

**STORM SURGE MARKETING:
AUDIENCE ANALYSIS FINAL REPORT**

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I. Executive Summary

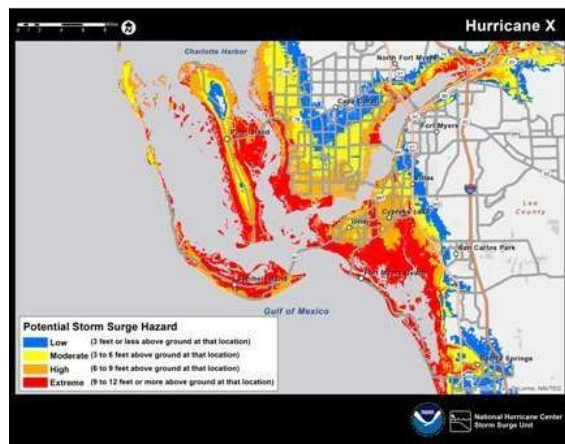
Although storm surge is often the greatest threat to life and property from a hurricane, many people do not understand this term or the threat it represents. The National Weather Service's (NWS's) National Hurricane Center (NHC) has been developing two new products to help increase the public's understanding and response to storm surge: 1) a storm surge warning/watch and accompanying map, and 2) a storm surge inundation map (see figures below). NHC has used social science research techniques to guide the development of these new products, engaging its stakeholders throughout the process.

In the first phase of this project, ERG supported NHC in testing a number of prototype storm surge products with key stakeholder groups under a National Oceanic and Atmospheric Administration (NOAA) task order for the Hurricane Forecast Improvement Program. This testing was conducted in 2011-2012.

Figure ES-1 Prototype Storm Surge Warning Map



Figure ES-2 Prototype Storm Surge Inundation Map



In the second phase of the project, ERG conducted site visits in four pilot communities centered on NWS Weather Forecast Offices (WFOs) in Gray, Maine; Morehead City, North Carolina; Slidell, Louisiana; and Tampa Bay, Florida. This work was conducted under a NOAA task order for the National Ocean Service, Coastal Services Center.

The goals of the site visits were to:

1. Gauge the ability of key NWS stakeholders to appropriately **interpret the storm surge products**.
2. Understand how these stakeholders would **use the products in their communities**.
3. Identify **training, marketing, and coordination needs and opportunities** for rolling out the new storm surge products.

The stakeholders/partners who participated in the discussion groups varied for each community, but generally included the **emergency management community, media, community groups, and local decision-makers**. In all regions, ERG also conducted meetings with the WFO staff, and their issues and concerns are reflected in this analysis as well.

The sessions focused on gathering attendees' input around five key questions:

1. What is your community's recent experience, vulnerability, level of awareness, and understanding of storm surge?
2. What language, graphical products, and community initiatives do you currently use to communicate what storm surge is and the threats a storm surge can pose? What barriers do you face in communicating about storm surge?
3. Do you think a separate storm surge watch/warning will be useful to you? How far in advance do you need it, how will you use it, and do people need to be educated about it? What barriers do you foresee?
4. How would you use the storm surge inundation map in your community? How far in advance do you need it, and what do you need to help people understand this map? What barriers do you foresee in using this map?
5. What else could the National Weather Service do to assist you in both outreach and actual storm surge event response?

Community Vulnerability

ERG facilitators engaged the participants in a conversation about the community's recent experiences and vulnerability to storm surge. There are many types of **vulnerable populations** among the different pilot communities. These include people who tend to be less educated and less aware of their hurricane vulnerability, as well as those that are transient, geographically vulnerable, or have limited means to evacuate. These vulnerable populations tend to need specialized outreach and education.

A number of factors affect the public's willingness to take protective action during a hurricane. Discussion groups cited **lack of living memory, hurricane fatigue, negative evacuation experiences, and overconfidence in levee systems** as some of the key factors. Every community mentioned the influence of living memory and that people believe "it can't happen here" if they have not experienced a catastrophic hurricane in their lifetimes. Even in areas that have experienced catastrophic events, awareness tends to dissipate every year there isn't a major storm.

Storm Surge Watch/Warning and Inundation Map

ERG facilitators asked discussion group participants to assess the working definition for the warning and to review the prototype storm surge warning map. People had many tweaks to the definition. A general consensus was that it needs to be **more succinct**. They took issue with the terms

***Working Definition for the Storm Surge Warning:
A significant risk of life-threatening flooding from
rising water moving inland from the shoreline.***

“moving inland,” “shoreline” and “life-threatening,” noting that they were too vague. They also wanted to see a stronger word (connoting imminent danger) than “significant.” Many people in all regions suggested adding the adjective “rapidly” or “quickly” before the phrase “rising water.”

Regarding the lead time for the storm surge watch/warning, participants in all pilot regions universally expressed concern that 48 hours is **not enough lead time for evacuations**; in many communities, 72 or 60 hours of lead time is required for an effective evacuation.

The pilot communities reacted favorably to the storm surge inundation map. People thought that the product will be very helpful in making informed decisions about where to deploy limited emergency response resources and in increasing the rate of evacuation among members of the public. However, participants in all regions also conveyed some concerns about providing the general public with too much information, in a format that suggests too high a level of precision with a forecast. There was a difference of opinion about whether to include descriptive risk categories in the legend, but everyone **took exception to the term “low”** to describe the range of surge depth of 3 feet or less above ground at that location. People also differed in their opinion of the “above ground at that location” terminology used in the legend, but most thought the **terminology simplifies the concept** greatly for the public. Finally, some participants in New England suggested that the ranges on the map should be adjusted to take into account regional topographic differences, noting that the higher storm surge ranges depicted on the map would undermine credibility of the warning along coastlines where such heights are unlikely to occur. In both Maine and North Carolina, participants noted that waves and tides were of equal or greater concern and ought to be accounted for.

Participants wanted the map to include **more roads and landmarks**. They also wanted to be able to zoom in on the map and see neighborhoods, parcels of lands, and even individual houses. Everyone wanted to see which roads would be under water. Many participants felt strongly that NHC should develop **visualization tools** to accompany the inundation map to help illustrate what different levels of water look like: “Here’s what six inches of water will look like in your neighborhood.”

In all regions, there were concerns that the inundation map would not correlate with FEMA flood maps, confusing members of the public. People also expressed concern with how the storm surge inundation map and warning map would line up with their evacuation zones. People also thought that it was important to communicate that the maps and ranges are showing “potential.” They stated that people have an expectation that a **forecast = what is going to happen**.

Marketing, Training, and Coordination Issues

The discussion groups talked about how to ensure the buy-in, use, and credibility of the new NHC products in their community. In all regions, participants brought up the need for 1) a **verbal/narrative product** for the public that would accompany the inundation map and explain it, as well as 2) a full **technical description** for higher-end users that would detail how the map was generated and what assumptions were used.

Participants mentioned the importance of getting messages out **repeatedly**. They also commented on the need to **personalize** information, such as by using “storm veterans” and testimonials from people who have weathered horrendous storms. Many discussion group participants stated that messaging

needs to use **strong and forceful language**, citing Chris Christie’s approach in New Jersey during Hurricane Sandy as a model.

When asked where people get information before and during a storm, many participants cited **television**, but noted that more people also use their **computers and cell phones** to get information. They suggested that the new NHC products be displayed on Web pages, mobile apps, and social media. They also suggested developing text alerts for cell phones that could be tied to the maps.

Participants mentioned some vulnerable populations will be **hard to reach** because they are not tied into traditional communication channels, have a language barrier, or do not trust government or media sources. It will be necessary to use trusted messengers to reach these groups, like senior centers, neighborhood associations, and churches and faith-based groups.

People also cited the need to provide messages in **multiple formats** (such as brochures, pictures, websites, and media spots). Videos topped the list of products participants would like to have on hand. Many cited the need for **continuing education, outreach, and awareness-building** throughout the year, not just during a storm, particularly for vulnerable populations who are not accustomed to storms or fully aware of the dangers.

Everyone agreed that it is critical for EMs, fire and rescue chiefs, and other first responders to receive **training** to know how to read these maps and to effectively communicate the information on the map. The training could be integrated into sessions that are already conducted for these groups, such as FEMA training.

Coordination among NWS, EMs, and the broadcast media community was also a topic of discussion in every region. Numerous participants expressed the need for a single, consistent message. The issue of coordination with the local WFOs also was discussed in the different regions. Local WFOs expressed the need for **flexibility** in deciding how and when to push out the maps and in interpreting them for their area. They also pointed to the need for a smooth transition between tropical and sub- or post-tropical conditions and expressed that “the maps should be produced regardless of what category storm created it or how the storm is classified.” Participants also suggested that NWS should be involving **commercial weather vendors** in the process now to ensure that vendors can quickly incorporate the new products into their services.

Next Steps

The site visits provided an opportunity to engage stakeholders in a dialogue around storm surge in four different communities. They helped to identify barriers to effectively using the maps and provided insights into the kinds of messages that are most likely to promote greater understanding of storm surge risk and greater adherence to evacuation orders. The next step in rolling out these products is to develop messages and marketing strategies to accompany these products that are applicable and replicable across other U.S. communities.

It will be important to test the messages and approaches by working with the WFOs to identify community leaders or groups in each of the four geographies that could serve as partners in the testing. This testing would likely take the form of a simulation or tabletop exercise. It could be designed to mimic

an actual event and provide participants with different scenarios for the size, timing, and impact of an expected storm surge, along with NHC inundation maps and corresponding messages, to explore their understanding, attitudes, reactions, and preparation behaviors. The information gained from the testing will help to ensure the smooth rollout of the storm surge warning and the maps as they enter the experimental product phase.

II. Background

Recent studies funded by the National Oceanic and Atmospheric Administration (NOAA) and other organizations have demonstrated that the members of the public—and even some coastal emergency managers (EMs)—do not understand the meaning of “storm surge” associated with tropical cyclones. This type of misunderstanding can translate into poor risk decisions with severe consequences, as storm surge is often the greatest threat to life and property from a hurricane.

For several years, NWS has been actively investigating whether new storm surge forecast communication approaches are needed to improve decision-making to protect life and property during tropical cyclones. NWS is exploring the possibility of developing explicit storm surge warnings that would be issued separately from NHC’s present package of tropical cyclone watch/warning advisories. Not only would a storm surge warning better convey the threat from deadly storm surge, but it would also address the fact that hurricane-force winds and storm surge do not always occur in the same places or at the same times. A storm surge threat is also very dependent upon elevation and other details of the coastline. In some instances, storm surge can threaten communities far inland from the coast.

In 2011–2012, ERG worked with the National Hurricane Center (NHC) to use social science research techniques to inform the development of two new prototype National Weather Service (NWS) products intended to improve communication, public understanding, and response to the threat of storm surge:¹

- A storm surge watch/warning and accompanying map
- A storm surge inundation map

The storm surge warning would identify indicate areas where storm surge flooding is expected to threaten people’s safety. A working definition for the storm surge warning is: “A significant risk of life-threatening flooding from rising water moving inland from the shoreline.” The watch would be generally issued within 48 hours of the arrival of tropical cyclone conditions that would hinder evacuation or other preparedness actions, and the warning would be issued within 36 hours. If a warning for storm surge is issued, a map (see Figure 1) would show the area included in the warning, similar to the approach currently used for hurricane and tropical storm warnings. More detailed maps (see Figure 2) would also be provided for localities showing the potential inundation, or height of water, expected in an area.

Figure 1 Prototype Storm Surge Warning Map



Figure 2 Prototype Storm Surge Inundation Map



¹ This work was conducted under NOAA EA133C-09-CQ-0034, #17, “Hurricane Forecast Improvement Program (HFIP) Socio-Economic Research and Recommendations.”

In the first phase of this project, ERG tested prototype storm surge products with key stakeholder groups under a NOAA task order for the Hurricane Forecast Improvement Program.² During this process, the graphics were refined, tested, and refined again. This iterative process resulted in several graphics that were then tested empirically through Web-based surveys with the main users of NHC forecast communication products.

In the second phase of the project, ERG introduced the refined prototype storm surge graphics to stakeholder groups in four pilot communities centered on NWS Weather Forecast Offices (WFOs) in Gray, Maine; Morehead City, North Carolina; Slidell, Louisiana; and Tampa Bay, Florida. This work was conducted under a NOAA task order for the National Ocean Service, Coastal Services Center.³

ERG tested the prototype products through small discussion groups, training sessions, conference polls, and surveys with the main users of NHC forecast communication products, including NWS WFOs/Warning Coordination Meteorologists (WCMs), EMs, and the broadcast media. The results showed extensive support for the two products.

² This work was conducted under NOAA EA133C-09-CQ-0034, # 17, Hurricane Forecast Improvement Program Socio-Economic Research and Recommendations.

³ This work was conducted under NOAA EA133C-09-CQ-0034, # 25, "Storm Surge Marketing Plan."

III. Site Visits/Pilot Communities

NWS chose four test geographies to introduce the prototype storm surge graphics to key stakeholder/audience groups, gauge their ability to interpret the graphics, and better understand how they would use the graphics in their communities to help make responsible protective decisions. The pilot geographies were centered on WFOs in Gray, Maine; Morehead City, North Carolina; Slidell, Louisiana; and Tampa Bay, Florida.

In March and April 2013, ERG visited each community for two days to conduct small discussion groups⁴ with individuals identified by the region's WFO staff. Prior to the site visits, meteorologists in each of the four WFOs presented a webinar to NOAA/NWS/NHC and the ERG team. The webinars conveyed information about the makeup of each community, its vulnerabilities and resilience challenges, current misconceptions or confusions about storm surge, and timing and methods for interacting and communicating with intermediaries during a storm.

While the webinars provided a good foundation for gathering a basic understanding each pilot community, the site visits enabled the ERG team to engage in dialogue and gather feedback on storm surge communication needs and challenges with the WFO and its key stakeholders/partners during a storm.

Site Visit Goals

The goals of the site visits were to:

1. Gauge the ability of key NWS stakeholders to appropriately **interpret the storm surge products**—for themselves as well as for the groups with which they interact.
2. Understand how these stakeholders would **use the products in their communities** to help make responsible protective decisions and raise awareness of the threat of storm surge.
3. Identify **training, marketing, and coordination needs and opportunities** for rolling out the new storm surge products.

Discussion Group Participants

The stakeholders/partners who participated in the discussion groups varied for each community, but generally included:

- **Emergency management community:** Seasoned and newly appointed EMs, local/state/federal emergency services directors and coordinators, operations personnel, and fire and rescue chiefs.
- **Media:** Primarily broadcast meteorologists and newspaper reporters/editors.

⁴ To collect this feedback, ERG received approval from the Office of Management and Budget for an information collect request (OMB Control Number 0690-0030).

- **Community groups:** Organizations that have a role or a stake in communicating hurricane hazard information within a community; organizations representing vulnerable populations, such as the elderly and disabled; and organizations that are trusted messengers in a community. Discussion group participants included people representing the national relief organizations, hospital and nursing associations, associations for the aging, advocacy groups, citizen emergency response teams, coastal adaptation workgroups, and shoreline commissions.
- **Decision-makers:** Transportation officials, town/county managers, park rangers, public works officials, state department of environment/natural resources officials, local/state/regional planners, and school/university officials.

In all regions, ERG also conducted formal or informal meetings with the WFO staff, and their issues and concerns are reflected in this analysis as well.

Discussion Group Format

Each community discussion group was about two hours long. Participants were asked to review the working definition of the storm surge watch/warning, the storm surge warning map, and the storm surge inundation map. In New Orleans, groups also reviewed a preliminary storm surge inundation map showing levee-protected areas and possible overtopping.

The sessions focused on gathering attendees' input around five key questions:

1. What is your community's recent **experience, vulnerability, level of awareness, and understanding of storm surge**?
2. What language, graphical products, and community initiatives do you currently use to **communicate what storm surge is** and the threats a storm surge can pose? What barriers do you face in communicating about storm surge?
3. Do you think a separate **storm surge watch/warning** will be useful to you? How far in advance do you need it, how will you use it, and do people need to be educated about it? What barriers do you foresee?
4. How would you use the **storm surge inundation map** in your community? How far in advance do you need it, and what do you need to help people understand this map? What barriers do you foresee in using this map?
5. What else could the National Weather Service do to assist you in both **outreach and actual storm surge event response**?

Summaries of each of the four discussion groups are included in Appendix A. Field notes on the inundation map are included in Appendix B, and field notes on the inundation map with levees (used in New Orleans only) are included in Appendix C. Appendix D includes a complete discussion group script.

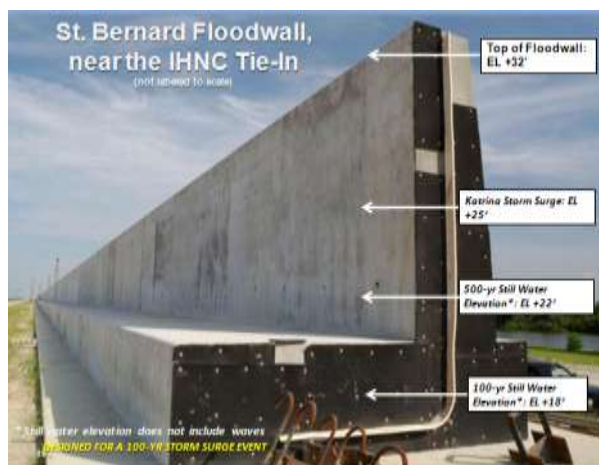
IV. Community Vulnerability and Understanding of Storm Surge

At the start of each discussion group, ERG facilitators engaged the participants in a conversation about the community's recent experiences and vulnerability to storm surge. As part of this discussion, participants shared their observations about vulnerable areas and populations. The discussion then moved to the public's level of awareness and understanding of storm surge. Participants shared some of the tools they currently use to help educate people and expressed thoughts about where challenges and barriers remained.

Geography

Each region's **unique geography** presents special vulnerabilities to storm surge:

- The **New Orleans area** has been ravaged repeatedly by hurricanes during its history. Since Katrina, portions of the levee system, called the Risk Reduction System, have been rebuilt by the Army Corps of Engineers. While the system offers protection for many weaker hurricane scenarios, breaches and overtopping can still occur. These can result in deep, life-threatening flooding. A large portion of the Metro New Orleans area (with land elevation near sea level) is in this protected area; however, some parishes, or portions of parishes, lie outside it. Many participants noted that every storm is different, and it can be difficult to predict which areas will or will not flood in a storm.
- **Tampa Bay's** geography, coastal development, and population growth makes it among the most vulnerable U.S. regions with regard to storm surge. Tampa's population (now approximately 4 million people) has grown more than 2,500 percent from 1920 to 2010. Many barrier islands that were once uninhabited are now densely developed. Low elevations and limited exit routes increase the area's vulnerability.
- High-risk storm surge areas for **North Carolina** include a very broad expanse of the coast and inland areas. Vulnerable counties are located along the Albemarle and Pamlico Sounds, including lower reaches of the Neuse and Pamlico Rivers and coastal areas from North Topsail Beach to Duck. The Outer Banks are particularly vulnerable to storm surge, and breaches can cut off these barrier islands from the mainland.
- The **Maine/New Hampshire** coastline's primary concerns are extra-tropical and hybrid storms. These storms tend to be larger than tropical systems and can therefore affect a large region. While storm surge values tend to be modest in the area, they can occur during very high



astronomical tides and be accompanied by battering waves. Thus, the coincidence of storm surge with high tides, especially astronomical high tides, is the primary concern.

Vulnerable Populations

There are many types of **vulnerable populations** among the different pilot communities—groups who tend to **need specialized outreach and education**. These include people who tend to be less educated and aware of their hurricane vulnerability, as well as those who are vulnerable geographically or have limited means to evacuate. The pilot communities cited the following groups as those warranting particular concern:

- Transient populations, including tourists, recent residents, college students, military personnel on bases, and people living in trailer parks.
- Elderly, disabled, deaf and blind, and medically at-risk individuals.
- Immigrant workers, undocumented residents, and foreign language speakers.
- Low-income populations.
- Barrier island residents, long-term waterfront residents, boaters, fishermen, and others engaged in maritime industries.

Factors Affecting Decisions to Take Protective Action

A number of factors affect the public's willingness to take protective action during a hurricane. Discussion groups cited **lack of living memory, hurricane fatigue, negative evacuation experiences, and overconfidence in levee systems** as some of the key factors. Every community mentioned the influence of living memory and that people believe "it can't happen here" if they have not experienced a catastrophic hurricane in their lifetimes.

While the Tampa Bay region is regularly impacted by tropical storms, it has been more than 90 years since Tampa Bay was last in the direct path of a major hurricane. The New Hampshire and Maine coastal communities routinely experience coastal flooding, but there is a general lack of preparedness for a major storm. Even in New Orleans, where people *have* experienced recent disastrous hurricanes, people tend to forget and become complacent. This complacency was worrisome to forecasters attending the discussion groups, who noted that it is simply a matter of time before their communities experience a major event. In every region, at least one participant noted that "even though people think they have seen the worst, they have not."

V. Understanding Storm Surge

Understanding of storm surge varies among the pilot regions. In the northern New England states, coastal communities do not frequently experience a tropical cyclone, but they routinely experience extratropical and hybrid systems. Tides and waves are dominant in this region, and most people define storm surge as water levels that occur above the expected high tide. A similar situation exists in North Carolina, where most people focus on “coastal flooding” or “high water” and are generally more concerned about the wind and rainfall threats of a storm rather than storm surge. North Carolina and New Orleans participants also noted that people tend to equate the term storm surge with “tsunami.” In Tampa, several broadcast meteorologists who took part in the discussion groups asserted that a large segment of their viewing audience doesn’t understand the difference between storm surge and “flooding rains.”

Many participants in the New Orleans groups felt that many people now do understand storm surge, stating that Isaac was a “wake-up call” for New Orleans. However, even in New Orleans, people have a tendency to confuse Saffir-Simpson storm categories with storm surge impacts. **In every region, participants stated that there is still a tendency to correlate the danger of a storm (including surge) with the category number.** This is compounded by the fact that some broadcast meteorologists and public officials still use categories to communicate storm surge hazard. Participants noted that more education is needed about disconnect between storm category and surge. Several individuals noted that “People don’t realize Category 1 hurricanes can result in extreme storm surge.”

Regardless of people’s understanding of the term, participants in several locations made a similar point that “water is water.” They observed that most people don’t care what you call it, and don’t care nor understand the difference between precipitation, flooding, and storm surge. What is important, they said, is to communicate storm surge in a **humanistic way** so people understand it. One person stated it well: “We need to humanize announcements and take out the technical jargon and explain impact in a personal way.”

They noted several other messaging needs around storm surge, as well:

- Messaging is needed to clarify that storm surge can be more than a coastal/beachfront problem, and that it can also affect people at **inland or sheltered shorelines**, as well as along lakes and rivers.
- Generally speaking, people get storm surge mixed up with **FEMA flood maps**. Surge zones and flood zones are very different things.
- People don’t understand **timing** of storm surge and that it can happen early or late in a storm.

VI. Storm Surge Products

NWS has been exploring the possibility of developing an explicit storm surge watch/warning that would be issued separately from NHC's present package of tropical cyclone watch/warning advisories. ERG facilitators asked discussion group participants to assess the working definition for the warning and to review the prototype storm surge warning map. The facilitators explained that if NWS were to issue a **separate storm surge warning**, it would distribute localized maps like the prototype being shown for areas under the warning.

The discussion groups also reviewed a prototype **storm surge inundation map** that NHC is expecting to roll out in an experimental form in 2013 or 2014. The map will depict the potential depth of ocean water in a region from storm surge.

Storm Surge Warning Definition/Map

People had many suggested edits to the definition. A general consensus was that it needs to be more succinct. They took issue with the terms "moving inland," "shoreline" and "life-threatening," noting that the terms were too vague. They also wanted to see a stronger word (connoting imminent danger) than "significant." Many people commented that the definition did need to convey that storm surge is a coastal threat and that it is from "rising water." Many individuals in all regions suggested adding the adjective "rapidly" or "quickly" before the phrase "rising water."

Storm Surge Warning Working Definition: A significant risk of life-threatening flooding from rising water moving inland from the shoreline.

Common comments included the following:

- What does "from the shoreline" mean?
- When you say shoreline, people don't understand whether it is river or coast.
- People want to know where the water is coming from—shoreline is vague.
- Inland from the shoreline—is shoreline the ocean-facing shoreline or river shoreline?
- If water is moving inland, it means it's coming from...where? The sound? The ocean?
- What does "moving inland" mean when you're in the sound? Need to tweak this for local geographies.
- "Rising water" are the most important words to convey and that is a coastal storm (versus flooding from precipitation).
- Need to add "rapidly" rising water.
- Need words "extreme coastal flooding."
- What is the definition of significant risk?

- Need the word “dangerous.” The word “significant” doesn’t connote enough danger.
- What is life-threatening? How many feet above ground level? Four feet or chest level?
- Could say: “Significant risk of death because of...” Would be more direct if coupled with “if you do not leave.”

People wondered how the storm surge warning will **fit in with the current hurricane watch/warning** and with the coastal flooding warning. They asked if there could be communities that are under a hurricane warning but not a storm surge warning and vice versa? While most participants thought the warning would be useful in educating the public and getting people prepared, they did wonder if another warning could cause confusion, particularly if there are differences along the coast and some communities are under a warning, while others are not.

Regarding the **lead time** for the storm surge watch/warning, participants in all pilot regions universally expressed concern that 48 hours is not enough lead time for evacuations; in many communities, 72 or 60 hours of lead time is required for an effective mass evacuation.

Several people also brought up the idea of providing some kind of **flood warning continuum** after the storm surge warning is dropped. They noted that flooding from rainfall and from rivers can occur after an event: “We can have extended five-day flooding from rain and rivers. We need to maintain consistency among agencies about warnings.”

Participants didn’t have many comments on the map itself. Some thought it had limited usefulness; others thought that it would be useful for “the big picture” and in tandem with the more detailed and localized inundation map. In every region, however, people wanted to know more about how the two maps would be used and what their **relationship was to one another**. A few people also expressed a concern that having a line on the map might make people feel safe if they are on the other side of the surge line when in fact they might be vulnerable.

Storm Surge Inundation Map

Generally, this map was well received in the pilot communities. Many EMs, in particular, commented that the product will be very helpful in making informed decisions about where to deploy limited emergency response resources. They also thought that the map would help increase the rate of evacuation among members of the public. However, participants in all regions also conveyed some concerns about providing the general public with too much information, in a format that suggests the precision of the forecast is higher than it truly is. Some felt the map was more appropriate for EMs and planners than the general public.

A summary of the major comments on the map are detailed below. Detailed field notes on the inundation map from all four pilot communities can be found in Appendix C. Appendix D includes field notes on the inundation map produced for New Orleans.

Risk Categories

There was a difference of opinion about whether or not to include **descriptive risk categories** in the legend. Many people wanted just numbers; fewer people liked the categories, but those who did so

stated that “people get categories.” A North Carolina participant thought Category 1–5 should be used for both wind and surge (e.g., Cat 1 wind, Cat 4 storm surge). Numerous participants in every group and in every region took issue with the term “**low**” to describe the range of surge depth of 3 feet or less above ground at that location. There was also consensus that the highest category should not have an upper bound. Some participants suggested using zones or categories of colors to depict the extent of flooding. They suggested using Zones 1, 2, 3 or A, B, C, or “red,” “orange,” etc., to communicate risk and what actions should be taken if a person is in a particular zone.

Above Ground Level

People also differed in their opinion of the “above ground at that location” terminology used in the legend. In North Carolina, many participants said they were accustomed to using “mean sea level” and the switch to “above ground level” (AGL) was confusing. Some participants had a difficult time understanding that the map accounts for elevation. Others thought that the AGL terminology simplifies the concept greatly for the public.

Text/Narrative Description and Technical Description

In all the regions, participants expressed that the map could not stand alone. It needed to be paired with a textual or narrative description that explained the map. For the public, this description needed to be concise, understandable, and free of jargon. It needed to translate the gravity of the map, state what it does and does not include (such as tides and waves), tell people what the categories mean, convey uncertainty (see “Probability and Uncertainty” below), and explain where to get more information.

Participants also had many questions about how the map would be created and the models that would be used. They wanted to see a full technical description of the inundation map, along with more detail about its resolution and scale. Participants also wondered if the map factored in all sources of water, including river flooding. High-end users, like transportation planners, modelers, and GIS analysts, were particularly interested in technical issues, such as resolution and scale.

Level of Detail and Interactive Capabilities

Repeatedly, people expressed doubt in the public’s ability to read maps. Because of this limitation, discussion group participants strongly suggested that the map include **more roads and landmarks**, including shelters and schools. Although participants understood the limitations of forecasting, they still wanted to be able to zoom in on the map and see neighborhoods, parcels of lands, and even individual houses. Many people in the discussion groups said they would like the map to show if roads are inundated.

Many participants felt strongly that NHC should develop **visuals** to accompany the inundation map to help illustrate what different levels of water look like: “Here’s what six inches of water will look like in your neighborhood.” Many people suggested that the map be produced in an interactive platform with the capability to click or mouse-over different areas to see these different water levels against local landmarks. Mouseovers could also convey helpful information like “ You are in X Parish or X County. You need to take X actions.”

In all regions, there were concerns that the inundation map would not correlate with FEMA flood maps, causing confusion among the members of the public. People also expressed concern with how the storm surge inundation map and warning map would line up with their evacuation zones. They commented that evacuation plans may need to be updated to reflect the possibility of an area not being under a hurricane warning but under a storm surge warning. They worried that the maps could make an EM's job more difficult if the inundation or warning map showed an area under evacuation as dry or in the "low" category. The map could make the public second-guess an EM or an evacuation order.

Probability and Uncertainty

The question of **probability** came up with this map. People asked: "Is this most likely scenario or the worst-case scenario?" In one discussion group, a participant suggested that NHC provide two maps: 1) a "plausible/what we think will happen" map, and 2) a worst case scenario map. Others in the group disagreed and thought two scenarios would be too confusing, and the public wouldn't know what to do. They felt only EMs needed probability, not the public.

In other discussion groups, a number of EMs and forecasters also said that they were interested in seeing range of confidence maps. One individual stated: "Let us chose which certainty to pick." A suggestion also was made to change the categories on the map to a range of "most likely" or "worst case," "like 1 foot is most likely, 3 feet is likely." Others disagreed with this statement and suggested that probability could be accounted for as the map is updated every six hours.

In all regions, people agreed that communicating **uncertainty** is difficult. Participants stated that "People do not think of uncertainty," and that "People do not understand the basic uncertainty of weather." Some participants felt it wasn't necessary to communicate uncertainty to the public in terms of a 1 out of 10 chance, but that it was important to communicate that the maps and ranges are showing "potential." They stated that people have an expectation that a **forecast = what is going to happen**. They worried that if the map is wrong nine times of out 10, it will lose its effectiveness. To counter this problem, discussion group participants said it is important to include a disclaimer on the map and to message that the map is telling people what they need to prepare for, which won't necessarily happen.

VII. Marketing, Training, and Coordination

The information gained from these site visits will be used to develop messaging and marketing strategies to ensure the smooth rollout of the products during their experimental testing phase. The discussion groups provided many excellent suggestions for messaging, marketing strategies, and tools to help educate people about storm surge and the new NHC products. Throughout the various meetings, participants also provided an array of suggestions for providing training and for improving future coordination between NWS/NHC and the various stakeholder groups.

Messaging

The discussion groups talked about how to ensure the buy-in, use, and credibility of the new NHC products in their community. In all regions, participants brought up the need for a **verbal or narrative product to accompany the inundation map** and explain it. Specific comments included:

- Narrative must accompany this map and the warning. This is true now even for coastal flood warning.
- Visual community landmarks/historic flood elevations should be promoted so people understand how high the water could be where they live and work.
- Need narrative from WFO that translates the gravity of map and tells people what the categories mean.
- Need text to convey the uncertainty component and what is timing on maximum water elevation and for how long (duration).
- Need public education about red, yellow, orange, blue means. A community could send out text messages for when they are in a red zone and what that means.
- Need to tie actions to messages (e.g., here is what you should be doing if you are in the red zone).

To effectively market the new storm surge products, one discussion group member suggested that NWS craft its messaging in a manner that ensures the audience “receives, remembers, and reacts.” Many individuals liked the idea of a **catchy slogan** to communicate the threat of storm surge, such as “turn around, don’t drown.” In New Orleans, several EMs and broadcasters stated they use the “run from the water, hide from the wind” slogan. People mentioned the importance of getting messages out **repeatedly**. They also commented on the need to **personalize** information, such as by using “storm veterans” and testimonials from people who have weathered horrendous storms. Participants liked the idea of getting personal stories from people who were warned to evacuate and didn’t heed the warning. Personal experiences might be more persuasive than other means of communicating threats.

Another important part of messaging is to communicate that **storm surge can occur early or late during a storm**, and that people can experience flooding in some regions days after a storm makes landfall due

to rainfall and water backing up in rivers and tributaries. In addition, even if people are not really in danger of imminent flooding, they can lose their power—and their power could be out for a week. People need to **understand the aftermath of the storm**—and messaging should communicate this information.

Many discussion group participants stated that messaging needs to use **strong and forceful language**. Several EMs suggested that messaging convey that “we can’t come and get you if you decide to stay.” They also referenced the language that Chris Christie used during Hurricane Sandy in New Jersey: “If you don’t evacuate, you could die.” One EM in New Orleans commented on his experience during Katrina: “At one point, we told people if they didn’t get out, they would die, and they still didn’t leave.”

Other suggestions around messaging include:

- Messages have to be concise and understandable to the general public.
- Visualizations are more effective than text messages.
- The simpler the better; less jargon.
- People don’t understand the details.
- Target a 5th and 6th grade reading level.
- Messages have to grab attention and hold attention quickly.

Broadcast meteorologists expressed an interest in both shorter and longer messages to use on the air and on their websites and social media platforms. They commented that they could “spend hours going over every detail with who will/will not flood,” but that their on-air time is limited. They can, however, go into more detail on their websites. Typically, they need a script for a 30-second spot to communicate the essence of what’s happening during a storm and what people should do. They also can use messaging for a 3- to 4-minute slot of continuing coverage. These longer spots provide an opportunity to educate people more generally about storm surge, as well.

Broadcasters commented that teaching moments after an event don’t happen often. One broadcaster commented: “We do post-hurricane stories, but people don’t tune in because they are still cleaning up. Then when they do tune in, it’s too late because it’s old news.” Newspaper reporters commented that they have more flexibility to do post-hurricane stories, longer stories, and series.

Messengers and Mechanisms

When asked where people get information before and during a storm, many participants cited television, stating that “everyone watches local broadcasts” and “cable TV is big.” While the discussion groups agreed that most residents get their information during a storm from television, it was noted that power outages typically accompany a storm event (especially along the Atlantic coast), so television is often not an option. More and more people are using their computers and cell phones to get information. They suggested that the new NHC products be displayed on **Web pages, mobile apps, and social media**. They also suggested developing **text alerts for cell phones** that could be tied to the maps. One individual suggested putting a recording on 211 that would tell people where to get the maps, and then have a website set up so people go there routinely. Participants also mentioned that the maps

should be included in **Web-mapping services** so they can be used with others that are currently available.

Participants mentioned that certain terms, like “hurricane,” “storm surge,” and “National Hurricane Center,” will naturally catch people’s attention. But some vulnerable populations will be **hard to reach**—either because they are not tied into traditional communication channels, have a language barrier, or do not trust government or media sources. It will be necessary to use **trusted messengers** to reach these groups. Discussion groups suggested NWS work with senior centers, neighborhood associations, churches and faith-based groups, community groups, hotel associations, hospitals, nursing homes, retirement associations, property management associations, and health organizations to distribute the maps and convey information about storm surge to these hard-to-reach populations.

People also cited the need to provide messages in **multiple formats** (such as brochures, pictures, websites, and media spots). Many people said: “We need it all.” **Videos** topped the list of products participants would like to have on hand. Numerous participants stated that video is better than static images for showing impacts. Several people also suggested developing **visualization tools** to show the progression of storm surge during an event in terms of timing and inundation.

People also wanted to see information conveyed in **printed materials**, like handouts and brochures. These materials could be given out at festivals, expos, boat shows, grocery stores, and hardware stores. They could also be delivered to people’s homes or included as bill stuffers. People also cited the need for **translations** for foreign language speakers.

Several participants noted the need for a **broad national marketing campaign**. They suggested that NWS work with media partners such as the Weather Channel and utilize venues like hardware stores, grocery stores, and Wal-Mart, as well as mechanisms like jumbo-trons at sports arenas and LED road signs.

Ongoing Education

Many cited the need for education, outreach, and awareness-building throughout the year, not just during a storm, particularly for vulnerable populations who aren’t accustomed to storms and aren’t fully aware of the dangers. Several participants endorsed the idea of using people’s living memory to compare expected flood levels to past levels and storms. To enhance peoples’ memories, they suggested showing photographs of what happened on a particular date.

Some activities that are currently ongoing in different communities include:

- Businesses sometimes **display pictures of big storms**. Participants felt that sharing photographs can have a big impact because people can relate to recognizable landmarks.
- Some communities are **marking water levels on local benchmarks**. Participants liked the idea of making this effort a community-driven process whereby residents are involved in measuring and marking the levels, noting this experience in itself is a learning process. They stated communities could also mark where the water could go, even if it hasn’t happened in the past. The importance of visual markers (photos in restaurants, lines marked on the sides of buildings or

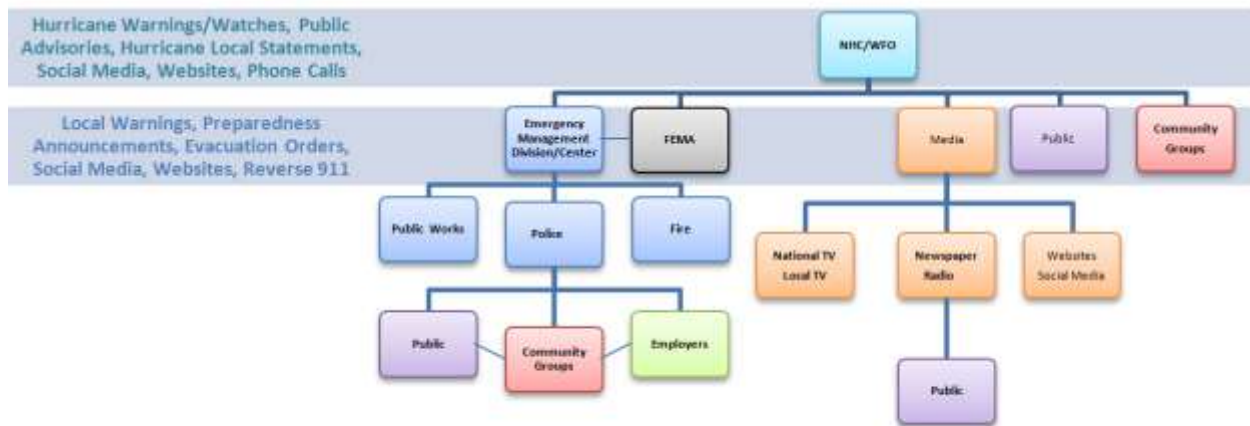
along roadsides) was noted as an important means of messaging to the public in order to keep past memory alive. This is a form of education that is already being used in many communities.

- Some communities are doing education at peak times to **educate seasonal populations and tourists**. These include putting up evacuation signs and publishing articles in the newspaper.
- Many discussion groups suggested developing materials for **school children**. They stated: “Start with the kids. Educate when they are young.” Children can also be effective in bringing messages home to their parents and caregivers. Suggestions included developing coloring books and curriculum materials. Many people thought 5th grade was a good place to target these efforts.
- New Hampshire is part of the **StormSmart Coasts Network**, which is a Web resource to help coastal communities address the challenges of storms, flooding, sea level rise, and climate change. Maine is also part of the network where it is called **StormSmart Connect**.

Coordination and Training

Discussion groups were asked how communication flows during a storm event. They were also asked to draw the flow or chain of communication in their community. A typical chain is displayed below.

Typical Risk Communication Chain During a Hurricane



The importance of **coordination among the NWS (including the NHC and the WFOs), the emergency management community, and the media community** was echoed in every region. Numerous participants expressed the need for a single, consistent message. One person noted: “A unified message is important. All the weather people need to be on board. But they all say different things.” The importance of media being on the same page as NWS was particularly important, participants stated, because they are on the front lines. In most regions, participants felt that the media tended to be “in synch” with the NHC and the local WFO. But in some cases, discussion groups felt that while local

meteorologists are “in theory with us,” their ratings are also important and they must stay competitive. A broadcaster in one session echoed this sentiment and stated: “At the behest of people that want to have high ratings, we are made to do stuff that we aren’t necessarily comfortable with. We should get off business and let NWS do it.” He noted that management can be more concerned with what a graphic looks like, rather than if it is accurate.

Participants suggested that NWS should be involving commercial weather vendors in the process now to ensure vendors are able to quickly incorporate the new products into their services. A number of broadcasters expressed their appreciation for the NWS chat rooms, particularly because it makes them feel more comfortable about speaking openly about their varying opinions about the forecast. Broadcasters did point to a need for more geographic-specific, access-controlled chat rooms

Participants also noted another challenge in coordination in that “anyone can put anything out.” There are many unqualified people putting out forecasts. This can be a real challenge to EMs who stated that “people shop for what they want to hear.” Several EMs voiced the opinion that they would like to “shut down the Internet and social media during a storm.”

Among all the pilot regions, EMs and the NWS/local WFO appear to work together well. In fact, many EMs stated they rely solely on NWS for their forecast information. One person stated: “Realistically in a storm, we are doing so many things and don’t have time to sit at computer, so we rely on the Weather Service.” In the Gulf States, some EMs felt that **coordination among the coastal and inland WFOs could be improved**. One person stated: “We get accurate information from NHC and from the Mobile and Slidell WFOs, but others have to deal with the Jackson WFO, which is getting information from different sources and not meshing with coastal concerns.”

Coordination with **local officials** is another challenge. Broadcasters conveyed that before they put an official on air, they brief the person ahead of time and try to make sure he or she conveys uncertainty in the right terms. One broadcaster noted: “When we say 4 to 6 feet of water and stop right there, most people take that literally and decide they are out of threat. We try to get officials to talk about a range. We tell them to say 4 to 6 feet and possibly 8. This conveys the idea of what we think can happen and what *could* happen. Over predicting is not a bad thing. Coming up short is far worse.”

The issue of coordination with NHC and local WFOs was discussed in different regions. The local WFOs expressed the need for **flexibility** in deciding how and when to push out the maps and in interpreting them for their area. They also wondered whether to use the storm surge warning or wind warning during a tropical event that has both wind and surge. In addition, they pondered how the storm surge warning would be incorporated into the Hurricane Local Statement (HLS) or if it would be a separate product because it could get lost in the HLS. Finally, they pointed to the need for a **smooth transition between tropical and sub- or post-tropical conditions** and expressed that “the maps should be produced regardless of what category storm created it or how the storm is classified.”

Everyone agreed that it is critical for EMs, fire and rescue chiefs, and other first responders need **training** to know how to read these maps. The training could be integrated into sessions that are already been conducted for these groups, such as FEMA training. Some people thought it would be best if the training sessions were **certified**. Training should also include helping the messengers communicate the message to their constituents. Many regions cited turnover among EMS as a problem, making training even more important.

VIII. Next Steps

The site visits provided an opportunity for an exchange of values around storm surge in four different communities. They helped to identify barriers to effectively using the maps and provided insights into the kinds of messages that are most likely to promote adherence to evacuation orders. Pilot communities shared valuable information about how messaging chains work within a community, who the trusted messengers are, and where in this chain of messaging information can break down or be altered.

NHC is already using the feedback gathered from these site visits as it finalizes the prototype graphics and prepares for their rollout in the experimental product period. During this two-year period, NHC encourages comments or suggestions from the public to determine if modifications are needed to the products and whether the products should become part of its operational suite.

Another important next step is the development of a marketing plan that includes messages to accompany the products and strategies that are applicable and replicable across other U.S. communities. It will be important to test the messages and approaches developed in the marketing plan by working with the WFOs to identify community leaders or groups in each of the four geographies that could serve as partners in the testing.

Training and coordination among the user groups would also be useful, using modules, simulations, role plays, or tabletop exercises with small groups of people to test the messages, maps, and storm surge definition. Such exercises could be designed to mimic an actual event and provide participants with different scenarios for the size, timing, and impact of an expected storm surge, along with NHC inundation maps and corresponding messages, to explore their understanding, attitudes, reactions, and preparation behaviors. The information gained from this kind of testing will help to ensure the smooth rollout of the storm surge warning and the maps as they enter the experimental product phase.