WRITTEN TESTIMONY OF
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NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
U. S. DEPARTMENT OF COMMERCE

OVERSIGHT HEARING ON
"2006 HURRICANE SEASON"

BEFORE THE
COMMITTEE ON APPROPRIATIONS
SUBCOMMITTEE ON COMMERCE, JUSTICE AND SCIENCE
UNITED STATES SENATE

JUNE 7, 2006

Chairman Shelby, Ranking Member Mikulski and Members of the Committee, I am
Conrad C. Lautenbacher, Jr., Under Secretary for Oceans and Atmosphere and
Administrator of the National Oceanic and Atmospheric Administration (NOAA) in the
Department of Commerce (DOC). I am joined by Dr. Louis Uccellini, Director of
NOAA's National Weather Service, National Centers for Environmental Prediction.
Thank you for inviting us here today to discuss the outlook for the 2006 Hurricane
Season, and to talk about what we can each do to be best prepared to protect lives and
livelihoods in the event of a hurricane.

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 has been fully distributed
and is being used as directed, including funding forecast model improvements, storm
surge and inland hurricane forecasting improvements, and the procurement of an
additional Hurricane Hunter aircraft. Thank you again for your support.

NOAA Provided Critical Information and Support
Before and After the 2005 Hurricanes

Before I discuss the details of the 2006 hurricane outlook, I would like to briefly
highlight one of NOAA's most notable successes in recent memory – our performance
during the 2005 season.

Among our many hurricane-related missions, NOAA has the primary responsibility to
provide weather data, forecasts and warnings for the United States and its territories.
NOAA's forecasts and warnings for Hurricane Katrina and Hurricane Rita pushed the

limits of state-of-the-art hurricane prediction. NOAA's National Weather Service (NWS) operates the most advanced weather and flood warning and forecast system in the world, helping to protect lives and property and enhance the national economy. In partnership with the Department of Defense, NASA, the National Science Foundation, other federal agencies, and the academic community, the long-term continuous research efforts, including observations, modeling, and expanded computational resources have led to NOAA's current predictive capabilities and improved ways of describing uncertainty in prediction. Reconnaissance data from NOAA and Air Force Reserve aircraft provided critical data NOAA forecasters used for their accurate hurricane predictions. Hurricane forecasts for Katrina and Rita were some of the most accurate ever for storm track, size, intensity, surge, and warning lead time, allowing for evacuation of 85-90% or more of the Texas and Louisiana coasts. While Katrina and Rita are blamed for over 1200 deaths, it may well have been much, much worse.

But NOAA's work does not end with the forecast. This was particularly evident last August, when NOAA responded immediately to the destructive hurricanes in several ways. NOAA provided over 9,500 aerial images of the impacted coastline to help emergency responders assess the situation, analyzed satellite imagery to determine the coastal impacts, and sent Scientific Support Coordinators to address nearly 400 hazardous material spills. We also sent Navigation Response Teams to survey for obstructions to navigation in critical ports and waterways to allow relief supplies to be delivered and maritime commerce to resume. NOAA ships THOMAS JEFFERSON and NANCY FOSTER were diverted from planned missions to areas impacted by the hurricanes and helped collect data needed to reopen critical Gulf Coast ports and to assess impacts on Gulf Coast ports and fisheries. Immediately following the storms, NOAA contributed $4.3M to the States to assist with environmental enforcement and search-and-rescue. Readings from NOAA's National Water Level Observation Network (NWLON) tide stations in the region provided emergency responders with real time storm tides, and are now invaluable data that can be used in planning the rebuilding of the coast.

NOAA's wide-ranging capabilities continue to support the impacted areas with response to spills and maritime incidents. NOAA invested more than $3.7M in 2005 grant funding to Gulf States to build, and in some cases re-build, their infrastructure and capacity to determine and deliver consistent and timely geodetic height information. Accurate land and water level heights are critical to determining effective highway evacuation routes, levee heights, storm surge modeling, flood plain mapping, sea level rise calculations, vessel under-keel and bridge clearance, subsidence monitoring, and restoration of coastal habitats. So, as you see, NOAA can and will continue to bring more to the table than just our forecasts. Your continued support of NOAA across the board is critical to our ability to add value to science for the American people.

2006 Atlantic Hurricane Season Outlook

Everywhere we go we are asked about the forecast for this 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 businesses and people to prepare for what might happen.

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 mid-August to late October. NOAA's prediction for the 2006 Atlantic hurricane season is for 13-16 tropical storms, with eight to 10 becoming hurricanes, of which four to six 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 storms.
We are predicting an 80 percent likelihood of an above average number of storms in the Atlantic Basin this season. This is the highest percentage we have ever issued. Our forecast for this season is based primarily on the continuing Multi-Decadal Signal in the global tropics – a climate pattern that has been 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 ongoing 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 saw all too vividly the destruction and devastation individual hurricanes can cause. This 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

As mentioned above, we have observed that steering patterns for major hurricane landfalls can *sometimes* persist over several years. During the 1940s many major hurricanes hit Florida. During the 1950s, the focus of land falling hurricane shifted to the U.S. East Coast. During the 1960s, the central and western Gulf Coast were slammed by several hurricanes.

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 (in addition to Hawaii and other interests in the Pacific and Caribbean) remain at risk for hurricanes, and the business community 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 which hit the Galveston/Houston area. And in 1992, we only had one hurricane make landfall in the United States, but that was Category 5 Hurricane Andrew, which hit southern Miami-Dade County, Florida.

No one can tell us reliably, months in advance when or where 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 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 at the start of hurricane season.

NOAA Efforts to Improve Hurricane Predictions

Improving hurricane forecasting is a top priority for the Administration. NOAA has made great strides in improving hurricane track forecasting; our 5-day forecasts are now as accurate as 3-day forecasts were 15 years ago. NOAA spends over $300 million per year to track and forecast hurricanes. In FY 2007, we are requesting $109 million in increases for hurricane-related investments.

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. The Geophysical Fluid Dynamics Laboratory in NOAA's Office of Oceanic and Atmospheric Research (OAR) developed this hurricane model and incorporated it into operations 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. We expect significant improvements in intensity, precipitation and wind distribution forecasting 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 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).

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 percent by 2015.

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 impacted by bathymetry 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.

We believe the NOAA 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.

NOAA's Atlantic Oceanographic and Meteorological Laboratory (AOML) Hurricane Research Division (HRD) 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 for use in models. Through a greater understanding of physical processes and advanced hurricane modeling, in collaboration with federal partners, academic researchers, and commercial enterprises, NOAA continually improves models for predicting hurricane intensity and track.

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. The $14.2M NOAA received in FY 2006 supplemental appropriations to improve future aircraft service will add an additional W-P3 next year, and upgrade the radar and instrumentation on all of NOAA's aircraft.

A specialized instrument flown on 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.

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 activity and outreach takes place outside hurricane season. Last month, as part of our ongoing mission to enhance economic security and national safety, NOAA led a Hurricane Awareness Tour along the Gulf Coast. The tour helped raise awareness about the potential effects from a hurricane landfall. The National Weather Service 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. 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.

While NOAA will continue to do its best to provide as much warning as possible, it is my hope that each business, each family, and each community, on or near the coast, will develop and be able to execute a hurricane preparedness plan. We must all be ready to protect our lives and property from the power of hurricanes.

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, a hurricane will hit in 2006. Could it be the Gulf Coast 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.

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, including inland communities, must be prepared to protect their lives and property in the event of a hurricane. Thank you.