

**WRITTEN TESTIMONY OF
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U. S. DEPARTMENT OF COMMERCE**

**OVERSIGHT HEARING ON
“2006 HURRICANE SEASON AND AT-RISK CITIES”**

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

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Mr. Chairman and Members of the Committee, I am Max Mayfield, Director of the Tropical Prediction Center/National Hurricane Center. The National Hurricane Center is a part of the National Weather Service (NWS), of the National Oceanic and Atmospheric Administration (NOAA) in the Department of Commerce. Thank you for inviting me here today, during National Hurricane Preparedness Week, to discuss the outlook for the 2006 Hurricane Season, and to talk about our country’s cities most vulnerable to hurricanes.

First, let me express my sincere gratitude to the members of this Committee. Your continued support of NOAA and our hurricane program enables us to make the best forecasts possible, helping ensure the people of our Nation understand the potential impacts from hurricanes and what they can do 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, and storm surge and inland hurricane forecasting improvements. Thank you again for your support.

Everywhere I go I am asked about the forecast for the upcoming hurricane season. People want to know how many hurricanes there will be and if one will hit their area. The media also gives these seasonal forecasts high visibility, and this can have a very positive effect because it raises awareness about the threat from hurricanes and encourages people to prepare for what might happen.

The official hurricane season is from June 1 through November 30, with the average peak of hurricane activity occurring with the warmest water temperatures, from mid-August to late October. NOAA's prediction for the 2006 Atlantic hurricane season is for 13-16 tropical storms, with 8-10 becoming hurricanes, of which 4-6 could become major hurricanes. A major hurricane is a storm Category three or higher on the Saffir-Simpson hurricane scale, with winds greater than 110 miles per hour. Major hurricanes cause

about 80 % of the damage sustained from tropical cyclones. We are predicting an 80% likelihood of an above average number of storms in the Atlantic Basin. Our forecast for this season is based primarily on the continuing Multi-Decadal Signal in the global tropics. This year, the signal indicates favorable atmospheric (location and strength of upper and lower atmospheric wind and pressure patterns with their associated vertical and horizontal wind shears) an oceanic (warm sea surface temperatures) conditions for hurricane formation.

Last year was a record setting hurricane season with 28 storms and 15 hurricanes, of which 7 were major hurricanes. We know all too vividly the destruction and devastation hurricanes can cause. That is why it is important not to focus only on the total number of storms. It takes only one hurricane landfall to make for a bad year. A relatively quiet season does not mean there will be no problems. Let's recall 1992. That year was below average in the number of storms, but catastrophic for southern Florida because of Hurricane Andrew. No one can tell us reliably months in advance when or where the hurricanes are going to strike. The state of the science is simply not advanced enough at this time to do that. 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.

Vulnerable Communities

While all coastal communities can suffer the catastrophic impacts from hurricanes, there are a few areas particularly susceptible to the effects from a land-falling hurricane. These areas are uniquely vulnerable due to their large population and/or the length of time it would take to evacuate people out of harm's way. Houston/Galveston, Tampa Bay, southwest Florida, Florida Keys, southeast Florida, New York City/Long Island, and believe it or not, New England, are all especially vulnerable. And let's not forget, just because a hurricane struck the central Gulf Coast states last year, does not mean it will not happen again -- New Orleans remains vulnerable to future hurricanes.

We work year-round with Federal, state, and local emergency managers; we educate them about weather impacts 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. Just three weeks ago I finished a Hurricane Awareness Tour along the Gulf Coast states to help raise awareness about the potential impact from hurricanes. The NWS forecast offices arrange 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. During landfalling storms it is essential for the emergency management community and the weather community to have one message for the public so people can take appropriate action. Nowhere is this more critical than in areas most vulnerable to the impact from hurricanes.

Let me elaborate further on vulnerabilities and first look at the New York City area. In the past two decades, two hurricanes passed near New York City – Hurricane Gloria on

September 27, 1985 and Hurricane Bob on August 19, 1991. Each hurricane was moving north-northeastward. Gloria moved inland across Long Island and struck at low tide, so the storm tide (a combination of storm surge and astronomical tide) was not as high as it could have been. In contrast, Bob skirted Long Island and impacted Rhode Island and Massachusetts. Bob struck at high tide resulting in more damage. The New England Hurricane of 1938 also made landfall on Long Island on a northward track and was moving at about 60 miles per hour as it made landfall as a Category 3 storm. This speed caused an unusually rapid deterioration of conditions and allowed less time for preparation than normal. Storm surges of 10 to 12 feet inundated portions of the coast from Long Island and Connecticut eastward to southeastern Massachusetts, with the most notable surges in Narragansett Bay and Buzzards Bay.

What if those storms were stronger and headed northwest and hit the central New Jersey Coast? NOAA's storm surge model, SLOSH (Sea, Lake, Overland Surge from Hurricanes), indicates a Category 3 hurricane could produce a storm surge raising water levels over 25 feet (slide 1) above mean sea level in some locations in the New York City area. The slide shows the surge from a hurricane moving along the black line making landfall in New Jersey. It is not a question of **if** a major hurricane will strike the New York area, but **when**. Fortunately, this is not news to New York Emergency Managers. They have been working with NOAA to plan for this type of disaster for two decades. They know it will happen, maybe this year, maybe next, maybe one hundred years from now – but it will happen and they are planning for it.

Let me talk briefly about a few other areas. A large, fast moving Category 5 storm can inundate the Houston/Galveston area with a storm surge over 30 feet (slide 2), while a large (size of Katrina) northeast moving Category 5 storm would flood some sections of the Tampa Bay area with over 20 feet of water (slide 3). Strong winds with the storm will produce large waves on top of the storm surge and potentially catastrophic flooding in these areas. The Florida Keys is another area particularly vulnerable to hurricanes. The Keys sit only a few feet above sea level and there is only one way in and out of the region. This escape route floods well before the hurricane strikes, and it takes about 48-72 hours to evacuate the region. Although emergency managers in the Keys recognize the potential impacts, it is still difficult to get people to take appropriate actions. Almost all of the Keys could be covered by water from an approximate 12 foot surge accompanying a Category 5 hurricane moving west to east across southern Florida (slide 4).

The next slide shows potential storm surges for other particularly vulnerable areas – southwest Florida near Fort Myers can have a surge over 20 feet (slide 5); a 15 foot surge could impact southeast Florida (slide 6); and New England could see about 20 feet of water along the coast (slide 7). And let's not forget what can happen in New Orleans with a Category 5 storm, flooding the city with a 20 foot surge (slide 8) meaning that some areas well below sea level could be under 30 feet of water.

While I specifically mentioned a few areas that are particularly vulnerable, let me emphasize that anywhere along the coast can be devastated by a hurricane. Just

remember Hurricane Hugo, which hit South Carolina in 1989 making landfall just north of Charleston. The storm surge was large, up to 20 feet just north of Charleston (slide 9). 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.

We have observed that steering patterns for major hurricane landfalls can *sometimes* persist over several years. For example, during the 1940s many major hurricanes hit Florida (slide 10). During the 1950s, many major hurricanes hit the U.S. East Coast (slide 11). During the 1960s, many storms hit the central and western Gulf Coast (slide 12). 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 (slide 13) – Florida and the Gulf coast are likely targets again this season. However, in each of these decades there were exceptions. For example, in the 1940's, while most storms hit Florida, two made landfall in the Gulf and one made landfall in New England. In addition, in the 1930s (slide 14) major landfalling 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. The coastal communities along the Gulf and East Coasts (in addition to Hawaii and other interests in the Pacific and Caribbean) remain at risk for hurricanes, and the public must be prepared to respond if a situation arises.

It only takes one hurricane over a given community to make for a bad year. In 1983 there was only one landfalling hurricane in the United States, but it was Category 3 Hurricane Alicia that hit the Galveston/Houston area (slide 15). And in 1992, we only had one hurricane make landfall in the United States, but that was Category 5 Hurricane Andrew that hit Southern Miami-Dade County, Florida (slide 16).

The message from NOAA is very consistent. We want every individual, every family, every business and every community on or near the coast to have a hurricane preparedness plan and have it in place before the hurricane season gets here. But I also want to go beyond the seasonal forecast for this coming year and focus on something I think is even more important. The research community is telling us we are in an active period for major hurricanes that could last another 10 to 20 years or more. Again, the message is clear. We all need to be prepared.

NOAA Efforts to Improve Hurricane Predictions

NOAA is focused on improving hurricane track, intensity, storm surge and rainfall predictions. 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. This hurricane forecasting model was developed by the Geophysical Fluid Dynamics Laboratory in

NOAA's Office of Oceanic and Atmospheric Research (OAR) and incorporated into operations at NWS's National Center for Environmental Prediction (NCEP). NOAA's Central Computer System will be upgraded in FY 2007 to 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. Significant improvements in intensity, precipitation and wind distribution forecasting are expected from the next generation operational modeling system.

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, in the past, placed their emphasis. Within the past few years, the on emphasis improving intensity prediction has increased. Leading the way, in FY 2007 NOAA plans to introduce a new hurricane modeling system, called the Hurricane Weather Research and Forecasting model (HWRF), which is being developed by NCEP's Environmental Modeling Center. Congress supported this effort in the FY 2006 Hurricane Supplemental Funding, and HWRF implementation and development is included in the FY 2007 President's Budget request. The HWRF will be a coupled atmosphere-ocean prediction system that will take advantage of the latest atmosphere and ocean observations, the most advanced methods to analyze those data and state of the art physics to produce our Nation's next generation hurricane forecast system. Once the HWRF becomes operational, our goal is to improve hurricane intensity predictions by about 30% by 2015.

NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) also conducts research to better understand internal storm dynamics and interactions between a hurricane and the surrounding atmosphere and ocean. AOML's scientists provide data and information to operational NOAA forecasters and models. Through a greater understanding of physical processes and advanced hurricane modeling, NOAA continually improves models for predicting hurricane intensity and track, in collaboration with federal partners, academic researchers, and commercial enterprises.

To help guide future research efforts, NOAA's Science Advisory Board commissioned a Hurricane Intensity Research Working Group to provide recommendations to the agency on the direction of hurricane intensity research. The Working Group expects to transmit its final report to the Science Advisory Board in July 2006. The National Science Board of the National Science Foundation has also convened a working group of external advisors to review hurricane science and engineering. The final report from this group is scheduled to be submitted to the National Science Board in August 2006. Recommendations from these reports will be carefully considered by NOAA as we plan our efforts to improve our operations and predictions.

Aircraft Reconnaissance Data

NOAA aircraft, the W-P3 Orions and the Gulf Stream IV, provide essential observations critical to the National Hurricane Center forecasters and supplement the U.S. Air Force

Reserve Command's 53rd Weather Reconnaissance Squadron flights. A specialized instrument flown on both of the W-P3s, the Stepped Frequency Microwave Radiometer (SFMR), was developed by NOAA researchers at AOML 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 \$10.5M to the Air Force to outfit the complete fleet of Hurricane Hunters with this instrument. We hope the first of these additional units will be available toward the end of the 2006 Hurricane Season.

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, will be impacted by hurricanes in 2006. Could it be Florida again? Maybe. How about New England or New York City? That's 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. Having said that, Katrina is a grim reminder that the greatest potential for large loss of life is from the storm surge near the coast.

Now, please look at the last graphic (slide 17), which 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, including inland communities that can be impacted by heavy rain and tornadoes associated with hurricanes, must be prepared to protect their lives and property in the event of a hurricane.