BROADCAST MEDIA ON-LINE SURVEY ON EXTRATROPICAL AND TROPICAL CYCLONE FORECAST INFORMATION:

NOAA STORM SURGE ROADMAP AND HURRICANE FORECAST IMPROVEMENT PROGRAM

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EXECUTIVE SUMMARY

Purpose

The National Weather Service (NWS) issues a wide array of text and graphical products to communicate forecasts associated with tropical cyclones (TC) and extratropical cyclones (ET). The National Hurricane Center (NHC) issues a suite of text and graphical products to communicate the forecasted conditions from threatening tropical cyclones. During extratropical cyclones and other unique events resulting in storm surge, such as high astronomical tides, Weather Forecast Offices (WFOs) issue Coastal Flood Advisories, Watches, and Warnings, which include detailed, localized information on expected storm surge and other hazards. This report on a survey of broadcast meteorologists is part of a larger body of work to better understand how National Oceanic and Atmospheric Administration (NOAA) weather forecast products might improve public understanding and response to tropical and extratropical storms. The major focus is on storm surge, but the survey was also an opportunity to solicit media opinions on related topics such as their perceptions of public understanding of forecasts and their assessments of several tropical cyclone forecast track and wind graphics. Respondents were directed to sections of the survey based on their locations relative to TC and ET risk.

Major funding for this project came from the National Oceanic and Atmospheric Administration/ National Ocean Service (NOAA/NOS) project, "Assessing Current Storm Surge Information from the Public Perspective." As an extension of that project, we also leveraged resources from the NOAA-funded "Hurricane Forecast Improvement Project (HFIP) Socio-Economic Impacts Assessment" (through Eastern Research Group Associates). To meet the objectives of this expanded project, we solicited opinions from emergency managers, broadcast meteorologists, NWS Warning Coordination Meteorologists, and the general public. Here we report the findings from the survey of broadcast meteorologists (also referred to as the media).

Survey Development, Implementation, and Sample

Survey questions were developed in consultation with the NWS staff involved in both the Storm Surge Roadmap and the HFIP Socioeconomic Working Group. Early exploration included one-on-one webinars and informal discussions with several broadcast meteorologists. This project built on information gathered in an earlier National Science Foundation-funded study of the hurricane forecast communication process (Demuth et al. 2012) and prior surveys on public

preferences for hurricane information (Lazo and Waldman 2011; Lazo et al. 2010). A crucial part of the survey was assessment of several graphic prototypes developed for communicating storm forecast information. The survey was web-based because the respondents needed to view the graphics. The survey questions were reviewed by key NWS personnel and approved by the Human Subjects Committee at the University Corporation for Atmospheric Research.

The target population for this survey was broadcast meteorologists in areas subject to TCs or ETs. We solicited contributions from the main or chief broadcast meteorologist at local television stations (ABC, CBS, Fox, and NBC) serving the Atlantic, Gulf and Pacific coasts as well as Alaska, Puerto Rico, and Hawaii. In all, 121 received invitations and 51 completed the survey during June–July 2012, for a response rate of 42%. All but 4 of the 24 targeted states and territories are represented in our sample, and the missing areas tend to be incorporated into larger television markets that are represented. About 82% reported their area as vulnerable to TCs and 90% to ETs. (Respondents were directed to sections of the survey based on the vulnerability of their market to tropical cyclones, extratropical cyclones, or both.) Looking at the hazards most related to this survey, the represented regions are most heavily impacted by heavy rain, coastal storms, and flash floods, and these meteorologists do not think their public is well prepared for them. Most of the sample had extensive experience in meteorology and in severe storm response. Thus, this was an appropriate sample for the survey.

Summary of Results

A key question was whether these broadcast meteorologists thought the NWS should issue storm surge watches and warnings. Their answers reflected strong support for both – 90% agreed that watches should be issued and 95% supported a storm surge warning. Most believed these products would result in greater attention to these threats in their weathercasts and to the public paying more attention to storm surge. A proposed graphic for showing the area under a surge warning received high marks on effectiveness but there were calls for higher resolution and more localized information.

Respondents were asked what language should be used in describing level of storm surge inundation. Unexpectedly, Height of Water Above Land was their first choice, closely followed

by Depth of Water Above Land. Above Ground Level and Above Ground received moderate support and Above Elevation was rejected by 88% of the sample.

They were then provided an opportunity to assess three prototype graphics that had been developed through an iterative process to show local surge inundation forecasts (Figure ES-1).

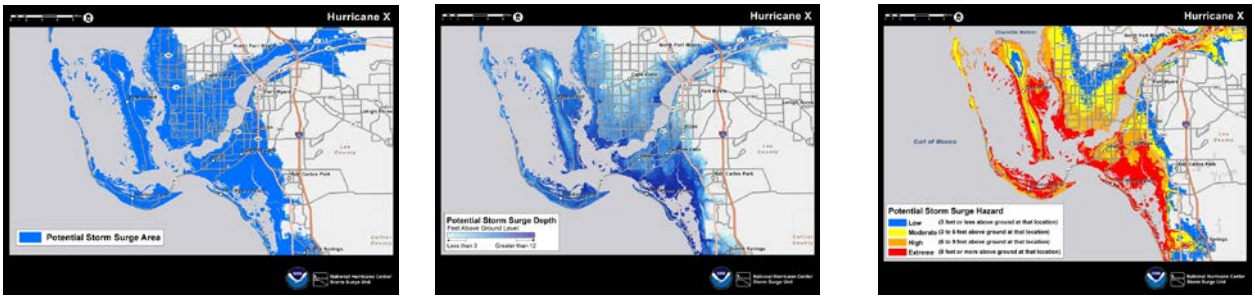

Figure ES-1. Potential Storm Surge Area in One Color, in Gradations of One Color, and in Different Colors

One was solid blue and showed the entire area at risk for surge, one used shades of blue to indicate varying depths, and one used multiple colors to show Low, Moderate, High and Extreme levels. They were asked to evaluate each one on two criteria: ease of understanding and usefulness in communicating to the public. Assessments of all three were generally positive, but when asked to pick only one, 88% picked the multicolored map.

Moving beyond storm surge, a set of maps presented three versions of the Tropical Cyclone Forecast Cone, typically referred to as the Cone of Uncertainty (Figure ES-2). All respondents answered the surge questions, but only those working in areas at risk for TCs were directed to this section. The first map showed the current cone (white with a solid black line showing the edges), the second one was transparent gray and used dashed lines for the edges as perhaps a better way to indicate uncertainty, and the third one was a transparent gray cone with no lines at the edges.

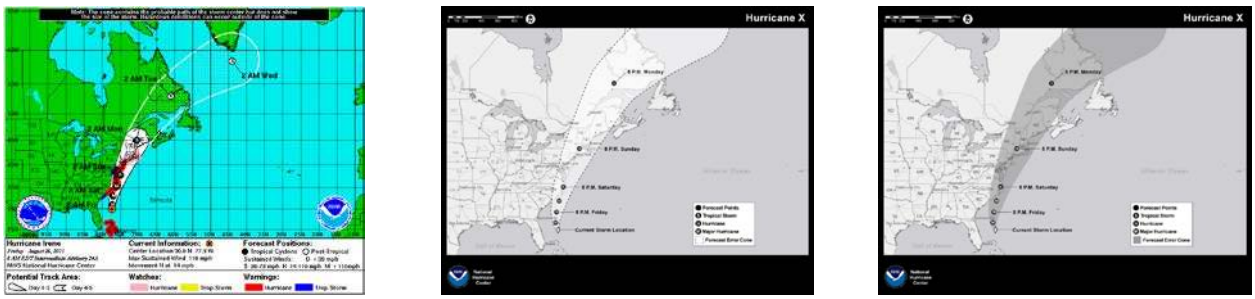

Figure ES-2. Current Tropical Cyclone Forecast Cone, Transparent Forecast Error Cone with Dashed Lines, and Transparent Forecast Error Cone with No Lines

Although only 7% rated the current cone as excellent, a total of 83% gave it a positive rating (good, very good, or excellent) on both criteria. In contrast, the transparent gray cone with dashed lines received positive scores of 72% on ease of understanding and 69% on usefulness. Similarly, for the transparent cone with no edge lines, the total positive scores were 76% on ease of understanding and 74% on usefulness. These maps received many comments reflecting considerable thought on this matter. The consensus was that while the current cone could be improved, the public was used to it even if they didn't always understand the data it represented. They knew it had to do with track uncertainty. A common complaint was that the public tended to think the total storm would fall within the confines of the track. This was the motivation, in fact, behind the development of the next products evaluated in the survey.

The next map communicated the area with Potential for Damaging Winds in which Low, Moderate, High, and Extreme (each defined in terms of mph winds) were depicted in different colors against a light gray U.S. map. This received positive reviews – 83% on ease of understand and 88% on usefulness. Some respondents were very enthusiastic about it; 17% gave it an excellent rating.

The next two maps combined the wind map just evaluated and the forecast track cone. The impetus behind its development was to illustrate that the winds expected in a specific tropical cyclone would not conform to the track cone. The first map showed the entire wind field and the second one masked the portion over water with the intent to better emphasize the land areas under threat. Although the majority (62–64%) gave positive ratings to each map, they were not enthusiastic about either one. Most comments had to do with too much information on one graphic that might confuse the public.

The last map (Figure ES-3) was created in response to the request of emergency managers for a product that showed when they should expect the arrival of tropical storm force winds because this is what drives their decision making timeline. All preparations need to be completed by then. The map used several distinct gradations of one color (red) to illustrate the approximate time (early Friday morning, Saturday, etc.). There was very strong support amongst the broadcast media sample for this graphic, with 95% giving it a positive rating on both criteria.

Figure ES-3. Arrival of Tropical Storm Force Winds (%)

This survey was taken as an opportunity to also learn more about the needs of coastal broadcast meteorologists related to tropical and extratropical forecast products. Most often identified as needs were as follows:

- Timing of forecast products to arrive no later than15–20 minutes before the hour because broadcasts usually begin on the hour
- Simplification of product templates – shorter, simpler, with less generic information and the most dangerous threats at the top
- Fewer warnings for less important events such as inland high wind warnings in some regions
- Use of well-known landmarks in descriptions of warning areas
- More attention paid to inland flooding and to water levels
- More maps and graphics for extratropical events.

When asked if their station used commercial weather vendors, 71% said yes. The major reason for using them was better graphics and data reliability, followed by timeliness and more model information. The suggestion was made that the NWS should coordinate the development of new forecast products with commercial vendors.

At the end of the survey, these broadcast meteorologists were given an opportunity to make any comments about the survey and the products presented. There were numerous accolades such as "Looks good guys. I like the direction we're headed in" and "The ideas presented here are good ones and definitely a step in the right direction."

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1. BACKGROUND

Tropical cyclones (TCs) and extratropical cyclones (ETs) can cause significant storm surge along virtually all coastal areas of the United States. The latest dramatic example of this was Tropical Storm/Hurricane Sandy along the Mid-Atlantic States in October 2012. More than 100 deaths have been recorded due to Sandy nearly half of which occurred in New York City. Most of these deaths are related to storm surge (*New York Times*, Nov. 17, 2012).

During TC situations, the National Oceanic and Atmospheric Administration's (NOAA's) National Hurricane Center (NHC) issues a suite of text and graphical products to communicate the forecasted conditions. These products include information about the position, movement, and characteristics of the storm as well as the threats it poses. The Public Advisory, Forecast Discussion, and Probabilistic Storm Surge products include detailed information about the storm surge threat, but this information is combined with all the other TC forecast information. Several products are used to communicate wind threat, including the categories based on the Saffir-Simpson Wind Scale, and probabilistic wind data and graphics. Projected storm track is typically displayed using the Cone of Uncertainty. The TC Watches and Warnings issued by the NHC currently are based on wind speed criteria only (i.e., for tropical storm- and hurricane-force wind speeds). During TC situations, local National Weather Service (NWS) Weather Forecast Offices (WFOs) also issue detailed Hurricane Local Statements, which include localized information on the various hazards associated with a storm. Many of these WFOs are also issuing experimental TC Impacts Graphics, which detail expected storm impacts, including surge. During some TC situations, storm surge can occur at coastal locations outside of the areas covered by NHC-issued TC Watches and Warnings. In these situations, local NWS WFOs issue Coastal Flood Advisories, Watches, and Warnings, which include detailed, localized information on expected storm surge.

During ETs and other unique events resulting in storm surge, such as high astronomical tides, WFOs again issue Coastal Flood Advisories, Watches, and Warnings with detailed, localized information on expected storm surge.

The serious threat to life and property posed by storm surge suggests that this threat should be specifically communicated so people can make better proactive and protective decisions. As

most recently illustrated by Tropical Storm Debby (June 2012), and Hurricanes Isaac (August 2012) and Sandy, dangerous storm surge can occur in tropical storms (less than 74 mph winds) and hurricanes classified at the lower categories of the Saffir-Simpson Wind Scale. These latest storms brought renewed calls for clearer NWS forecast messaging and more modern dissemination systems (Norcross 2012).

Are new storm surge forecast communication approaches needed to improve decision making to protect life and property? The development of a storm surge index has been suggested, most recently after Hurricane Isaac (Schleifstein 2012), but NWS experts argue that providing the expected surge depth in feet is, in fact, a scale (National Hurricane Center Public Affairs 2012). Issuing a separate Storm Surge Warning, accompanied by local inundation maps, is under consideration. Before making final decisions, however, the NOAA entities involved decided to support social science research aimed at soliciting opinions from key stakeholders, including the general public, emergency managers, broadcast media, and NWS Warning Coordination Meteorologists (WCMs). Several projects are gathering this information from across coastal areas of the United States and its territories, including the Atlantic, Gulf, and West coasts; Alaska; the Hawaiian Islands; and U.S. territories in the Pacific Ocean. This work reported here focuses on the media (broadcast meteorologists) in both ET and TC locales. The associated work under way with the public (conducted by ERG Associates), emergency managers, and WCMs will be reported subsequently. Related work includes the *Survey of Coastal Emergency Managers Perspectives on NWS Storm Surge Information* (Morrow and Lazo 2012) and the *Survey of Coastal U.S. Public's Perspective on Extra Tropical – Tropical Cyclone Storm Surge Information* (Lazo and Morrow forthcoming).

The NOAA/National Ocean Service (NOS)-funded project "Assessing Current Storm Surge Information from the Public Perspective" defined two objectives:

1. To explore and assess the public's awareness and understanding, or lack thereof, concerning storm surge and currently available storm surge information, regardless of the meteorological cause; i.e., "Do they know what storm surge is?"

2. To assess whether the NWS should develop new storm surge informational approaches to improve the communication and decision-making with respect to extratropical and tropical cyclone storm surge risk.

As part of that project, we leveraged resources from the NOAA-funded "Hurricane Forecast Improvement Project (HFIP) Socio-Economic Impacts Assessment" to assess the opinions of broadcast meteorologists related to the presentation of storm surge information as well as certain track and wind forecast communication products. Resources from the two projects were pooled to support the research, of which this report is one part.

2. METHODS

2.1 Survey Development

Questions for this survey were developed in consultation with the NWS staff involved in both the Storm Surge Roadmap and HFIP. This work built on information gathered in an earlier National Science Foundation-funded study of the hurricane forecast communication process (Demuth et al. 2012; Lazrus et al. 2012), prior surveys on public preferences for hurricane information (Lazo and Waldman 2011; Lazo et al. 2010), qualitative exploratory interviews with stakeholders in hurricane vulnerable areas, exploratory one-on-one webinars and in-person interviews with several broadcast meteorologists, and a review of the literature on storm surge communication.[1] The graphics tested in this survey were developed through an iterative process involving input from stakeholders and NWS personnel. Survey questions were reviewed by key NOAA personnel and approved by the Human Subjects Committee at the University Corporation for Atmospheric Research (UCAR). It was programmed for online implementation, pilot tested, and administered by ResearchExec (http://www.researchexec.com/). The final survey consisted of 81 questions, including demographics. (The codebook in Appendix B includes the complete questionnaire and summary response data.)

2.2 Sample

Since this survey covered both extratropical and tropical forecast communication, the target population was broadcast meteorologists (preferably Chief Meteorologists). Given that prior research indicates that most people rely on local television stations for their storm forecasts (Lazo, Morss, and Demuth 2009), we focused on those employed by the major local U.S. television outlets (ABC, CBS, Fox, and NBC) in coastal areas of the Atlantic (including Puerto Rico), Gulf, and Pacific (including Hawaii). [2] The NHC gave us a list that was then expanded by searching the websites of major local stations. Electronic mail addresses were obtained and verified through directories, phone calls, websites, and a trial message. An introductory letter was emailed to each address (see Appendix A). ResearchExec then sent an email with details for participation (see Appendix A). Twice during the process reminders were sent to those who had not yet completed the survey. A total of 121 broadcast meteorologists were sent invitations, but 20 of the addresses were never verified or returned, so we cannot be sure the messages were ever

[1] A separate report is forthcoming on the literature review.
[2] The U.S. Virgin Islands and Guam do not have local broadcast meteorologists.

received. Some may have been intercepted by spam protection programs. A total of 51 broadcast meteorologists completed the survey. If we assume all 121 of the targeted sample received invitations, the response rate for the survey is 42%. Respondents were directed to sections of the survey based on the vulnerability of their market to tropical cyclones, extratropical cyclones, or both.

Table 2-1. Location of respondents

Coastal State or Territory	Number of Respondents
Alaska	0
Alabama	1
California	4
Connecticut	1
Delaware	0
District of Columbia	1
Florida	13
Georgia	1
Hawaii	1
Louisiana	7
Maine	2
Maryland	2
Massachusetts	2
Mississippi	0
North Carolina	2
New Hampshire	0
New Jersey	0
New York	2
Oregon	1
Puerto Rico	1
Rhode Island	1
South Carolina	1
Texas	4
Virginia	1
Washington	3
Totals	51

Table 2-1 reports the number of respondents from each coastal state or territory. Delaware, Mississippi, New Hampshire, and New Jersey are not represented in the results, but are likely located within the market area of television stations in nearby states that did participate. We also received no responses from Alaska.

Figure 2-1 maps where the respondents are located. Some cities had responses from more than one broadcaster.

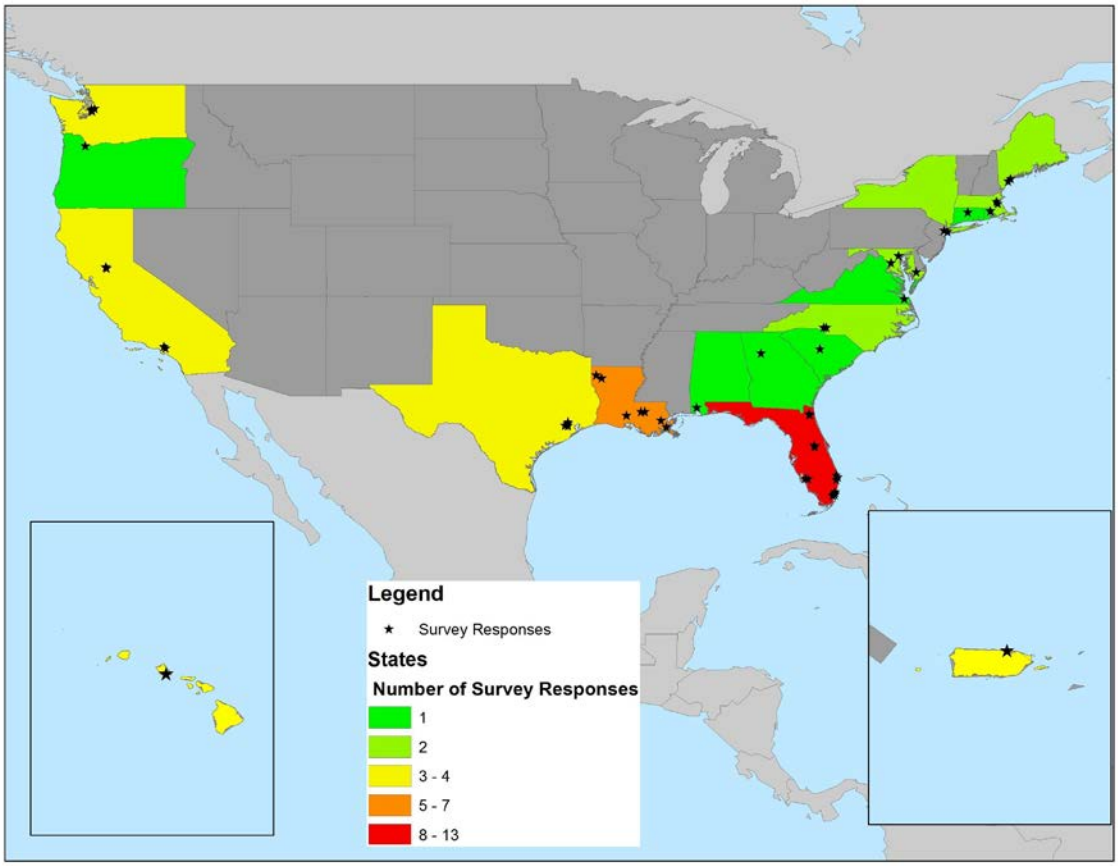

Figure 2-1. Locations of Respondents

Most markets served by the television stations represented in the survey are large, both in territory and population. More than 77% reported their market area population as 1 million or more and another 10% between 500,000 and 1 million. Internal organization and titles vary across television stations, but about 85% of the respondents indicated their title as Chief Meteorologist. They have been meteorologists for an average of 19 years and have been in their current position for an average of 12 years. When asked about certifications, 54% are American Meteorological Society (AMS) Certified Broadcast Meteorologists, 81% have the AMS Seal of Approval, and 31% have the National Weather Association Seal of Approval. Clearly, this is a very experienced and skilled sample of coastal broadcast meteorologists whose opinions will be valuable to this project.

2.3 Survey Administration and Data Analysis

The survey was designed to provide a better understanding of cyclone-related concerns of broadcast meteorologists and how they assess and use selected NWS products in their forecasts. They were also asked to review prototypes of several graphics being considered for communicating track, wind, and surge information. Because survey respondents needed to view graphics as they answered the questions, the survey was web-based. ResearchExec formatted and administered it during June–July 2012. Indicative of the importance of the topic to the respondents, the median time spent on the survey was 43 minutes. This represents a significant time commitment on the part of these media respondents. Data were then analyzed and a codebook with questions and a summary of responses was prepared at NCAR (see Appendix B.)

3. RESULTS

3.1 Regional Hazards Risk and Public Preparation

As an introduction to the survey, the meteorologists were asked how often their market area was affected by each of 12 different hazards. The choices were presented in a five-point scale: 1 Never, 2 Rarely, 3 Occasionally, 4 Often, and 5 Frequently. Then they were asked how prepared they thought people are for each hazard. The choices were scaled: 1 Not at All Prepared, 2 Somewhat Prepared, 3 Prepared, 4 Very Prepared, and 5 Extremely Prepared. As an indication of potential gaps between threat and preparation, the median scores for each hazard were then compared. Figure 3-1shows the relationship between risk and preparation for each of the hazards.

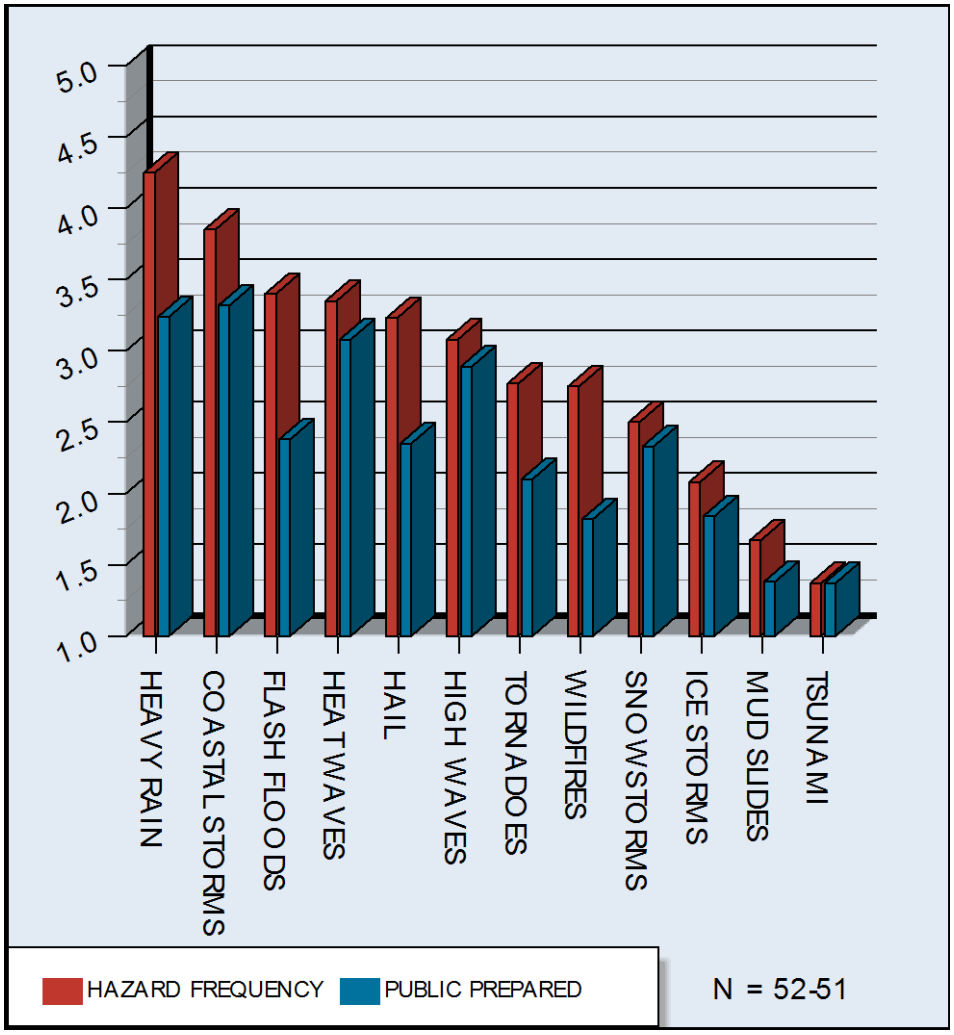

Figure 3-1. Comparison of Hazard Risk and Public Vulnerability

Although the response scales are not directly comparable, looking at difference in the gaps across hazards, in all hazards except tsunamis the risk was rated higher than public preparation, but this was especially true for heavy rain, flash floods, hail, wildfires, and tornadoes. There also was a difference regarding coastal storms—a median of 4 for risk and 3 for public preparation. When asked if there were any other weather-related hazards, most often mentioned were lightning, high wind events, fog, and cold weather events.

After a short description of tropical and extratropical storms, they were asked to rate the vulnerability of their market (from Extremely Vulnerable to Not At All Vulnerable with Vulnerable as the midpoint response item) to TCs and ETs that produce at least gale force (39–54 mph) winds. The answers to these two questions are reported in Figure 3-2a and 3-2b.

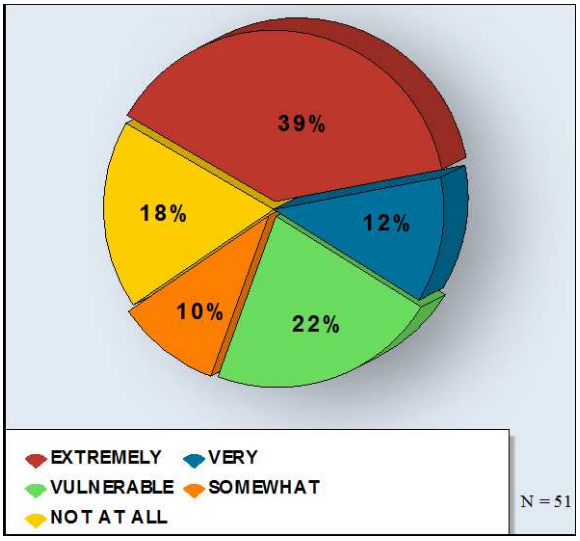

Figure 3-2a. Vulnerability to Tropical Storms

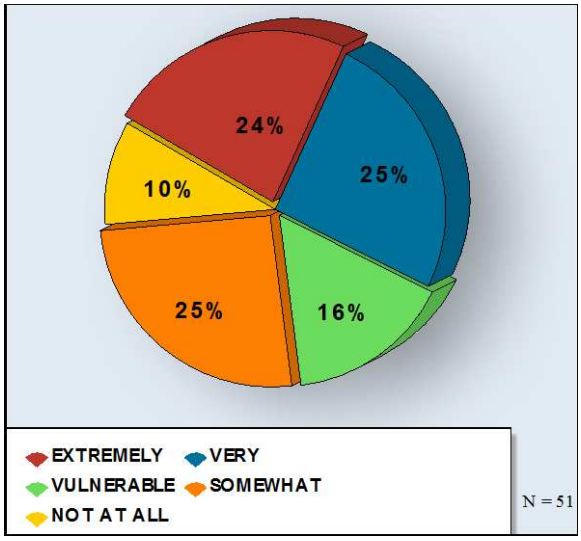

Figure 3-2b. Vulnerability to Extratropical Storms

The results indicate a great deal of vulnerability to both types of storms. Only 18% reported that they were not vulnerable to TCs and 10% to ETs. For unknown reasons, several respondents working in areas that might be impacted by TCs indicated they were not at all vulnerable them.

This sample of broadcast meteorologists, in fact, has considerable experience dealing with tropical and extratropical cyclones as indicated in Table 3-1.

Table 3-1. Incidence of storms in last 10 years (%)				
	0	1-4	5-8	9 or more
Tropical Storms	14	28	39	20
Hurricanes	20	41	33	6
Extratropical Storms	10	43	10	37
N= 51				

Table 3-1 shows that the median number of storms for the entire sample was five to six tropical storms, one to two hurricanes, and three to four extratropical storms. Again, these experienced meteorologists will provide valuable opinions regarding NWS severe storm forecast products.

Table 3-2. Level of concern about hazards (%)*					
Hazard	Extremely concerned	Very concerned	Concerned	A little concerned	Not at all concerned
Wind	51	26	16	8	0
Storm Surge	47	22	12	2	10
Inland Flooding	43	14	29	14	0
Tornadoes	26	18	33	20	2
Heavy Snow	18	12	8	18	35
N = 51 * Rows may not add to 100% due to rounding.					

The next series of questions probed their level of concern (Table 3-2) about hazards associated with tropical and extratropical storms, specifically storm surge, wind, tornadoes, inland flooding, and heavy snow (Table 3-2). Wind and storm surge are the greatest concern. More than three-quarters are either extremely or very concerned about wind, followed by two-thirds for storm surge.

When asked what portion of the population lives in areas vulnerable to storm surge, the answers varied from zero to 90%, with 30% being the median. On average they estimated that only 30%–40% of those who are at surge risk understand their vulnerability.

3.2 STATION RESPONSE

Given that the media is the primary interpreter and communicator of NWS forecast messages, it is important to understand current policies related to storm coverage. In response to a question asking how likely it was that their station will do these three things when a severe coastal storm threatens their market, the rates of those answering extremely or very likely are:

- 96.0% would emphasize in regular broadcasts;
- 86.3% would add special coverage;
- 50.9% would go to round-the-clock coverage.

Other answers included sending reporters into the field for extra coverage, increased coverage on station websites, increased use of social media, and addition of call-in shows where the public can have their questions answered.

3.3 OPINIONS REGARDING STORM FORECAST PRODUCTS

3.3.1 Storm Surge Warning

An introduction was provided at the beginning of this section of the survey:

> *For tropical storms the Saffir-Simpson Hurricane Wind Scale and watches and warnings are based on wind speeds. Due to the lack of consistent correlation between wind and surge, storm surge information has been removed from the scale. This has led to an investigation of how surge information should be communicated for BOTH tropical and extratropical cyclones.*

Respondents were then asked to what extent they agree or disagree with two statements that the NWS should issue storm surge watches or warnings.

Table 3-3. Opinion about storm surge watches and warnings (%)

Statement	Strongly agree	Agree	Undecided	Disagree	Strongly disagree
The NWS should issue Storm Surge Watches	69	21	4	6	0
The NWS should issue Storm Surge Warnings	75	20	4	2	0
N= 51					

As shown in Table 3-3. both a storm surge watch and a warning are strongly supported by these broadcast meteorologists (Table 3-3). In fact, only 6% disagree that a watch should be issued and only 2% disagree with issuance of a storm surge warning.

Respondents were asked to provide reasons for their answers. Most of the comments are supportive and give useful insights.

> "I believe the general public reacts better to an official storm surge warning than having the potential of storm surge conveyed independently by a TV station."

> "SOMEONE should be in charge of these watches/warnings and it should be the NWS."
>
> "Yes, to raise awareness by providing a single message that would be broadcast to the public on air and via other electronic means. It would certainly identify surge as a unique threat."
>
> "It's a huge deal and with the storm surge watches and warnings being apart from the wind forecast, all of the local influences can be taken into consideration."
>
> "The current surge information is vague and confusing."
>
> "Because so many times we have seen people who want to ride the storm out to see what will happen. They do not realize the imminent danger."
>
> "Like watches and warnings for severe weather, the Storm Surge Watches/Warnings would elevate the importance of the threat to the viewing public. It's another weapon in the arsenal to get the message across. In addition, the proprietary data that is available to the NWS via the SLOSH Model is not available to broadcast meteorologists."
>
> "Any information about storm surge threats, assuming that it is based on sound science (and potentially includes past observations), is of extreme value to the coastal communities and the emergency response sector."

A few caveats and negative comments were offered, some of which may reflect confusion about the issue.

> "But only when the science justifies it. I'm not sure the accuracy or the products are good enough at this time. And the education to media and end users will take some time."
>
> "Local NWS offices can be more specific based on local knowledge gained over the years."
>
> "Surges and how bad they might be aren't really known until shortly before landfall…In general, yes, you have a good idea that there will be some kind of surge. I think a watch requires specifics and it's too dangerous to put out those specifics that early…better to just say the hurricane watch is for hurricane winds and storm surge."
>
> "We already have more than enough warnings being issued during tropical events."

And further questions were raised.

> "People need to know time of arrival of worst surge conditions in order to make preparations, pack and leave the area."
>
> "Bigger question is, what will be the criteria?"

Respondents were then asked a series of questions about the effects of a potential Storm Surge Warning. When asked if they thought a separate surge warning would result in the public paying more attention to a coastal flooding or surge threat, 70.6% answered Probably or Definitely. When asked if it would result in better communication of potential threat in their weathercasts, the rate was 90.2%. In a similar question about whether it would result in greater emphasis on

coastal flooding and surge in their weathercasts, 84.3% gave those positive answers. These findings combined strongly indicate the broadcasters feel a storm surge warning would improve the communication of and response to storm surge threats.

When asked to evaluate several names that might be given to a surge warning product, including Extreme Coastal Flood Warning, Storm Surge Warning, Storm Surge Risk, and Storm Surge Danger, the broadcasters strongly supported simply labeling it as Storm Surge Warning. More than 84% supported that choice. Some comments were:

> "The watch/warning terminology is well known within the public. Introducing any other type of terminology will only create confusion."
>
> "I think Storm Surge Warning gets to the point and is quite effective. KEEP IT SIMPLE STUPID probably applies here."
>
> "I like the naming convention with 'warning' in it since the public is used to hearing warnings issued for other weather events."

One respondent voiced concern that

> "one of my pet peeves with the Weather Service is that there are too many types of flood watches and warnings, such as Flash Flood, Urban Flood, Areal Flood and so on. Either an area floods or it doesn't. There should only be two types of Flood Advisories, Flash Flood and Flood."

Other name suggestions were Ocean Surge Warning, Storm Surge Flood Warning, Storm Surge Coastal Flood Warning/Storm Surge Inland Flood Warning, and Storm Surge Threat.

3.3.2 Storm Surge Warning Area Map

Assessing proposed graphics for illustrating surge threatened areas was an important part of this survey. These graphics underwent considerable exploratory research with various stakeholders and were revised in an iterative process before arriving at the ones being tested here.

If a Storm Surge Warning is issued, the question is how it will be displayed on the NWS public websites. Respondents were asked to assess the effectiveness of several graphics starting with the map in Figure 3-3.

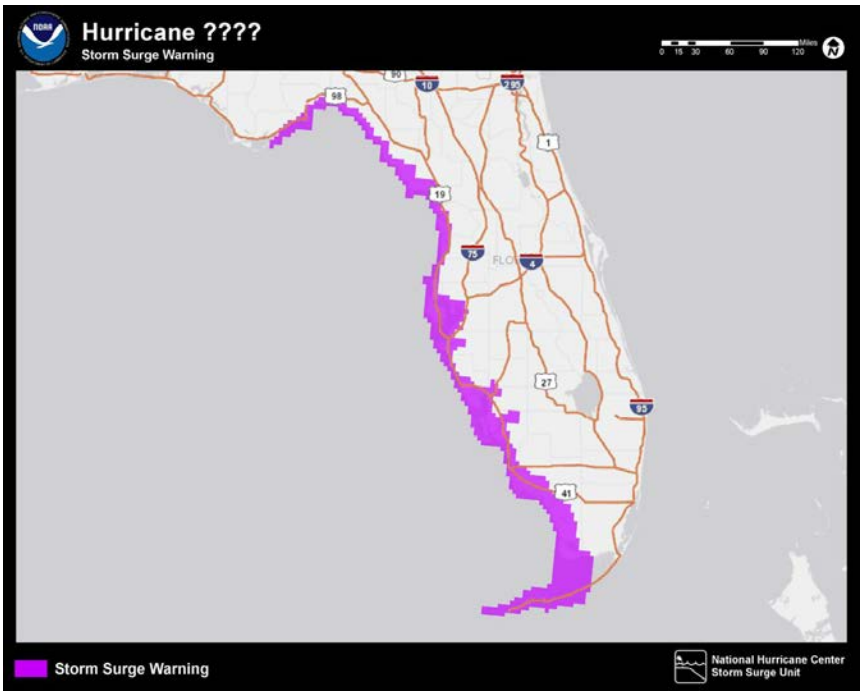

Figure 3-3. Proposed Map For Showing Area Under Storm Surge Warning

As illustrated on Figure 3-4, the results were very positive: 67% rated the map as being Extremely Effective or Very Effective, only 8% rated it Not Very Effective, and less than 1% rated it Not Effective at all (not indicated on chart).

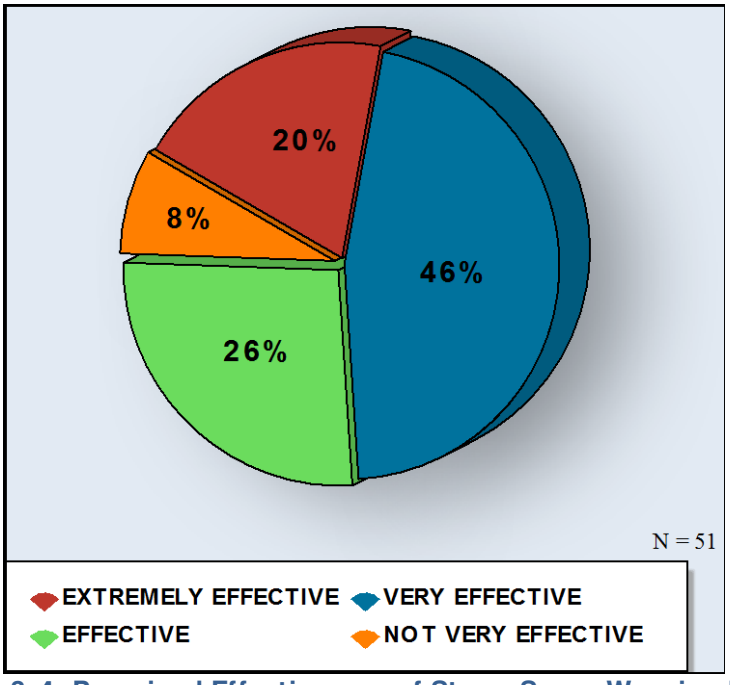

Figure 3-4. Perceived Effectiveness of Storm Surge Warning Map

The map elicited many comments, including several calls for higher resolution and more localized information. (At this point in the survey the respondents did not know about the planned surge inundation maps that they were subsequently asked to evaluate.)

> *"A map that allows individuals to zoom in and see their road, along with the expected storm* surge (or simply just the warning area) would be fantastic and extremely effective."
>
> "As long as you can zoom in and show to which highway, county line or landmark the threat goes. NO ONE knows their own geographic, trust me."
>
> "Provide the highest resolution that you can possibly accurately predict. People think in terms of neighborhoods and parts of a city/town. The on-air mets can also take the data and customize it to their area."
>
> "We need hyper detail here in New England for our storm surge threat. Some communities and shore roads are more susceptible than others. Like any overused watch or warning, blanket coverage will make people ambivalent."
>
> "This map ALONE won't be much help. Water inundation maps would need to accompany the general warning map pictured here."

Which leads nicely into the next section of the survey.

3.3.3 Storm Surge Inundation Maps

A preamble to this section explained that the NHC is developing tropical cyclone storm-specific inundation maps for their website and that similar maps might be developed by NWS in the future for extratropical storms. It was explained that the maps show estimates of the amount of ocean water (including tides) expected on top of the land. The elevation above sea level of that general area will already have been subtracted. Before assessing the maps, they were asked about the best way to label this hazard so it is easy for the public to understand. They were asked to assess five possible names (see Table 3-4).

Table 3-4. Preference for storm surge labels (%)

Label	Extremely clear	Very clear	Clear	Not very clear	Not at all clear
Height of Water Above Land	12	41	29	16	2
Depth of Water Above Land	16	29	29	18	8
Above Ground Level	8	16	31	33	12
Above Ground	2	18	26	43	12
Above Elevation	0	4	8	51	37
N= 51					

The results as shown in Table 3-4 were somewhat unexpected. If the three positive choices are added together, Height of Water Above Land is considered to be clear (to some degree) by 82%, Depth of Water Above Land by 75%, Above Ground Level by 55%, and Above Ground is considered clear by 45%. Perhaps the idea that it would be measured above ground, i.e., above where people would be standing, explains the preference for height over depth (which would be measured from the top down). Above Elevation was considered unclear by 88% of these broadcast meteorologists.

Other suggestions included Flood Height, Flood Water Height, Storm Surge Height, Total Water Level Rise, and Wave Height Above Ground. One respondent noted:

> "What happened to Storm Tide (Mean high tide + wind/wave driven surge). We have people versed in that already, how we want to change it? Keep this as simple as possible. People want the time, place and severity of the surge."

Some reflected different perspectives, such as:

> "Above sea level – everyone can find that number!!!"

and

> "Inundation maps should simply show how far inland the water will go. People are smart enough to realize that if the water goes 1 mile inland, their house is under water."

A crucial part of this survey was an assessment of three different prototypes developed for showing the area that is forecast to have storm surge inundation. The broadcast meteorologists were asked to assess each map on two criteria: ease of understanding and usefulness. They were then asked to pick the one that they prefer.

The first map (Figure 3-5) depicts as one color the entire area forecast to be affected by surge. We note that the maps were presented in the same order to all respondents (not randomized).

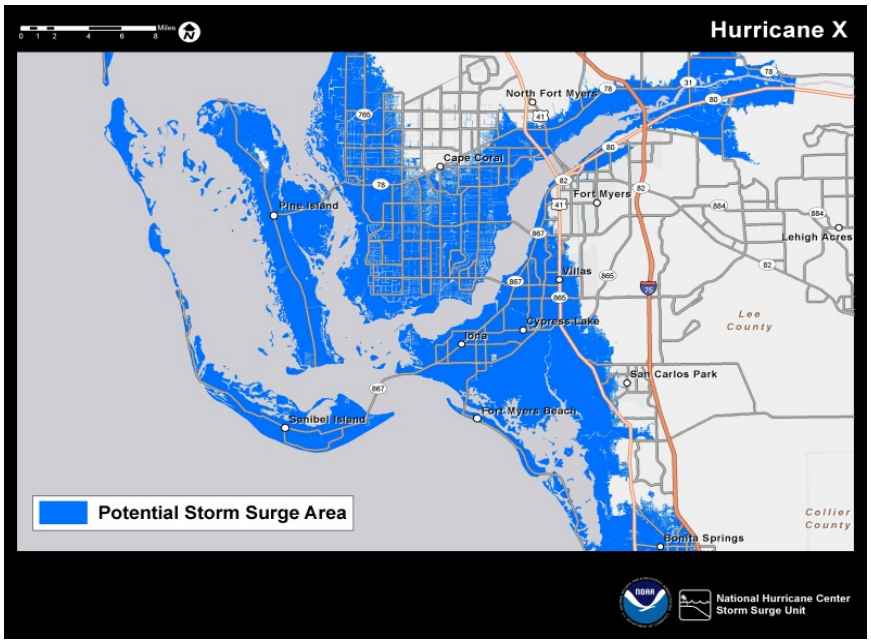

Figure 3-5. Potential Storm Surge Area in One Color

About 90% rated this map as Good, Very Good, or Excellent in ease of understanding and 86% gave these rates in usefulness. Many called for more information about how much surge is expected. Other suggestions were to give more contrast to the colors used for the ocean and land, to add more landmarks and to make it zooming possible.

The second map (Figure 3-6) uses color gradation to illustrate expected levels of storm surge.

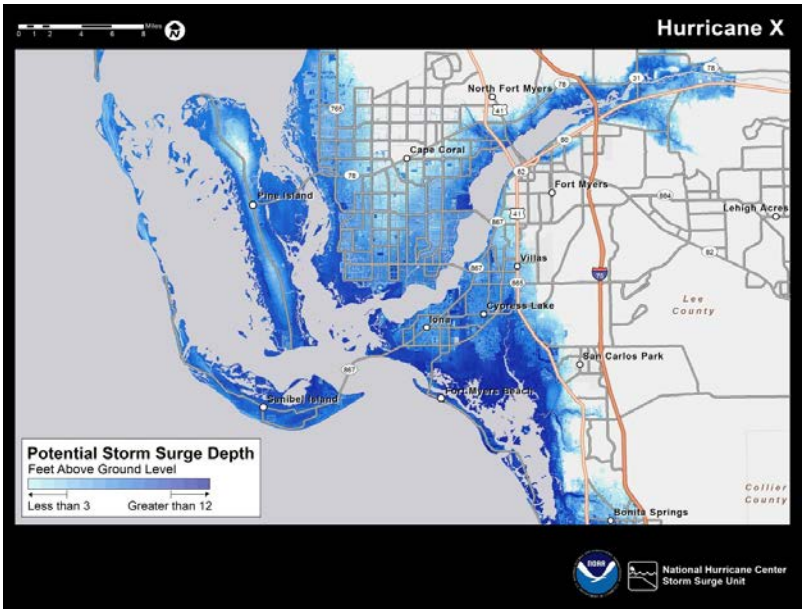

Figure 3-6. Potential Storm Surge Depths in Gradations of One Color

About 84% thought this map was Good, Very Good, or Excellent in ease of understanding, and 90% made those same positive choices for usefulness in communicating to the public. There were many comments about liking this one better than the first one. The most common complaint was that it did not use different colors to show surge levels.

Another issue mentioned:

> "This is useful information for the media and emergency managers, but not for the public. It assumes that the forecast will be accurate and does not say how much error there could be in the forecast. This might lead those in marginal areas to stay when in fact they should leave."

The third map (Figure 3-7) uses colors to depict different expected depths (Low, Moderate, High, Extreme—based on the feet above ground level as indicated in the parentheses in the legend) of storm surge.

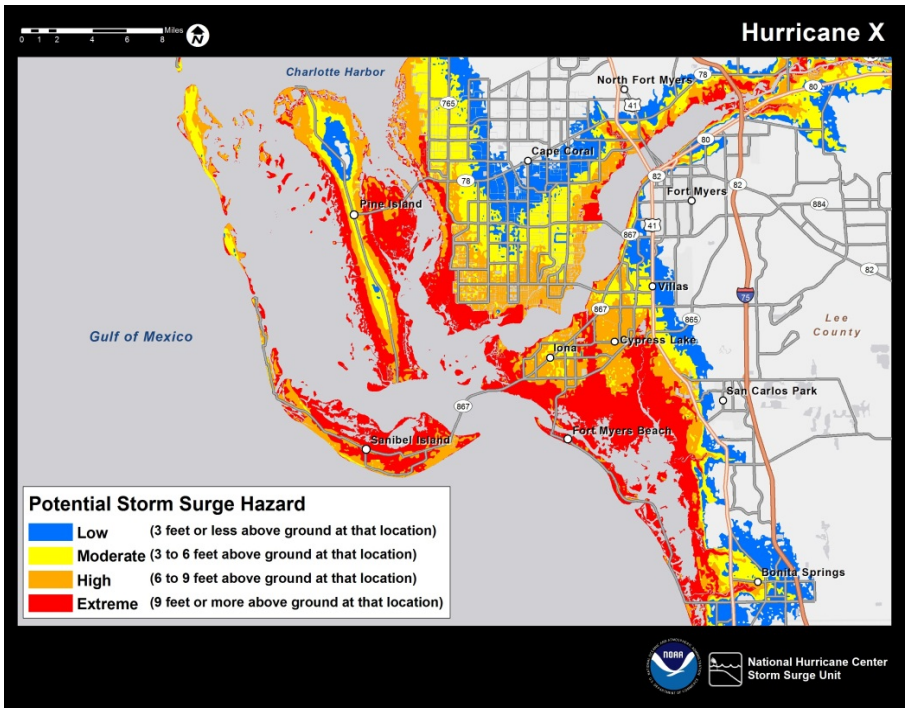

Figure 3-7. Potential Storm Surge Depths in Different Colors

This map received the most positive assessments. In terms of ease of understanding, 96% rated it Good, Very Good, or Excellent and for usefulness in communication the total was 94%. There were numerous positive comments about this one, some quite enthusiastic. Several suggestions

for improvement were made, including the use of green instead of blue and concerns that using the term "Low" might imply no danger. [3]

Several reservations and concerns were offered.

> "I'm concerned that those in the low hazard areas would interpret this as a low risk and not leave."
>
> "This is a problem I have with all NWS impact graphics…using low, mod, high, extreme. 3 feet of water is life threatening in some situations. Could give people the idea that no big deal… I would remove those terms."

A suggestion was made that this map should be combined with something like the Storm Surge Simulator in use in Miami-Dade County where residents can type in their address and visualize the height of water on a person or a home.

Assessments of all three maps are largely positive. Respondents were then asked to make a choice. If the NHC uses only one of these inundation maps on its website, which would be best? The results are unequivocal in favor of the multicolored map (see Figure 3-8).

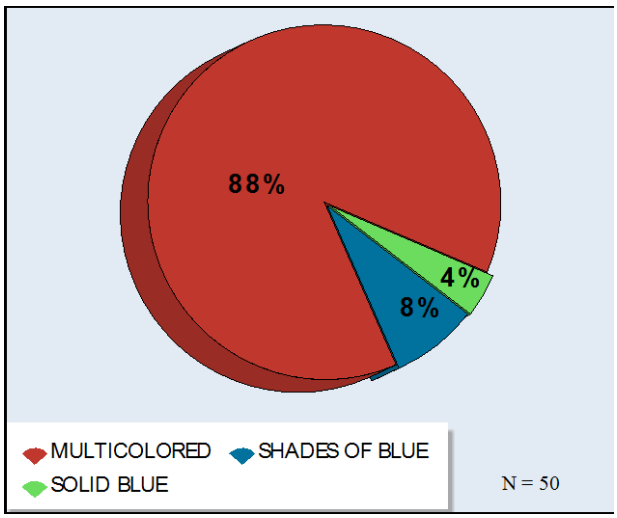

Figure 3-8. Preference for Inundation Maps

When asked why they thought their choice was best, there were numerous statements related to providing more information, more detail, more specifics, and being more eye-catching. There

[3] Suggestions have been made to substitute Significant for Low.

were several comments, however, that the colors were too bright ("garish") and the contrast should be lowered.

The invitation to provide any additional comments or thoughts regarding surge inundation maps in general yielded several comments to be considered.

> "A lot of education will be needed – not just on how to use the maps but in learning how emergency managers and other local officials will use these maps. Surely, the NWS would not want everyone in blue areas with a couple feet of inundation to evacuate."
>
> "There is a 'learning curve' for the audience, and a limitation would be the number of times these maps might be shown over the course of a few years in a coastal market."
>
> "The street mapping is the key. People need to know where they are by streets and highways. Great map."
>
> "This is great for people that know where they are on a map, but many (most?) viewers don't."
>
> "Easy to understand for those who can read and interpret maps, but that's mainly out of your control. Plus a broadcast meteorologist is paid to walk people through it. Of course, that won't help with a map on a web site."
>
> "From my experience providing enough information helps viewers make decisions to protect life and/or property. There is always a struggle between providing too much information and providing too little, but if you don't provide enough, complacency seems to be higher."

3.3.4 Forecast Track Cone Maps

Broadcast meteorologists who indicated they worked in a region not impacted by tropical cyclones skipped this section, reducing the sample size to 41. The section began by asking for an assessment of the current Tropical Cyclone Forecast Cone (Figure 3-9).

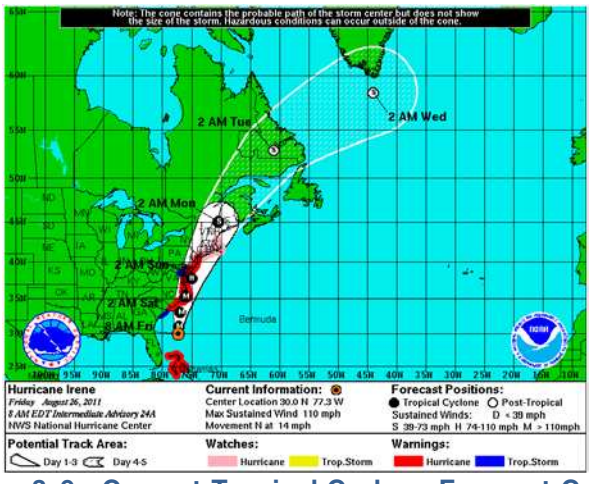

Figure 3-9. Current Tropical Cyclone Forecast Cone

Asked to take the public perspective, these broadcast meteorologists were generally positive about the current cone. Although only 7% rated it as Excellent, combining those who thought it was Good, Very Good, and Excellent resulted in an 83% positive rating on both ease of understanding and usefulness. The comments were generally positive but some raised concerns.

> "We all know this map, it works."
>
> "The graphic does more than an adequate job for those familiar with it. In reality there is a LOT of information here…more than initially meets the eye."
>
> "The map generally works well but the presenter must be careful and articulate when communicating what the map means."
>
> "I think the public has become accustomed to this type of forecast track. I welcome a more detailed approach."
>
> "Cone doesn't take into account size of storm and entire area at risk. Size of cone should be dynamic to allow NHC tropical specialists to adjust it based on forecast confidence…or lack thereof."
>
> "Doesn't say anything about where the worst winds or surge will be…gives a false understanding of the storm's structure and what the threat really is."
>
> "The problem with the cone is that viewers think the winds are only confined to the cone area."

In the second map (Figure 3-10), the track forecast cone was presented as transparent and with dashed lines in an effort to signify uncertainty.

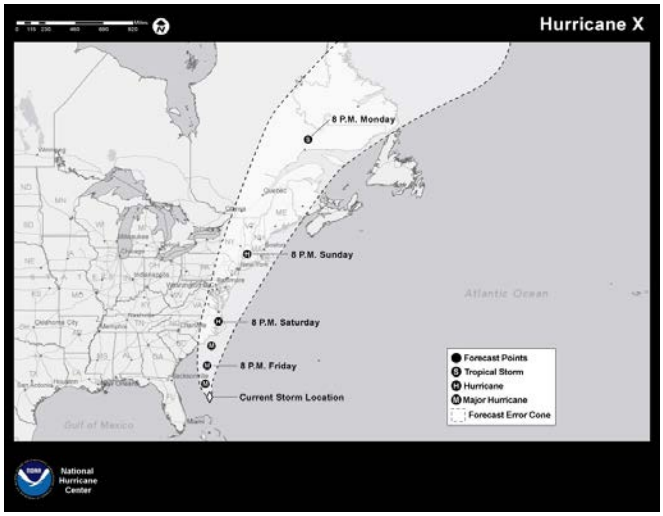

Figure 3-10. Transparent Forecast Error Cone with Dashed Lines

Assessments were generally positive for this one, but respondents tended to like it less than the traditional cone. Again, few thought it was Excellent, but 72% rated it Good, Very Good, or Excellent on ease of understanding, and 69% gave it these positive ratings on usefulness to the

public. Some thought the dashed lines did not help get the uncertainty message across. Many of the comments actually dealt with the fact that the same amount of information is not included on this one nor is it in color. So there were important differences beyond the dashed lines. In retrospect, in order to get a fair assessment, the ONLY thing different on this map should have been the way the cone was displayed.[4]

> "Like the term 'Forecast Error Cone'…the cone is often misinterpreted."
>
> "I don't know how a dashed line lets people think the storm could be OUTSIDE the cone."
>
> "It is only of value if accompanying text explains that the graphic only deals with the likely track of the center of the tropical cyclone. Without the text it is extremely misleading."
>
> "This, like all NHC maps, requires some interpretation. (And a little color, I might add.)"
>
> "Too blah looking for an age of intense graphics and color."
>
> "The cone does not show the shape, size, surge, tornadoes…there is so much the cone does not show. It is so important that this information be explained."
>
> "Need windfields in the track, as to how high outside of center the winds are. We may miss the center but what should we expect 100 to 200 miles of the center?"

On the third map in this series (Figure 3-11), the cone is transparent gray with no lines.

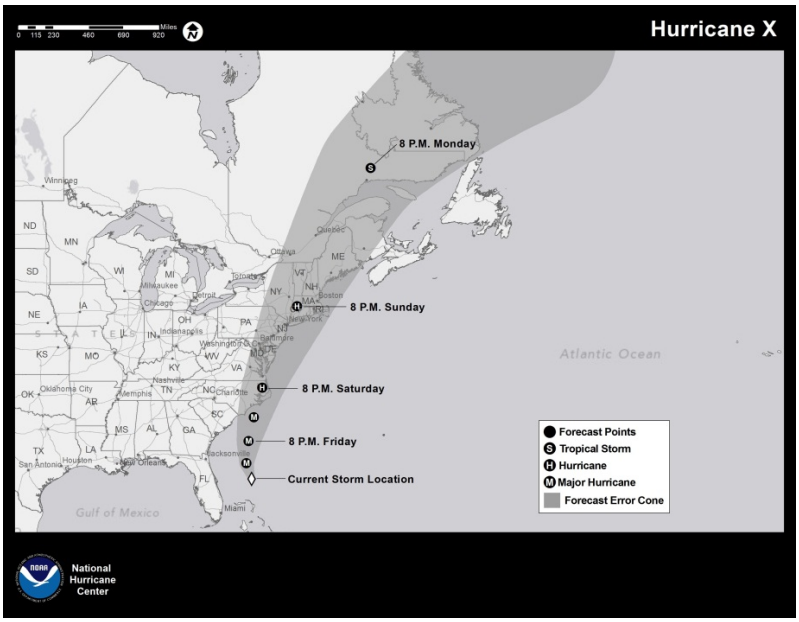

Figure 3-11. Transparent Forecast Error Cone with No Lines

[4] These responses also reveal the value of eliciting input on potential changes as even well-intentioned changes may lead to unexpected or unanticipated interpretations.

Again, although only 2% rated it as Excellent, the positive choices together added to 76% on ease of understanding and 74% on usefulness. The comments were fewer and mixed.

> "Once again, it will work to better inform the public, but with different colors."
>
> "A cone is a cone is a cone. Don't overthink it."
>
> "Prefer this to dashed lines."
>
> "…stop calling this the Error Cone. By using that terminology, you're already telling the public this forecast is wrong. Why should anyone evacuate if you tell them upfront you don't know what the storm is doing?"
>
> "I doubt that cone shading, or broken vs. solid cone outlines really affect how the information is delivered. The key is for there to be a clear, concise statement alerting the user that roughly 1-in-3 systems ultimately end up outside the cone."

When looking at these three cone versions individually, the positive answers (Good, Very Good, Excellent) added together varied from 69% to 83% across both criteria. Now, respondents were asked to make a choice between the three cone options.

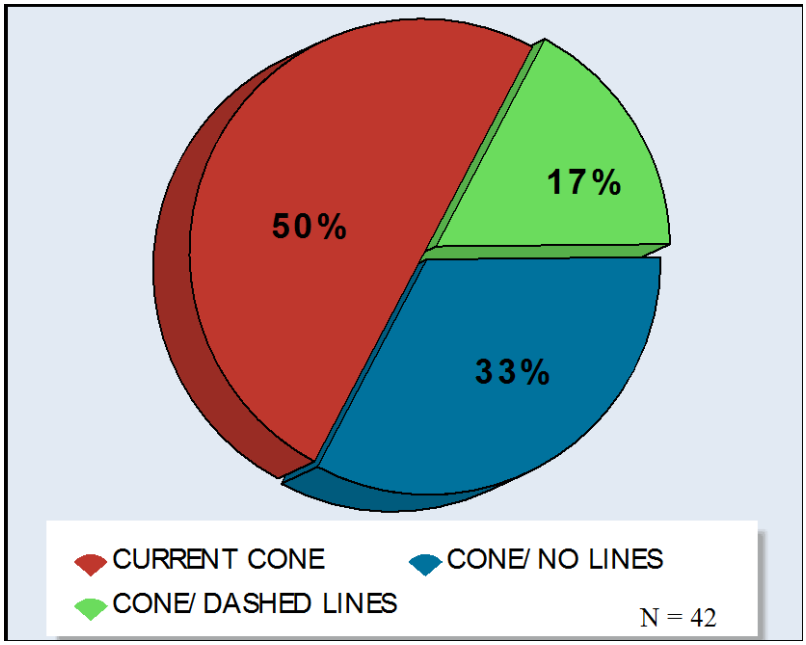

Figure 3-12. Preference for Tropical Cyclone Forecast Cones

Results as shown in Figure 3-12 indicate that 50% prefer the current cone, 33% the cone with no lines, and 17% the one with dashed lines. When asked to explain their choice, many commented that the first cone provided more information (watches, warnings, etc.) and was in color. Even some who liked the cones with dashed lines or no lines mentioned they needed color and more information. As previously noted, this would have been a better test of potential changes in cone

characteristics for conveying uncertainty if all three maps had shared the same features EXCEPT for the line differences.

3.3.5 Wind Map

The next map (Figure 3-13) shows the varying potential for damaging winds for the same storm used in the previous cone examples.

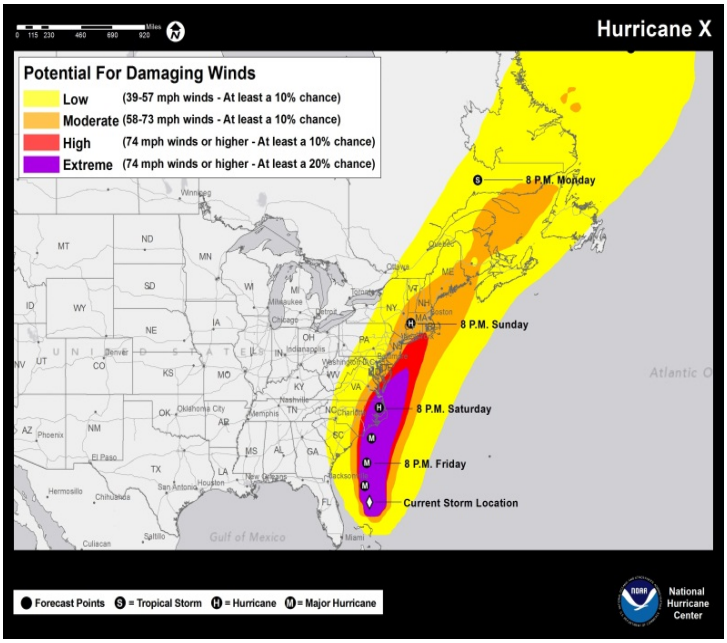

Figure 3-13. Potential for Damaging Winds

Respondents were positive about this graphic, with 17% giving it an Excellent rating on ease of understanding and 24% an Excellent rating on usefulness. All of the positive choices together equaled 83% on the understanding scale and 88% on the usefulness scale. In general, respondents liked the presentation, i.e., strong colors against a plain background. Some positive comments:

> "This is more like it."
>
> "This map puts numbers on the storm in terms of wind fields, that's concrete info viewers can use to prepare for the storm."

Again some comments revealed additional concerns and issues:

> "I think this product would take a little hand-holding by a broadcast meteorologist for the public to really understand. However, I think it's highly useful as a tool..."
>
> "Again, I don't like the impact words…What's moderate…loss of power?"

"I don't think this graphic is doable unless NHC issues the wind field forecasts through 5 days."

"Does the data take into account the length of time that areas will be experiencing different winds?"

3.3.6 Wind and Cone Maps

The next maps add the dashed cone to the Potential Damaging Winds map. Two versions were presented (Figures 3-14 and 3-15), with the second one showing the wind graphic over land only, masking the water portion. We discuss them together.

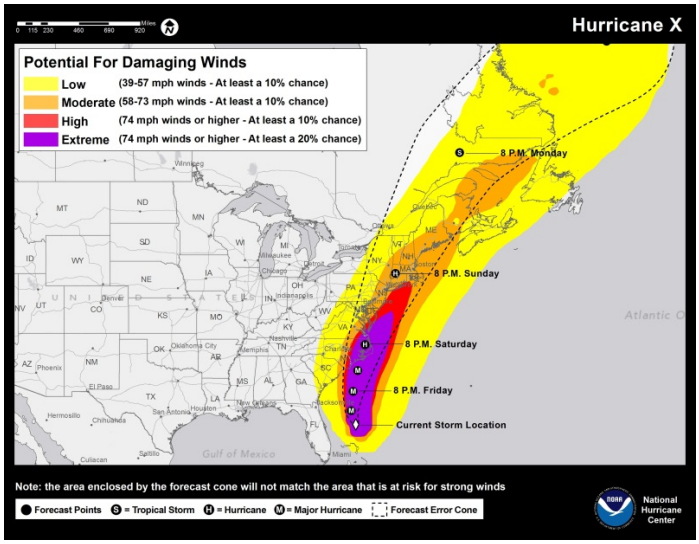

Figure 3-14. Combined Wind and Cone

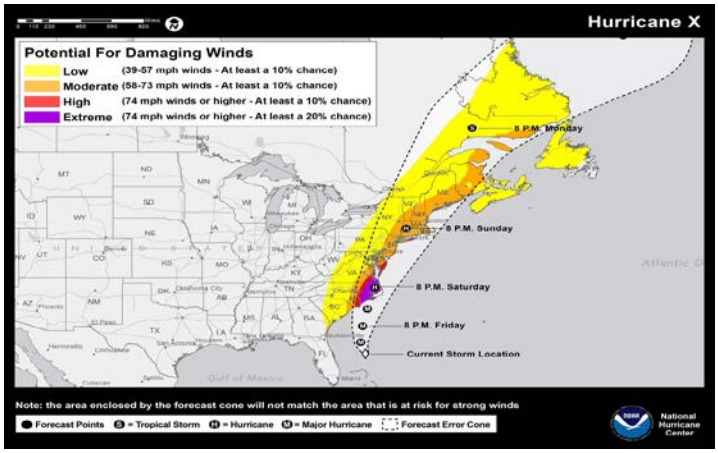

Figure 3-15. Combined Wind and Cone – Land Only

Ratings of these two graphics are shown in Table 3-5. Although the majority (62–64%) gave positive (Good, Very Good, Excellent) ratings to both, they were not enthusiastic about either.

Most complaints had to do with too much information on one graphic that might confuse the public. A typical comment:

> "Great information, but for the general public, this is probably too much for them to digest."

Table 3-5. Assessment of combined wind and cone map (%)

	Excellent	Very good	Good	Fair	Poor
Combined Cone And Wind – Total (Figure 3-14)					
Ease of Understanding	10	21	31	14	24
Usefulness	12	29	24	14	21
Combined Cone And Wind – Land Only (Figure 3-15)					
Ease of Understanding	5	31	26	21	17
Usefulness	5	31	26	17	21
N=41					

Some were just uncertain about both. Opinions about showing the wind information over land only were mixed—some were enthusiastic and others worried about marine interests. Some positive comments:

> "I think adding the forecast cone makes it easier to explain how things might change if the track of the storm varies from the forecast path."
>
> "This is even better. I think the note about the forecast cone not matching the area at risk of wind damage is an important addition."

On the other hand, this comment indicates an initial lack of understanding even on the part of broadcast meteorologists:

> "This is too much. Besides you have some parts of the 'Error Cone' that have no potential for damaging winds. How is that possible?"

Using the same maps and posing an example of North Carolina and Virginia, respondents were asked which best communicates the threat. The first one, over land and water, was preferred, to land-only 48% to 41%. More positive comments, however, were made about the second one. Most of these had to do with making the risk more obvious. Most concerns with the land only graphic had to do with marine interests.

A possible issue:

> "It seems to me that the potential for wind damage is based on the center line of the forecast of the storm. The potential should shift, depending on the path within the cone. I don't see how the two match."

There were suggestions that toggling would be good—being able to toggle the track cone on and off, and also to toggle the ocean portion of the wind graphic.

3.3.7 Arrival of Tropical Storm Force Winds

As noted in Morrow and Lazo (2012), emergency managers have been asking NWS for information about when to expect the arrival of tropical storm force winds, because all preparations should be completed by then. The map in Figure 3-16 was developed to address that need.

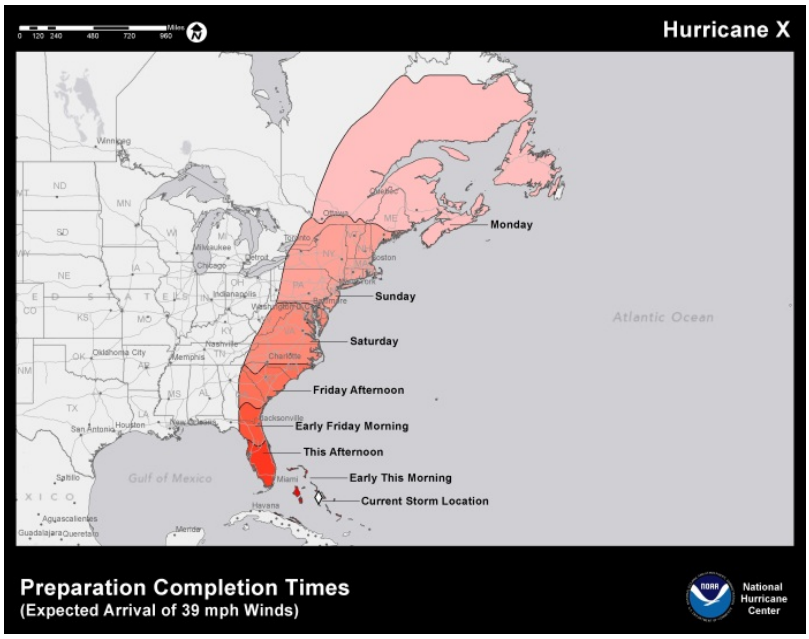

Figure 3-16. Arrival of Tropical Storm Force Winds (%)

Table 3-6. Assessment of arrival to tropical storm force winds map (%)

	Excellent	Very good	Good	Fair	Poor
Ease of Understanding	24	46	24	5	0
Usefulness	27	49	20	5	0
N= 41					

As shown in Table 3-6, this graphic was strongly supported by these broadcast meteorologists; about 95% gave it a positive rating (Excellent, Very Good, or Good) on both ease of understanding and usefulness (Table 3-6). Comments were enthusiastic.

> "DO THIS FOR ALL THREATS….DO IT, DO IT. BEST MAP YET."
>
> "I love it."

> "It's very simple and easy to understand. Extremely useful for the public and emergency managers. A great graphic!"
>
> "We too get this request via emails and social networks. This graphic is a welcome addition to the family."

There were several suggestions to use different colors to provide more contrast and one call for more specific times. Based on this strongly positive response, we feel that further consideration is warranted for developing and testing this product for potential implementation.

3.4 OPINIONS REGARDING NWS SERVICES

When asked to rate their relationship with the NWS offices serving their area, the results were positive. All but one person rated the relationships Good, Very Good, or Excellent. In fact, 56% said they had an excellent relationship with their local WFOs.

The next part of the survey explored how this sample of coastal broadcast meteorologists used NWS products and services. Two open-ended follow-up questions were asked: 1) What, if any, special issues or challenges do you have in receiving and using NWS tropical and extratropical storm forecast and warning products in your work? and 2) What, if anything is the single most important change the NWS could make to improve its severe storm forecast and warning products and services?

About 30 respondents wrote answers to each question. Considerable overlap existed between the questions, so the comments below are merged by topic and presented here in order of frequency with those mentioned most often summarized first.

- Timing of products does not meet the needs of broadcast meteorologists. Information is needed 15–20 minutes before the hour when they go on the air, and they also need more frequent updates.
- Product templates need to be simplified. Too much generic information is included, making them too long and difficult to decipher. Most dangerous threat should be at the top.
- Too many warnings are issued. One example given is too many inland high wind warnings in some regions, such as the Pacific Northwest during winter cold fronts.

- Well-known landmarks should be mentioned when describing areas under threat.
- Warnings are not dropped quickly enough when the danger is over.
- More attention should be paid to inland flooding and to water levels.
- More maps and graphics should be supplied for extratropical events.
- More information about the timing of events should be provided.
- NWS should work with commercial vendors to be sure any new NWS products are compatible.

3.5 COMMERCIAL VENDORS

When asked if they use a paid commercial vendor, 36 of the 51 broadcasters (71%) said yes. Those who said yes were then asked to assess the importance of several reasons for using vendors.

Table 3-7. Reasons for using commercial vendors (%)

Reason	Extremely important	Very important	Important	Not very important	Not at all important
Better Graphics	71	21	9	0	0
Data Reliability	56	24	21	0	0
Timeliness	59	24	15	0	3
More Model Information	56	15	21	9	0
Tailored to Market	32	24	29	9	0
Interpretation of NWS Data	15	21	21	35	9
N = 30 (note – 6 of the 36 who said they used vendors didn't respond to this question)					

As shown in Table 3-7, the most important reasons for using commercial vendors are better graphics and data reliability, closely followed by timeliness. Next in importance are more model information and tailored to their market. A distant last was interpretation of NWS data.

3.6 FINAL COMMENTS

At the end of the survey, the broadcast meteorologists were given an opportunity to make any comments about the survey and the products presented. There were numerous accolades such as

> "Looks good guys. I like the direction we're headed in"

and

> "The ideas presented here are good ones and definitely a step in the right direction."

One interesting additional suggestion was that there be a Confidence in Model assessment, such as

> "The overall confidence in this model is high."
>
> "This would give us an idea of how strongly to impress the cone on our viewers."

In closing, several mentioned their appreciation for the opportunity to participate in the survey. And one comment this report's authors especially liked was

> "Thanks to my social scientist friends for getting involved in improving the Nation's hurricane program."

4. SUMMARY

A key question was whether these broadcast meteorologists thought the NWS should issue storm surge watches and warnings. Their answers reflect strong support for both. A proposed graphic for showing the area under a surge warning received high marks on effectiveness, but there were calls for higher resolution and more localized information. When shown three possible maps for showing local inundation, they preferred one that used different colors to indicate different levels of potential inundation. Most preferred that this be labeled Height of Water Above Land.

Those meteorologists working in areas at risk for tropical cyclones were provided an opportunity to assess three versions of the Tropical Cyclone Forecast Cone. The map showing the current cone was preferred. However, one reason for this preference was that it provided more information. Therefore, for a valid assessment, further testing is needed on transparent cones with dashed or no lines that also include the extra information.

A map indicating Potential for Damaging Winds using different colors to indicate four levels was positively received on both effectiveness and usefulness. Two maps were then superimposed the forecast track cone over the wind graphic, one showing the entire wind field and the other only showing potential winds over land. Although the majority gave positive ratings to each, they were not enthusiastic about either one. Most comments had to do with too much information on one graphic.

Emergency managers have been asking the NHC to provide more information on when to expect the arrival of tropical force winds. In response, the last map on the survey showed this information using varying intensities of red. Support for this graphic was very strong.

The survey ended with several questions about the needs of these coastal broadcast meteorologists related to tropical and extratropical forecast products. The most often cited needs were timing of forecast products to arrive no later than 15–20 minutes before the hour when they go on the air, simplification of forecast templates (shorter, simpler), fewer warnings for less important events, greater use of well-known landmarks in forecasts products, more attention to inland flood and to water levels, and more maps and graphics for extratropical events. Nearly three-fourths of the stations represented used commercial weather forecast vendors. With the

most important reasons for doing so being better graphics, data reliability, timeliness, and more model information.

In summary, the results of this survey provide important information to guide improvement and innovation in the communication of tropical and extratropical forecast products.

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Appendix A. Advance/ Introductory Emails Sent to Broadcast Meteorologists

March 25, 2012

Dear Selected Coastal Broadcast Meteorologist:

You will soon receive an email inviting you to participate in a very important survey about NWS severe storms forecasts and products. The Societal Impacts Program of the National Center for Atmospheric Research is conducting this study to inform the National Weather Service (NWS) Storm Surge Project, as well as the Hurricane Forecast Improvement Program (HFIP) Socioeconomic Task Force's initiative to develop and test hurricane forecast products.

YOU HAVE BEEN CHOSEN TO BE A MEMBER OF THE BROADCAST METEOROLOGIST SAMPLE.

We realize that your main interest is receiving quality forecast data from the NWS that you then package in text and graphics according to the needs and interests of your station's market. However, as an increasing segment of the general public is going to the Internet for weather information, an important part of the NWS mission is to present hurricane forecasts that the public can understand and, when called for, utilize to take precautionary actions. Therefore we have undertaken several projects to improve the way we present severe storm information to the public. **As experts in the presentation of weather information, we are soliciting the opinions of coastal broadcast meteorologists regarding storm forecast products.**

Dr. Jeff Lazo (National Corporation for Atmospheric Research) and Dr. Betty Morrow (SocResearch Miami) and directing this project. Research Exec, a professional Internet survey administration company will administer the survey.

Please watch for a future email from us explaining how you will log in to complete the survey.

Do not hesitate to call or email Jeff (303-497-2857 – lazo@ucar.edu) or Betty (305-385-5953 betty@bmorrow.com) if you have questions or concerns. **YOUR PARTICIPATION IS VERY IMPORTANT.**

Jeffrey K. Lazo
lazo@ucar.edu

June 26, 2011

From: National Center for Atmospheric Research <surveys@researchexec.com>
Subject: National Weather Service Storm Surge Roadmap

Dear [insert name]

You may have been recently contacted about participating in a survey being conducted to provide guidance on the National Weather Service (NWS) Surge Roadmap Project. **Information in this email will explain how to participate.**

The survey will ask for your opinion about various forecast practices and products being considered for use on NWS websites when coastal areas are threatened by severe storms. Select emergency managers from coastal areas along the Atlantic, Gulf and Pacific coasts, as well as Alaska, are being asked to participate.

As an expert in the presentation of weather information, we are soliciting your opinion.

Click on the following link to take a survey: [link]

Please be sure that the link has not wrapped. If you are prompted for a key, enter the key as follows: [key]

Attention AOL Users: If the survey does not load when you click on the above link, please click here.

Dr. Jeff Lazo (National Corporation for Atmospheric Research) and Dr. Betty Morrow (SocResearch Miami) are directing the project. Research Exec, a professional Internet survey company is administering the survey. Do not hesitate to email us questions or concerns.

YOUR PARTICIPATION IS VERY IMPORTANT.

Thanking you in advance,

Jeff Lazo (lazo@ucar.edu) and Betty Morrow (betty@bmorrow.com)

Appendix B. Survey Codebook (Not Including Open-Ended Responses)

NWS Storm Surge – Emergency Manager Survey
August 2012
OE Responses not included to maintain respondent confidentiality

INTRODUCTION

Important information about this survey. Please read!

You can influence how the National Weather Service (NWS) communicates tropical and extratropical system forecasts on its websites. We are collecting opinions from a select group of experienced broadcast meteorologists from coastal areas of the Atlantic, Gulf and Pacific, as well as Alaska. As part of the selected sample, your opinions are very important to the success of this project. The Societal Impacts Program at the National Center for Atmospheric Research (NCAR) is conducting this study to inform the development and testing of tropical and extratropical severe storm products. This is not a commercial survey. This survey builds on the results from earlier surveys, webinars and discussions in which you may have been involved. As a professional emergency manager we are very interested in your insights. The survey should take you about 20 minutes to complete. We will analyze your responses together with all others, thus preserving confidentiality. Neither your name nor that of your agency or jurisdiction will be reported in the results. Completing this survey is voluntary. By clicking on the "AGREE AND CONTINUE" button below you are indicating that you have read this and agree to participate in this survey. Otherwise, please click on the "Exit" button.

["Agree and continue" button – required to click on this to continue – if not, they will exit the survey. "Exit" button will take them to a Thank You screen and end data collection]

HAZARD VULNERABILITY OF YOUR JURISDICTION

1.) How often, if at all is your jurisdiction affected by each of these weather-related hazards?

Sub-question	Variable Name	Never	Rarely	Occasionally	Often	Frequently	Mean	Median	SD	n	# missing
	Q1	1	2	3	4	5					
Tsunami		75 64.1%	31 26.5%	11 9.4%	0 0.0%	0 0.0%	1.45	1	0.66	117	0
Snowstorms		39 33.3%	40 34.2%	22 18.8%	7 6.0%	9 7.7%	2.21	2	1.19	117	0
Hail		5 4.3%	42 35.9%	51 43.6%	16 13.7%	3 2.6%	2.74	3	0.84	117	0
Heavy rain		1 0.9%	1 0.9%	30 25.6%	46 39.3%	39 33.3%	4.03	4	0.84	117	0
Wildfires		10 8.5%	29 24.8%	40 34.2%	29 24.8%	9 7.7%	2.98	3	1.07	117	0
High waves		8 6.8%	14 12.0%	36 30.8%	41 35.0%	18 15.4%	3.40	4	1.10	117	0
Coastal storms		2 1.7%	1 0.9%	24 20.5%	55 47.0%	35 29.9%	4.03	4	0.84	117	0
Mud slides		74 63.2%	19 16.2%	16 13.7%	6 5.1%	2 1.7%	1.66	1	1.01	117	0
Flash floods		14 12.0%	24 20.5%	50 42.7%	17 14.5%	12 10.3%	2.91	3	1.11	117	0
Ice storms		39 33.3%	44 37.6%	25 21.4%	8 6.8%	1 0.9%	2.04	2	0.95	117	0
Tornadoes		18 15.4%	40 34.2%	45 38.5%	12 10.3%	2 1.7%	2.49	3	0.93	117	0
Heat waves		6 5.1%	16 13.7%	45 38.5%	37 31.6%	13 11.1%	3.30	3	1.01	117	0

2.) What other weather-related hazards might significantly affect your area?
OPEN-ENDED RESPONSE

3.) In general, how prepared do you think people in your jurisdiction are for each of these hazards?

Sub-question	Variable Name	Not at all prepared	Somewhat prepared	Prepared	Very prepared	Extremely prepared	Does not apply	Mean	Median	SD	n	# missing
	Q3	1	2	3	4	5	6					
Tsunami		48 41.7%	28 24.3%	9 7.8%	4 3.5%	2 1.7%	24 20.9%	1.73	1	0.97	115	2
Snowstorms		34 29.6%	29 25.2%	17 14.8%	11 9.6%	1 0.9%	23 20.0%	2.09	2	1.07	115	2
Hail		21 18.3%	45 39.1%	35 30.4%	9 7.8%	2 1.7%	3 2.6%	2.34	2	0.94	115	2
Heavy rain		0 0.0%	17 14.8%	55 47.8%	31 27.0%	12 10.4%	0 0.0%	3.33	3	0.86	115	2
Wildfires		11 9.6%	51 44.3%	30 26.1%	14 12.2%	3 2.6%	6 5.2%	2.51	2	0.94	115	2
High waves		6 5.2%	39 33.9%	40 34.8%	21 18.3%	4 3.5%	5 4.3%	2.80	3	0.94	115	2
Coastal storms		0 0.0%	24 20.9%	38 33.0%	39 33.9%	12 10.4%	2 1.7%	3.35	3	0.93	115	2
Mud slides		39 33.9%	23 20.0%	9 7.8%	3 2.6%	0 0.0%	41 35.7%	1.68	1	0.85	115	2
Flash floods		11 9.6%	52 45.2%	29 25.2%	12 10.4%	3 2.6%	8 7.0%	2.48	2	0.92	115	2
Ice storms		34 29.6%	45 39.1%	10 8.7%	4 3.5%	1 0.9%	21 18.3%	1.86	2	0.85	115	2
Tornadoes		26 22.6%	52 45.2%	23 20.0%	7 6.1%	3 2.6%	4 3.5%	2.18	2	0.96	115	2
Heat waves		4 3.5%	39 33.9%	44 38.3%	20 17.4%	5 4.3%	3 2.6%	2.85	3	0.91	115	2

4.) Tropical storms include tropical cyclones and hurricanes. An extratropical storm is a large, strong coastal storm that causes large waves and high water levels along the coast, causing flooding and severe erosion. Extratropical storms include extra-tropical cyclones, sometimes called mid-latitude cyclones or wave cyclones, in the middle or high latitudes. For instance, a nor'easter is a common extratropical storm that moves along the east coast of North America with winds blowing from a northeasterly direction. How would you rate the vulnerability of your jurisdiction to tropical storms and extratropical storms that produce at least gale-force (39-54 mph) winds?

Sub-question	Variable Name	Extremely vulnerable	Very vulnerable	Vulnerable	Somewhat vulnerable	Not at all vulnerable	Mean	Median	SD	n	# missing
	Q4	1	2	3	4	5					
Tropical Storms		48 42.5%	24 21.2%	12 10.6%	18 15.9%	11 9.7%	2.29	2	1.41	113	4
Extratropical Storms		41 36.8%	21 18.4%	16 14.0%	25 21.9%	10 8.8%	2.49	2	1.40	113	4

5.) All tropical and extratropical storm systems are different, but in general, if a severe storm were predicted for your area, to what extent would you be concerned about each of the following hazards?

Sub-question	Variable Name	Extremely concerned	Very concerned	Concerned	A little concerned	Not concerned at all	Does not apply	Mean	Median	SD	n	# missing
	Q5	1	2	3	4	5	6					
Storm Surge		49 43.4%	42 37.2%	16 14.2%	6 5.3%	0 0.0%	0 0.0%	1.81	2	0.87	113	4
Wind		39 34.5%	54 47.8%	18 15.9%	2 1.8%	0 0.0%	0 0.0%	1.85	2	0.75	113	4
Tornadoes		36 31.9%	34 30.1%	19 16.8%	12 10.6%	5 4.4%	7 6.2%	2.21	2	1.17	113	4
Inland Flooding		37 32.7%	39 34.5%	25 22.1%	11 9.7%	0 0.0%	1 0.9%	2.09	2	0.97	113	4
Heavy Snow		10 8.8%	16 14.2%	21 18.6%	16 14.2%	10 8.8%	40 35.4%	3.00	3	1.25	113	4

6.) What other hazards associated with tropical or extratropical storms are of special concern in your area?
OPEN-ENDED RESPONSE

7.) What portion of your jurisdiction's population do you think live in areas vulnerable to storm surge or coastal flooding?

Variable Name	None	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Other	Mean	Median	SD	n	# missing
Q7	1	2	3	4	5	6	7	8	9	10	11	12					
	0 0.0%	18 16.2%	20 18.0%	17 15.3%	10 9.0%	7 6.3%	9 8.1%	12 10.8%	6 5.4%	4 3.6%	4 3.6%	4 3.6%	5.41	5	2.90	111	6

8.) Of those who are vulnerable, what portion would do you think adequately understand their storm surge or coastal flooding vulnerability?

Variable Name	None	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%	Other	Mean	Median	SD	n	# missing
Q8	1	2	3	4	5	6	7	8	9	10	11	12					
	1 0.9%	17 15.3%	10 9.0%	22 19.8%	11 9.9%	20 18.0%	5 4.5%	4 3.6%	11 9.9%	8 7.2%	1 0.9%	1 0.9%	5.38	5	2.61	111	6

9.) How many times would you estimate your agency has been activated during the last 10 years for the following?

Sub-question	Variable Name	0	1-2	3-4	5-6	7-8	9-10	More than 10	Mean	Median	SD	n	# missing
	Q9	1	2	3	4	5	6	7					
Tropical Storms		16 14.5%	11 10.0%	17 15.5%	26 23.6%	15 13.6%	5 4.5%	20 18.2%	3.98	4	1.96	110	7
Hurricanes		22 20.0%	12 10.9%	29 26.4%	22 20.0%	7 6.4%	5 4.5%	13 11.8%	3.43	3	1.87	110	7
Extratropical Storms		28 25.5%	31 28.2%	17 15.5%	14 12.7%	7 6.4%	6 5.5%	7 6.4%	2.88	2	1.79	110	7

STORM SURGE FORECAST PRODUCT

For tropical storms the Saffir-Simpson Hurricane Wind Scale and watches and warnings are based on wind speeds. Due to the lack of consistent correlation between wind and surge, storm surge information has been removed from the scale. This has led to an investigation of how surge information should be communicated for BOTH tropical and extratropical cyclones.

12.) To what extent do you agree or disagree with the following options:

Sub-question	Variable Name	Strongly Disagree	Not very likely	Likely	Very likely	Extremely likely	Mean	Median	SD	n	# missing
	Q12	1	2	3	4	5					
The NWS should issue Storm Surge Warnings		9 8.2%	2 1.8%	3 2.7%	41 37.3%	55 50.0%	4.19	5	1.15	110	7
The NWS should issue Storm Surge Watches		9 8.2%	3 2.7%	7 6.4%	42 38.2%	49 44.5%	4.08	4	1.17	110	7

13.) Why or why not?
OPEN-ENDED RESPONSE

14.) If a separate warning product is issued for the surge or coastal flooding associated with tropical and extratropical storms, how would you evaluate each of these possible names?

Sub-question	Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
	Q14	1	2	3	4	5					
Extreme Coastal Flood Warning		15 14.0%	16 15.0%	26 24.3%	28 26.2%	22 20.6%	3.24	3	1.32	107	10
Storm Surge Warning		3 2.8%	8 7.5%	24 22.4%	41 38.3%	31 29.0%	3.83	4	1.02	107	10
Storm Surge Risk		22 20.6%	21 19.6%	32 29.9%	21 19.6%	11 10.3%	2.79	3	1.26	107	10
Storm Surge Danger		22 20.6%	25 23.4%	31 29.0%	18 16.8%	11 10.3%	2.73	3	1.26	107	10

15.) What other name would you suggest or what other comments would you like to make about what it should be called?
OPEN-ENDED RESPONSE

16.) Do you think a separate NWS warning for surge would result in the public paying greater attention to a coastal flooding or storm surge threat?

Variable Name	Definitely not	Probably not	Possibly	Probably	Definitely	Mean	Median	SD	n	# missing
Q16	1	2	3	4	5					
	1 0.9%	9 8.4%	32 29.9%	38 35.5%	27 25.2%	3.76	4	0.96	107	10

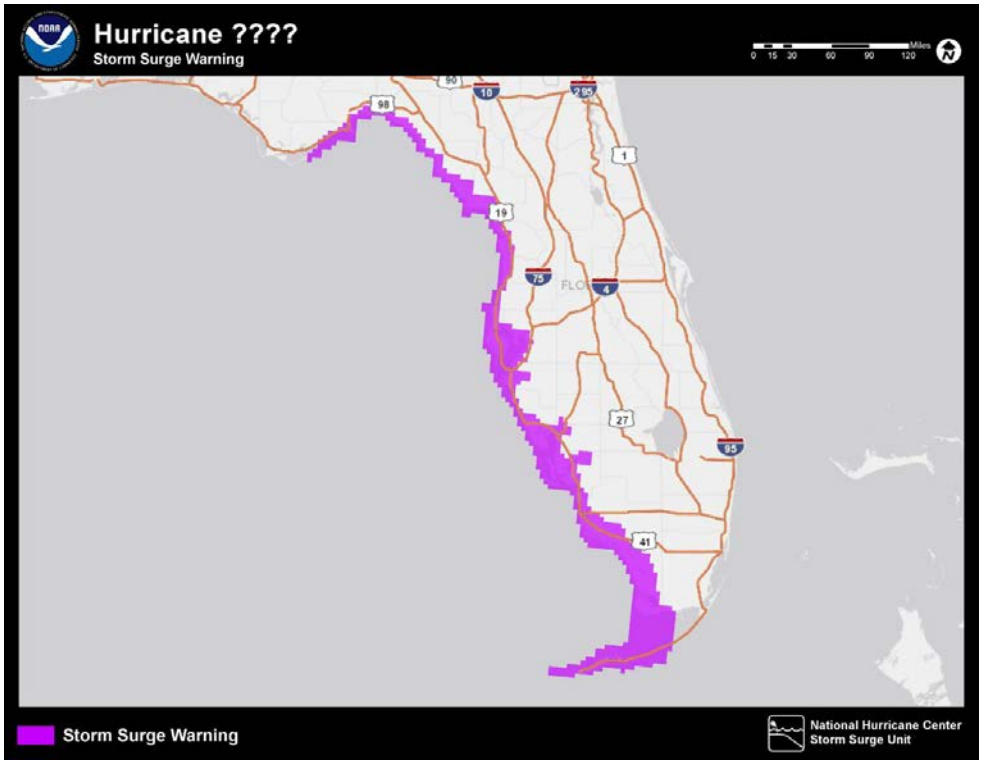
17.) Do you think a separate NWS warning for storm surge would result in a better informed response by your jurisdiction?

Variable Name	Definitely not	Probably not	Possibly	Probably	Definitely	Mean	Median	SD	n	# missing
Q17	1	2	3	4	5					
	2 1.9%	6 5.6%	23 21.5%	43 40.2%	33 30.8%	3.93	4	0.96	107	10

18.) Would a separate NWS warning for storm surge result in greater emphasis of coastal flooding or storm surge threat in your emergency management decision making?

Variable Name	Definitely not	Probably not	Possibly	Probably	Definitely	Mean	Median	SD	n	# missing
Q18	1	2	3	4	5					
	4 3.7%	6 5.6%	22 20.6%	34 31.8%	41 38.3%	3.95	4	1.08	107	10

If a separate warning for storm surge is issued, a map will show the area included in the warning, as currently done for other warnings. (Local inundation maps will also be released.) The color purple is used in this example in order to avoid colors used for other NWS watches and warnings.



19.) How effective do you think a map like this would be in communicating to the public the area under storm surge or coastal flooding warning?

Variable Name	Not effective at all	Not very effective	Effective	Very effective	Extremely effective	Mean	Median	SD	n	# missing
Q19	1	2	3	4	5					
	0 0.0%	8 7.5%	29 27.1%	44 41.1%	26 24.3%	3.82	4	0.89	107	10

20.) Please provide any additional comments or thoughts about this map.
OPEN-ENDED RESPONSE

COASTAL FLOODING MAPS

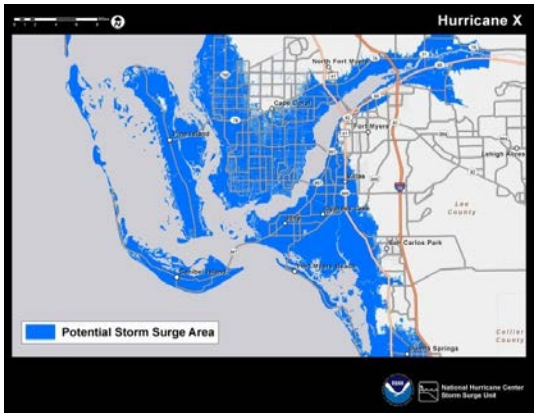
To improve storm surge communication in tropical events the National Hurricane Center (NHC) is developing storm-specific inundation maps for tropical cyclones for its websites. Similar maps could be developed for extratropical storm surge events in the future. Therefore, we welcome the opinions of those of you from regions not subject to tropical cyclones. These maps show estimates of the amount of ocean water (including tides) expected on top of the land. The elevation above sea level of that general area will already have been subtracted.

21.) We are searching for the best way to label this so people understand. Please assess how clear or easy to understand you think each of these labels would be for the public.

Sub-question	Variable Name	Not at all clear	Not very clear	Clear	Very clear	Extremely clear	Mean	Median	SD	n	# missing
	Q21	1	2	3	4	5					
Above Ground Level		10 9.5%	25 23.8%	38 36.2%	22 21.0%	10 9.5%	2.97	3	1.10	105	12
Above Ground		11 10.5%	48 45.7%	29 27.6%	13 12.4%	4 3.8%	2.53	2	0.97	105	12
Above Elevation		33 31.4%	52 49.5%	14 13.3%	3 2.9%	3 2.9%	1.96	2	0.91	105	12
Depth of Water Above Land		5 4.8%	18 17.1%	41 39.0%	29 27.6%	12 11.4%	3.24	3	1.02	105	12
Height of Water Above Land		2 1.9%	16 15.2%	37 35.2%	30 28.6%	20 19.0%	3.48	3	1.03	105	12

22.) Please suggest another label you think would be clear to the public.
OPEN-ENDED RESPONSE

Next you will see 3 different ways coastal flooding might be mapped. A past hurricane forecast for Lee County, Florida is used for the example. The NHC would put maps like this on its website for any area under a surge warning. Similar maps might be developed in the future for extratropical storms. You will be asked to comment on each map individually, and then to choose the one you think would be most effective. Please click CONTINUE to proceed.



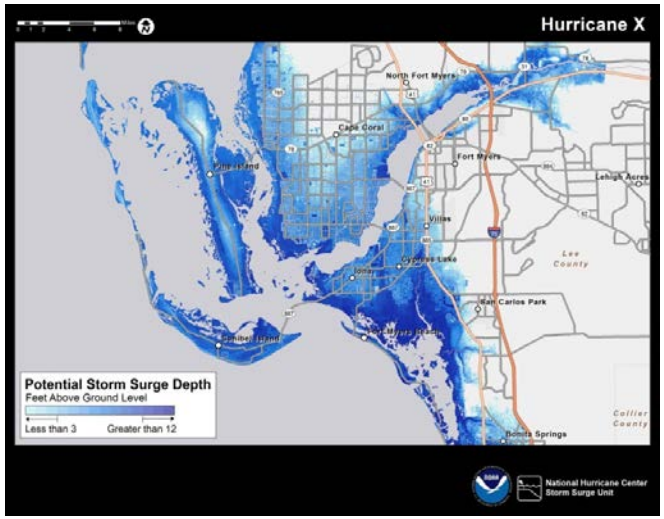
23.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q23	1	2	3	4	5					
	3 2.9%	16 15.2%	39 37.1%	34 32.4%	13 12.4%	3.36	3	0.98	105	12

24.) How would you rate the usefulness of this map for communicating to the public what they need to know about potential storm surge?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q24	1	2	3	4	5					
	6 5.7%	20 19.0%	39 37.1%	27 25.7%	13 12.4%	3.20	3	1.07	105	12

25.) Please provide any additional comments or thoughts about this map.
OPEN-ENDED RESPONSE



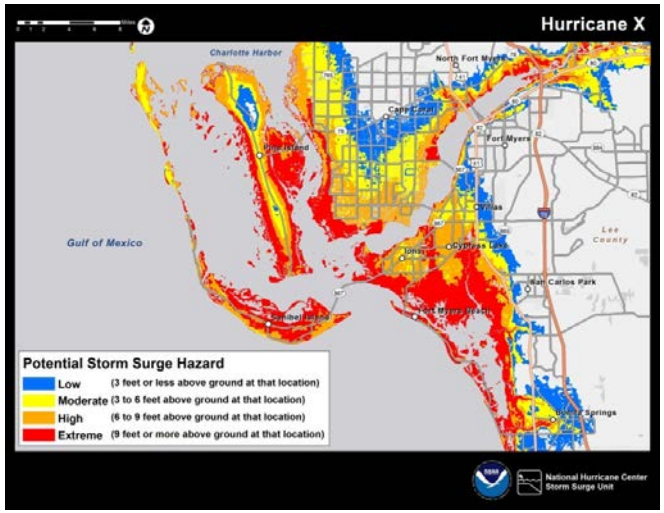
26.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q26	1	2	3	4	5					
	6 5.8%	20 19.4%	29 28.2%	36 35.0%	12 11.7%	3.27	3	1.09	103	14

27.) How would you rate the usefulness of this map for communicating to the public what they need to know about potential storm surge?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q27	1	2	3	4	5					
	10 9.7%	18 17.5%	34 33.0%	29 28.2%	12 11.7%	3.15	3	1.14	103	14

28.) Please provide any additional comments or thoughts about this map.
OPEN-ENDED RESPONSE



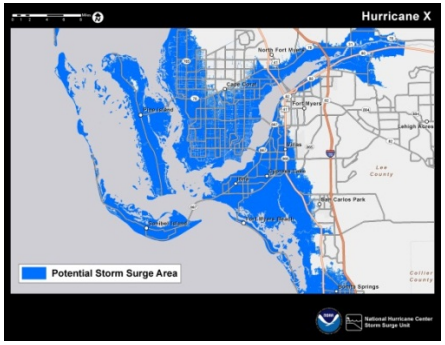
29.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q29	1	2	3	4	5					
	4 3.9%	10 9.8%	12 11.8%	37 36.3%	39 38.2%	3.95	4	1.12	102	15

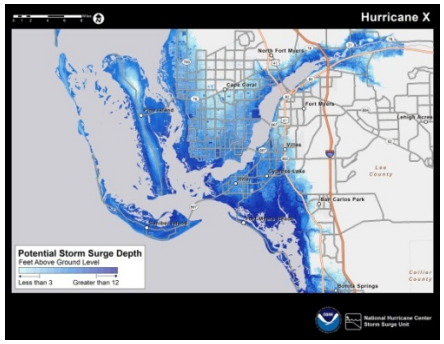
30.) How would you rate the usefulness of this map for communicating to the public what they need to know about potential storm surge?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q30	1	2	3	4	5					
	5 4.9%	11 10.8%	12 11.8%	37 36.3%	37 36.3%	3.88	4	1.16	102	15

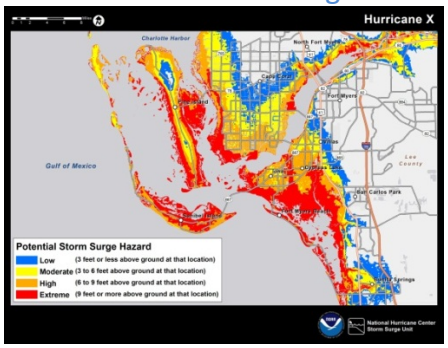
31.) Please provide any additional comments or thoughts about this map.
OPEN-ENDED RESPONSE



All Blue



Blue with Shading



Multi-Colored

32.) If the NHC uses only one of these inundation maps on its website, which do you think is BEST?

Variable Name	**All Blue** – one shade of blue shows entire area under threat	**Blue with Shading** – shades of blue show range of potential storm surge depth	**Multi-Colored** – colors show 4 levels with potential range of surge depth for each	Mean	Median	SD	n	# missing
Q32	1	2	3					
	14 13.7%	7 6.9%	81 79.4%	2.66	3	0.71	102	15

33.) Why do you think it is best?**OPEN-ENDED RESPONSE**

34.) Thinking about the one you choose, how would you rate it on these qualities?

Sub-question	Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
	Q34	1	2	3	4	5					
Easy to Understand		0 0.0%	3 2.9%	15 14.7%	50 49.0%	34 33.3%	4.13	4	0.77	102	15
Provides Useful Information		2 2.0%	0 0.0%	16 15.7%	51 50.0%	33 32.4%	4.11	4	0.81	102	15
Communicates the Risk		2 2.0%	3 2.9%	12 11.8%	48 47.1%	37 36.3%	4.13	4	0.88	102	15
Promotes Protective Action		5 4.9%	9 8.8%	19 18.6%	45 44.1%	24 23.5%	3.73	4	1.07	102	15

35.) Please provide any additional comments or thoughts regarding surge inundation maps.**OPEN-ENDED RESPONSE**

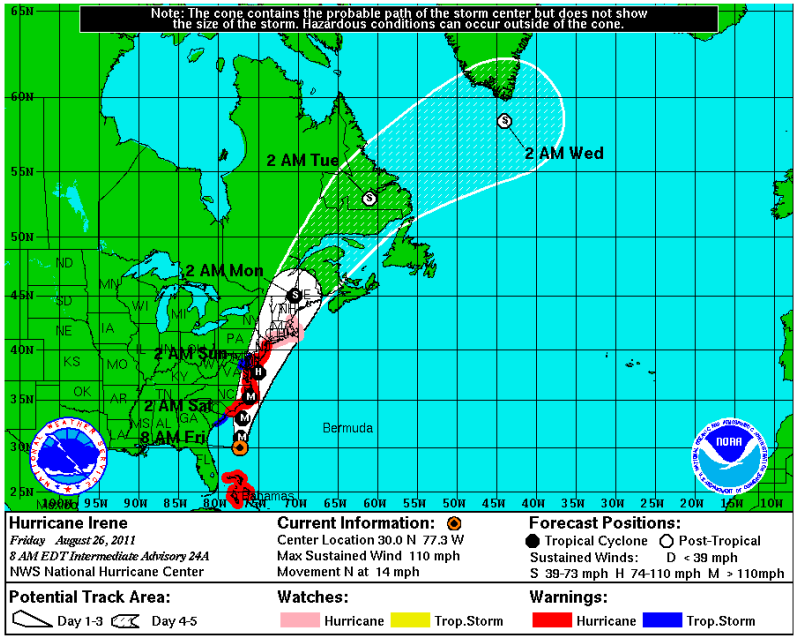
36.) We need to ask again in order to direct you to the next section of the survey - Do you work in an area that can be impacted by tropical cyclones?

Variable Name	Yes	No
Q36	1	2
	81 79.4%	21 20.6%

➔ If "No", go to Q63

TROPICAL CYCLONE FORECAST CONE

Below is the Forecast Cone as it appeared in the Hurricane Irene forecast. As you know, the Cone represents the probable track of the center of a tropical cyclone. It uses official forecast errors over a 5-year sample to estimate that the center will remain within the cone approximately two-thirds of the time.



37.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

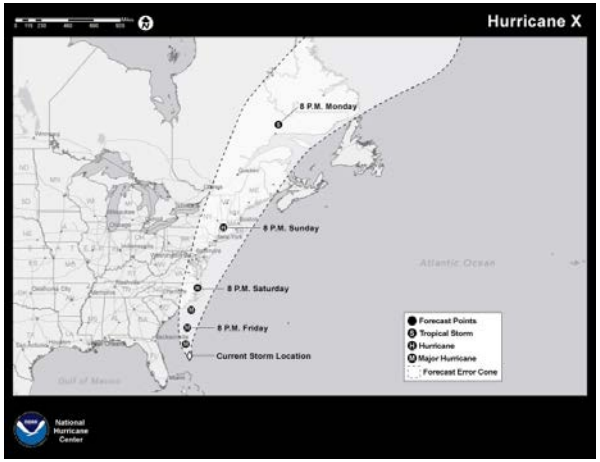
Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q37	1	2	3	4	5					
	1 1.2%	10 12.3%	30 37.0%	31 38.3%	9 11.1%	3.46	4	0.90	81	0

➔ n* = 81 because it does not include the 21 who answered "no" to Q36

38.) How would you rate the usefulness of this map for communicating to the public what they need to know about the track of a threatening tropical cyclone?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q38	1	2	3	4	5					
	1 1.2%	12 14.8%	25 30.9%	36 44.4%	7 8.6%	3.44	4	0.89	81	0

39.) Please provide any additional comments or thoughts about this graphic.
OPEN-ENDED RESPONSE



40.) The Forecast Cone in the next graphic is transparent with DASHED LINES to indicate that the storm can extend beyond the cone. Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

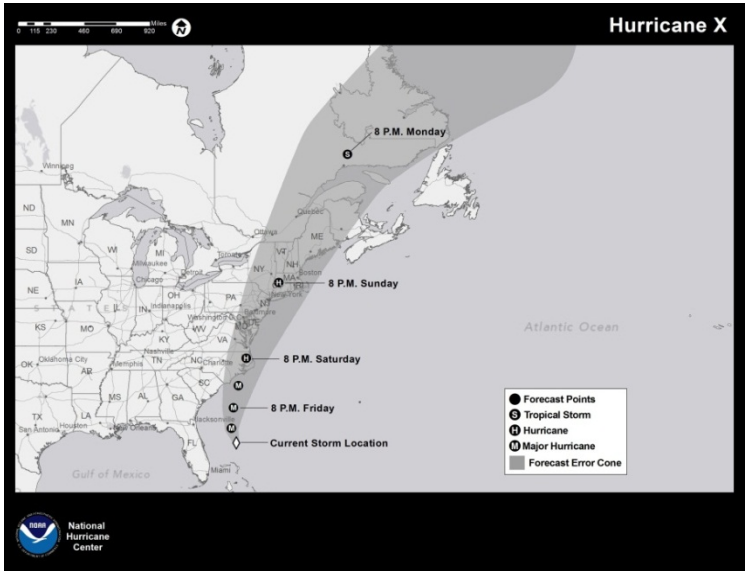
Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q40	1	2	3	4	5					
	2 2.5%	26 32.1%	30 37.0%	19 23.5%	4 4.9%	2.96	3	0.93	81	0

41.) How would you rate the usefulness of this map for communicating to the public what they need to know about their chance of being affected by this storm?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q41	1	2	3	4	5					
	5 6.2%	23 28.4%	31 38.3%	19 23.5%	3 3.7%	2.90	3	0.96	81	0

42.) Please provide any additional comments or thoughts about this graphic.

OPEN-ENDED RESPONSE



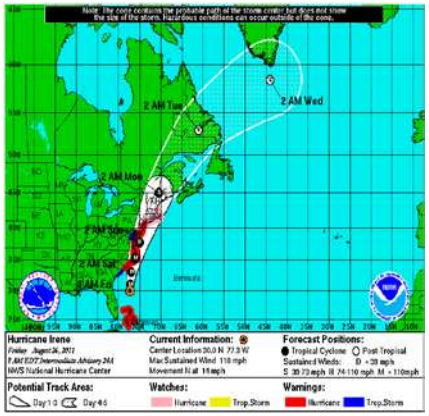
43.) The Forecast Cone in the next graphic is transparent with NO LINES to indicate that the storm can extend beyond the cone. Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q43	1	2	3	4	5					
	8 9.9%	16 19.8%	37 45.7%	18 22.2%	2 2.5%	2.88	3	0.95	81	0

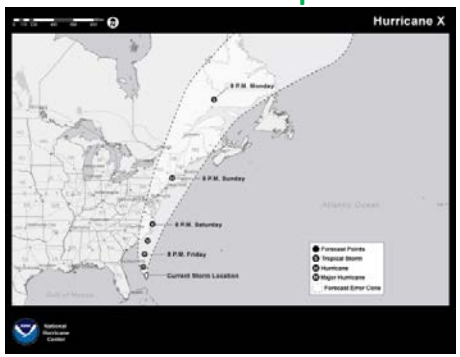
44.) How would you rate the usefulness of this map for communicating to the public what they need to know about their chance of being affected by this storm?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q44	1	2	3	4	5					
	8 9.9%	15 18.5%	38 46.9%	18 22.2%	2 2.5%	2.89	3	0.95	81	0

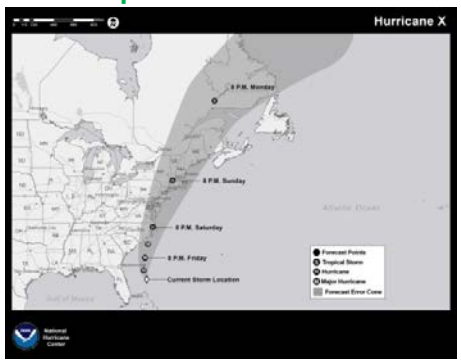
45.) Please provide any additional comments or thoughts about this graphic.
OPEN-ENDED RESPONSE



Current Map



Map with Dashed Lines



Map with no Dashed Lines

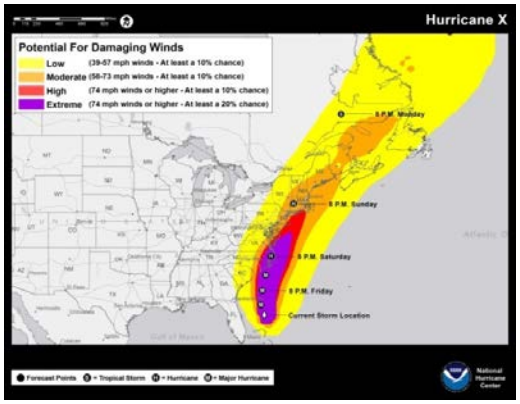
46.) Which do you prefer?

Variable Name	Current forecast cone	Transparent cone with dashed lines	Transparent cone with no lines	Mean	Median	SD	n*	# missing
Q46	1	2	3					
	52 64.2%	12 14.8%	17 21.0%	1.57	1	0.82	81	0

47.) Please provide your suggestions or comments regarding the Track Forecast Cone.
OPEN-ENDED RESPONSE

POTENTIAL FOR DAMAGING WINDS

The next map shows areas with varying potential for experiencing damaging winds from this storm.



48.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q48	1	2	3	4	5					
	1 1.3%	6 7.5%	28 35.0%	29 36.3%	16 20.0%	3.66	4	0.93	80	1

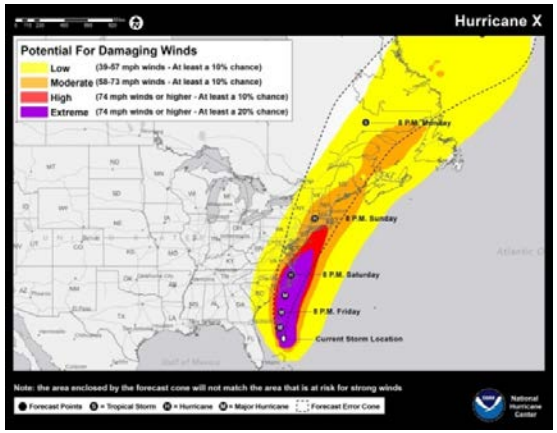
49.) How would you rate the usefulness of this map for communicating to the public what they need to know about their chances of experiencing damaging winds?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q49	1	2	3	4	5					
	1 1.3%	4 5.0%	30 37.5%	29 36.3%	16 20.0%	3.69	4	0.89	80	1

50.) Please provide any additional comments or thoughts about this graphic. OPEN-ENDED RESPONSE

WIND PLUS CONE

The next two maps combine the track cone and damaging wind information.



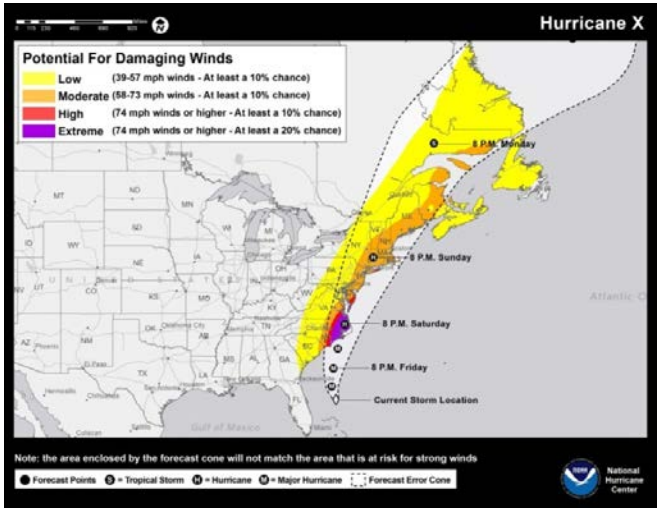
51.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q51	1	2	3	4	5					
	7 8.8%	13 16.3%	19 23.8%	32 40.0%	9 11.3%	3.29	4	1.14	80	1

52.) How would you rate the usefulness of this map for communicating to the public what they need to know about their potential for being affected by this storm?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q52	1	2	3	4	5					
	7 8.8%	13 16.3%	18 22.5%	34 42.5%	8 10.0%	3.29	4	1.13	80	1

53.) Please provide any additional comments or thoughts about this graphic.OPEN-ENDED RESPONSE



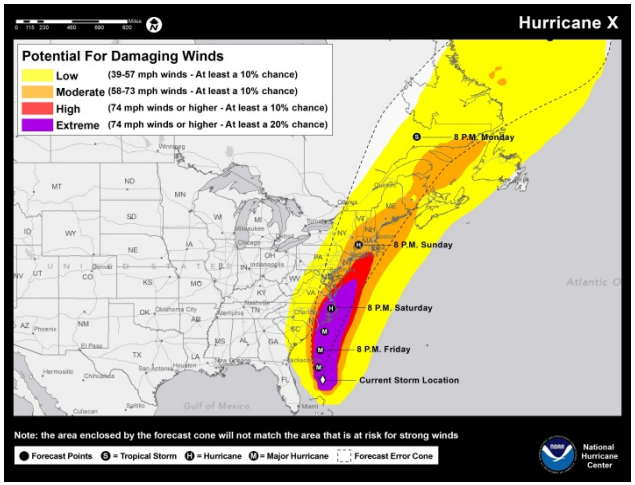
54.) This graphic also combines the track and wind information, but this time it's only illustrated over the land area. Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q54	1	2	3	4	5					
	8 10.0%	19 23.8%	17 21.3%	28 35.0%	8 10.0%	3.11	3	1.18	80	1

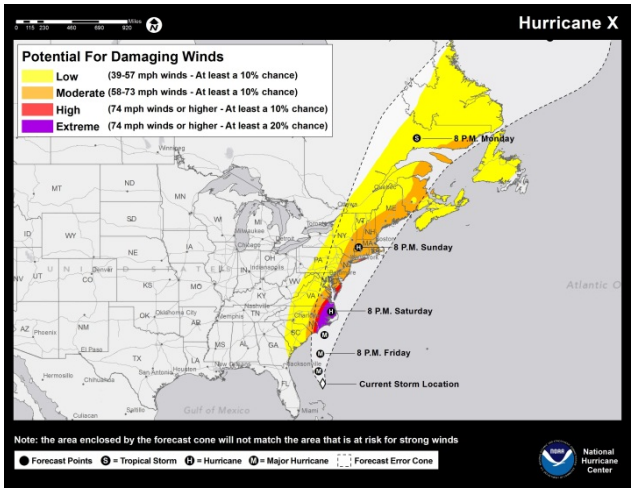
55.) How would you rate the usefulness of this map for communicating to the public what they need to know about their potential for being affected by this storm?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q55	1	2	3	4	5					
	8 10.0%	21 26.3%	14 17.5%	29 36.3%	8 10.0%	3.10	3	1.20	80	1

56.) Please provide any additional comments or thoughts about this graphic.OPEN-ENDED RESPONSE



On Land & Water



On Land Only

57.) The areas most likely to be affected by this storm are coastal North Carolina and Virginia. Which map do you think best communicates the urgency to those areas?

Variable Name	On land & water	On land only	Not sure/don't know	Mean	Median	SD	n*	# missing
Q57	1	2	3					
	51 63.8%	26 32.5%	3 3.8%	1.34	1	0.48	80	1

58.) Why do you think this is the best one?
OPEN-ENDED RESPONSE

59.) Do you have any comments you'd like to make about these graphics?
OPEN-ENDED RESPONSE

ARRIVAL OF TROPICAL STORM FORCE WINDS

Emergency managers have been asking NWS to provide information about when to expect the arrival of tropical storm force winds (39 mph or higher that last at least one minute) as all preparations should be completed by then. The following map depicts the approximate time when areas on the East Coast should expect Tropical Storm Force Winds from this storm.

60.) Taking the perspective of the general public, how would you evaluate this map in terms of ease of understanding?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q60	1	2	3	4	5					
	4 5.0%	10 12.5%	28 35.0%	29 36.3%	9 11.3%	3.36	3	1.01	80	1

61.) How would you rate the usefulness of this map for communicating to the public when they should be ready?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n*	# missing
Q61	1	2	3	4	5					
	5 6.3%	11 13.8%	24 30.0%	31 38.8%	9 11.3%	3.35	4	1.06	80	1

62.) Please provide any additional comments or thoughts about this graphic.
OPEN-ENDED RESPONSE

TROPICAL AND EXTRATROPICAL WEATHER INFORMATION SOURCES

63.) What, if any, special issues or challenges do you have in receiving and using NWS tropical and/or severe costal storm forecast and warning data in your work?
OPEN-ENDED RESPONSE

64.) What, if anything, is the single most important change the NWS could make to improve its severe coastal storm forecast and warning products and services?
OPEN-ENDED RESPONSE

65.) In what town or city is the NWS office for your jurisdiction located? If more than one serves your area, please list them all. If you are not sure or you do not know, simply click Continue to skip this question.
OPEN-ENDED RESPONSE

66.) How would you rate your relationship with your local National Weather Service Forecast Office(s)?

Variable Name	Poor	Fair	Good	Very Good	Excellent	Mean	Median	SD	n	# missing
Q66	1	2	3	4	5					
	0 0.0%	0 0.0%	5 5.0%	19 18.8%	77 76.2%	4.71	5	0.55	101	16

67.) Please provide any additional comments or thoughts about that relationship.
OPEN-ENDED RESPONSE

68.) Do you use a paid commercial vendor for weather forecast information?

Variable Name	Yes	No
Q68	1	2
	29 28.7%	72 71.3%

➔ if "yes", go to Q68a and Q68b

68a.) Please list your paid commercial vendor for weather forecast information?

OPEN-ENDED RESPONSE

68b.) To what extent is each of these an important reason for using a commercial vendor in addition to the products and services NWS provides?

Sub-question	Variable Name	Not important at all	Not very important	Important	Very important	Extremely important	Mean	Median	SD	n*	# missing
	Q68b	1	2	3	4	5					
Data reliability		2 6.9%	3 10.3%	19 65.5%	2 6.9%	3 10.3%	3.03	3	0.94	29	0
Better graphics		5 17.2%	6 20.7%	11 37.9%	4 13.8%	3 10.3%	2.79	3	1.21	29	0
Tailored to my market		2 6.9%	5 17.2%	11 37.9%	8 27.6%	3 10.3%	3.17	3	1.07	29	0
Timeliness		3 10.3%	2 6.9%	11 37.9%	7 24.1%	6 20.7%	3.38	3	1.21	29	0
More model information		2 6.9%	5 17.2%	12 41.4%	8 27.6%	2 6.9%	3.10	3	1.01	29	0
Interpretation of NWS data		5 17.2%	4 13.8%	11 37.9%	5 17.2%	4 13.8%	2.97	3	1.27	29	0

➔ n* = 29 because it does not include the 72 who answered “no” to Q68

69.) If a hurricane or severe coastal storm threatens your area, to what extent do you go to each of the following sources for your forecast information?

Sub-question	Variable Name	Never	Rarely	Occasionally	Often	Frequently	Mean	Median	SD	n	# missing
	Q69	1	2	3	4	5					
Local TV news		4 4.0%	14 13.9%	23 22.8%	37 36.6%	23 22.8%	3.60	4	1.11	101	16
National TV (e.g., ABC, CBS, NBC, CNN, or FOX)		8 7.9%	21 20.8%	33 32.7%	23 22.8%	16 15.8%	3.18	3	1.17	101	16
The Weather Channel on TV		6 5.9%	16 15.8%	34 33.7%	22 21.8%	23 22.8%	3.40	3	1.18	101	16
Local Radio		8 7.9%	26 25.7%	40 39.6%	17 16.8%	10 9.9%	2.95	3	1.07	101	16
Weather Underground		17 16.8%	18 17.8%	33 32.7%	19 18.8%	14 13.9%	2.95	3	1.27	101	16
NOAA Weather Radio		8 7.9%	20 19.8%	22 21.8%	21 20.8%	30 29.7%	3.45	4	1.32	101	16
Internet		2 2.0%	1 1.0%	7 6.9%	29 28.7%	62 61.4%	4.47	5	0.83	101	16

70.) What other public sources do you use?
OPEN-ENDED RESPONSE

71.) How much will you probably use each of these websites for storm information?

Sub-question	Variable Name	Never	Rarely	Occasionally	Often	Frequently	Mean	Median	SD	n	# missing
	Q71	1	2	3	4	5					
Local TV news websites		8 8.0%	24 24.0%	37 37.0%	16 16.0%	15 15.0%	3.06	3	1.15	100	17
National TV news websites		15 15.0%	29 29.0%	35 35.0%	12 12.0%	9 9.0%	2.71	3	1.14	100	17
National Hurricane Center website		14 14.0%	2 2.0%	5 5.0%	18 18.0%	61 61.0%	4.10	5	1.42	100	17
Local office of weather service website		1 1.0%	0 0.0%	8 8.0%	23 23.0%	68 68.0%	4.57	5	0.73	100	17
Other NOAA website		2 2.0%	8 8.0%	19 19.0%	33 33.0%	38 38.0%	3.97	4	1.04	100	17
Weather Channel website		11 11.0%	22 22.0%	40 40.0%	15 15.0%	12 12.0%	2.95	3	1.14	100	17
Weather Underground website		19 19.0%	23 23.0%	25 25.0%	17 17.0%	16 16.0%	2.88	3	1.34	100	17
Other weather website		10 10.0%	10 10.0%	48 48.0%	18 18.0%	14 14.0%	3.16	3	1.11	100	17
State emergency management website		3 3.0%	13 13.0%	29 29.0%	28 28.0%	27 27.0%	3.63	4	1.11	100	17

72.) Are there any other websites you'd like to mention?
OPEN-ENDED RESPONSE

SOCIO-DEMOGRAPHICS

D1. In what state or territory are you located?
OPEN-ENDED RESPONSE

D2. What is the ZIPCODE of your office?
OPEN-ENDED RESPONSE

D3. What is the official name of your agency?
OPEN-ENDED RESPONSE

D4. Which best describes your jurisdiction?

Variable Name	City or town	County, parish, or borough	Regional	State	Other	Mean	Median	SD	n	# missing
QD4	1	2	3	4	5					
	8 8.0%	91 91.0%	0 0.0%	1 1.0%	0 0.0%	1.94	2	0.34	100	17

D5. Please list the major counties, parishes or boroughs located within your jurisdiction.
OPEN-ENDED RESPONSE

D6. Please list any major cities located within your jurisdiction.
OPEN-ENDED RESPONSE

D7. What is the approximate population of your jurisdiction?

Variable Name	Under 50,000	Between 50,000 and 100,000	Between 100,000 and 500,000	Between 500,000 and 1,000,000	Over 1,000,000	Mean	Median	SD	n	# missing
QD7	1	2	3	4	5					
	33 33.0%	20 20.0%	31 31.0%	8 8.0%	8 8.0%	2.38	2	1.25	100	17

D8. What is your official title?

Variable Name	Director or Chief of Emergency Management	Emergency Manager	Director of Public Safety (or equivalent)	Other	Mean	Median	SD	n	# missing
QD8	1	2	3	4					
	58 58.0%	28 28.0%	0 0.0%	14 14.0%	1.70	1	1.03	100	17

D9. How many years have you been in emergency management?
OPEN-ENDED RESPONSE

D10. How long have you been in your current position?
OPEN-ENDED RESPONSE

D12. Finally – If you know of another emergency manager who would provide useful information for this survey please provide us with his or her name, email address, and telephone number and we will invite them to complete the survey as well. Note- they cannot simply complete it using the same link you were provided but must be "invited."
OPEN-ENDED RESPONSE

D13. What else would you like to say regarding the NWS tropical or extratropical cyclone products or about this survey?
OPEN-ENDED RESPONSE

COMPLETION

We greatly appreciate the time you took to complete this survey. Thank you! Please click the FINISH button below to record your responses.