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U. S. DEPARTMENT OF COMMERCE

FIELD OVERSIGHT HEARING ON
"HURRICANE SEASON AND RISK FOR SOUTH CAROLINA"

BEFORE THE
COMMITTEE ON COMMERCE, SCIENCE AND TRANSPORTATION
SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION
UNITED STATES SENATE

AUGUST 17, 2006

Mr. Chairman and Members of the Committee, I am John Jones, Deputy Director of the National Weather Service at the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. Thank you for inviting me here today to discuss the outlook for the remainder of the 2006 Hurricane Season, the threat posed to South Carolina by hurricanes and the work of National Weather Service (NWS) offices in forecasting inland threats from these storms.

First, I would like to thank you for your support of NOAA and our hurricane program. Your support enables us to make the best forecasts possible, helping to ensure the people of our nation understand the potential effects from hurricanes, and what action they can take to protect their life and property. The FY 2006 Hurricane Supplemental Funding approved by Congress is being used as directed, including funding forecast model improvements, storm surge and inland hurricane forecasting improvements. Thank you again for your support.

On August 8th, NOAA revised its prediction for the 2006 Atlantic Hurricane Season. The official hurricane season started June 1st and goes through November 30th, with the average peak of hurricane activity occurring with the warmest water temperatures, from now to late October. So far this year there have been 3 tropical storms (Alberto, Beryl, Chris). For the rest of the 2006 Atlantic Hurricane season, NOAA is predicting 9-12 more tropical storms, with 7-9 becoming hurricanes, of which 3-4 could become major hurricanes. A major hurricane is a storm Category 3 or higher on the Saffir-Simpson hurricane scale, with winds greater than 110 miles per hour. Major hurricanes cause about 80 percent of the damage sustained from tropical cyclones.

Our forecast for the remainder of this season is based primarily on the continuing Multi-Decadal Signal in the global tropics — a climate pattern in place since 1995. Since the

mid-1990s, nine of the last 11 hurricane seasons have been above normal, with only two below normal seasons during the El Niño years of 1997 and 2002. This multi-decadal signal will likely keep us in an active period for major hurricanes for another 10 to 20 years or more.

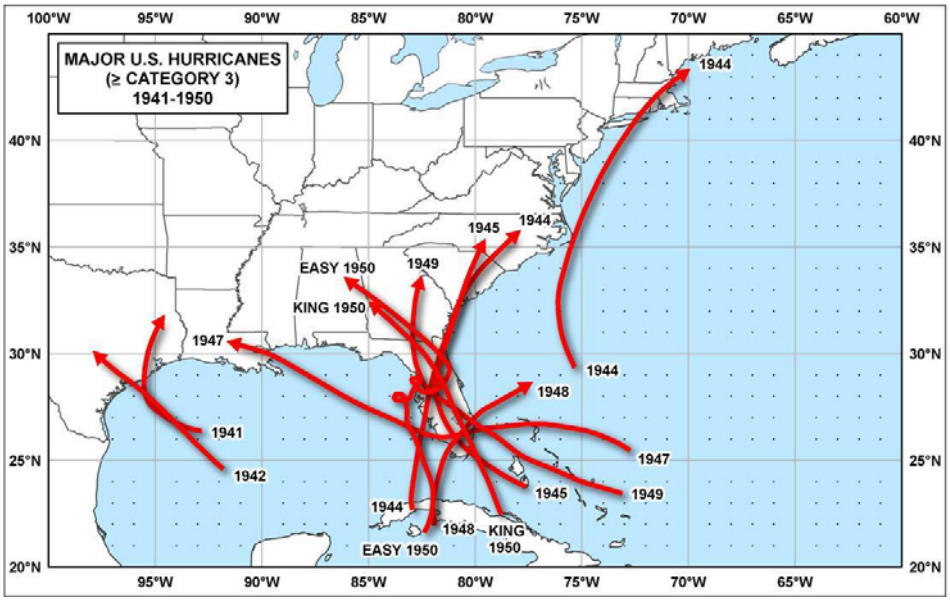
Warmer ocean water temperatures in the tropical Atlantic Ocean and Caribbean, combined with expected weaker easterly trade winds and a more favorable wind pattern in the mid-levels of the atmosphere, are factors that collectively will favor storms in greater numbers and greater intensity. Warm water is the energy source for storms while favorable wind patterns limit the wind shear that can tear apart a storm's building cloud structure.

NOAA is actively engaged in research to understand how climate variability and change may affect hurricane frequency and intensity. For example, climate effects from outside the Atlantic basin, such as El Niño/Southern Oscillation (ENSO), can impact hurricane formation in the Atlantic basin. This year, however, NOAA scientists predict neutral ENSO conditions, which means neither El Niño conditions (which tend to suppress hurricane formation), nor La Niña conditions (which tend to favor hurricane formation), will be a factor in this year's hurricane season.

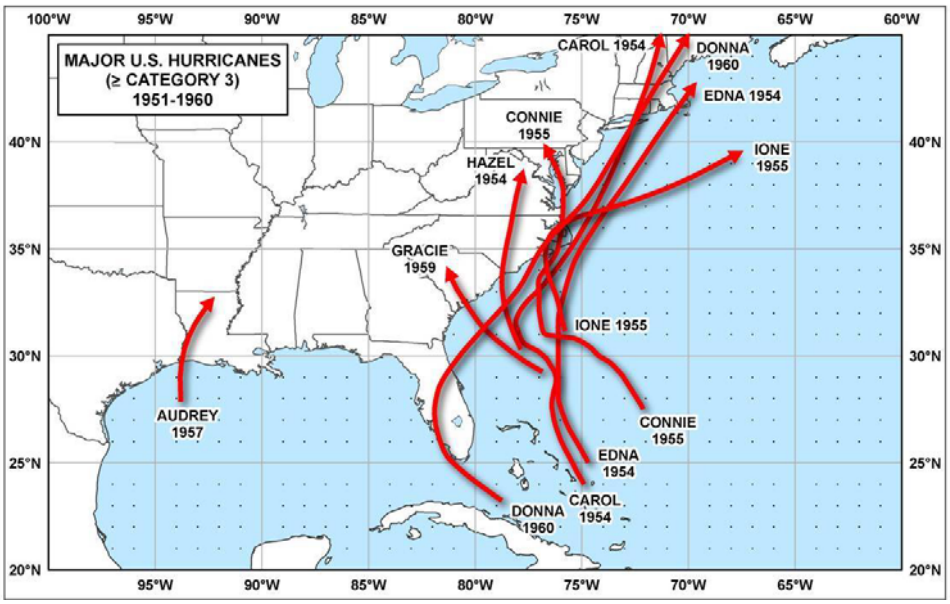
Last year was a record-setting hurricane season, with 28 storms and 15 hurricanes, of which seven were major hurricanes. We know all too vividly the destruction and devastation a *single* hurricane can cause. That is why it is important not to focus only on the total number of storms. The message is clear. We all need to be prepared.

Multi-decadal Climate Patterns

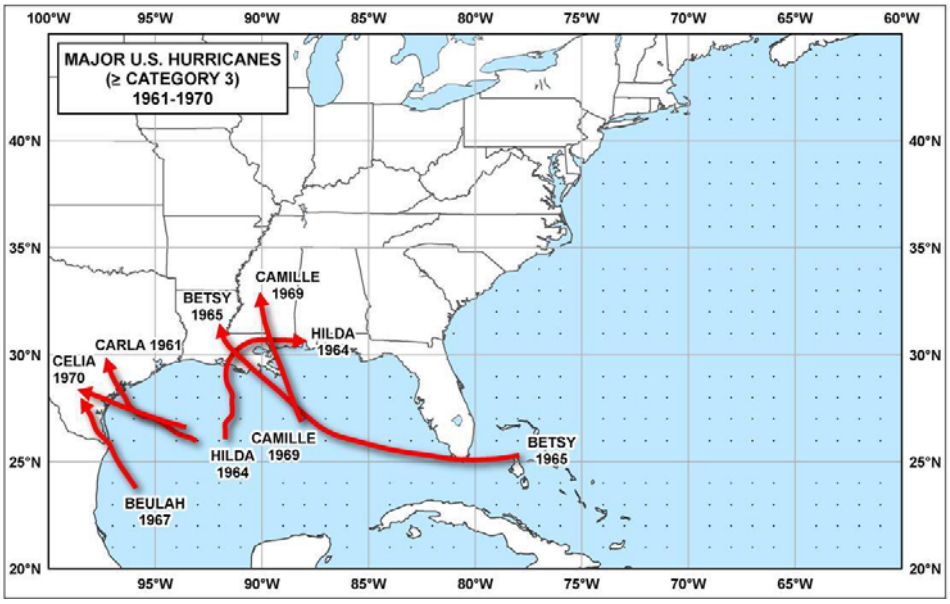
We observed that steering patterns for major hurricane landfalls can *sometimes* persist over several years. As shown in the three graphics below, during the 1940s many major hurricanes hit Florida. During the 1950s, the focus of land-falling hurricanes shifted to the U.S. East Coast. During the 1960s, the central and western Gulf Coast was hit by the hurricanes.



Graphic 1. Major land-falling hurricanes in the United States between 1941-1950.



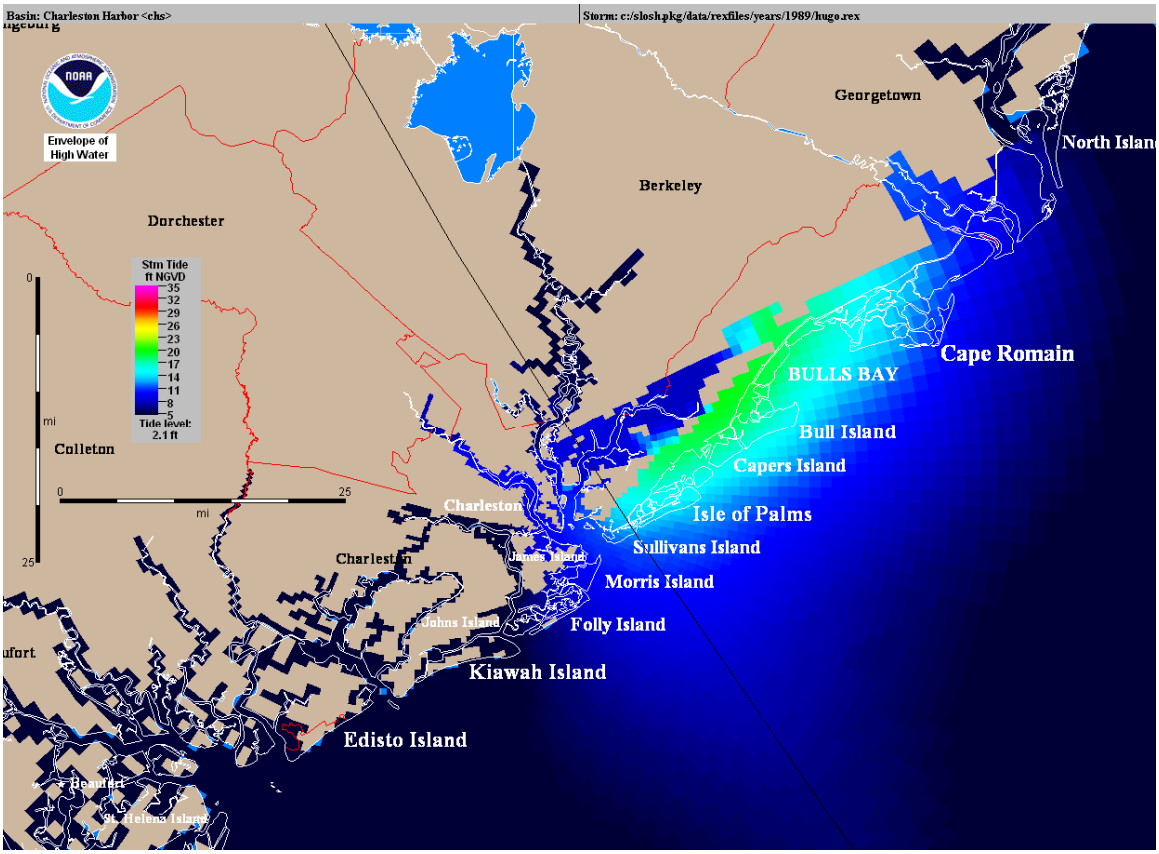
Graphic 2. Major land-falling hurricanes in the United States between 1951-1960.



Graphic 3. Major land-falling hurricanes in the United States between 1961-1970.

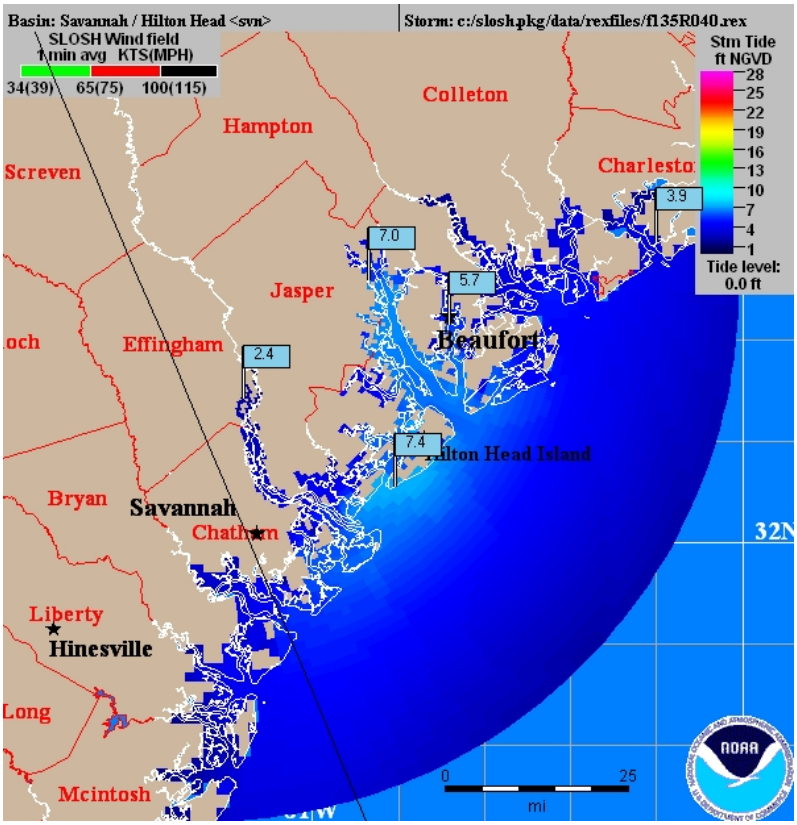
This pattern might lead one to assume that —given the recent major hurricanes like Charley, Ivan, Jeanne, Dennis, Katrina, Rita and Wilma in 2004 and 2005 — Florida and the Gulf Coast are likely targets again this season. However, in each of these decades there were exceptions. For example, in the 1940s, while most storms hit Florida, two made landfall in the Gulf, and one made landfall in New England. In addition, in the 1930s, major land-falling hurricanes were relatively well distributed along the U.S. coastline — hitting the U.S. coast from Texas to New England. Consequently, while it is possible to observe these trends and make generalizations based upon these observations, it is important to understand that in any given year a hurricane can impact any part of the U.S. coastline from Texas to Maine. Coastal communities along the Gulf and East Coasts, including here in South Carolina, remain at risk for hurricanes, and the business community and the public must be prepared to respond if a storm approaches. South Carolina is no stranger to hurricanes or tropical storms. In 2004 alone, two Category 1 hurricanes hit the state — Charlie on August 14 and Gaston on August 29 — and two other tropical systems crossed the state.

It takes only one hurricane to hit a community to make for a bad year. Just recall Hugo which hit South Carolina in 1989, its center making landfall just north of Charleston. The storm surge was large; up to 20 feet just north of Charleston (see graphic 4, below). The impacts of Hurricane Hugo reached well inland, with many portions of South Carolina and North Carolina devastated by heavy rain and strong winds, knocking down trees and disrupting power supplies for over a month in some areas.



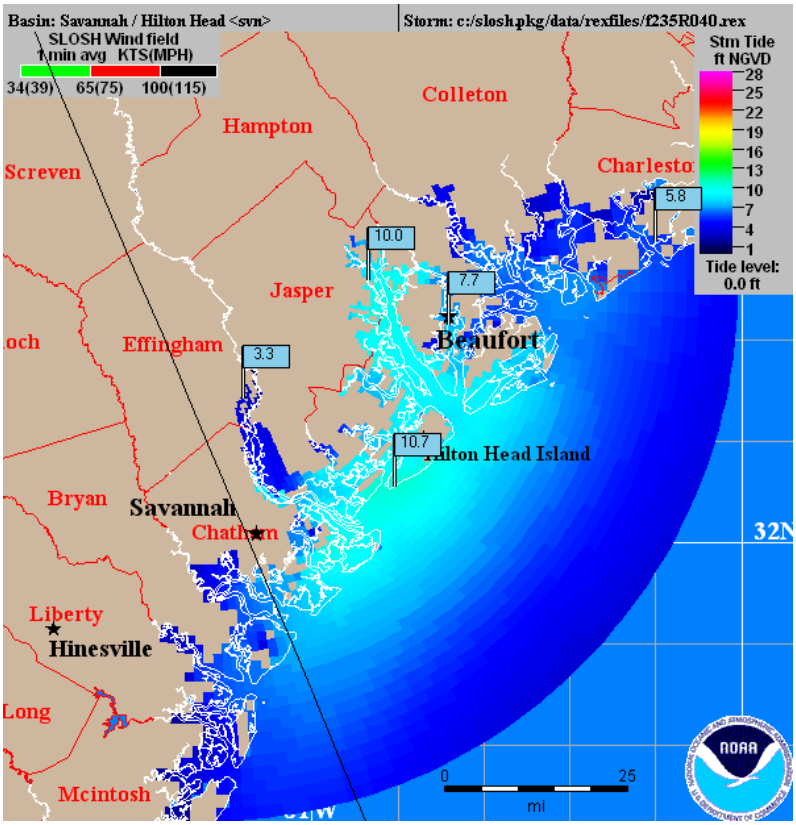
Graphic 4. Observed Water Levels During Hurricane Hugo

Let's now examine the potential effects from storms making landfall near Beaufort, South Carolina. The first graphic below (graphic 5) depicts the storm surge from a Category 1 storm moving to the north-northwest at 35 miles per hour. The track is similar to the one Hugo took and almost perpendicular to the coast, except it is shifted about 50 miles farther south. The storm surge reaches about eight feet along the coast. This is the amount of surge from the storm only. The astronomical tide would be added (or subtracted) from this value to obtain the water level. In the Beaufort area, the surge is about five feet and the astronomical tide could increase (or decrease) the water level by five feet.

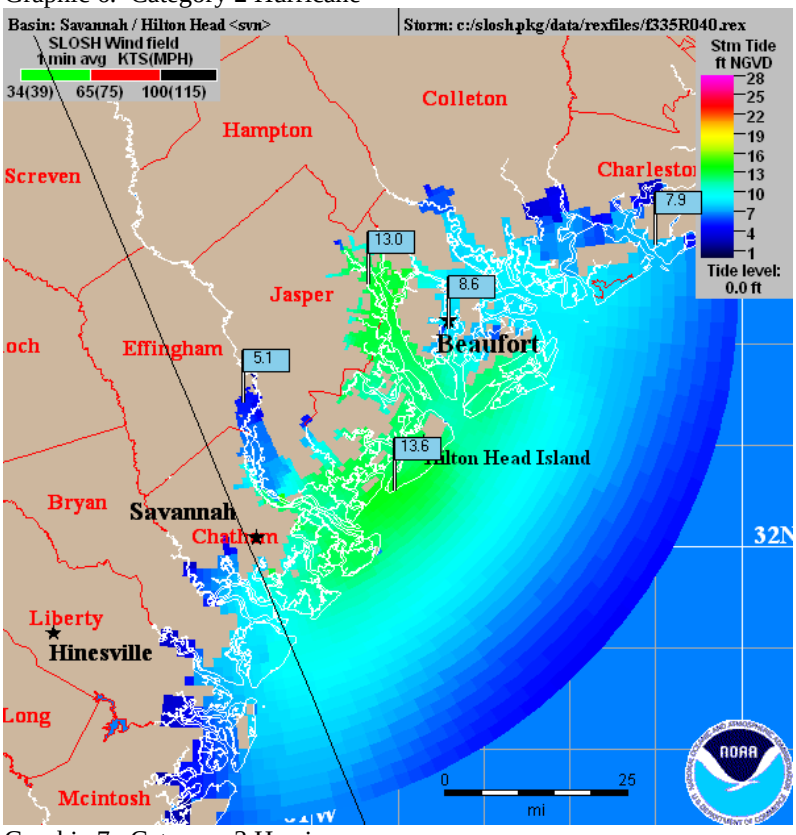


Graphic 5. Category 1 Hurricane

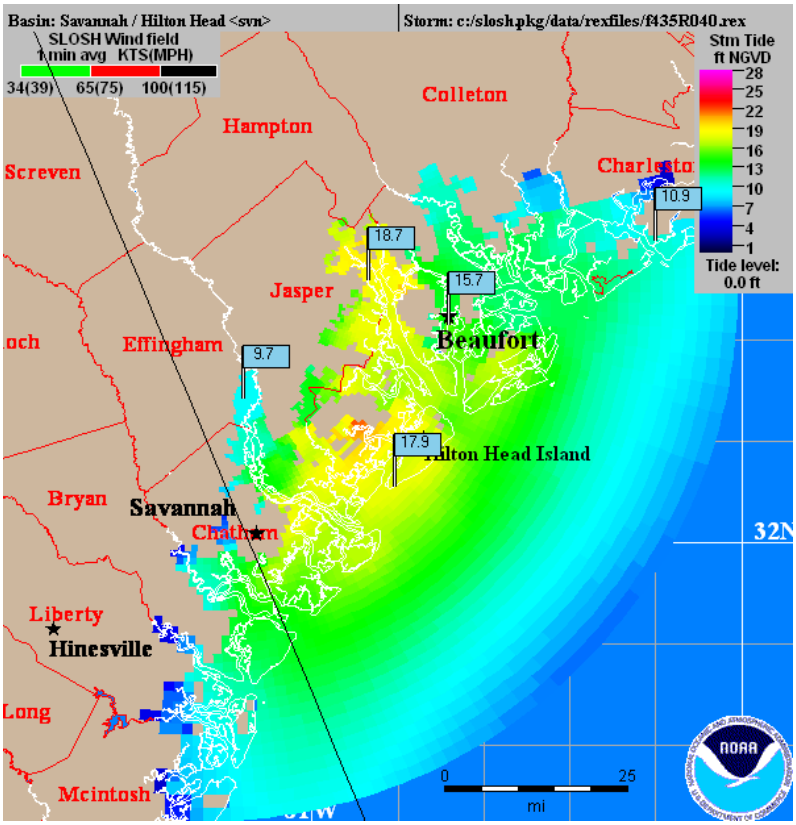
Notice how much farther inland the flooding penetrates with successively stronger hurricanes traveling along the same, hypothetical path (see graphics 6, 7, 8, and 9, below). A land-falling Category 5 hurricane could cause a surge of water near 20 feet high, reaching well inland and devastating everything in its path. Add to this the astronomical tides, and water could be 25 feet deep in downtown Beaufort with a Category 5 storm.



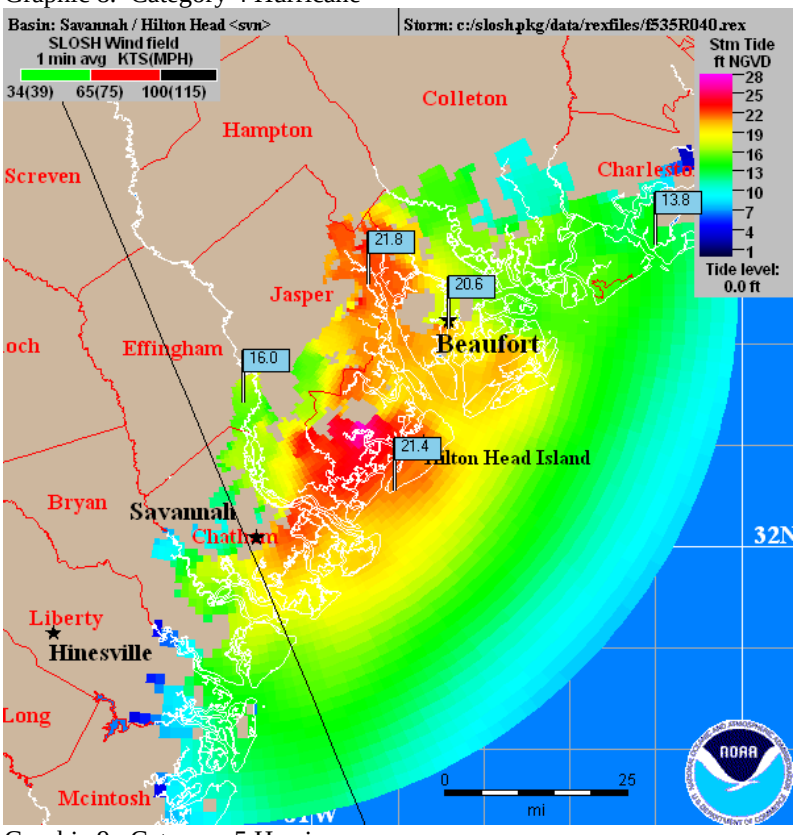
Graphic 6. Category 2 Hurricane



Graphic 7. Category 3 Hurricane



Graphic 8. Category 4 Hurricane



Graphic 9. Category 5 Hurricane

No one can say with any reliability, months in advance, when or where hurricanes are going to strike. The state of the science is simply not advanced enough at this time. The bottom line is that all coastal states from Texas to Maine, Hawaii, and other U.S. interests in the Pacific and the Caribbean are vulnerable to the devastation brought by a hurricane. The message from NOAA is very consistent. We want every business, every family, every individual, and every community on or near the coast to have a hurricane preparedness plan and have it in place.

The Role of the National Weather Service in Tracking, Forecasting and Communicating the Threats of Hurricanes

The mission of the NWS is to issue weather, water, and climate forecasts and warnings for the protection of life and property and the enhancement of the national economy. Nowhere is that more evident than in the hurricane program. Various components of the NWS play important roles in the overall hurricane forecasting and warning process. The National Hurricane Center (NHC), within the NWS, has been the centerpiece of our nation's hurricane forecast and warning program for 50 years. The mission of the NHC is to save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, and forecasts of hazardous tropical weather and by increasing public understanding of these hazards.

NHC tropical cyclone forecasts are issued at least every six hours, more frequently during landfall threats, and include text messages as well as a suite of graphical products depicting our forecasts and the accompanying probabilities and "cone of uncertainty," as it has become known. The NHC is responsible for predicting the path and intensity of the system, issuing coastal hurricane watches and warnings, and describing broad effects to the areas impacted, including projected storm surge levels.

Local National Weather Service Weather Forecast Offices (WFO) also play a critical role in this process. WFOs use their local expertise to refine NHC advisories and provide specific, detailed information about the impacts from the hurricane to their local forecast area of responsibility. Weather forecast office staff have detailed knowledge of the local terrain and effects, and provide this information through direct interactions with local emergency managers via their local forecast products and messages. This detailed information is used by local emergency managers when making their evacuation and other preparedness decisions.

Inland Effects of Hurricanes

The effects of hurricanes can reach far inland and it is the responsibility of the local WFO to issue inland hurricane and tropical storm warnings and describe the local impacts from the storms. Local WFOs work with NWS River Forecast Centers to forecast and warn for floods and flash floods. WFOs also provide forecasts and warnings for all other inland effects including strong wind and tornadoes. The offices work closely with local emergency managers to ensure they are aware of the potential affects from the storms.

Local media relay NWS watch and warning information to the public providing a critical way to disseminate potential life saving information from the NWS.

Wind
Hurricane-force winds, 74 miles per hour or more, can destroy buildings and mobile homes. Debris, such as signs, roofing material, siding, and small items left outside, become flying missiles in hurricanes. Winds can stay above hurricane strength well inland. Hurricane Hugo in 1989 battered Charlotte, North Carolina—about 175 miles inland—with gusts near 100 miles per hour, downing trees and power lines.

Tornadoes
Hurricanes and tropical storms also produce tornadoes. These tornadoes most often occur in thunderstorms embedded in rain bands well away from the center of the hurricane. Usually, tornadoes produced by tropical cyclones are relatively weak and short-lived, but still pose a threat.

Inland/Freshwater Floods
All tropical cyclones can produce widespread torrential rain. This rain can produce deadly and destructive floods. Heavy rain can trigger landslides and mudslides, especially in mountainous regions. Flooding is the major threat from tropical cyclones to people well inland. For example, Tropical Storm Allison in 2001 was the most costly tropical storm in U.S. history, causing more than $5 billion in flood damage and causing 24 fatalities in southeast Texas and southern Louisiana. Allison then moved northeastward and weakened to a depression as it brought heavy rain to South Carolina. Hurricane Floyd in 1999 brought extremely heavy rainfall to many locations in the eastern United States.

Flash flooding, a rapid rise in water levels, can occur quickly due to intense rainfall. Longer term flooding on rivers and streams can persist for several days after the storm. Intense rainfall is not directly related to the winds of tropical cyclones, but rather to how fast the storms are moving and the geography of the area affected. Slower moving storms produce more rainfall. Mountainous terrain enhances rainfall from tropical cyclones and can lead to mudslides and debris flows. Inland flooding can be a major threat to people hundreds of miles from the coast.

Between 1970 and 2004, more people lost their lives from freshwater flooding associated with tropical storms and hurricanes than any other weather hazard from those storms. However, Hurricane Katrina provides a vivid reminder that potentially the most devastating component of tropical systems is still storm surge.

NOAA Efforts to Improve Hurricane Predictions

NOAA is focused on improving hurricane track, intensity, storm surge, and rainfall predictions. Research conducted by the Hurricane Research Division (HRD) improves our understanding of these elements as well as helping to ensure that hurricane prediction models properly represent physical processes within hurricanes. HRD is part of the

Atlantic Oceanographic and Meteorological Laboratory within NOAA's Office of Oceanic and Atmospheric Research (OAR). The accuracy of NOAA's hurricane forecasts is closely tied to improvements in computer-based numerical weather prediction models. This year NOAA implemented advances in its hurricane forecasting model that are expected to yield improved track and intensity guidance for our forecasters. The Geophysical Fluid Dynamics Laboratory, also within OAR, developed this hurricane model, which has been transferred to operational use at NWS's National Center for Environmental Prediction (NCEP).

NOAA's Central Computer System upgrade in FY 2007 will increase computational speed, memory, and storage capabilities. This allows more sophisticated numerical models to run and make use of available data, including data from NOAA's polar orbiting and geostationary satellites.

Predicting hurricane intensity remains one of our most difficult forecast challenges. We are all aware of the improvements made in predicting hurricane track forecasts, and this has been where NOAA and the research community have placed their emphasis. Within the past few years, the emphasis on improving intensity prediction has increased. Leading the way, in FY 2007 NOAA plans to introduce a new hurricane modeling system developed by NCEP's Environmental Modeling Center called the Hurricane Weather Research and Forecasting model (HWRF). We expect improvements in intensity, precipitation and wind distribution forecasting from the next generation operational modeling system. Congress supported our model improvement effort in the FY 2006 Hurricane Supplemental Funding, and HWRF implementation and development are included in the FY 2007 President's Budget request.

Hurricane Katrina is a grim reminder that the greatest potential for economic destruction and large loss of life is from the storm surge near the coast. Storm surge is also very difficult to predict because it depends on the hurricane track and wind field, but it also is affected by bathymetry, topography, and natural and man-made barriers, such as dunes and roadways. A slight difference in track or wind field can mean a huge difference in where the highest storm surge impacts the coast.

NOAA's Storm Surge Model, known as SLOSH (Sea, Lake and Overland Surge from Hurricanes), provided excellent guidance during last year's hurricanes. We realize many other storm surge models exist, and NOAA recently formed an assessment team to re-examine our users' requirements for real-time storm surge information and products, to direct storm surge modeling within NOAA, and to plan for future enhancement of, or the replacement of, the SLOSH model.

Our local NWS offices work closely with the research and academic community to improve our understanding of tropical systems using that information to improve forecasts and warnings. Recent efforts include improved detection of tornadoes associated with tropical systems and forecasting the location of heaviest rainfall from tropical systems. Efforts also continue to improve communicating the severity of the impacts and communicating the level of certainty in our predictions.

Aircraft Reconnaissance Data

NOAA aircraft, the W-P3 Orions and the Gulf Stream IV, provide essential observations critical to NHC forecasters, and supplement the U.S. Air Force Reserve Command's 53rd Weather Reconnaissance Squadron ("Hurricane Hunter") flights. A specialized instrument flown on both of the W-P3s, the Stepped Frequency Microwave Radiometer (SFMR), was developed by NOAA researchers at the HRD and provides essential data on hurricane structure, surface wind and rain rate to hurricane forecasters. The SFMR allows forecasters and researchers to see fluctuations in hurricane intensity not observed before. *The Military Construction Appropriations and Emergency Hurricane Supplemental Appropriations Act*, 2005 (P.L. 108-324) provided $10.5 million to the Air Force to outfit the complete fleet of Hurricane Hunters with this instrument.

NOAA Encourages Everyone to Prepare

We work year-round with federal, state, and local emergency managers; we educate them about weather effects from hurricanes and they educate us about response issues and their challenges. It is a constant learning process and the key is working together to ensure the public takes appropriate action. Most preparedness activities and outreach takes place outside hurricane season. Last spring, as part of our ongoing mission to enhance economic security and national safety, NOAA conducted a Hurricane Awareness Tour along the Gulf Coast. The tour helped raise awareness about the potential effects from a hurricane landfall. The NWS forecast offices arranged the tour events with the Federal Emergency Management Agency, local governments, emergency managers, schools, the public and the media in a team effort to increase hurricane awareness and encourage preparedness in this vulnerable area of the nation. On May 5, 2005, the Hurricane Awareness Tour stopped in Charleston where 1,000 school aged children, and many others, toured the plane and were informed about hurricane preparedness.

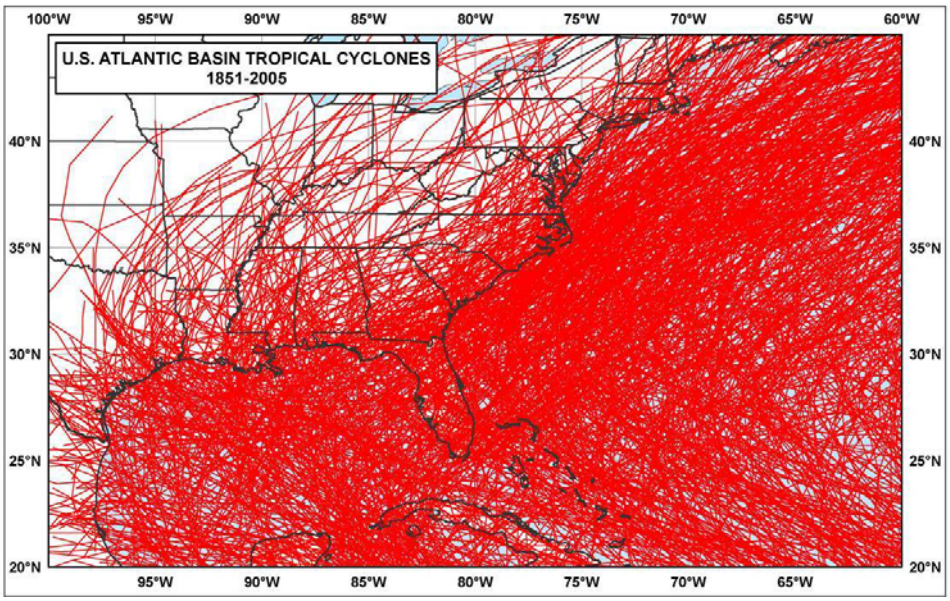
One way a community could prepare is to become StormReady. StormReady is a nationwide community preparedness program to help communities develop plans to handle all types of hazardous weather events, from hurricanes to tornadoes. South Carolina has 42 StormReady designations, 36 counties and 6 communities.

During land-falling storms, it is essential for the emergency management community and the weather community to have one message for the public so businesses and people can take appropriate action. Nowhere is this more critical than in areas most vulnerable to the impact of a hurricane. Our local NWS offices in South Carolina work very closely with local emergency managers to ensure we all speak with one voice. During the past year, NWS offices in Greensboro, Columbia, and Charleston, South Carolina, as well as the NWS Office in Wilmington, North Carolina, gave numerous presentations, online "hurricane chats," and training classes to people in South Carolina to discuss weather and the potential impact from hurricanes and tropical systems. These outreach efforts raise awareness and hopefully allow people to prepare for the storms long before they happen.

Conclusion

The truth is, right now, no one knows exactly what areas of the coast, or which states or locations within those states, if any, another hurricane will hit in 2006. Could it be the Gulf Coast again? Maybe. How about New England or New York City? What about South Carolina? They're all possible, but, right now we just don't know. We also need to remember a hurricane is not just a coastal event. The strong winds, heavy rains, and tornadoes from weakening tropical systems can spread well inland and cause tremendous damage.

The chart below shows the tracks of tropical storms and hurricanes since 1851. I think most people can look at this graphic and understand that the United States is vulnerable to hurricanes. The bottom line is that all coastal states from Texas to Maine, Hawaii, and other U.S. interests in the Pacific and the Caribbean are at risk. Everyone along the coast as well as communities susceptible to the inland effects from tropical systems must be prepared to protect their lives and property in the event of a hurricane. Thank you and I am happy to answer any questions that you might have.



Graphic 10. All Atlantic basin tropical storms and hurricanes, 1851-2005.