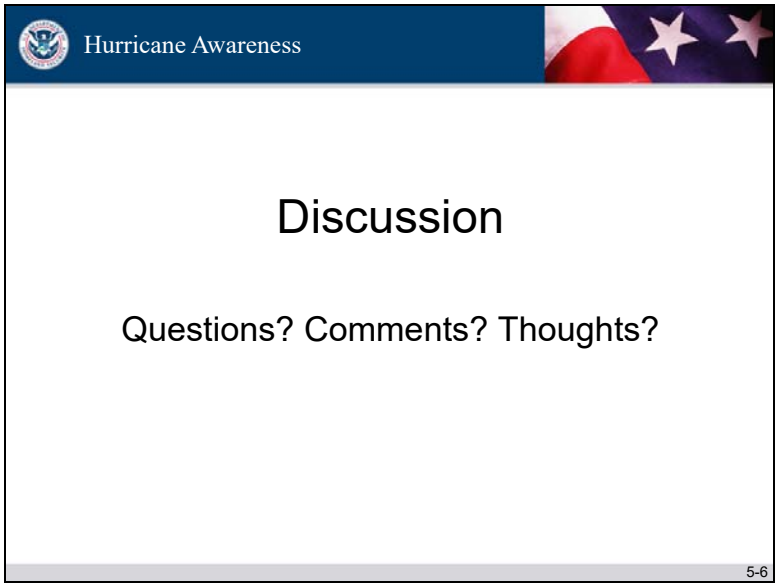


Slide 5-5. Additional Resources (continued)

Participants may also be interested in the following FEMA hurricane course offerings:

- IS-324.A: Community Hurricane Preparedness
- L-324: Hurricane Preparedness for Decision Makers
- L-320: Hurricane Preparedness for Decision Makers
- L-311/ G-363: Hurricane Readiness for Coastal Communities
- L-310: Hurricane Readiness for Inland Communities
- AWR-326: Tornado Awareness
- AWR-331: Winter Weather Hazards: Science and Preparedness
- AWR-332: Hazardous Weather Preparedness for Campuses

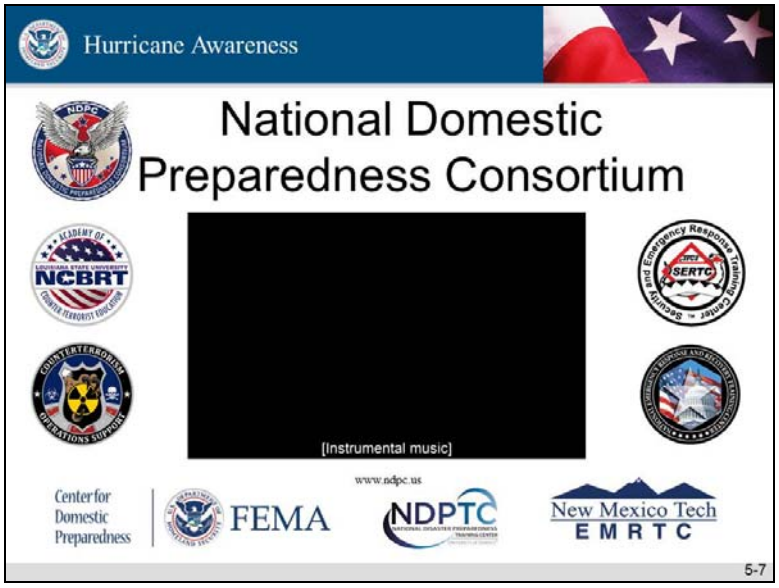
Participant Notes:



Slide 5-6. Discussion

Participants are welcome to ask any questions or share any comments or thoughts about the course.

Participant Notes:



Slide 5-7. National Domestic Preparedness Consortium

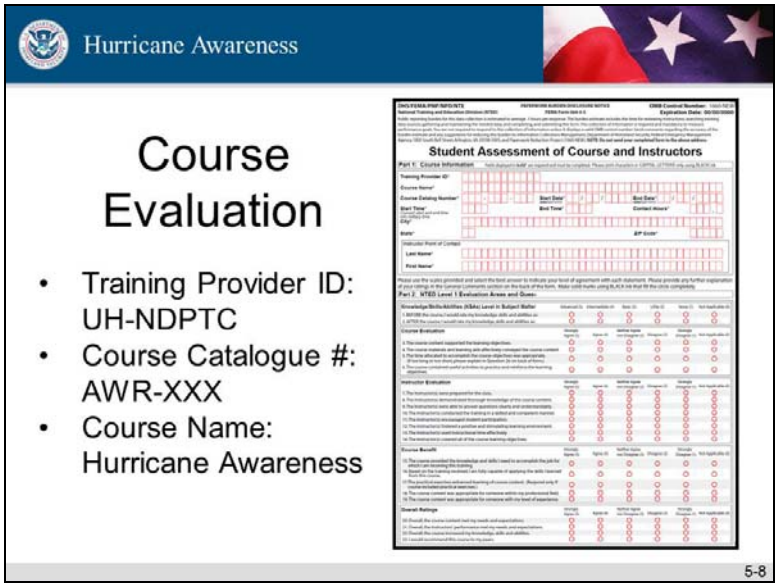
The National Domestic Preparedness Consortium (NDPC) is a professional alliance sponsored through the Department of Homeland Security/FEMA National Preparedness Directorate.

The NDPC membership includes:

- University of Hawai'i: National Disaster Preparedness Training Center (NDPTC);
- Louisiana State University's Academy of Counter-Terrorist Education: National Center for Biomedical Research and Training;
- Texas A&M: National Emergency Response and Rescue Center;
- The New Mexico Institute of Mining and Technology: Energetic Materials Research and Testing Center;
- Center for Domestic Preparedness (CDP);
- US Department of Energy Nevada Test Site: Counter-Terrorism Operations Support; and
- Transportation Technology Center, Inc./Security and Emergency Response Training Center.

Each member brings a unique set of assets to the domestic preparedness program.

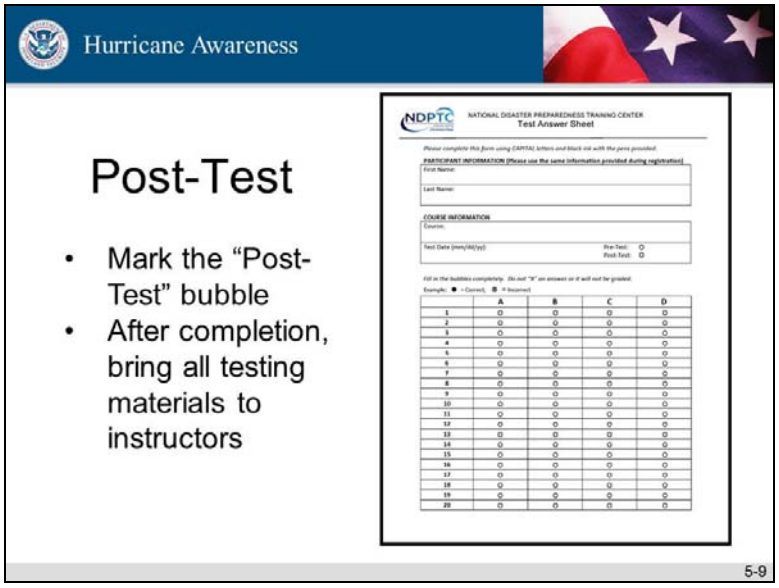
Participant Notes:



Slide 5-8. Course Evaluation

The instructors will distribute a Course Evaluation Form to participants and ask them to provide constructive feedback on the course material and instruction. Participants have 10 minutes to complete the form.

Participant Notes:



Slide 5-9. Post-Test

This course concludes with a post-test, which allows the instructors to evaluate participant knowledge on the topics addressed in the course. The post-test provides participants with an opportunity to demonstrate mastery of the Terminal Learning Objectives, and is similar in design and content to the pre-test that participants completed at the beginning of the course. Participants' pre-test and post-test scores will be compared to measure the benefit of the course and identify the knowledge and skills participants gained during their attendance.

Unlike the pre-test, every question should be answered. Participants must not leave any answers blank on the answer sheet. Participants will have 10 minutes to complete the post-test, and should work independently to complete the answers.

Participant Notes:

Slide 5-10. Thank You!

This concludes NDPTC's "Hurricane Awareness" training course. Thank you for attending!

Hurricane Awareness

Appendix A: Module 4 Activity

Version 1.0

FEMA

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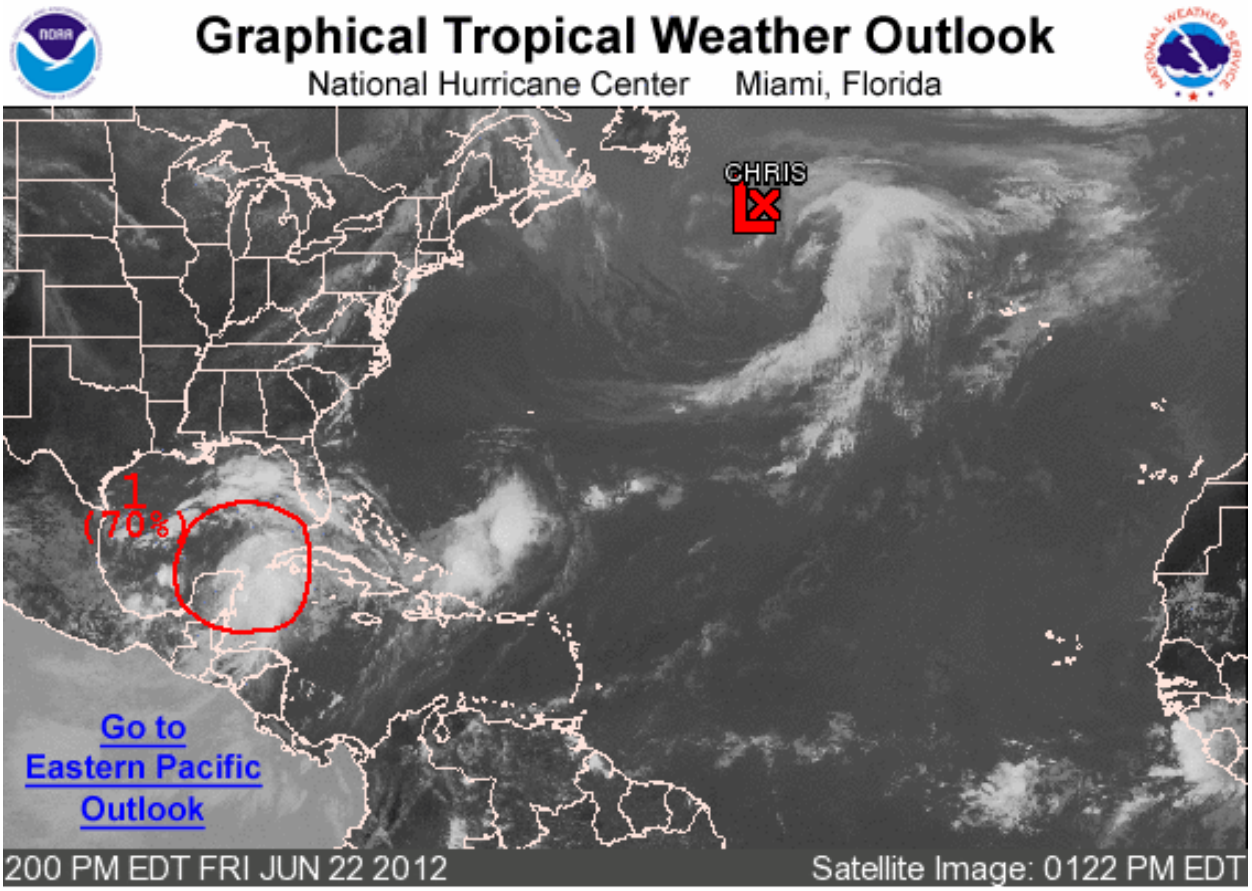
Appendix A: Module 4 Activity

Time
30 minutes

Practical Exercise Statement
A tropical storm activity is presented and each group is expected to properly read, analyze, and utilize National Hurricane Center advisory products provided to them. The instructor will ask groups specific questions about the advisory products and a lead class discussion. The activity will challenge participants to demonstrate comprehension of hurricane science, forecasting, and warning.

Actions to be Completed
1. Gather in small groups of five to seven participants
2. Analyze information presented in this appendix as it is assigned by instructors
3. Answer questions and discussion prompts as a group

Tropical Weather Outlook



Outlined areas denote current position of systems discussed in the Tropical Weather Outlook. Color indicates probability of tropical cyclone formation within 48 hours.

Low <30% Medium 30-50% High >50%

Tropical Weather Outlook (continued)

TROPICAL WEATHER OUTLOOK
NWS NATIONAL HURRICANE CENTER MIAMI FL
200 PM EDT FRI JUN 22 2012

FOR THE NORTH ATLANTIC...CARIBBEAN SEA AND THE GULF OF MEXICO...

THE NATIONAL HURRICANE CENTER HAS ISSUED THE FINAL ADVISORY ON POST-TROPICAL CYCLONE CHRIS...LOCATED ABOUT 335 MILES EAST- SOUTHEAST OF CAPE RACE NEWFOUNDLAND.

1. SATELLITE IMAGERY AND SURFACE OBSERVATIONS INDICATE THAT THE CIRCULATION ASSOCIATED WITH THE BROAD SURFACE LOW LOCATED JUST NORTH OF THE YUCATAN PENINSULA HAS BECOME A LITTLE BETTER DEFINED OVER THE PAST FEW HOURS. WHILE THE SHOWER AND THUNDERSTORM ACTIVITY HAS CHANGED LITTLE IN ORGANIZATION...ENVIRONMENTAL CONDITIONS APPEAR CONDUCIVE FOR A TROPICAL DEPRESSION TO FORM. THIS SYSTEM HAS A HIGH CHANCE...70 PERCENT...OF BECOMING A TROPICAL CYCLONE DURING THE NEXT 48 HOURS AS IT BEGINS TO MOVE SLOWLY NORTHWARD. INTERESTS ALONG THE UNITED STATES GULF COAST SHOULD MONITOR THE PROGRESS OF THIS DISTURBANCE THROUGH THE WEEKEND. HEAVY RAINS AND LOCALIZED FLOODING ARE POSSIBLE ACROSS THE YUCATAN PENINSULA...WESTERN CUBA...AND SOUTHERN FLORIDA THROUGH SATURDAY.

ELSEWHERE...TROPICAL CYCLONE FORMATION IS NOT EXPECTED DURING THE NEXT 48 HOURS.

Public Advisory

BULLETIN TROPICAL STORM LYDIA ADVISORY NUMBER 1

NWS NATIONAL HURRICANE CENTER MIAMI FL AL042012
400 PM CDT SAT JUN 23 2012

...TROPICAL STORM LYDIA FORMS IN THE CENTRAL GULF OF MEXICO...
...TROPICAL STORM WARNING ISSUED FOR A PORTION OF THE LOUISIANA COAST...

SUMMARY OF 400 PM CDT...2100 UTC...INFORMATION

LOCATION...26.2N 87.6W
ABOUT 220 MI...355 KM SSE OF THE MOUTH OF THE MISSISSIPPI RIVER
MAXIMUM SUSTAINED WINDS...50 MPH...85 KM/H
PRESENT MOVEMENT...N OR 360 DEGREES AT 6 MPH...9 KM/H
MINIMUM CENTRAL PRESSURE...1001 MB...29.56 INCHES

WATCHES AND WARNINGS

CHANGES WITH THIS ADVISORY...

A TROPICAL STORM WARNING HAS BEEN ISSUED FROM THE MOUTH OF THE PEARL RIVER WESTWARD TO MORGAN CITY LOUISIANA...NOT INCLUDING THE CITY OF NEW ORLEANS OR LAKE PONTCHARTRAIN.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT...

A TROPICAL STORM WARNING IS IN EFFECT FOR... *
THE COAST OF LOUISIANA FROM THE MOUTH OF THE PEARL RIVER WESTWARD TO MORGAN CITY...NOT INCLUDING THE CITY OF NEW ORLEANS OR LAKE PONTCHARTRAIN

A TROPICAL STORM WARNING MEANS THAT TROPICAL STORM CONDITIONS ARE EXPECTED SOMEWHERE WITHIN THE WARNING AREA WITHIN 36 HOURS.

FOR STORM INFORMATION SPECIFIC TO YOUR AREA...INCLUDING POSSIBLE INLAND WATCHES AND WARNINGS...PLEASE MONITOR PRODUCTS ISSUED BY YOUR LOCAL NATIONAL WEATHER SERVICE FORECAST OFFICE.

DISCUSSION AND 48-HOUR OUTLOOK

AIRCRAFT RECONNAISSANCE AND BUOY DATA INDICATE THAT THE AREA OF LOW PRESSURE IN THE GULF OF MEXICO HAS BECOME TROPICAL STORM.

Public Advisory (continued)

AT 400 PM CDT...2100 UTC...THE CENTER OF TROPICAL STORM LYDIA WAS LOCATED NEAR LATITUDE 26.2 NORTH...LONGITUDE 87.6 WEST. LYDIA IS MOVING TOWARD THE NORTH NEAR 6 MPH...9 KM/H. A SLOW NORTHWARD MOTION IS EXPECTED TONIGHT...FOLLOWED BY A WESTWARD TURN ON SUNDAY. ON THE FORECAST TRACK...THE CENTER OF LYDIA WILL BE MOVING OVER THE NORTHERN GULF OF MEXICO DURING THE NEXT FEW DAYS.

MAXIMUM SUSTAINED WINDS ARE NEAR 50 MPH...85 KM/H...WITH HIGHER GUSTS. THESE WINDS ARE OCCURRING WELL EAST OF THE CENTER OF CIRCULATION. SOME STRENGTHENING IS FORECAST DURING THE NEXT 48 HOURS.

TROPICAL-STORM-FORCE WINDS EXTEND OUTWARD UP TO 175 MILES...280 KM TO THE EAST OF THE CENTER.

MINIMUM CENTRAL PRESSURE ESTIMATED FROM RECONNAISSANCE DATA IS 1001 MB...29.56 INCHES.

HAZARDS AFFECTING LAND

WIND...TROPICAL STORM CONDITIONS ARE EXPECTED TO FIRST REACH THE COAST WITHIN THE WARNING AREA BY SUNDAY NIGHT...MAKING OUTSIDE PREPARATIONS DIFFICULT OR DANGEROUS.

STORM SURGE...THE COMBINATION OF A STORM SURGE AND THE TIDE WILL CAUSE NORMALLY DRY AREAS NEAR THE COAST TO BE FLOODED BY RISING WATERS. THE WATER COULD REACH THE FOLLOWING DEPTHS ABOVE GROUND IF THE PEAK SURGE OCCURS AT THE TIME OF HIGH TIDE...

MISSISSIPPI AND SOUTHEASTERN LOUISIANA...1 TO 3 FT

THE DEEPEST WATER WILL OCCUR ALONG THE IMMEDIATE COAST IN AREAS OF ONSHORE FLOW. SURGE-RELATED FLOODING DEPENDS ON THE RELATIVE TIMING OF THE SURGE AND THE TIDAL CYCLE...AND CAN VARY GREATLY OVER SHORT DISTANCES. FOR INFORMATION SPECIFIC TO YOUR AREA...PLEASE SEE PRODUCTS ISSUED BY YOUR LOCAL NATIONAL WEATHER SERVICE OFFICE.

RAINFALL...LYDIA IS EXPECTED TO PRODUCE RAIN ACCUMULATIONS OF 3 TO 6 INCHES ALONG THE GULF COAST FROM SOUTHERN LOUISIANA TO THE FLORIDA PANHANDLE...WITH POSSIBLE ISOLATED MAXIMUM AMOUNTS OF 10 INCHES.

NEXT ADVISORY

NEXT INTERMEDIATE ADVISORY...700 PM CDT.
NEXT COMPLETE ADVISORY...1000 PM CDT.

Forecast Advisory

TROPICAL STORM LYDIA FORECAST/ADVISORY NUMBER 6
NWS NATIONAL HURRICANE CENTER MIAMI FL AL042012
2100 UTC SUN JUN 24 2012

CHANGES IN WATCHES AND WARNINGS WITH THIS ADVISORY...

THE TROPICAL STORM WATCH HAS BEEN EXTENDED SOUTHWARD ALONG THE WEST COAST OF FLORIDA TO ENGLEWOOD.

THE TROPICAL STORM WARNING FROM THE MOUTH OF THE PEARL RIVER WESTWARD TO MORGAN CITY HAS BEEN DISCONTINUED.

SUMMARY OF WATCHES AND WARNINGS IN EFFECT...

A TROPICAL STORM WARNING IS IN EFFECT FOR...
* THE MISSISSIPPI-ALABAMA BORDER EASTWARD TO THE SUWANNEE RIVER RIVER FLORIDA

A TROPICAL STORM WATCH IS IN EFFECT FOR...
* SOUTH OF THE SUWANNEE RIVER TO ENGLEWOOD FLORIDA

A TROPICAL STORM WATCH MEANS THAT TROPICAL STORM CONDITIONS ARE POSSIBLE WITHIN THE WATCH AREA...IN THIS CASE LATER TODAY.

TROPICAL STORM CENTER LOCATED NEAR 28.4N 85.8W AT 24/2100Z POSITION ACCURATE WITHIN 40 NM

PRESENT MOVEMENT TOWARD THE NORTHEAST OR 40 DEGREES AT 3 KT

ESTIMATED MINIMUM CENTRAL PRESSURE 993 MB
MAX SUSTAINED WINDS 50 KT WITH GUSTS TO 60 KT.
50 KT..... 0NE 0SE 0SW 25NW.
34 KT.....175NE 170SE 40SW 100NW.
12 FT SEAS..180NE 210SE 30SW 125NW. 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 28.4N 85.8W AT 24/2100Z AT 24/1800Z CENTER WAS LOCATED NEAR 28.3N 85.9W

FORECAST VALID 25/0600Z 28.7N 85.5W
MAX WIND 50 KT...GUSTS 60 KT.
50 KT... 25NE 25SE 0SW 25NW.
34 KT...175NE 150SE 40SW 100NW.

Forecast Advisory (continued)

FORECAST VALID 25/1800Z 29.0N 85.5W
MAX WIND 50 KT...GUSTS 60 KT.
50 KT... 25NE 25SE   0SW 20NW.
34 KT...150NE 150SE 40SW 100NW.

FORECAST VALID 26/0600Z 29.0N 85.5W
MAX WIND 55 KT...GUSTS 65 KT.
50 KT... 25NE 25SE   0SW 25NW.
34 KT...150NE 150SE 40SW 100NW.

FORECAST VALID 26/1800Z 29.0N 85.5W
MAX WIND 60 KT...GUSTS 75 KT.
50 KT... 25NE 25SE   0SW 25NW.
34 KT...120NE 120SE 40SW 75NW.

FORECAST VALID 27/1800Z 29.5N 85.5W
MAX WIND 60 KT...GUSTS 75 KT.
50 KT... 25NE 25SE   0SW 25NW.
34 KT...120NE 120SE 40SW 90NW.

EXTENDED OUTLOOK. NOTE...ERRORS FOR TRACK HAVE AVERAGED NEAR 175 NM ON DAY 4 AND 225 NM ON DAY 5...AND FOR INTENSITY NEAR 20 KT EACH DAY

OUTLOOK VALID 28/1800Z 30.0N 85.5W
MAX WIND 40 KT...GUSTS 50 KT.

OUTLOOK VALID 29/1800Z 30.5N 85.5W...INLAND
MAX WIND 30 KT...GUSTS 40 KT.

REQUEST FOR 3 HOURLY SHIP REPORTS WITHIN 300 MILES OF 28.4N 85.8W

NEXT ADVISORY AT 25/0300Z

Forecast Discussion

TROPICAL STORM LYDIA DISCUSSION NUMBER 8
NWS NATIONAL HURRICANE CENTER MIAMI FL AL042012
400 AM CDT MON JUN 25 2012

LYDIA HAS A HIGHLY UNIMPRESSIVE APPEARANCE ON SATELLITE IMAGERY. ALTHOUGH RADAR DATA CONTINUE TO DEPICT SOME SHOWER ACTIVITY OVER THE CIRCULATION...THESE SHOWERS ARE BEING PRODUCED BY SHALLOW CONVECTION AS THE ENHANCED IR IMAGES DO NOT SHOW ANY SIGNIFICANT AREAS OF COLD CLOUD TOPS. AIRCRAFT DATA FROM SEVERAL HOURS AGO ALONG WITH SYNOPTIC OBSERVATIONS INDICATE THAT THE MAXIMUM SURFACE WINDS HAVE DECREASED...AND THE CURRENT INTENSITY IS SET AT 45 KT. LYDIA IS LOCATED NORTH OF THE AREA OF MAXIMUM OCEANIC HEAT CONTENT...BUT AS LONG AS THE CYCLONE REMAINS OVER WATER AND IS ABLE TO REGENERATE SOME DEEP CONVECTION THERE IS A POTENTIAL FOR AT LEAST SLIGHT RE-INTENSIFICATION. THE CURRENT NHC INTENSITY FORECAST IS A LITTLE LOWER THAN THE PREVIOUS ONES...BUT A LITTLE HIGHER THAN MOST OF THE NUMERICAL GUIDANCE.

BEST GUESS AT INITIAL MOTION IS QUASI-STATIONARY. LYDIA REMAINS IN A COLD REGION OF THE MID-TROPOSPHERIC STEERING FLOW BETWEEN TWO ANTICYCLONES...AND IS LIKELY TO REMAIN SO FOR THE NEXT COUPLE OF DAYS. THEREFORE LITTLE MOTION IS ANTICIPATED DURING AT LEAST THE FIRST HALF OF THE FORECAST PERIOD. IN THE LONGER-TERM...THE TRACK GUIDANCE CONTINUES TO BE ALL OVER THE PLACE...WITH SOME MODELS TAKING LYDIA WEST AND NORTH OF ITS CURRENT POSITION AND OTHERS MOVING EAST OR NORTHEAST AND ULTIMATELY INTO THE ATLANTIC. THE LATTER SCENARIO ASSUMES THAT LYDIA WILL EVENTUALLY BE INFLUENCED BY A MID-TROPOSPHERIC TROUGH OVER THE NORTHEASTERN UNITED STATES. THIS SCENARIO SEEMS MORE LIKELY SINCE IT IS SUPPORTED BY BOTH THE GFS AND THE ECMWF MODELS. REGARDLESS OF WHICH SCENARIO PLAYS OUT...THE CYCLONE DOES NOT SEEM TO BE GOING ANYWHERE ANYTIME SOON.

FORECAST POSITIONS AND MAX WINDS

INIT 25/0900Z 28.6N 85.8W 45 KT 50 MPH
12H 25/1800Z 28.8N 85.7W 45 KT 50 MPH
24H 26/0600Z 28.9N 85.6W 50 KT 60 MPH
36H 26/1800Z 29.0N 85.5W 50 KT 60 MPH
48H 27/0600Z 29.2N 85.4W 55 KT 65 MPH
72H 28/0600Z 29.4N 85.3W 55 KT 65 MPH
96H 29/0600Z 29.7N 85.2W 45 KT 50 MPH...INLAND
120H 30/0600Z 30.2N 85.0W 30 KT 35 MPH...INLAND

Wind Speed Probabilities (1 of 3)

TROPICAL STORM LYDIA WIND SPEED PROBABILITIES NUMBER 7
NWS NATIONAL HURRICANE CENTER MIAMI FL AL042012
0300 UTC MON JUN 25 2012

AT 0300Z THE CENTER OF TROPICAL STORM LYDIA WAS LOCATED NEAR LATITUDE 28.3 NORTH...LONGITUDE 85.9 WEST WITH MAXIMUM SUSTAINED WINDS NEAR 50 KTS...60 MPH...95 KM/H.

Z INDICATES COORDINATED UNIVERSAL TIME (GREENWICH)
ATLANTIC STANDARD TIME (AST)...SUBTRACT 4 HOURS FROM Z TIME
EASTERN DAYLIGHT TIME (EDT)...SUBTRACT 4 HOURS FROM Z TIME
CENTRAL DAYLIGHT TIME (CDT)...SUBTRACT 5 HOURS FROM Z TIME

I. MAXIMUM WIND SPEED (INTENSITY) PROBABILITY TABLE

CHANCES THAT THE MAXIMUM SUSTAINED (1-MINUTE AVERAGE) WIND SPEED OF THE TROPICAL CYCLONE WILL BE WITHIN ANY OF THE FOLLOWING CATEGORIES AT EACH OFFICIAL FORECAST TIME DURING THE NEXT 5 DAYS.
PROBABILITIES ARE GIVEN IN PERCENT. X INDICATES PROBABILITIES LESS THAN 1 PERCENT.

- - - MAXIMUM WIND SPEED (INTENSITY) PROBABILITIES - - -

VALID TIME HOUR	12Z MON 12	00Z TUE 24	12Z TUE 36	00Z WED 48	00Z THU 72	00Z FRI 96	00Z SAT 120
DISSIPATED	X	1	3	6	18	37	44
TROP DEPRESSION	3	11	13	15	26	32	30
TROPICAL STORM	90	77	66	53	45	29	25
HURRICANE	7	10	19	27	12	2	1
HUR CAT 1	6	9	16	22	10	2	1
HUR CAT 2	1	1	2	4	2	X	X
HUR CAT 3	X	X	1	1	1	X	X
HUR CAT 4	X	X	X	X	X	X	X
HUR CAT 5	X	X	X	X	X	X	X
FCST MAX WIND	50KT	50KT	55KT	60KT	55KT	35KT	30KT

II. WIND SPEED PROBABILITY TABLE FOR SPECIFIC LOCATIONS

CHANCES OF SUSTAINED (1-MINUTE AVERAGE) WIND SPEEDS OF AT LEAST
...34 KT (39 MPH... 63 KPH)...
...50 KT (58 MPH... 93 KPH)...
...64 KT (74 MPH...119 KPH)...
FOR LOCATIONS AND TIME PERIODS DURING THE NEXT 5 DAYS
PROBABILITIES FOR LOCATIONS ARE GIVEN AS IP(CP) WHERE

Wind Speed Probabilities (2 of 3)

IP IS THE PROBABILITY OF THE EVENT BEGINNING DURING AN INDIVIDUAL TIME PERIOD (INDIVIDUAL PROBABILITY)
(CP) IS THE PROBABILITY OF THE EVENT OCCURRING BETWEEN 00Z MON AND THE FORECAST HOUR (CUMULATIVE PROBABILITY)

PROBABILITIES ARE GIVEN IN PERCENT
X INDICATES PROBABILITIES LESS THAN 1 PERCENT
PROBABILITIES FOR 34 KT AND 50 KT ARE SHOWN AT A GIVEN LOCATION WHEN THE 5-DAY CUMULATIVE PROBABILITY IS AT LEAST 3 PERCENT.
PROBABILITIES FOR 64 KT ARE SHOWN WHEN THE 5-DAY CUMULATIVE PROBABILITY IS AT LEAST 1 PERCENT.
- - - - WIND SPEED PROBABILITIES FOR SELECTED LOCATIONS - - - -

TIME PERIODS		FROM 00Z MON TO 12Z MON	FROM 12Z MON TO 00Z TUE	FROM 00Z TUE TO 12Z TUE	FROM 12Z TUE TO 00Z WED	FROM 00Z WED TO 00Z THU	FROM 00Z THU TO 00Z FRI	FROM 00Z FRI TO 00Z SAT
FORECAST HOUR		(12)	(24)	(36)	(48)	(72)	(96)	(120)
LOCATION	KT							
CHARLESTON SC	34	X	X(X)	X(X)	1(1)	X(1)	1(2)	1(3)
ATLANTA GA	34	X	1(1)	1(2)	1(3)	3(6)	1(7)	1(8)
AUGUSTA GA	34	X	X(X)	1(1)	1(2)	1(3)	2(5)	X(5)
SAVANNAH GA	34	1	X(1)	1(2)	2(4)	2(6)	2(8)	X(8)
MAYPORT NS	34	3	2(5)	3(8)	2(10)	4(14)	2(16)	X(16)
JACKSONVILLE	34	3	3(6)	4(10)	3(13)	4(17)	1(18)	1(19)
DAYTONA BEACH	34	3	2(5)	3(8)	3(11)	4(15)	1(16)	X(16)
ORLANDO FL	34	4	2(6)	3(9)	4(13)	3(16)	1(17)	1(18)
COCOA BEACH FL	34	2	2(4)	2(6)	2(8)	3(11)	1(12)	X(12)
PATRICK AFB	34	2	2(4)	2(6)	2(8)	3(11)	1(12)	X(12)
FT PIERCE FL	34	1	1(2)	2(4)	2(6)	1(7)	1(8)	1(9)
W PALM BEACH	34	X	1(1)	X(1)	2(3)	2(5)	X(5)	1(6)
MIAMI FL	34	X	X(X)	1(1)	1(2)	2(4)	X(4)	X(4)
MARATHON FL	34	X	X(X)	1(1)	1(2)	1(3)	1(4)	X(4)
KEY WEST FL	34	X	X(X)	1(1)	1(2)	2(4)	1(5)	X(5)
MARCO ISLAND	34	2	2(4)	2(6)	3(9)	2(11)	1(12)	1(13)
FT MYERS FL	34	3	3(6)	3(9)	3(12)	3(15)	1(16)	X(16)
VENICE FL	34	8	3(11)	5(16)	4(20)	4(24)	1(25)	X(25)
TAMPA FL	34	12	4(16)	6(22)	6(28)	4(32)	X(32)	1(33)
TAMPA FL	50	X	X(X)	1(1)	1(2)	1(3)	1(4)	X(4)
CEDAR KEY FL	34	24	7(31)	8(39)	5(44)	5(49)	X(49)	X(49)
CEDAR KEY FL	50	X	1(1)	X(1)	2(3)	2(5)	X(5)	1(6)
CEDAR KEY FL	64	X	X(X)	X(X)	X(X)	1(1)	X(1)	X(1)
TALLAHASSEE FL	34	28	11(39)	8(47)	6(53)	5(58)	1(59)	X(59)
TALLAHASSEE FL	50	X	1(1)	2(3)	2(5)	3(8)	X(8)	X(8)
ST MARKS FL	34	37	10(47)	7(54)	6(60)	4(64)	1(65)	X(65)
ST MARKS FL	50	X	1(1)	2(3)	3(6)	4(10)	X(10)	X(10)
ST MARKS FL	64	X	X(X)	X(X)	1(1)	X(1)	1(2)	X(2)

Wind Speed Probabilities (3 of 3)

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

TIME PERIODS		FROM 00Z MON TO 12Z MON	FROM 12Z MON TO 00Z TUE	FROM 00Z TUE TO 12Z TUE	FROM 12Z TUE TO 00Z WED	FROM 00Z WED TO 00Z THU	FROM 00Z THU TO 00Z FRI	FROM 00Z FRI TO 00Z SAT
FORECAST HOUR		(12)	(24)	(36)	(48)	(72)	(96)	(120)
LOCATION	KT							
APALACHICOLA	34	99	X(99)	X(99)	X(99)	X(99)	X(99)	X(99)
APALACHICOLA	50	2	5(7)	5(12)	6(18)	4(22)	1(23)	X(23)
APALACHICOLA	64	X	X(X)	2(2)	2(4)	2(6)	X(6)	X(6)
GFMX 290N 850W	34	99	X(99)	X(99)	X(99)	X(99)	X(99)	X(99)
GFMX 290N 850W	50	6	9(15)	6(21)	6(27)	4(31)	1(32)	X(32)
GFMX 290N 850W	64	1	2(3)	1(4)	3(7)	1(8)	1(9)	X(9)
PANAMA CITY FL	34	99	X(99)	X(99)	X(99)	X(99)	X(99)	X(99)
PANAMA CITY FL	50	3	6(9)	6(15)	5(20)	5(25)	X(25)	X(25)
PANAMA CITY FL	64	X	1(1)	1(2)	2(4)	1(5)	X(5)	X(5)
COLUMBUS GA	34	3	3(6)	4(10)	4(14)	3(17)	2(19)	1(20)
MONTGOMERY AL	34	3	3(6)	6(12)	3(15)	4(19)	3(22)	1(23)
PENSACOLA FL	34	13	13(26)	11(37)	5(42)	6(48)	1(49)	1(50)
PENSACOLA FL	50	1	2(3)	2(5)	3(8)	4(12)	1(13)	X(13)
PENSACOLA FL	64	X	X(X)	X(X)	1(1)	1(2)	X(2)	X(2)
GFMX 290N 870W	34	99	X(99)	X(99)	X(99)	X(99)	X(99)	X(99)
GFMX 290N 870W	50	24	5(29)	5(34)	3(37)	2(39)	X(39)	X(39)
GFMX 290N 870W	64	1	1(2)	2(4)	1(5)	2(7)	X(7)	X(7)
MOBILE AL	34	5	5(10)	9(19)	5(24)	5(29)	2(31)	X(31)
MOBILE AL	50	X	X(X)	1(1)	1(2)	3(5)	1(6)	X(6)
GULFPORT MS	34	2	4(6)	7(13)	5(18)	5(23)	1(24)	1(25)
GULFPORT MS	50	X	X(X)	X(X)	1(1)	2(3)	1(4)	X(4)
STENNIS SC	34	2	3(5)	5(10)	4(14)	5(19)	2(21)	1(22)
STENNIS SC	50	X	X(X)	X(X)	1(1)	1(2)	X(2)	1(3)
BURAS LA	34	2	3(5)	6(11)	6(17)	5(22)	1(23)	1(24)
BURAS LA	50	X	X(X)	X(X)	1(1)	2(3)	1(4)	X(4)
BURAS LA	64	X	X(X)	X(X)	X(X)	1(1)	X(1)	X(1)
GFMX 280N 890W	34	4	5(9)	6(15)	7(22)	6(28)	1(29)	1(30)
GFMX 280N 890W	50	X	X(X)	1(1)	2(3)	2(5)	1(6)	X(6)
GFMX 280N 890W	64	X	X(X)	X(X)	X(X)	1(1)	X(1)	X(1)
JACKSON MS	34	X	1(1)	1(2)	2(4)	3(7)	1(8)	X(8)
NEW ORLEANS LA	34	1	2(3)	4(7)	3(10)	4(14)	2(16)	1(17)
GFMX 280N 910W	34	1	1(2)	2(4)	3(7)	4(11)	1(12)	1(13)
BATON ROUGE LA	34	X	1(1)	2(3)	1(4)	4(8)	1(9)	1(10)
NEW IBERIA LA	34	X	1(1)	X(1)	1(2)	4(6)	1(7)	X(7)
GFMX 280N 930W	34	X	X(X)	X(X)	1(1)	1(2)	1(3)	1(4)

Tropical Storm Local Statement

URGENT - IMMEDIATE BROADCAST REQUESTED
TROPICAL STORM LYDIA LOCAL STATEMENT
NATIONAL WEATHER SERVICE TALLAHASSEE FL
537 PM EDT TUE JUN 26 2012

...TROPICAL STORM LYDIA FINALLY MAKES LANDFALL IN THE SOUTHEAST FLORIDA BIG BEND...HEAVY RAIN THREAT CONTINUES...

.NEW INFORMATION...
TROPICAL STORM LYDIA MAKES LANDFALL JUST SOUTH OF STEINHATCHEE FLORIDA. HEAVY RAINFALL THREAT CONTINUES THROUGH THIS EVENING FOR THE SOUTHEAST FLORIDA BIG BEND. ONGOING RIVER FLOODING TO CONTINUE.

.AREAS AFFECTED...
THIS LOCAL STATEMENT PROVIDES IMPORTANT INFORMATION AND RECOMMENDED ACTIONS FOR PEOPLE AND MARINE INTERESTS IN SELECT LOCATIONS IN THE EASTERN FLORIDA PANHANDLE AND FLORIDA BIG BEND.

.WATCHES/WARNINGS... A TROPICAL STORM WARNING CONTINUES FOR THE FOLLOWING LOCATIONS... COASTAL DIXIE.

FOR MARINE INTERESTS...A TROPICAL STORM WARNING REMAINS IN EFFECT FROM THE STEINHATCHEE RIVER SOUTHWARD TO THE MOUTH OF THE SUWANNEE RIVER OUT TO 20 NAUTICAL MILES.

A FLASH FLOOD WATCH IS IN EFFECT FOR TAYLOR...DIXIE...LAFAYETTE AND MADISON COUNTIES.

.STORM INFORMATION... AT 5 PM EDT...THE CENTER OF TROPICAL STORM LYDIA WAS LOCATED NEAR LATITUDE 29.5 NORTH...LONGITUDE 83.4 WEST. THIS WAS ABOUT 80 MILES SOUTHEAST OF TALLAHASSEE FL...OR ABOUT 15 MILES SOUTHWEST OF CROSS CITY FL. STORM MOTION WAS NORTHEAST AT 6 MPH. STORM INTENSITY WAS 40 MPH. .SITUATION OVERVIEW... TROPICAL STORM LYDIA HAS MADE LANDFALL IN DIXIE COUNTY FLORIDA AND IS CONTINUING TO MOVE NORTHEAST ACROSS THE FLORIDA BIG BEND AND INTO NORTH CENTRAL FLORIDA. EVEN THOUGH THE STORM IS MOVING INLAND AND AT A FASTER PACE THAN THE PAST COUPLE OF DAYS...ONGOING HEAVY RAINS WILL CONTINUE THIS EVENING ACROSS THE SOUTHEAST FLORIDA BIG BEND. DRENCHING RAINS OVER THE PAST COUPLE OF DAYS WILL ALSO LEAD TO MODERATE TO MAJOR FLOODING ON AREA RIVERS IN NORTH FLORIDA...INCLUDING THE SOPCHOPPY...SAINT MARKS...AND SUWANNEE RIVERS.

.PRECAUTIONARY/PREPAREDNESS ACTIONS... PRECAUTIONARY/PREPAREDNESS ACTIONS... LISTEN CAREFULLY TO THE ADVICE OF YOUR LOCAL EMERGENCY MANAGEMENT AGENCY. SOME COUNTIES HAVE ORDERED EVACUATIONS OF LOW LYING AREAS NEAR RIVERS ACROSS NORTH FLORIDA. IF YOU ARE ORDERED TO EVACUATE...DO SO IMMEDIATELY.

Appendix B: New Operational Forecast Products from the National Hurricane Center (NHC)

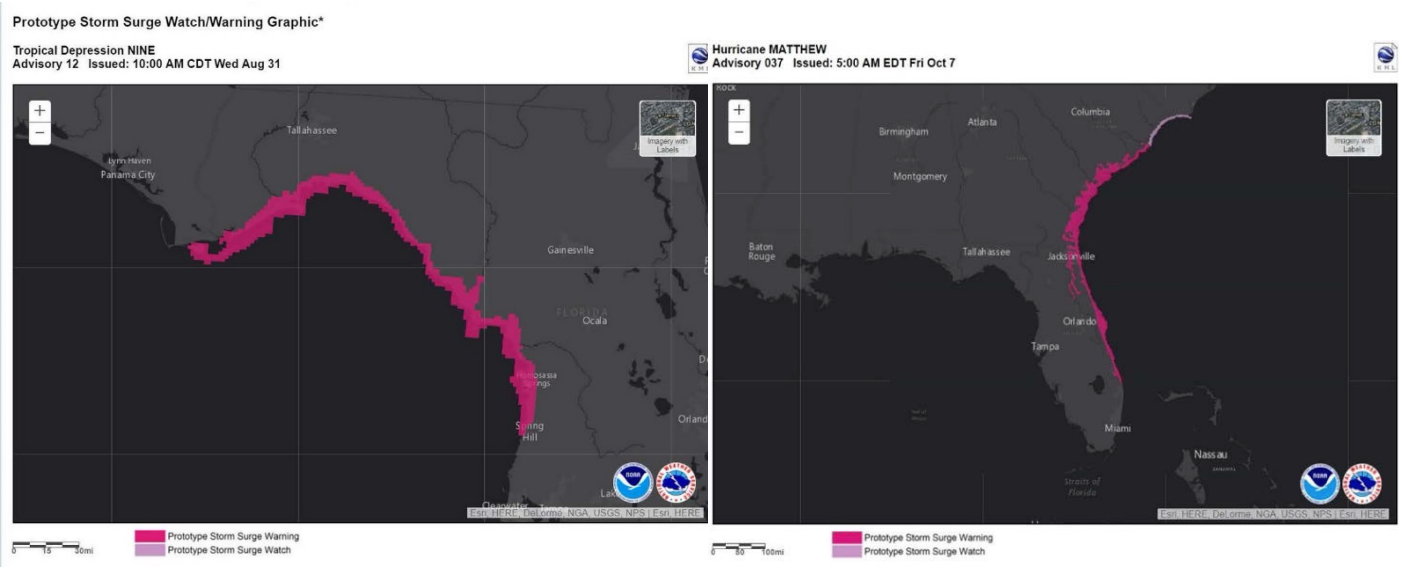
Background

The National Hurricane Center issues forecasts for tropical depressions, tropical storms, and hurricanes for the Atlantic and Eastern Pacific ocean basins. In March 2017, two new operational products were added to the existing forecast products: a storm surge watch/warning, and potential tropical cyclone watch/warning. These will be incorporated into existing forecast vehicles, such as the Public Advisory, as well as have their own graphics. NHC graphics have also been streamlined, but otherwise existing forecast products have not changed.

Storm Surge Watch/Warning

Storm surge is the pushing up of seawater over normally dry land by the strong winds of a tropical cyclone or other strong storm. Storm surge is one of the most serious threats to life and property associated with hurricanes. Beginning in 2017, NHC will issue watches and warnings for storm surge, separate from tropical storm/hurricane watches and warnings. A storm surge watch or warning will be communicated using a graphic (depicted below) as well as in the watch/warning section of the NHC Public Advisory using coastal breakpoints and the WFO Hurricane Local Statement. As with other National Weather Service watches and warnings, a watch means there is a possibility of life-threatening conditions (in this case, rising water) within the specified area within 48 hours; a warning indicates there is a danger of life-threatening conditions within the specified area within 36 hours.

Storm Surge Watch/Warning Graphic



Source: NHC, 2017

Watches, Warnings, and Advisories for Potential Tropical Cyclones

In 2017, NHC will have the option to issue advisories, watches, and warnings for disturbances that are not yet a tropical cyclone, but which pose the threat of bringing tropical storm or hurricane conditions to land areas within 48 hours. Advances in forecasting over the past decade or so now allow the confident prediction of tropical cyclone impacts while these systems are still in the developmental stage. For these land-threatening "potential tropical cyclones", NHC will now issue the full suite of text, graphical, and watch/warning products that previously has only been issued for ongoing tropical cyclones. Because NHC will be issuing its normal graphical products depicting the five-day forecast track and uncertainty cone for potential tropical cyclones, to avoid potential confusion the Graphical Tropical Weather Outlook will no longer display a formation area for these systems. Potential tropical cyclone advisories will not be issued for systems that pose a threat only to marine areas.

Additional Information and Resources

Graphics and descriptions of new products are derived from the official NHC press release dated March 9, 2017, which includes descriptions of additional standard updates, experimental products, and other points of interest for the 2017 hurricane season:
http://www.nhc.noaa.gov/news/20170309_pa_2017SeasonChanges.pdf

Examples of the new Potential Tropical Cyclone watch/warning can be viewed at:
http://www.nhc.noaa.gov/potentialtc_tcp_example.php

Examples of new, streamlined graphics can be viewed at:
http://www.nhc.noaa.gov/aboutnhcgraphics.shtml

For the current tropical cyclone threats to the Atlantic and Eastern Pacific, visit NHC's website:
http://www.nhc.noaa.gov