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THE LIFESAVING ROLE OF ACCURATE HURRICANE PREDICTION AND PREPARATION

HEARING

BEFORE THE

SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

ONE HUNDRED NINTH CONGRESS

FIRST SESSION

SEPTEMBER 20, 2005

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CONTENTS

	Page
Hearing held on September 20, 2005	1
Statement of Senator DeMint	1
Statement of Senator Bill Nelson	5
Statement of Senator E. Benjamin Nelson	4
Statement of Senator Stevens	3
Statement of Senator Vitter	54

WITNESSES

Blackwell, Dr. Keith G., Associate Professor of Meteorology, Coastal Weather Research Center, University of South Alabama	17
Prepared statement	20
Curole, Windell, General Manager, South Lafourche Levee District	36
Prepared statement	38
Levitan, Dr. Marc L., Director, Hurricane Center/Charles P. Siess, Jr. Associate Professor of Civil Engineering, Louisiana State University; President, American Association for Wind Engineering	30
Prepared statement	32
Mayfield, Max, Director, Tropical Prediction Center/National Hurricane Center	7
Prepared statement	9
Roberts, C. Patrick, President, Florida Association of Broadcasters (FAB)	40
Prepared statement	41

APPENDIX

Inouye, Hon. Daniel K., U.S. Senator from Hawaii, prepared statement	69
Response to written questions submitted to Max Mayfield by:	
Hon. Jim DeMint	70
Hon. Daniel K. Inouye	70

THE LIFESAVING ROLE OF ACCURATE HURRICANE PREDICTION AND PREPARATION

TUESDAY, SEPTEMBER 20, 2005

U.S. SENATE,
SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Washington, DC.

The Subcommittee met, pursuant to notice, at 3:05 p.m. in room SD–562, Dirksen Senate Office Building, Hon. Jim DeMint, Chairman of the Subcommittee, presiding.

OPENING STATEMENT OF HON. JIM DEMINT, U.S. SENATOR FROM SOUTH CAROLINA

Senator DEMINT. Good afternoon, everyone. Traditionally, I would start the hearing by launching immediately into my opening statement, but the tragedy that has befallen the people of the Gulf Coast warrants a more different tone. I've asked Chaplain Black to begin our hearing today.

Chaplain?

Chaplain BLACK. Let us pray.

Lord of the winds and rain, it is because of your mercies that we are not consumed. As natural disasters remind us that we are finite, we look to you, our hope for years to come. Give wisdom to the many who seek to bring order out of the chaos of Hurricane Katrina. Remember also those who are braced for Hurricane Rita. Empower all who are involved rebuilding the affected region to do justly, to love mercy, and to embrace humility. Comfort those who mourn, and heal the sick and injured. Bring restoration to those who have been scarred emotionally, particularly the children. Guide this Disaster Prediction and Prevention Subcommittee in its efforts to do your will on Earth, even as it is done in Heaven.

We pray in Your sovereign name. Amen.

Senator DEMINT. I'd like to read a statement that's titled "Hurricane Local Statement, Urgent: Devastating damage expected. Hurricane Katrina, a most powerful hurricane, with unprecedented strength, rivaling the intensity of Hurricane Camille, in 1969. Most of the area will be uninhabitable for weeks, perhaps longer. At least half of well-constructed homes will have roof and wall failure. All gable roofs will fail. All wood-framed, low-rising apartment buildings will be destroyed. All windows will be blown out. The vast majority of trees will be snapped or uprooted. Only the hardiest will remain standing, but be totally defoliated. Power outages will last for weeks, as most power poles will be down and trans-

formers destroyed. Water shortages will make human suffering incredible by modern standards."

Now, this wasn't a last-minute plea issued by emergency managers Monday morning, this is the verbatim announcement from the New Orleans Weather Forecast Office 20 hours before the storm hit the city. Sadly, too, it is largely what I saw when I toured the region on the 9th of September.

As you can see from the photos that we have around the room today, the damage was massive, comprehensive, and eerily similar to what was described by the weather service.

What quickly became clear to me is that television does not accurately convey what happened. Seeing a home demolished on television begins to communicate the tragedy, but when you see 60 to 70 miles of that repeated over and over again, it is heartbreaking and almost impossible to comprehend. Entire neighborhoods are completely gone, except for concrete foundations that serve as markers of what once stood. Every home is a displaced family. Every demolished neighborhood is a community that will never be the same.

Another realization during the trip is that there are two separate disasters in the Gulf. In Mississippi, the houses themselves have been demolished by the wind and the storm, but the land is dry. In New Orleans, the homes are standing, but still flooded and ruined. One thing both locations have in common, though, is that the homes will never again be habitable. The wind-damaged homes, those that still stand, will likely be declared a complete loss and have to be torn down. In New Orleans, the homes that are flooded are permanently damaged and are beyond repair and will have to be torn down, as well.

And all of this pales in contrast to the human toll of the storm. Hundreds of lives have been lost, families have been separated, an entire region of people have been scattered throughout the Nation, jobless, homeless, and with no idea of when they will be able to return home.

Now, based on what I saw, it's clear that the Nation will need leaders who will work together to solve problems today and help America become better prepared for disasters in the future. The last thing we need now is more critics who are trying to blame others and make political gains.

Clearly, our first job is to provide humanitarian relief to the victims, to make available all the resources that are essential to rebuilding communities and jobs, and to remove all bureaucratic obstacles to getting the job done as quickly as possible. Every American, including every Congressman and Senator, should be involved in this massive relief and rebuilding effort. All of us are called on for sympathy, sacrifice, and solutions.

But we can't stop at just thinking about recovering from this disaster. We need to be thinking about the next disaster. The job of this committee is focused on specific aspects of this effort. Our mission is to oversee the Federal Government's role in predicting national—natural disasters and to develop policies that will minimize the loss of life and property when natural disasters occur. This task is crucial, because accurate predictions will help ensure that indi-

viduals are in shelters, and not in their homes, when the storm blows through.

We're going to examine, today, how the Federal agencies responsible for predicting the impact of the storm performed; in this case, of Katrina. That responsibility falls largely to the National Oceanic and Atmospheric Administration, commonly referred to as NOAA. About 2 months ago, in this Subcommittee, Senator Vitter, of Louisiana, used NOAA predictions to warn us of the catastrophic impact that a Category-4 or -5 hurricane would have if it hit New Orleans. The scenario Senator Vitter presented is almost exactly what happened on August 29. Sadly, while NOAA's predictions and warnings for New Orleans have been publicized for almost two decades, somehow it didn't sink in. This disaster was predicted, and largely inevitable, yet private citizens and officials at every level of government failed to prepare.

In fairness to everyone involved, however, after seeing the incredible scale of the destruction firsthand, we should be grateful for the effective response of thousands who helped to reduce the loss of life. Without aggressive evacuation efforts—I apologize, we got out of order here—grateful for those who did respond and reduced the loss of life. Without aggressive evacuation efforts, NOAA had estimated the loss of life could have been as high as 100,000 in New Orleans alone. While the focus of this committee is natural disasters, all Americans must now recognize how vulnerable we are to manmade disasters. We saw how a relatively small attack on New York disrupted the entire Nation's financial markets. We saw how one hurricane disrupted the energy supplies for a large part of the country and placed a severe strain on the Federal Government. We must not be surprised again. We must be prepared. Because, unlike a hurricane, a terrorist will not give us 56 hours' notice of its point of attack.

Today, I've asked officials from NOAA and from the private disaster prediction community to detail the predictions and preparations related to Katrina. We want to know what they did well and what they can do better and what they need from us to continuously improve their ability to prepare Americans for hurricanes, tornadoes and tsunamis. It is crucial that we get hurricane prediction right. The best defense our Nation has against hurricanes is accurate prediction as well as effective evacuations.

I'd like to yield now to the Chairman of the Commerce Committee, and then to our Ranking Member of the Subcommittee.

STATEMENT OF HON. TED STEVENS,
U.S. SENATOR FROM ALASKA

The CHAIRMAN. Thank you very much, Mr. Chairman. I just want to emphasize, this hearing is not intended to be a forum to discuss the FEMA response or any other response to the recent hurricane.

We created this Subcommittee to deal with disaster prevention—prediction and prevention. And I think we're here to listen to you all tell us what you predicted, and it's our job to see whether prevention mechanisms are in place to react to what you predict.

So, I thank you very much for you being here.

Senator DEMINT. Senator Nelson?

STATEMENT OF HON. E. BENJAMIN NELSON, U.S. SENATOR FROM NEBRASKA

Senator BEN NELSON. Thank you, Mr. Chairman.

First, I want to say thank you to Max Mayfield and your team at the National Weather Service and the National Hurricane Center. I think everyone can agree that the accuracy of your forecast significantly contributed to saving lives during this disaster, and we certainly appreciate that.

The human loss caused by this storm certainly would have been far greater if not for that accuracy. In the midst of the tragedy caused by Hurricane Katrina, we have the opportunity today to focus on one area during this disaster where things went terribly right, rather than terribly wrong.

The National Weather Service did an exceptional job in forecasting the storm and predicting its impact point and the devastation that it would deliver, and I think it's important that we do look at what went right in order to ensure that we keep that course as this hurricane season progresses and as we look to the future, as well.

Or course, the superb job of the National Weather Service in forecasting Hurricane Katrina's path is greatly diminished when the information that is given out, sometimes ignored, certainly not paid attention to, or isn't used to ensure measures are put in place immediately to respond to the aftermath of the storm. So, while I think it's appropriate to examine the stellar job of forecasting that was done during Hurricane Katrina, I cannot help but voice my frustration, and, I think, the frustration of so many, by the lack of follow-up to make sure that they were prepared to respond to a Category-4 hurricane hitting the Gulf Coast.

Chairman DeMint read from the notice about what was expected in the way of a hurricane well in advance of its coming to shore. And so, there is no question but what the information was there early, it was accurate. And I'm interested in learning, today, about the process that the National Hurricane Center used in relaying the information to Federal, State, and local officials. What information was sent, when was it sent, and who received it?

The bottom line is that the National Weather Service provided an accurate prediction and forecast. Others failed to coordinate an adequate response. It's my understanding that the National Weather Service forecasted New Orleans and the Gulf Coast areas being within the cone of strike probability approximately 60 hours before landfall. The National Hurricane Center first forecast Katrina to hit southeast Louisiana as a major hurricane, with winds of 130 miles per hour, on Friday, August 26, at 10 p.m. The actual track would deviate little from the predicted one for the duration of Katrina's approach. In addition, 24 hours prior to landfall, the center of the forecasted track was approximately 25 miles off the actual track; and, 12 hours prior, the forecasted track was less than 10 miles off.

So, what I would like to explore during today's hearing is how to capitalize on that accuracy and that fairly long lead time. How do we ensure that this great forecasting information translates into better prevention of loss of life and property, as well as better organization and reaction to the aftermath.

And so, I hope this hearing today will highlight the truly superb job that the National Weather Service and the National Hurricane Center did in forecasting Hurricane Katrina. I think it's important that we do so. And I also hope this hearing will shed light on how we can better use the information to prevent a repeat of what happened in the Gulf Coast.

Obviously, there are other issues that will have to be addressed at times, such as the inability of communication to work as well after the impact of the storm. The whole question about interoperability and intercommunication will have to be explored, as well. But today our focus is on how we can use the lead time and the prediction in natural disasters.

Chairman DeMint has already indicated that when you have terrorist actions, we are not going to have lead time. We'll have to deal with other issues, such as alert—National Alert Systems and similar kinds of protection. But today our focus is on the case at hand.

Thank you, Mr. Chairman.

Senator DEMINT. Thank you.

Senator Nelson?

STATEMENT OF HON. BILL NELSON,
U.S. SENATOR FROM FLORIDA

Senator BILL NELSON. Mr. Chairman—by the way, if you think you're seeing double, you are.

[Laughter.]

Senator BILL NELSON. This is a topic of especially important gravity, because the topic is the lifesaving role of accurate hurricane prediction. I happen to live in a land that is a peninsula that sticks down into the middle of something known as "Hurricane Highway." And we're fortunate that we have two of our Floridians on this panel today.

You not only have been accurate, your predictions and the information that is fed to you in increasing volumes, which is processed by those onboard computers on those Hurricane Hunters, which I've had the privilege of flying on, and then beamed, realtime, to you by satellite at the National Hurricane Center, cranked into your various computer models, has come to give you such prediction of such accuracy that, indeed, it is lifesaving. And if people in the Nation didn't understand that by virtue of what we've gone through in Florida—most recently, four within a 6-weeks' period—they certainly do now.

But, there are people who want to take Max Mayfield off the air. They don't want him to conduct individual interviews with individual broadcasters or individual networks. There are folks that want to take his website off of the Internet, a website that was established after a direction by President Bush in 2001 that every government agency would have a website. And, in fact, people want to take it off if there is a competing commercial interest.

Now, it just so happened that in the first hurricane of this season, Dennis, that took a bead back toward Pensacola, ended up drifting a little east of Pensacola, one of those commercial interests had predicted that it was going to New Orleans. And if that had been the only forecast, because people didn't have access to the Na-

tional Weather Service website, the people of the Florida northwest coast would have let down their guard.

During that 6 weeks' period last year, Max Mayfield's and NOAA's weather site got nine billion hits. Billion, with a "B." That's, by far, more than any other government website hits. The only thing that came close to that was the NASA website, of six billion hits, when the Mars Rover landed on Mars.

So, I can tell you that this Senator—I don't know what the weather is like in a lot of other states, but I know understanding the weather and its accurate prediction is often a matter of life and death in Florida. And we're not going to let people monkey around by taking you off the air.

Thank you, Mr. Chairman.

Senator DEMINT. Thank you, Senator.

We have a number of witnesses appearing this afternoon who are going to discuss with the Committee the prediction of Hurricane Katrina and provide their perspectives on how we can continue to have accurate predictions and what we can do to prepare for these storms.

Appearing before the Subcommittee this afternoon is Mr. Pat Roberts, President and CEO of the Florida Association of Broadcasters. Mr. Roberts will be discussing the work of the broadcast community to communicate with communities before, during, and after a disaster. He will also discuss the crucial role broadcasters play in disaster preparedness.

Also joining him is Dr. Keith Blackwell. Dr. Blackwell is Assistant Professor of Meteorology at the University of Southern Alabama. Mr. Blackwell will discuss with the Committee his perspectives on how we can work to improve the ability of the National Hurricane Center to predict the landfall of major hurricanes. He will also discuss what can be done to improve the quality of the products it produces.

I would also like to introduce Dr. Marc Levitan. Dr. Levitan is Director of the Louisiana State University Hurricane Center. Dr. Levitan is joining us to follow up on his testimony from our last hearing and to discuss the LSU Hurricane Center and how it has been actively involved with the prediction and preparedness activities surrounding this storm.

Joining him is Mr. Windell Curole. Mr. Curole is General Manager of the District of Galliano, Louisiana. Mr. Curole will discuss his extensive work in Louisiana with hurricane preparedness planning and what he believes needs to be done to get citizens to take the threat posed by hurricanes seriously.

Finally, returning this afternoon, is Mr. Max Mayfield. Mr. Mayfield is Director of the National Hurricane Center. We appreciate him coming back before the Subcommittee today to discuss the National Hurricane Center's work to predict the landfall of Hurricane Katrina. Mr. Mayfield came before this committee in June and described the nightmare scenario of a major hurricane making landfall near New Orleans. Unfortunately, his concerns about the challenges of the terrain, the inability to evacuate the citizens of the city, and the devastation of the storm surge were, sadly, too well placed. I think we'll all wish a lot more people had listened to Mr. Mayfield back in June.

Regardless of whether or not the Nation completely heeded Mr. Mayfield's warning, his work, and the work of his crew down in Miami, put together a forecast that gave communities along the Gulf Coast the ability to issue evacuation orders far in advance of the storm making landfall. Because of that, a lot of communities evacuated and a lot of lives were saved.

Mr. Mayfield, on behalf of this committee and the U.S. Senate, I thank you for your work and for getting this forecast right. I hope you'll return to Miami and tell the folks down there that we really appreciate what they do and that they helped save a lot of lives.

With that, Mr. Mayfield, I think I'll start with you. If you can keep your testimony to around 5 minutes—if you need more, let us know.

The CHAIRMAN. Mr. Chairman, could I suggest we listen to all the witnesses before we ask any questions?

Senator DEMINT. That's a good idea. Thank you, sir.

STATEMENT OF MAX MAYFIELD, DIRECTOR, TROPICAL PREDICTION CENTER/NATIONAL HURRICANE CENTER

Mr. MAYFIELD. Mr. Chairman and members of the Committee, I'm Max Mayfield, the director of the Tropical Prediction Center and National Hurricane Center at Miami. This is part of the National Weather Service within NOAA. Thank you for inviting here today to discuss NOAA's role in forecasting and warning the public about hurricanes.

The catastrophic devastation along the Gulf Coast from Hurricane Katrina is like nothing that I have witnessed. Words cannot convey the physical destruction and the personal suffering in that part of our nation. However, without NOAA's National Weather Service forecast and warnings, the loss of life would have been far greater.

While I will be focusing my remarks today on forecasting and tracking Hurricane Katrina, NOAA's work does not end there. NOAA assesses damage from storms and evaluates waterways to allow our Nation's ports and waterways impacted by the storm to open. NOAA also assesses the impact to the area's fisheries, supports hazardous-materials containment and abatement efforts, and provides necessary data critical for post-storm recovery operations.

Hurricane Katrina began as a tropical depression near the southeastern Bahamas on Tuesday, August 23. The National Hurricane Center tropical cyclone forecasts were issued routinely every 6 hours, with intermediate updates, as necessary, and included numerous text and graphical products.

The National Hurricane Center accurately predicted Katrina would become a Category-1 hurricane before making landfall near Miami. And then, once Katrina emerged into the Gulf of Mexico, the National Hurricane Center hurricane forecast correctly predicted re-intensification of the storm. Within 9 hours, Katrina intensified from a tropical storm to a Category-2 hurricane.

Our forecast track from Sunday morning, August the 27th, about 2 days before landfall, had the storm curving northward and headed directly toward southeastern Louisiana and Mississippi, and the prediction was for Katrina to make landfall as a Category-4 hurricane.

The actual track would deviate little from this and subsequent forecasts for the rest of Katrina's approach. The intensity forecast would also prove to be correct.

At 10 a.m., Central Daylight Time, on Saturday, August 27, the National Hurricane Center posted a hurricane watch for southeast Louisiana, including the city of New Orleans. We issued additional watches and warnings for Louisiana to the Florida Panhandle soon thereafter. After reaching southeast Louisiana as a Category-4 hurricane, Katrina made final landfall along the Louisiana/Mississippi border on Monday morning as a Category-3 hurricane.

As I testified before this Subcommittee on June 29, storm surge represents our greatest risk for a large loss of life in the hurricanes in our country. Unfortunately, Katrina has reminded us of the deadly power of the storm surge.

I was very saddened about the loss of life caused by Hurricane Katrina. The reported evacuation rate of near 80 percent, however, far exceeds the 25 to 50 percent rates usually noted. This large evacuation saved many lives, and did not happen by accident. Rather, it resulted from a long working relationship and open communication between NOAA, the National Weather Service, the emergency-management community at all levels, and the media.

This collaboration is especially close and complementary during a hurricane threat. For example, since the 1970s NOAA has been delivering and updating thousands of storm-surge simulations it generates for the entire vulnerable coast, from Texas to Maine, long before any specific event. These storm-surge simulations were the basis for the evacuation plans and the storm-specific decisions made by the communities there. In addition, NOAA provides realtime storm-surge information.

I believe that the high evacuation rate was also due to the broad distribution and diverse formats of National Weather Service text and graphical forecast and warning products, the more than 400 media interviews my staff and I conducted, the more than 900 million hits the National Hurricane Center forecast product received, our public website, and, very importantly, the interactions of the local National Weather Service offices and the National Hurricane Center with emergency managers in the days prior to landfall.

The National Weather Service has partnered with FEMA to establish a hurricane liaison team, which is activated at the National Hurricane Center a few days in advance of any potential United States hurricane landfall, to help coordinate communications between the National Hurricane Center and the emergency-management community at the Federal and State levels. Local National Weather Service offices and forecast centers tailor Hurricane Center forecasts and warning information into pointed, timely, and focused information for their local emergency managers. These emergency managers and local and State officials consult with National Weather Service forecasters and then make their evacuation and other preparedness decisions.

Today is September 20, near the historical peak of the hurricane season. To date, we've had 17 tropical storms, 9 of which have become hurricanes, and 4 of those have been major hurricanes, at Category-3 or stronger. We believe that we will continue to have an active season.

Long-term tropical cyclone activity in the Atlantic is cyclical. The 1940s through the 1960s, they experienced an above-average number of major hurricanes, while the 1970s into the mid-1990s averaged far fewer hurricanes. The current period of heightened activity could last another 10 to 20 years, or more. This increased hurricane activity since 1995 is due to natural cycles of hurricane activity driven by the Atlantic Ocean along with the atmosphere above it.

This period of increased hurricane activity and growing coastal populations puts more people at risk to potential catastrophes like Katrina. To counter these trends requires an accelerated research and forecast operations program, especially to more accurately forecast periods when storms intensify rapidly, as Katrina did over the eastern Gulf of Mexico.

While we must focus our energy on addressing the impacts of Hurricane Katrina, we must also look to the future. Katrina will not be the last major hurricane to hit a vulnerable area, and New Orleans is not the only location vulnerable to a large disaster from a hurricane.

Galveston, Houston, Tampa Bay, southwestern Florida, the Florida Keys, southeastern Florida, New York City and Long Island, and, believe it or not, New England are especially vulnerable. And, of course, New Orleans remains vulnerable to future hurricanes.

At NOAA, we will continue our efforts to improve hurricane track, intensity, precipitation, and storm-surge forecasting and work with our partners to ensure the best-possible outcome during future hurricane events.

With that, I would just like to add that, Mr. Chairman and members of this committee, I would really like to thank you for your support to our Nation's hurricane warning program. It's greatly appreciated.

Thank you.

[The prepared statement of Mr. Mayfield follows:]

PREPARED STATEMENT OF MAX MAYFIELD, DIRECTOR, TROPICAL PREDICTION CENTER/NATIONAL HURRICANE CENTER

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 to discuss NOAA's role in forecasting, and warning the public about hurricanes, as well as NOAA's essential role and activities following landfall.

The devastation along the Gulf Coast from Hurricane Katrina is like nothing I have witnessed before. It is catastrophic. Words cannot convey the physical destruction and personal suffering in that part of our Nation. However, without NOAA's forecasts and warnings, the devastation and loss of life would have been far greater.

NOAA's forecasts and warnings for Hurricane Katrina pushed the limits of the state of the art of hurricane prediction. Our continuous research efforts at NOAA, and in partnership with other Federal agencies, have led to our current predictive capabilities and improved ways of describing uncertainty in prediction. But NOAA's work does not end there. NOAA does extensive work assessing damage from storms and evaluating waterways to assist dredging operations, to open our Nation's ports and waterways impacted by the storm. NOAA also assesses the impact to the areas' fisheries, supports hazardous materials containment and abatement efforts, and provides necessary data critical for post storm recovery operations.

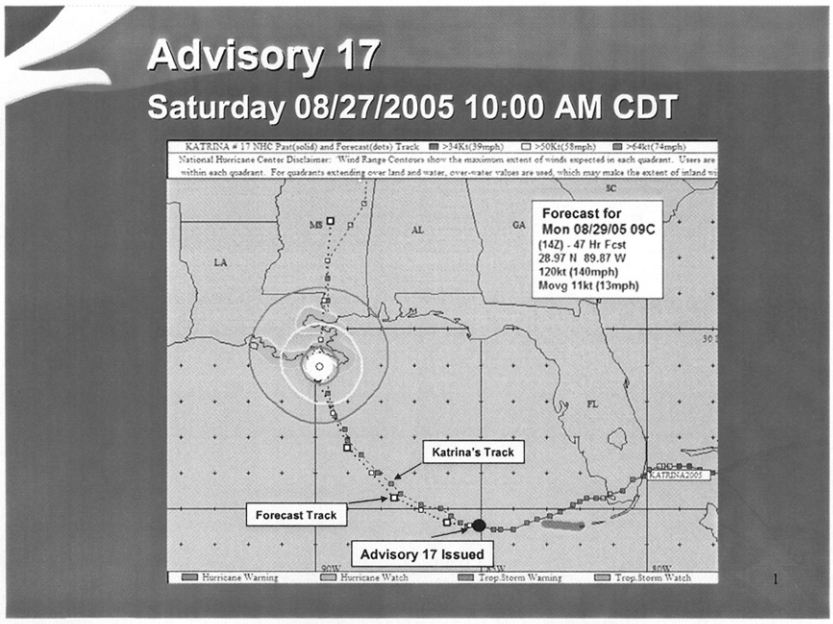
Tracking and Forecasting Hurricane Katrina

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 the public's understanding of these hazards.

NHC tropical cyclone forecasts are issued every six hours 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. Hurricane Katrina began as a tropical depression near the southeastern Bahamas on Tuesday, August 23. The National Hurricane Center accurately predicted it would become a Category 1 hurricane before making landfall near Miami. The storm deluged southeast Florida with 16″ of rain in some places, causing downed trees, flooding, and extended power outages as it passed across the southern portion of the state.

Once Katrina re-emerged into the Gulf of Mexico, NOAA hurricane forecasters correctly predicted re-intensification of the storm. Katrina intensified more quickly and became stronger than initially predicted. Within nine hours, Katrina intensified from a tropical storm, with winds of 70 miles per hour, to a Category 2 storm with 100 mile per hour winds.

As you can see in the graphic below, our forecast track from Saturday morning, August 27, about two days before landfall, had the storm curving northward and headed directly toward southeastern Louisiana and Mississippi. The projected path of Katrina aimed directly at southeast Louisiana, and the prediction was for Katrina to make landfall as a Category 4 hurricane. The actual track would deviate little from this and subsequent forecasts for the rest of Katrina's approach. On average, NOAA forecasts of where Katrina would go were more accurate than usual, with all of the forecast tracks during the last 48 hours lining up almost directly on top of the actual track. This forecast beats the Government Performance and Results Act goal established for NOAA hurricane forecasts this year.



At 10:00 a.m. Central Daylight Time (CDT) Saturday morning, August 27, the National Hurricane Center posted a hurricane watch for southeast Louisiana, including the city of New Orleans. The watch extended eastward to Mississippi and Alabama that afternoon. A hurricane watch means hurricane conditions are possible in the specified area, usually within 36 hours. Messages from the National Hurricane Center highlighted the potential for this storm to make landfall as a Category 4 or Category 5 storm.

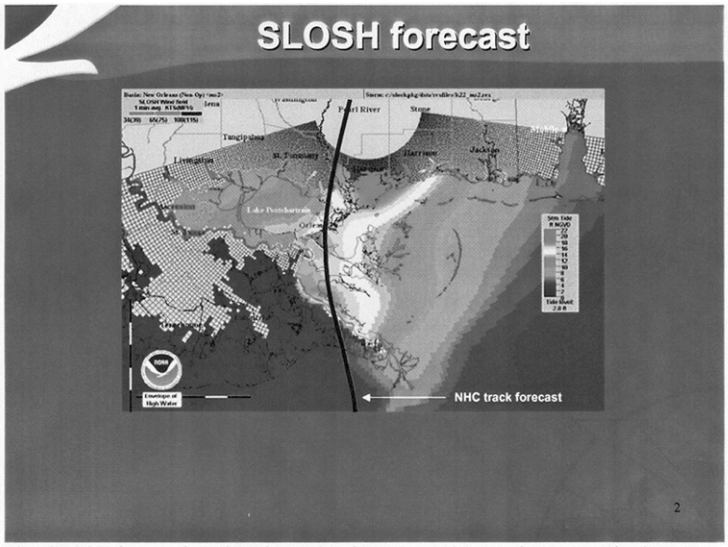
Predicting hurricane intensity remains a challenge. Even though we knew conditions were favorable for the storm to intensify, there was some error in the intensity forecast for the eastern Gulf due to its rapid intensification. While we accurately predicted the intensity at landfall, there is still more work to be done in improving intensity prediction, especially for rapidly intensifying or rapidly weakening storms.

Storm Surge

Storm surge has caused most of this country's tropical cyclone fatalities, all too vividly evident in the past two weeks, and still represents our greatest risk for a large loss of life in this country. Following Hurricane Camille in 1969, NOAA established a group that developed and implemented a storm surge model called SLOSH (Sea, Lake, and Overland Surges from Hurricanes). The SLOSH model calculates storm surge heights resulting either from historical, hypothetical or actual hurricanes. SLOSH incorporates bathymetry and topography, including bay and river configurations, roads, levees, and other physical features that can modify the storm surge flow pattern. Comprehensive evacuation studies, conducted jointly by the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers, NOAA, and state and local emergency managers, are based on the simulated surges computed by SLOSH.

The National Hurricane Center introduced storm surge forecasts for the Gulf Coast in public advisories at 10:00 a.m. CDT Saturday—32 hours prior to Katrina's landfall in Louisiana. The initial forecast (10:00 a.m. CDT, Saturday, August 28) for storm surge was predicted at 15 to 20 feet, locally as high as 25 feet, and that forecast was updated the following morning to a range of 18 to 22 feet, locally as high as 28 feet, when the forecast intensity for landfall was increased. "Large and battering" waves were forecast on top of the surge. In addition, the 4:00 p.m. CDT public advisory issued by the National Hurricane Center on Sunday, August 28, stated that some levees in the greater New Orleans area could be overtopped. Actual storm surge values are being determined at this time.

I know there have been recent news reports that I notified FEMA that the New Orleans' levees would be breached. In fact, I did not say that. What I indicated in my briefings to emergency managers and to the media was the possibility that some levees in the greater New Orleans area could be overtopped, depending on the details of Katrina's track and intensity. This possibility was also indicated in our advisory products.



First SLOSH forecast based on the National Hurricane Center's forecast track of Hurricane Katrina. This information was available on the Internet at 9:20 a.m. CDT Sunday, August 29. The graphic depicts the predicted high water level above mean sea level. Additional SLOSH model forecasts were available following each advisory issued by the National Hurricane Center.

Communicating Our Forecasts

The FEMA/NWS Hurricane Liaison Team (HLT), which is activated at NHC a few days in advance of any potential U.S. hurricane landfall, coordinates communications between NOAA and the emergency management community at the Federal and state levels. The HLT was established in 1996. After consulting with our local weather service offices and the National Hurricane Center, *emergency managers* make evacuation and other preparedness decisions. The HLT provides an excellent way to communicate with the large number of emergency managers typically impacted by a potential hurricane. This is a critical effort to ensure emergency managers and first responders know what to expect.

The media is our most essential partner and helps us get the information to the public. Without the media, it would be very difficult to get the information as widely distributed. The media provided an invaluable service to the people of the impacted Gulf Coast by communicating National Hurricane Center forecast and warning information about Hurricane Katrina. From Thursday, August 25, through Katrina's landfall in Mississippi on Monday, August 29, NOAA's Tropical Prediction Center/National Hurricane Center provided a total of 471 television and radio interviews, through their media pool or via telephone.

On Saturday evening, August 27, I personally called the Chief of Operations at the Alabama Emergency Management Agency, as well as the Governors of Louisiana and Mississippi and the Mayor of New Orleans, to communicate the potential meteorological and storm surge impacts from Hurricane Katrina. In addition, the National Hurricane Center web activity, as supported by NOAA's web-mirroring project, registered 900 million hits during Katrina.

NOAA Support Efforts

NOAA is focused on improving the forecasting of hurricane frequency, track, and intensity as well as predicting hurricane impacts on life and property. Using a combination of atmospheric and ocean observations from satellites, aircraft, and all available surface data over the oceans, NOAA conducts experiments to better understand internal storm dynamics and interactions between a hurricane and the surrounding atmosphere and ocean. Through 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. These numerical modeling improvements, once demonstrated, are transitioned into operations at the National Hurricane Center.

NOAA Aircraft, the W–P3 Orions and the Gulf Stream IV, provided essential observations critical to the National Hurricane Center forecasters and supplement U.S. Air Force Reserve Command's 53rd Weather Reconnaissance Squadron flights. A specialized instrument flown on one of the W–P3s, the Stepped Frequency Microwave Radiometer (SFMR), provided essential hurricane structure, surface wind and rain rate data to hurricane forecasters right up to and following landfall in Louisiana and Mississippi. The Military Construction Appropriations and Emergency Hurricane Supplemental Appropriations Act, 2005 (Pub. L. 108–324) provided $10.5M to the Air Force to outfit the complete fleet of Hurricane Hunters with this instrument, the first of these additional units should be available during the 2006 Hurricane Season.

The Military Construction Appropriations and Emergency Hurricane Supplemental Appropriations Act, 2005 also provided funding to NOAA for seven hurricane buoys, which NOAA deployed this past year in the Caribbean, the Gulf of Mexico, and the Atlantic. Those new buoys provided us with critical information during this active hurricane season.

NOAA's Activities After Hurricane Katrina's Landfall

Immediately following Hurricane Katrina's second landfall, several NOAA ships and aircraft were tasked with assisting in the hurricane response. Our aircraft flew damage assessment flights using a sophisticated digital camera to collect imagery to assess damage. Over 5,000 high-resolution images collected by NOAA aircraft are assisting emergency managers and other agencies in recovery operations and long-term restoration and rebuilding decisions.

It is also NOAA's responsibility to assess the damage to the commercial fishing industry in that section of the Gulf of Mexico. We are working closely with each of the impacted state resource agencies and commercial entities to assess the storm's impacts to the longer-term social and economic viability of local fishing communities. NOAA employees also are assisting recovery efforts by working with other Federal agencies in planning, organizing, and conducting oil spill and hazardous material response and restoration in the impacted areas of the Gulf.

NOAA ships are tasked with surveying critical ports and waterways for depths, wrecks and obstructions for navigational safety. NOAA Navigation Response Teams were on scene before the hurricane hit to survey for hazards and help the U.S. Coast Guard and the Army Corps of Engineers re-open waterways to commercial and emergency traffic. The THOMAS JEFFERSON, a highly specialized hydrographic survey ship equipped with multibeam and side scan sonar and two 28-foot launches for near shore and mid-water surveys will be surveying the entrances to Pascagoula and Gulfport, Mississippi. Another NOAA ship, the NANCY FOSTER, is outfitted with survey technology and is presently conducting wreck and obstruction surveys in Mobile Bay, Alabama. The efforts of these NOAA ships are critical to rebuilding the Gulf's economic infrastructure by enabling vessels of all sizes to pass safely through these waterways thereby allowing emergency materials, oil, and commercial goods to make it to their destinations. Other NOAA ships and aircraft are assisting directly with the recovery effort by providing fuel, communications, and supplies to NOAA facilities as well as temporary office space for local emergency responders.

Outlook for the Future

Today is September 20, near the historical peak of the hurricane season. To date we have had fifteen tropical storms, seven of which have become hurricanes, four of those have been major hurricanes at Category 3 or stronger. We believe we will continue to have an active season, with a total of l8–21 tropical storms. We believe this heightened period of hurricane activity will continue due to multi-decadal variance, as tropical cyclone activity in the Atlantic is cyclical. The 1940s through the 1960s experienced an above average number of major hurricanes, while the 1970s into the mid-1990's averaged fewer hurricanes. The current period of heightened activity could last another 10–20 years. The increased activity since 1995 is due to natural fluctuations/cycles of hurricane activity, driven by the Atlantic Ocean itself along with the atmosphere above it and not enhanced substantially by global warming. The natural cycles are quite large with on average 3–4 major hurricanes a year in active periods and only about 1–2 major hurricanes annually during quiet periods, with each period lasting 25–40 years.

While we have made significant progress in hurricane forecasting and warnings, we believe we have more work to do. From a scientific standpoint, the gaps in our capabilities fall into two broad categories: first, our ability to assess the current state of a hurricane and its environment (analysis), and second, our ability to predict a hurricane's future state (the forecast). Finally, we would like to improve public preparedness.

Conclusion

The government's ability to observe, predict, and respond quickly to storm events is critical to public safety. We must also now look ahead to post-storm redevelopment strategies for communities impacted by Katrina and future storms to help manage and anticipate these extreme events. NOAA has the expertise in coastal management and hazard mitigation, and is committed to working with out partners in reducing vulnerability to hurricanes and other coastal storm events. It is critical that we work to protect and restore natural features along the Gulf Coast, such as dunes, wetlands, and other vegetated areas that offer protection against coastal flooding and erosion.

While we must focus our energy on addressing the impacts of Hurricane Katrina, we also need to look to the future. Katrina will not be the last major hurricane to hit a vulnerable area, and New Orleans is not the only location vulnerable to a large disaster from a land-falling hurricane. 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 New Orleans remains vulnerable to future hurricanes.

At NOAA we will continue our efforts to improve hurricane track, intensity, and storm surge forecasting, as well as provide technical tools and planning expertise to states and local governments.

With that, I'll be glad to answer any questions Members may have.

NOAA NATIONAL HURRICANE CENTER—HURRICANE KATRINA FORECAST TIMELINE

TUESDAY, AUGUST 23, 2005

1600 CDT: Katrina forms as a Tropical Depression 12, near Nassau in the Bahamas. Tropical Depression 12 Advisory 1 issued: "A TROPICAL STORM OR HURRICANE WATCH MAY BE REQUIRED FOR PORTIONS OF SOUTHERN FLORIDA LATER TONIGHT."

WEDNESDAY, AUGUST 24, 2005

0400 CDT: The National Hurricane Center's 5-day forecast puts the projected path of Katrina in the southeast Gulf of Mexico (as the system is still a tropical depression in the central Bahamas).

0700 CDT: Katrina is elevated to a Tropical Storm.

1000 CDT: Tropical Storm Katrina Advisory 4 is issued: ". . . A TROPICAL STORM WARNING AND A HURRICANE WATCH HAVE BEEN ISSUED FOR THE SOUTHEAST FLORIDA COAST . . ."

THURSDAY, AUGUST 25, 2005

1430 CDT: Katrina is elevated to a Category 1 Hurricane.

1730 CDT: Katrina makes landfall in Florida as a Category 1 Hurricane.

WEDNESDAY/THURSDAY, AUGUST 24/25

Hurricane Liaison Team conference calls were conducted both days, and included Florida emergency managers, FEMA Headquarters (FEMA HQ), and Region IV.

FRIDAY, AUGUST 26, 2005

0200 CDT: Katrina entered the Gulf of Mexico as a Tropical Storm.

0400 CDT: Katrina is elevated to a Category 1 Hurricane.

1000 CDT: Hurricane Katrina Advisory Number 12 is issued: "KATRINA IS A CATEGORY ONE HURRICANE ON THE SAFFIR-SIMPSON SCALE. SOME STRENGTHENING IS FORECAST DURING THE NEXT 24 HOURS . . . AND KATRINA COULD BECOME A CATEGORY TWO HURRICANE ON SATURDAY."

1015 CDT: Hurricane Liaison Team Coordination Audio Conference with FL.

1030 CDT: Katrina is elevated to a Category 2 Hurricane. Hurricane Katrina Advisory Number 13 is issued: ". . . KATRINA RAPIDLY STRENGTHENING AS IT MOVES SLOWLY WESTWARD AWAY FROM SOUTH FLORIDA AND THE FLORIDA KEYS . . . KATRINA IS MOVING TOWARD THE WEST NEAR 7 MPH . . . AND THIS MOTION IS EXPECTED TO CONTINUE FOR THE NEXT 24 HOURS . . . RECENT REPORTS FROM AN AIR FORCE RESERVE UNIT HURRICANE HUNTER AIRCRAFT NOW INDICATE MAXIMUM SUSTAINED WINDS ARE NEAR 100 MPH . . . WITH HIGHER GUSTS. KATRINA IS NOW A CATEGORY TWO HURRICANE ON THE SAFFIR-SIMPSON SCALE. SOME STRENGTHENING IS FORECAST DURING THE NEXT 24 HOURS . . . AND KATRINA COULD BECOME A CATEGORY THREE OR MAJOR HURRICANE ON SATURDAY."

1100 CDT: Hurricane Liaison Team Coordination Video Conference with FEMA HQ, Region IV, FL, AL, and GA.

1600 CDT: Hurricane Katrina Discussion Number 14 is issued: ". . . THE MODELS HAVE SHIFTED SIGNIFICANTLY WESTWARD AND ARE NOW IN BETTER AGREEMENT. THIS HAS RESULTED IN THE OFFICIAL FORECAST TRACK BEING SHIFTED ABOUT 150 NMI WEST OF THE PREVIOUS TRACK . . . HOWEVER . . . PROJECTED LANDFALL IS STILL ABOUT 72 HOURS AWAY . . . SO FURTHER MODIFICATIONS IN THE FORECAST TRACK ARE POSSIBLE. KATRINA IS EXPECTED TO BE MOVING OVER THE GULF LOOP CURRENT AFTER 36 HOURS . . . WHICH WHEN COMBINED WITH DECREASING VERTICAL SHEAR . . . SHOULD ALLOW THE HURRICANE TO REACH CATEGORY FOUR STATUS BEFORE LANDFALL OCCURS."

1615 CDT: Hurricane Liaison Team Coordination Audio Conference with FL. 2200 CDT: Hurricane Katrina Discussion Number 15 is issued: "THE OFFICIAL FORECAST BRINGS THE CORE OF THE INTENSE HURRICANE OVER THE NORTH CENTRAL GULF OF MEXICO IN 48 HOURS OR SO. IT IS WORTH NOTING THAT THE GUIDANCE SPREAD HAS DECREASED AND MOST OF THE RELIABLE NUMERICAL MODEL TRACKS ARE NOW CLUSTERED BETWEEN THE EASTERN COAST OF LOUISIANA AND THE COAST OF MISSISSIPPI. THIS CLUSTERING INCREASES THE CONFIDENCE IN THE FORECAST."

SATURDAY, AUGUST 27, 2005

0400 CDT: Katrina is elevated to a Category 3 Hurricane. Hurricane Katrina Advisory Number 16 is issued: "KATRINA BECOMES A MAJOR HURRICANE WITH 115 MPH WINDS . . . SOME STRENGTHENING IS FORECAST DURING THE NEXT 24 HOURS . . . RECONNAISSANCE AIRCRAFT DATA AND SURFACE OBSERVATIONS INDICATE THAT KATRINA HAS BECOME A LARGER HURRICANE . . ." Hurricane Katrina Discussion Number 16 is issued: "DUE TO THE DECREASING SPREAD IN THE MODELS . . . THE CONFIDENCE IN THE FORECAST TRACK IS INCREASING."

1000 CDT: Hurricane Katrina Advisory Number 17 is issued: "A HURRICANE WATCH IS IN EFFECT FOR THE SOUTHEASTERN COAST OF LOUISIANA EAST OF MORGAN CITY TO THE MOUTH OF THE PEARL RIVER . . . INCLUDING METROPOLITAN NEW ORLEANS AND LAKE PONCHARTRAIN . . . A HURRICANE WATCH WILL LIKELY BE REQUIRED FOR OTHER PORTIONS OF THE NORTHERN GULF LATER TODAY OR TONIGHT. INTERESTS IN THIS AREA SHOULD MONITOR THE PROGRESS OF KATRINA . . . SOME STRENGTHENING IS FORECAST DURING THE NEXT 24 HOURS . . . AND KATRINA COULD BECOME A CATEGORY FOUR HURRICANE . . ." Hurricane Katrina Discussion Number 17 is issued: ". . . IT IS NOT OUT OF THE QUESTION THAT KATRINA COULD REACH CATEGORY 5 STATUS AT SOME POINT BEFORE LANDFALL . . ."

1015 CDT: Hurricane Liaison Team Coordination Audio Conference with FL.

1100 CDT: Hurricane Liaison Team Coordination Video Conference with FEMA HQ, Region IV and VI, FL, LA, MS, AL, and GA.

1600 CDT: Hurricane Katrina Advisory Number 18 is issued: "THE HURRICANE WATCH IS EXTENDED WESTWARD TO INTRACOASTAL CITY LOUISIANA AND EASTWARD TO THE FLORIDA–ALABAMA BORDER. A HURRICANE WATCH IS NOW IN EFFECT ALONG THE NORTHERN GULF COAST FROM INTRACOASTAL CITY TO THE ALABAMA–FLORIDA BORDER. A HURRICANE WARNING WILL LIKELY BE REQUIRED FOR PORTIONS OF THE NORTHERN GULF COAST LATER TONIGHT OR SUNDAY. INTERESTS IN THIS AREA SHOULD MONITOR THE PROGRESS OF KATRINA." Hurricane Katrina Discussion Number 18 is issued: "THE INTENSITY FORECAST WILL CALL FOR STRENGTHENING TO 125 KT AT LANDFALL . . . AND THERE REMAINS A CHANCE THAT KATRINA COULD BECOME A CATEGORY FIVE HURRICANE BEFORE LANDFALL."

1615 CDT: Hurricane Liaison Team Coordination Audio Conference with FL. 1925 CDT: Louisiana Gubernatorial Briefing: Max Mayfield, Director of NOAA's Tropical Predication Center/National Hurricane Center provides a briefing to Kathleen Babineau Blanco.

1935 CDT: Max Mayfield, Director of NOAA's Tropical Predication Center/National Hurricane Center provides a briefing to Bill Filter, Chief of Operations, Alabama Emergency Management Agency.

1945 CDT: Mississippi Gubernatorial Briefing: Max Mayfield, Director of NOAA's Tropical Predication Center/National Hurricane Center provides a briefing to Haley Barbour.

2000 CDT: New Orleans Mayoral Briefing: Max Mayfield, Director of NOAA's Tropical Predication Center/National Hurricane Center provides a briefing to Ray Nagin. 2200 CDT: Hurricane Katrina Advisory Number 19 is issued: ". . . DANGEROUS HURRICANE KATRINA THREATENS THE NORTH CENTRAL GULF COAST . . . A HURRICANE WARNING ISSUED . . . AT 10 PM CDT . . . 0300Z . . . A HURRICANE WARNING HAS BEEN ISSUED FOR THE NORTH CENTRAL GULF COAST FROM MORGAN CITY LOUISIANA EASTWARD TO THE ALABAMA/FLORIDA BORDER . . . INCLUDING THE CITY OF NEW ORLEANS AND LAKE PONCHARTRAIN . . . PREPARATIONS TO PROTECT LIFE AND PROPERTY SHOULD BE RUSHED TO COMPLETION . . . COASTAL STORM SURGE FLOODING OF 15 TO 20 FEET ABOVE NORMAL TIDE LEVELS . . . LOCALLY AS HIGH AS 25 FEET ALONG WITH LARGE AND DANGEROUS BATTERING WAVES . . . CAN BE EXPECTED NEAR AND TO THE EAST OF WHERE THE CENTER MAKES LANDFALL . . . HEAVY RAINS FROM KATRINA SHOULD BEGIN TO AFFECT THE CENTRAL GULF COAST SUNDAY EVENING. RAINFALL TOTALS OF 5 TO 10 INCHES . . . WITH ISOLATED MAXIMUM AMOUNTS OF 15 INCHES . . . ARE POSSIBLE ALONG THE PATH OF KATRINA." Hurricane Katrina Discussion Number 19 is issued: ". . . DESPITE THESE CHANGES IN THE INNER CORE . . . THE BOTTOM LINE IS THAT KATRINA IS EXPECTED TO BE AN INTENSE AND DANGEROUS HURRICANE HEADING TOWARD THE NORTH CENTRAL GULF COAST . . . AND THIS HAS TO BE TAKEN VERY SERIOUSLY."

1500–2230 CDT: Media pool operated; TPC/NHC provided 12 television and 2 radio interviews. In addition, TPC/NHC participated in 51 telephone briefings or media contacts on August 27th.

SUNDAY, AUGUST 28, 2005

0040 CDT: Katrina is elevated to a Category 4 Hurricane.

0100 CDT: Hurricane Katrina Special Advisory Number 20 is issued: ". . . KATRINA STRENGTHENS TO CATEGORY FOUR WITH 145 MPH WINDS . . ."

0400 CDT: Hurricane Katrina Discussion Number 21 is issued: "THE SPREAD IN THE MODEL TRACKS ALONG THE NORTHERN GULF COAST IS AT MOST 90 MILES . . . SO CONFIDENCE IN THE OFFICIAL FORECAST IS RELATIVELY HIGH."

0615 CDT: Katrina is elevated to a Category 5 Hurricane.

0700 CDT: Hurricane Katrina Advisory Number 22 is issued: ". . . KATRINA . . . NOW A POTENTIALLY CATASTROPHIC CATEGORY FIVE HURRICANE . . . HEADED FOR THE NORTHERN GULF COAST . . . MAXIMUM SUSTAINED WINDS ARE NEAR 160 MPH . . . WITH HIGHER GUSTS. KATRINA IS A POTENTIALLY CATASTROPHIC CATEGORY FIVE HURRICANE ON THE SAFFIR-SIMPSON SCALE. SOME FLUCTUATIONS IN STRENGTH ARE LIKELY IN THE NEXT 24 HOURS."

1000 CDT: Hurricane Katrina Advisory Number 23 is issued: ". . . POTENTIALLY CATASTRPHIC HURRICANE KATRINA . . . EVEN STRONGER . . . HEADED FOR THE NORTHERN GULF COAST . . . REPORTS FROM AN AIR FORCE HURRICANE HUNTER AIRCRAFT INDICATE THAT THE MAXIMUM SUSTAINED WINDS HAVE INCREASED TO NEAR 175 MPH . . . WITH HIGHER WIND GUSTS . . . HURRICANE FORCE WINDS EXTEND OUTWARD UP TO 105 MILES FROM THE CENTER AND TROPICAL STORM FORCE WINDS EXTEND OUTWARDS UP TO 205 MILES . . . COASTAL STORM SURGE FLOODING OF 18 TO 22 FEET ABOVE NORMAL TIDE LEVELS . . . LOCALLY AS HIGH AS 28 FEET ALONG WITH LARGE AND DANGEROUS BATTERING WAVES . . . CAN BE EXPECTED NEAR AND TO THE EAST OF WHERE THE CENTER MAKES LANDFALL. Hurricane Katrina Discussion Number 23 is issued: ". . . HURRICANE FORCE WINDS ARE FORECAST TO SPREAD AT LEAST 150 N MI INLAND ALONG PATH OF KATRINA. CONSULT INLAND WARNINGS ISSUED BY THE NATIONAL WEATHER SERVICE FORECAST OFFICES . . ."

1015 CDT: Hurricane Liaison Team Coordination Audio Conference with FL.

1100 CDT: Hurricane Liaison Team Coordination Video Conference with FEMA HQ, Region IV and VI, FL, LA, MS, AL, GA, TX.

1300 CDT: Hurricane Katrina Advisory Number 23A is issued: "SIGNIFICANT STORM SURGE FLOODING WILL OCCUR ELSEWHERE ALONG THE CENTRAL AND NORTHEASTERN GULF OF MEXICO COAST."

1600 CDT: Hurricane Katrina Advisory Number 24 is issued: "KATRINA IS MOVING TOWARD THE NORTHWEST NEAR 13 MPH . . . AND A GRADUAL TURN TO THE NORTH IS EXPECTED OVER THE NEXT 24 HOURS. ON THIS TRACK THE CENTER OF THE HURRICANE WILL BE NEAR THE NORTHERN GULF COAST EARLY MONDAY. HOWEVER . . . CONDITIONS ARE ALREADY BEGINNING TO DETERIORATE ALONG PORTIONS OF THE CENTRAL AND NORTHEASTERN GULF COASTS . . . AND WILL CONTINUE TO WORSEN THROUGH THE NIGHT . . . KATRINA IS A POTENTIALLY CATASTROPHIC CATEGORY FIVE HURRICANE ON THE SAFFIR-SIMPSON SCALE. SOME FLUCTUATIONS IN STRENGTH ARE LIKELY UNTIL LANDFALL. KATRINA IS EXPECTED TO MAKE LANDFALL AT CATEGORY FOUR OR FIVE INTENSITY. WINDS AFFECTING THE UPPER FLOORS OF HIGH-RISE BUILDINGS WILL BE SIGNIFICANTLY STRONGER THAN THOSE NEAR GROUND LEVEL . . . SOME LEVEES IN THE GREATER NEW ORLEANS AREA COULD BE OVERTOPPED." 1615 CDT: Hurricane Liaison Team Coordination Audio Conference with FL. 2200 CDT: Hurricane Katrina Advisory Number 25 is issued: "A HURRICANE WARNING IS IN EFFECT FOR THE NORTH CENTRAL GULF COAST FROM MORGAN CITY LOUISIANA EASTWARD TO THE ALABAMA/FLORIDA BORDER . . . INCLUDING THE CITY OF NEW ORLEANS AND LAKE PONCHARTRAIN. PREPARATIONS TO PROTECT LIFE AND PROPERTY SHOULD BE RUSHED TO COMPLETION."

MONDAY, AUGUST 29, 2005

0200 CDT: Hurricane Katrina is downgraded to a Category 4.

0400 CDT: Hurricane Katrina Advisory Number 26 is issued: "EXTREMELY DANGEROUS CATEGORY FOUR HURRICANE KATRINA MOVING NORTHWARD TOWARD SOUTHEASTERN LOUISIANA AND THE NORTHERN GULF COAST . . . SOME FLUCTUATIONS IN STRENGTH ARE LIKELY PRIOR TO LANDFALL . . . BUT KATRINA IS EXPECTED TO MAKE LANDFALL AS A CATEGORY FOUR HURRICANE."

0600 CDT: Hurricane Katrina Advisory Number 26A is issued: "KATRINA REMAINS A VERY LARGE HURRICANE. HURRICANE FORCE WINDS EXTEND OUTWARD UP TO 120 MILES FROM THE CENTER . . . AND TROPICAL STORM FORCE WINDS EXTEND OUTWARD UP TO 230 MILES."

0610 CDT: Hurricane Katrina makes landfall in southeastern Louisiana as a Category 4 hurricane.

0800 CDT: Hurricane Katrina Advisory Number 26B is issued: ". . . THE CENTER OF HURRICANE KATRINA WAS LOCATED . . . ABOUT 40 MILES SOUTHEAST OF NEW ORLEANS LOUISIANA AND ABOUT 65 MILES SOUTHWEST OF BILOXI MISSISSIPPI . . . MAXIMUM SUSTAINED WINDS ARE NEAR 135 MPH . . . WITH HIGHER GUSTS. KATRINA IS AN EXTREMELY DANGEROUS CATEGORY FOUR HURRICANE ON THE SAFFIR-SIMPSON SCALE. WEAKENING IS FORECAST AS THE CIRCULATION INTERACTS WITH LAND TODAY . . . COASTAL STORM SURGE FLOODING OF 18 TO 22 FEET ABOVE NORMAL TIDE LEVELS . . . ALONG WITH LARGE AND DANGEROUS BATTERING WAVES . . . CAN BE EXPECTED NEAR AND TO THE EAST OF THE CENTER. STORM SURGE FLOODING OF 10 TO 15 FEET . . . NEAR THE TOPS OF LEVEES . . . IS POSSIBLE IN THE GREATER NEW ORLEANS AREA. SIGNIFICANT STORM SURGE FLOODING WILL OCCUR ELSEWHERE ALONG THE CENTRAL AND NORTHEASTERN GULF OF MEXICO COAST."

1000 CDT: Hurricane Katrina makes a second landfall at the LA/MS border as a Category 3 hurricane.

1015 CDT: Hurricane Liaison Team Coordination Audio Conference with FL.

1100 CDT: Hurricane Liaison Team Coordination Video Conference with FEMA HQ, Region IV and VI, LA, MS, AL, FL, TX.

1615 CDT: Hurricane Liaison Team Coordination Audio Conference with FL.

TUESDAY, AUGUST 30, 2005

1000 CDT: Katrina is downgraded to a tropical depression with winds of 35 mph, 25 miles south of Clarksville, TN. The final TPC/NHC advisory is issued at this time; the Hydrometeorological Prediction Center assumes inland public advisories.

WEDNESDAY, AUGUST 31, 2005

2200 CDT: Hurricane Katrina has dissipated; remnants absorbed by a front in southeast Canada.

NOTES:

- Timeline highlights the major aspects of NOAA's Tropical Prediction Center/National Hurricane Center (TPC/NHC). All advisories (graphic and text) are available on the Katrina archive page: *http://www/nhc.noaa.gov/archive/2005/KATRINA/shtml?*
- Storm surge is a consistent concern and associated threat with any land-falling hurricane, especially a major hurricane.
- Hurricane Liaison Team Coordination calls included the state emergency management officials for the states listed; calls with the State of Florida included both local and state emergency management officials.
- For Katrina (including for Florida) NOAA's Tropical Predication Center/National Hurricane Center provided a total of 471 television and radio interviews, through their media pool or via telephone.

Senator DEMINT. Thank you, Mr. Mayfield. And thank you, again, for a job well done.

Dr. Blackwell?

STATEMENT OF DR. KEITH G. BLACKWELL, ASSOCIATE PROFESSOR OF METEOROLOGY, COASTAL WEATHER RESEARCH CENTER, UNIVERSITY OF SOUTH ALABAMA

Dr. BLACKWELL. Thank you for asking me to come talk to this committee.

Ever since I was knee-high, I've been a hurricane freak, and I've now got the opportunity to have more than my share of storms to study and forecast. And, unfortunately, there's quite a bit of heartache and anguish with the results that these storms bring. But I can say that the National Hurricane Center did a good job with Hurricane Katrina. And hurricanes, by nature, are notoriously difficult to predict. Within 3 days of a northern–Gulf Coast landfall, the National Hurricane Center had refined the forecast to the area that eventually was impacted by the storm.

Hurricane forecasting has come a long way over the last half century. The advent of weather satellites was probably one of the most revolutionary developments in hurricane tracking. No longer would a storm be undetected over the vast expanse of tropical oceans and potentially strike an unsuspecting community without warning. Over the last several decades, reconnaissance and research aircraft have provided storm location and intensity information which was useful to hurricane forecasters.

In addition, these aircraft, combined with coastal Doppler radars, have provided large amounts of data which have been useful in understanding the structure and evolution of the hurricane's severe inner core of winds and rainfall.

The increased number of weather buoys deployed over the Gulf, Atlantic, and Caribbean Sea have helped to provide better coverage in a region where very few, if any, weather observations existed.

As computer capabilities have become larger and faster, sophisticated weather forecast models have used much of the increased weather data available to provide multi-day forecasts of tropical cyclones.

Here is an example of the expansion of hurricane forecasting lead time which has occurred over the last quarter century for various storms which struck the north-central Gulf Coast, beginning with Hurricane Frederic, in 1979. Believe it or not, looking at those old advisories, which I have in my library, they had 18 to 20 hours advance notice of where the storm was going to cross the coast. The forecasts only went out that far, less than a day. But then, shortly after that, by the time Hurricane Elena, in 1985, struck the Mississippi and Alabama coast, the forecast tracks had gone out to 5 days—or, excuse me, to 3 days. And then, of course, by the time Katrina came along, the forecasts were attempting to predict 5 days into the future.

Theoretically, with these longer-range forecasts, communities and the public have greater lead time in order to begin preparing. However, I'm not so sure that the vast majority of the public has the confidence necessary in these multi-day forecasts to motivate them to begin early preparation.

With Katrina, last month, the 3-day forecast was much more helpful in correctly portraying Katrina's actual landfall threat than most of the 5-day forecasts issued for that storm. At times, the 5-day forecasts can be very misleading, when the predictability of that particular atmospheric situation may only be 3 days.

Starting in 2004, forecast outlooks were expanded from 3 to 5 days. Having personally produced numerous forecasts for industrial clients on all storms threatening the U.S. since 1997, I, personally, do not believe a 5-day forecast should be produced for every tropical cyclone, assuming that that tropical cyclone's going to be alive for the next 5 days.

There are some storms which are absolutely unpredictable at the 4- and 5-day point. Many of these difficult storms are embedded within weak steering currents or within environments displaying moderate vertical wind shear. Some examples are presented in my testimony, which I submitted.

I believe that when 5-day forecasts are generated in situations when the atmosphere is not predictable out to that range, public

cynicism of hurricane forecasts grow, eventually leading to mistrust and inaction by many. I believe each storm should be forecast out for 3 days, regardless of the predictability. However, I believe that it would serve the public much better if forecasts out to 4 and 5 days were only issued when the confidence of the forecast is relatively high at that timeframe.

A confidence gauge could be developed by calculating the scatter, or standard deviation, of the more reliable hurricane forecast track models at the 5-day forecast point. If the scatter was within acceptable limits, then we should proceed with the 4- or 5-day forecast. But, otherwise, the forecast should be limited to only 3 days.

We have come a long way with track forecasting of hurricanes, but much still remains—but there still are often severe limits to our skill several days into the future. Much more work remains.

So far, I've only discussed hurricane track forecasting. There are many other aspects of a hurricane forecast in which we display very little skill. These include intensity, size, storm surge, and precipitation. There is much more data collection and research that needs to be accomplished in order to predict these storms better. Using a baseball-game analogy, we are roughly to second base in track forecasting. That's what we do best, I believe, is track forecasting. But we're nowhere near perfect.

The National Hurricane Center has a very tough job with these storms. They're incredibly fickle beasts, and they really rise—the folks, Max Mayfield and folks down there at the National Hurricane Center really rise to the occasion, often under very, very difficult circumstances.

Maybe, though, we're approaching first base in our ability to predict intensity and storm surge. But, often, we haven't even left the batter's box when it comes to accurate rainfall distribution, storm-size fluctuations, and the evolution of the inner-core structure of the storm.

One of the biggest drawbacks to hurricane prediction is the lack of quality data in and around the storm. These storms form over data-void tropical oceans where weather observations to the accuracy and resolution needed by computer prediction models are essentially nonexistent most of the time. If we cannot even accurately specify the present conditions of the storm as it exists today, how can we expect a computer to take this information—this incomplete data and generate an accurate forecast?

More weather data in and around the storm is extremely important to increasing our ability to better understand and predict hurricanes. Significantly more quality data is needed than what presently exists today.

We also need more research into computer simulations of hurricanes, which then will have direct benefits to operational hurricane forecasters. Presently, computers are too slow and do not have the necessary data density to predict hurricanes with the accuracy needed for the public to confidently begin early preparatory action.

In order to speed up computer hurricane forecast calculations so that the forecast is available in a timely manner, we end up taking many shortcuts on how important—on how important physical processes are calculated or represented in a model. These shortcuts

lead to significant forecast errors and also often lead to very little continuity between model forecasts.

We also need to come up with a four-pronged scale to rate the destructive potential of hurricanes, which will include a separate indicator for wind, storm surge, flooding, and storm size. The Saffir–Simpson scale is not representative of the true impact of a hurricane. Being only one number, it really doesn't tell the story, as I think we're seeing with Katrina, of what a hurricane can really do at landfall.

And, just to show you a storm that should not have a 5-day forecast attributed to it, this is Hurricane Ophelia, from a few days ago, off the East Coast of the United States. Those are the track models. Those are the track model forecasts, as presented here. They look like a spider web. What are you going to do with a storm that has that kind—where your guidance is like that? Fortunately, Katrina, for the most part, was much better behaved and did not have that kind of scatter. But this kind of situation presents us, time and time and time again—and with Katrina, we did have adequate warning to get people out of the way, but they needed to heed that warning.

But, with some storms in the future, we're going to have a problem with getting people out of the way, because the storm is going to do something very unexpected, given the problems we have with computer forecast simulations.

Thank you very much.

[The prepared statement of Mr. Blackwell follows:]

PREPARED STATEMENT OF DR. KEITH G. BLACKWELL, ASSOCIATE PROFESSOR OF METEOROLOGY, COASTAL WEATHER RESEARCH CENTER, UNIVERSITY OF SOUTH ALABAMA

The National Hurricane Center did a good job with Hurricane Katrina. Hurricanes, by nature, are notoriously difficult to predict. Within 3 days of a northern Gulf coast landfall, the National Hurricane Center had refined the forecast landfall to the area that eventually was impacted by the storm.

Hurricane forecasting has come a long way over the last half century. The advent of weather satellites was probably one of the most revolutionary developments in hurricane tracking. No longer would a storm be undetected over the vast expanse of tropical oceans and potentially strike an unsuspecting community without warning. Over the last several decades, reconnaissance and research aircraft have provided storm location and intensity information which was useful to hurricane forecasters. In addition, these aircraft, combined with coastal Doppler radars, have provided large amounts of data which has been useful in understanding the structure and evolution of the hurricane's severe inner core of winds and rainfall. The increased number of weather buoys deployed over the Gulf, Atlantic, and Caribbean Sea have helped to provide better coverage in a region where very few if any weather observations existed.

5-Day Forecast

As computer capabilities became larger and their speed faster, sophisticated weather forecast models have used much of this increased weather data to provide multi-day forecasts of tropical cyclones. Here is an example of the expansion of hurricane forecasting lead time which has occurred over the last quarter century for various storms which struck the north-central Gulf coast:

1979—Hurricane Frederic: 1-day forecast (only 18–20 hours lead time).
1985—Hurricane Elena: 3-day forecast.
1998—Hurricane Georges: 3-day forecast.
2005—Hurricane Katrina: 5-day forecast.

Theoretically, with these longer-range forecasts, communities and the public have greater lead times in order to begin preparing. However, I am not so sure that the

vast majority of the public has the confidence necessary in these forecasts to motivate them to begin early preparation.

With Katrina last month, the 3-day forecast was much more helpful in correctly portraying Katrina's landfall location than most of the 5-day forecasts. For example:

- From 5 p.m. Tuesday (23 Aug)—11 a.m. Wednesday (24 Aug): 5-day forecasts displayed some skill bringing the storm across Florida and into the eastern Gulf of Mexico (See Figure 1).
- After that, the 5-day forecast was generally not helpful in portraying the threat to New Orleans and the Mississippi Gulf Coast. Instead, the 5-day forecasts generally portrayed an incorrect threat to the Florida Big Bend and eastern portions of the Florida Panhandle (see Figure 2).
- By the time a serious threat to New Orleans became apparent, the storm was within 3 days of landfall. At 5 p.m. Friday (26 Aug), the storm is within 3 days of landfall and the 3-day forecast shows significant skill from this point forward with portraying a serious threat to the SE Louisiana, Mississippi, and Alabama coast. Thus, the 3-day, not the 5-day forecast, was useful in portraying Katrina's threat to the Louisiana/ Mississippi/ Alabama coastline (see Figure 3).

Starting in 2004, forecast outlooks were expanded from 3 days to 5 days. Having operationally produced numerous forecasts for industrial clients on all storms threatening the U.S. since 1997, I personally do not believe a 5-day forecast should be produced for *every* tropical cyclone (assuming 5 or more days of existence remain). There are some storms which are absolutely unpredictable at the 4 and/or 5 day point. Many of these "difficult" storms are embedded within very weak steering currents, or within environments displaying moderate vertical wind shear.

Initially, Katrina's steering currents were fairly well defined, as evidenced by the general agreement (*i.e.,* the general lack of scatter in the forecast tracks) between many models (see Figure 4). In this case, the 5-day forecast certainly indicated a possible future threat to the north-central Gulf coast area (see Figure 1). A couple of days later however, as scatter between model forecasts increased, the accuracy of Katrina's 5-day forecast went down as the northeast Gulf coast was now targeted (see Figure 5 and compare to Figure 2). Finally, after Katrina moved into the Gulf, the model forecast scatter once again began decreasing, and the threat shifted back to the north-central Gulf coast (see Figure 6 and compare to Figure 3). But by this time, the storm was within 3 days of landfall.

Hurricane Ophelia last week is an example of an unpredictable storm in which a forecast should be limited to only 3 days during certain times of the storm's life. Ophelia was embedded in weak steering currents and the scatter of the model forecast tracks was huge (Figure 7). The terribly large scatter of forecast tracks indicates that there should very little confidence in the storm's 5-day forecast; therefore, the public should only receive a 3-day forecast instead of the 5- day forecast as portrayed in Figure 8. Instead of striking South Carolina and moving well inland, the storm actually grazed the North Carolina coast before moving out to sea.

The National Hurricane Center's Tropical Cyclone Discussion from 5 a.m. EDT, Friday, September 9, 2005, indicates the forecaster's lack of confidence in the forecast track.

> . . . GIVEN THE LACK OF CONSISTENCY IN MODEL GUIDANCE THUS FAR WITH THIS STORM . . . I HAVE ONLY MADE A MODEST WESTWARD ADJUSTMENT WITH THE OFFICIAL FORECAST AT THIS TIME. IT IS TOO EARLY TO BE SPECIFIC ABOUT WHICH AREAS MIGHT ULTIMATELY BE AFFECTED BY OPHELIA . . . BUT THE PROXIMITY OF THIS CYCLONE TO THE COAST AND THE WEAK STEERING CURRENTS DICTATES THAT INTERESTS FROM FLORIDA THROUGH THE CAROLINAS WILL NEED TO MONITOR OPHELIA FOR THE NEXT SEVERAL DAYS. . . .

The graphic did not display this level of uncertainty any different than it would a more confident forecast, and most people see the graphic and not the Tropical Cyclone Discussion. Thus, a 4- and 5-day forecast track to South Carolina is misleading, even if there are huge margins of error depicted on the graphic. These margins of error (depicted by the white circular line surrounding the forecast track) are the same for every forecast, regardless of the true confidence of the forecast.

Yet, there are other storms in which the steering currents are well established and the storm is predictable with great accuracy out to 5 days. Hurricane Emily is an example of a storm with a highly predictable track (see Figures 9 and 10).

I believe that the 5-day forecast product contributes to public cynicism and too often tends to give the public the impression that "The 5-day forecast may have the

storm pointed at my city today, but it always changes; I will wait until tomorrow or the next day before I begin to take any action. After all, I fully expect the track to be pointed somewhere else tomorrow, so why should I begin to prepare now? " I believe some of this mentality may have affected actions by both the public and public officials prior to Katrina's landfall.

I believe each storm should be forecast at least out to 3 days, regardless of the predictability. However, I believe that it would serve the public much better if the 4 and/or 5 day forecast were only issued when the confidence of the forecast is relatively high at that time range. A "confidence gauge" could be developed by calculating the "scatter" or "standard deviation" of the more reliable track models at the 4- and 5-day forecast points. If the "scatter" was within acceptable limits, then proceed with the 4- or 5-day forecast, but otherwise limit the forecast to only 3 days.

I have only discussed forecast tracks in the above paragraphs. The success with intensity forecasting is much less than with track forecasting. There is much more data collection and research that needs to be accomplished in order to better predict these storms.

Increasing the frequency of Mexican weather balloon launches (to 6- or 12-hour intervals, rather than the current 24-hour intervals) when hurricanes are present in the Atlantic would help increase the accuracy of measuring steering currents which later might impact the hurricane track.

New Upgrade Needed for Saffir-Simpson Hurricane Scale

A new hurricane intensity scale is needed in order to better relate the expected effects of a hurricane on the threatened population, thus better preparing them for the storm and improving their ability to evacuate.

Need a new scale to rate hurricane effects at landfall. Need alternative estimates of storm intensity which better define what a storm is capable of doing.

- Saffir-Simpson Scale is not representative of what hurricanes can do. Winds are only part of the story.
- Need a 4-pronged scale to rate the destructive potential of hurricanes which will include:

  —Wind
  —Storm surge
  —Rainfall and inland flooding.
  —Storm size

All of these need to be independent of each other and able to stand on their own merit, depending on the situation.

Much More Storm Intensity Research Needed

There need to be better ways to observe present storm intensity and predict changes in intensity.

- How strong are hurricanes? This is a very elusive question.
- Some storms appear as though they should have strong winds, but make landfall without doing much wind damage.
- Some storms produce wind damage which far surpasses their expected intensity.
- Some storms bring their strong winds to the ground and others don't. We cannot predict this. When it comes to wind damage and effects of the wind on the storm surge, it is the wind speeds which occur at the ground (or ocean surface) that count.
- New tools on board aircraft are being used to measure winds close to the surface of the ocean:

  —Global Positioning System Dropsondes have provided unparalleled views of vertical wind profiles in hurricanes, particularly near the surface.

  —Stepped frequency microwave radiometers (SFMR) have recently been placed on board NOAA research aircraft.

    —Presently this type of equipment is needed on Air Force C–130 hurricane hunter aircraft.

    —The SFMR provides surface wind speed estimates over the ocean.

    —Good calibration of these SFMR wind measurements only exists for low and moderate wind speed situations. Additional work needs to be done to calibrate this instrument for high wind speeds, typical of intense hurricanes. Rainfall estimates are also possible with the SFMR.

—Important: The SFMR and other wind profiling instruments are critical to determining wave height out in the open ocean 1 or 2 days before landfall. In Katrina's case, waves generated while Katrina was a Category 5 over the central Gulf 1 or 2 days prior to landfall probably helped enhance the storm surge above what a weakening Katrina would have been capable of when it made landfall. In other words, the fact that Katrina was a large Category-5 hurricane in the central Gulf probably led to a larger storm surge on the Gulf coast well above what would probably have happened had Katrina never reached Category-5. Assuming that Katrina crossed the Mississippi coast as a high Category-3 or low Category-4 storm, the storm surge was probably much higher with this storm because it had a recent history as a large Category-5 storm. Had the storm not been so intense over the central Gulf 1–2 days before landfall, there probably would have been a smaller surge (everything else being equal). Thus, the ability to measure the size and strength of the storm is critical to storm surge prediction.

- UAVs (Unmanned Aerial Vehicles) offer great promise of long-term direct sampling of hurricanes, provided they are rugged enough to survive the hostile weather environment. Because of their small size and low speed, they may be better suited for remaining in the eye and measuring central pressure and temperature, rather than venturing into the rougher weather outside the eye to measure the maximum winds. Testing is ongoing.
- Storm winds near the ground in a landfalling hurricane are often difficult to assess.

—The storms produce power outages and severe damage which often either renders wind equipment useless in the core of hurricanes, unless they are "hardened" to handle such extreme events. However, when observations are available, they are invaluable for both assessing the storm strength and structure, and also for research.

- Coastal and portable Doppler radars are extremely useful tools for assessing storm strength, but often cannot sample the atmosphere at low enough levels to determine the wind speed near the ground.
- Mesonets (mesoscale networks), consisting of a fairly dense array of low-cost weather stations, are currently being set up by individual universities using grant money. Mesonets serve the dual purpose of providing operational and research benefits, particularly when hurricanes make landfall. In addition, they are good for public relations because the public likes to see local weather observations close to them. Dr. Kimball, at the University of South Alabama, is presently installing a mesonet along the north-central Gulf coast. She has had many requests from the public wanting access to her website which displays the observations taken by these instruments. Locating these instruments at schools also allows and educational component to be realized by teachers and students. During landfalling hurricane situations, these weather stations can provide extremely important wind and other weather information which can be used to determine the severity of the storm and later incorporated into research which furthers our understanding of these storms.

—Ken Crawford has been appointed the COOP modernization person at NOAA, but that office needs to be expanded. They are often too busy to pursue collaboration efforts with universities in hurricane-prone regions.

—These observations are critical to improving the accuracy of computer simulations attempting to re-create the structure, intensity, surge, and rainfall of actual storms which have made landfall.

—Also, these mesonets need funding for infrastructure and for long-term maintenance. After a university's mesonet grant expires, the stations may deteriorate, lose calibration, and eventually die.

Landfall Forecast Focus Needs to be Emphasized

- The accuracy of hurricane forecasts continues to slowly improve; however, the accuracy that really counts for most interests is the projected landfall location and intensity. This is where the most significant emphasis should continue to be placed. Much more research needs to be done to provide more accurate guidance to emergency managers and the public about what to expect as the hurricane approaches.

—Obviously, accurate track and intensity forecasts are critical at landfall, but other less-obvious challenges are important too.

—Better forecasting of size and structural changes in hurricanes will allow for improved forecasts for the onset of tropical storm-force winds and early water rise at the coastline.

—Onset of these winds effects evacuation efforts in the path of the storm (example: Often ferries and certain bridges used for evacuation may be closed early due to winds and/or tides exceeding limits, etc . . .)

Numerical Hurricane Modeling

Much of the future of hurricane prediction lies in better observations and more powerful numerical computer modeling. Weather data is seriously lacking in the vicinity of tropical cyclones. These cyclones form over data-void regions of the tropical and sub-tropical oceans where weather observations are scarce. This weather data must be easily convertible into quantitative data compatible for use by weather forecast computers.

- Weather data is needed over vast regions surrounding the hurricane. The newly acquired NOAA Gulfstream jet performs some of this function, but it is not feasible to keep this aircraft continuously deployed. Satellite also can help, but most of this data alone cannot provide the quantitative accuracy or vertical detail needed by numerical models. There are some platforms, such as the QuikScat instrument deployed on low-flying polar orbiting satellites which provide good estimates of surface winds over the oceans; however, there are two major shortcomings which need to be overcome with more research:

  a. The polar-orbiting satellite only allows twice-a-day fly-overs at best, and large data-void swaths exist over tropical oceans in expansive regions between the successive orbital paths of the satellite. Often, a hurricane will fall within one of these data-void swaths and no wind data will be collected from the vicinity of the hurricane for maybe a day or two.
  Possible solutions:

  —Equip several polar-orbiting satellites with QuikScat

  —Place QuikScat on geostationary satellites, thus allowing continuous wind measurements from the same oceanic region.

  b. The QuikScat wind measurements are degraded in areas of heavy rain. Since heavy rainfall is common in hurricanes, very limited information is available from this instrument within the hurricane itself.

- The Tropical Rainfall Monitoring Mission (TRMM) satellite is a special satellite which has been in a low earth orbit which circles the tropical regions of the globe. This operational satellite was recently targeted for elimination, but some funds were found to extend its life. This type of satellite needs to continue operations in the future over hurricane-prone regions of the tropical and sub-tropical oceans.
- For more accurate forecasts of the inner-core structure of a hurricane, better techniques need to be developed for inserting (known as "bogusing") a hurricane vortex into numerical models. Better data incorporation and data assimilation of a representative hurricane vortex is needed in numerical models. However, in order to bogus a more accurate vortex into a model, better data quality and quantity is needed in the inner core of the hurricane.
- Better computer resources are needed to refine forecast models. Currently, the operational resolution and parameterizations of operational models are inadequate to provide routinely accurate hurricane forecasts, particularly with regards to structural and intensity changes. Faster computers and more complete numerical models are needed for more detailed and accurate hurricane forecasting.
- Observations are needed to refine model parameters. NOAA P–3 Orion research aircraft fly at a maximum altitude of 5 km, but observations of microphysical cloud structure (*e.g.,* microphysics) above that level are needed due to their huge impacts on storm structure. The NOAA Gulfstream aircraft is capable of flying at some of these higher altitudes, but presently it only samples areas outside the immediate storm environment and not directly within the hurricane.
- Planetary boundary layer (PBL) parameters need to be refined for high wind regimes; exchange coefficients currently in use are for low winds, not the extreme wind speeds characteristic of hurricanes. Plus, there is a need for quantitatively measuring and incorporating into models correct values of sea spray and wave roughness.

- Correct modeling of hurricane structure, size, and intensity is crucial if one ever expects to correctly predict flooding rainfall, storm surge and wind speeds of landfalling hurricanes.

National Hurricane Center Public Relations

The Tropical Prediction Center National Hurricane Center (NHC) needs an experienced tropical meteorologist who is a professional public relations specialist. This person would be skilled at working with the media. Presently, this position is often filled by the NHC director himself (such as Mr. Mayfield). The NHC director needs to remain in the trenches with the hurricane forecasters. I do not believe that hurricane forecasts are improved by the NHC director having to devote so much time with the media when significant forecast challenges are always presented in landfalling hurricane situations. Public relations is extremely important in convincing the public that they should prepare for a hurricane, but it should not detract from the core NHC mission: accurate hurricane forecasts. (This is not to say that Mr. Mayfield does less than a stellar job in front of the camera.)

FIGURES

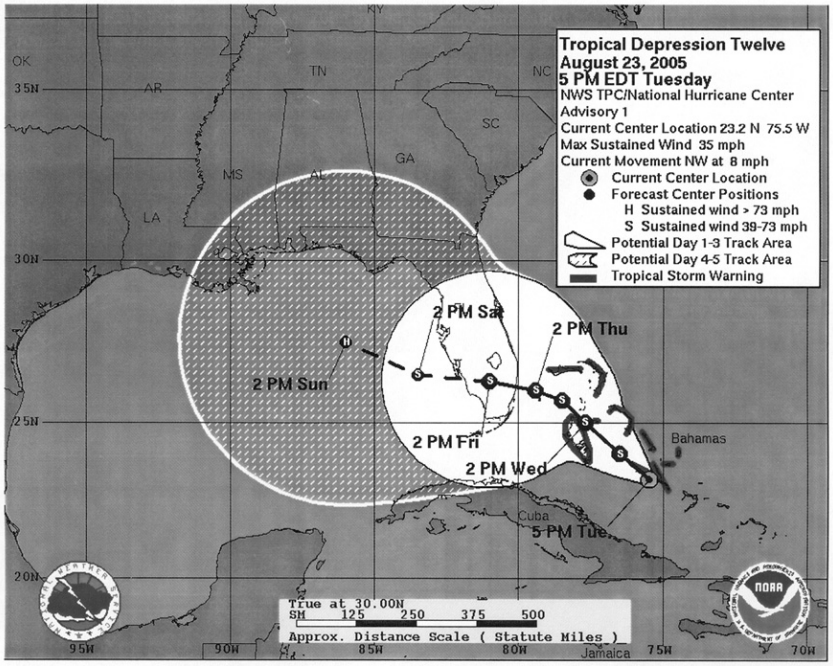


Figure 1. Hurricane Katrina 1 to 3-day forecast (solid line) and 4 to 5-day forecast (dashed line), issued 5 pm EDT Tuesday, 23 August 2005 by the National Hurricane Center. (Courtesy: Tropical Prediction Center/National Hurricane Center)

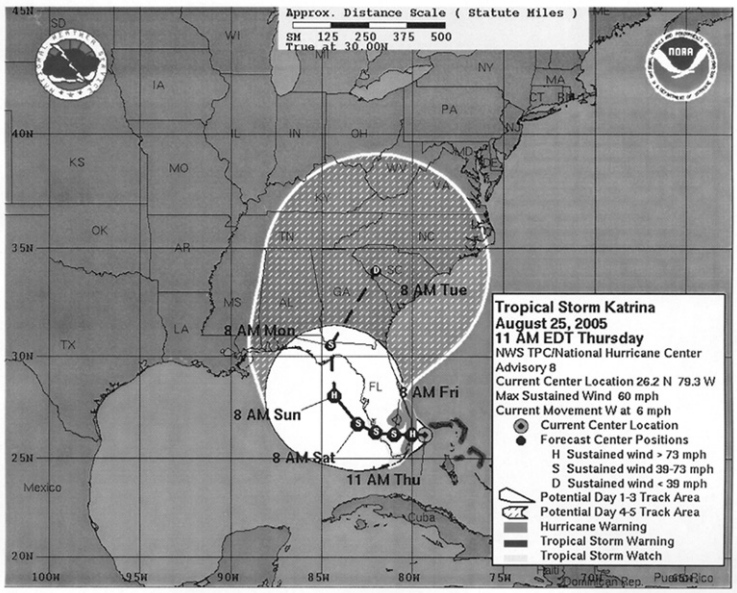


Figure 2. Hurricane Katrina 1 to 3-day forecast (solid line) and 4 to 5-day forecast (dashed line), issued 11 am EDT Thursday, 25 August 2005 by the National Hurricane Center. New Orleans, the actual landfall point, is not even within the cone of forecast uncertainty. (Courtesy: Tropical Prediction Center/National Hurricane Center)

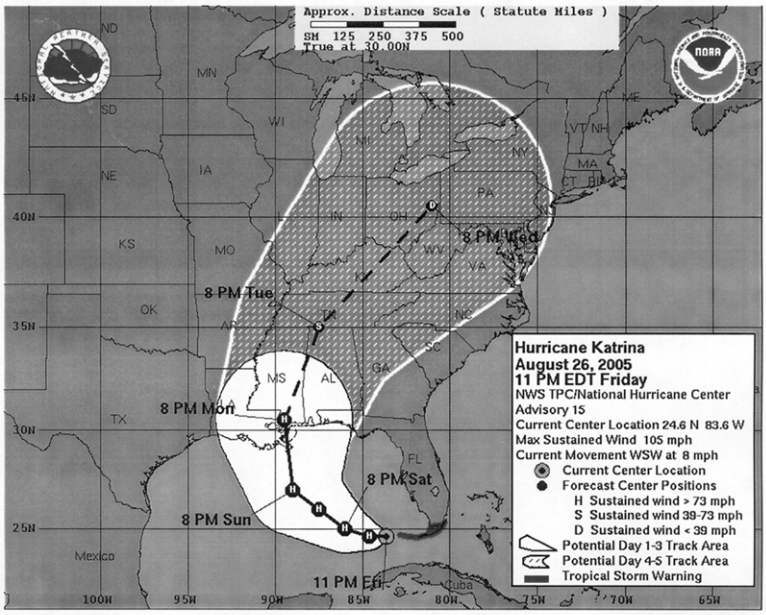


Figure 3. Hurricane Katrina 1 to 3-day forecast (solid line) and 4 to 5-day forecast (dashed line), issued 11 pm EDT Friday, 26 August 2005 by the National Hurricane Center. (Courtesy: Tropical Prediction Center/National Hurricane Center)

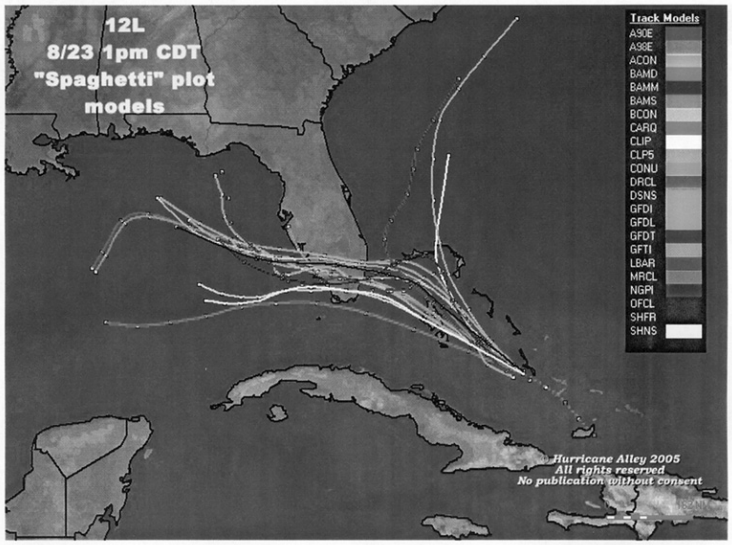


Figure 4. Hurricane Katrina forecast model tracks, issued 1 pm CDT Tuesday, 23 August 2005. Relatively good agreement between models indicates that there should be reasonable confidence in the 5-day forecast displayed in Figure 1. (Graphic used with permission from *Hurricane Alley*)

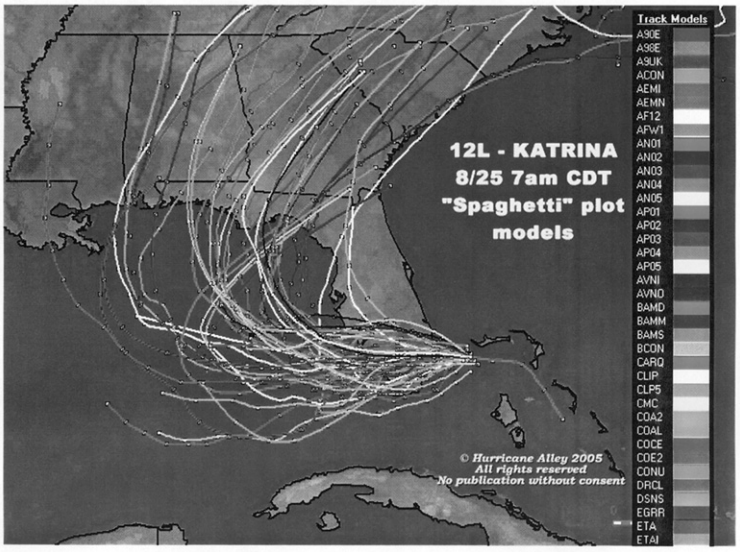


Figure 5. Hurricane Katrina forecast model tracks, issued 7 am CDT Thursday, 25 August 2005. Increasing scatter of forecast model tracks indicates that there should be less confidence in the 5-day forecast displayed in Figure 2. Maybe a 3 or 4 day forecast would be more useful than a 5-day forecast. Note that nearly all the models are much too far east and don't show a threat to New Orleans. (Graphic used with permission from *Hurricane Alley*)

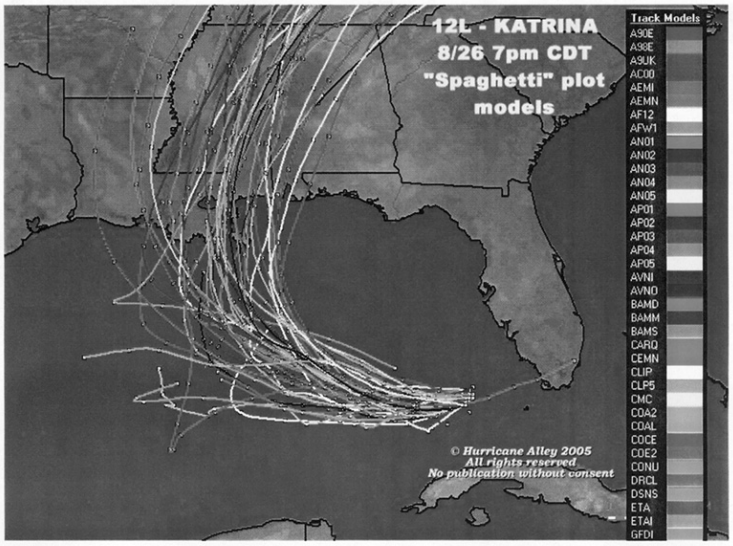


Figure 6. Hurricane Katrina forecast model tracks, issued 7 pm CDT Thursday, 26 August 2005. Decreased scatter of forecast model tracks indicates that there should again be greater confidence placed in the storm's 5-day forecast displayed in Figure 3 . A 5-day forecast is appropriate in this situation. (Graphic used with permission from *Hurricane Alley*)

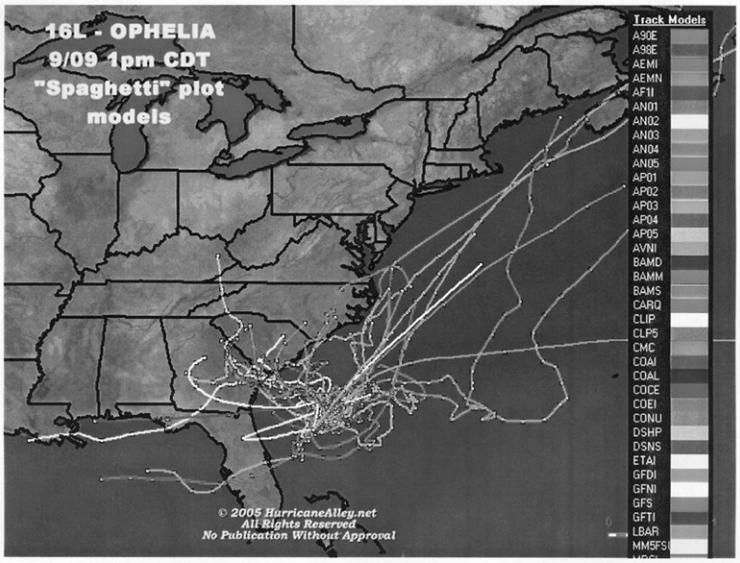


Figure 7. Tropical Storm Ophelia model forecast tracks, issued 1 pm CDT Friday, 9 September 2005. The terribly large scatter of forecast model tracks indicates that there should very little confidence in the storm's 5-day forecast; therefore, the public should only receive a 3-day forecast instead of a 5-day forecast as portrayed in Figure 8. (Graphic used with permission from *Hurricane Alley*)

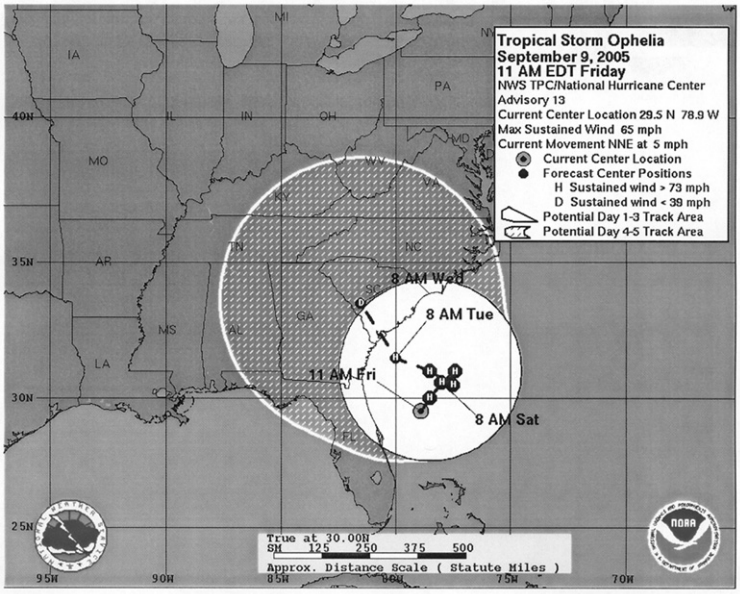


Figure 8. Tropical Storm Ophelia 1 to 3-day forecast (solid line) and 4 to 5-day forecast (dashed line), issued 11 am EDT Friday, 9 September 2005 by the National Hurricane Center. (Courtesy: Tropical Prediction Center/National Hurricane Center)

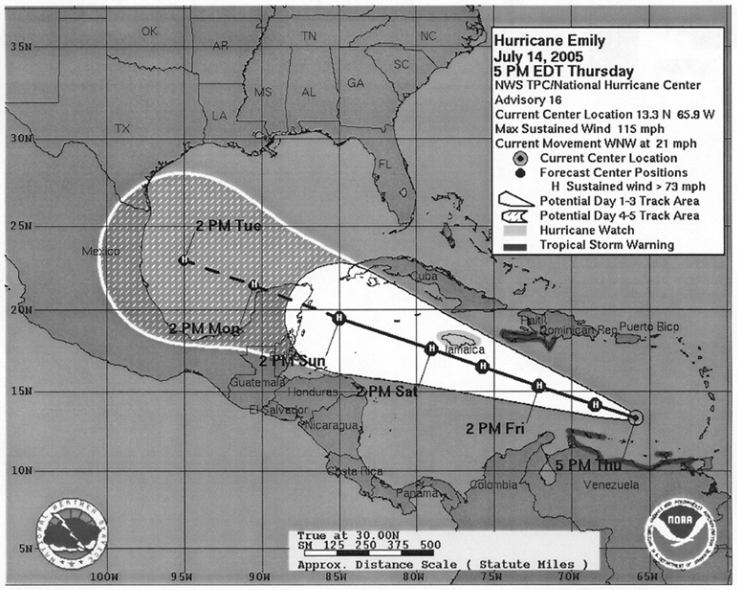


Figure 9. Hurricane Emily 1 to 3-day forecast (solid line) and 4 to 5-day forecast (dashed line), issued 5 pm EDT Thursday, 14 July 2005 by the National Hurricane Center. (Courtesy: Tropical Prediction Center/National Hurricane Center)

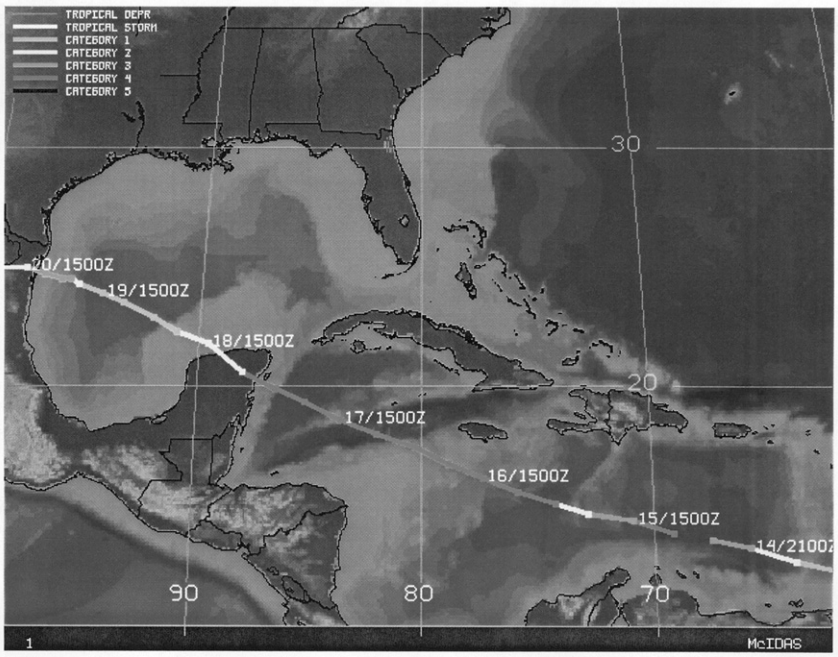


Figure 10. Hurricane Emily track. (Courtesy: Cooperative Institute for Meteorological Satellite Studies (CIMSS).

Senator DEMINT. Thank you, Dr. Blackwell.

Dr. Levitan?

STATEMENT OF DR. MARC L. LEVITAN, DIRECTOR, HURRICANE CENTER/CHARLES P. SIESS, JR. ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, LOUISIANA STATE UNIVERSITY; PRESIDENT, AMERICAN ASSOCIATION FOR WIND ENGINEERING

Dr. LEVITAN. Mr. Chairman and members of the Subcommittee, my name is Marc Levitan, Director of the LSU Hurricane Center.

I'd first like to discuss the role of the LSU Hurricane Center in operational response. On Saturday morning, August 27, we were activated by the Louisiana Office of Homeland Security and Emergency Preparedness to provide operational support. Our team includes the LSU Hurricane Center, the Southern Regional Climate Center, LSU Earth Scan Lab, and the Center for the Study of Public Health Impacts of Hurricanes.

The support that we provided in the State Emergency Operations Center, from before the storm until well after the storm, included satellite storm tracking, local meteorological condition information and support, storm-surge estimation, wind-damage estimation, consultations with technical information on evacuation and sheltering decisions, and many other technical aspects.

One of the most important aspects that we were able to provide is some additional information on storm-surge modeling. Let me pull that up here. And as—based on the forecast advisory, number

16, we use the ADCIRC, a different storm-surge model, to develop storm-surge flooding estimates on the LSU supercomputer.

Now, the information—as important as the track forecasting is, of course, we can't do any kind of good storm-surge estimations without having a good track. And so, we start with the track information developed by the National Hurricane Center. And this model provides—in the same way that we just saw, there are many different models available to predict where the storm will go—this is—becomes a second modeling tool that's available to us now, to have at least two models that can be used operationally to investigate what the possible storm-surge flooding is, in addition to the NOAA storm-surge model.

We briefed this—I actually—as our team was developing these models and running this information, I was in the EOC, briefing this. And, as of Saturday—this was a Saturday afternoon briefing, and it indicated some storm-surge flooding in the lower parishes, but no overtopping of the levees. However, we did note that levee overtopping certainly was possible, as the note on the graphic indicates.

By advisory 18, which we briefed very late Saturday night, close to midnight, that one did show, in the New Orleans east area, over here—we showed overtopping through the Mississippi River/Gulf outlet, and it showed a significant extent of flooding.

Now, I will say that none of the models—and we just do not have the technology yet—none predict breaching of the levee or failure of the levee. The flooding indicated by all these models is simply due to overtop. I will mention that we are working today, have been working over the last week, to upgrade our—the ADCIRC model to account for the damaged state of the levees as they are right now. We have teams in the field, measuring, getting information on those. So, if Hurricane Rita or other storms threaten New Orleans again during this season, then we'll be able to run storm-surge models with the damaged levee state in there to be able to see what the vulnerability of the city will be.

Again, this was a close-up showing what—this was the extent of flooding predicted simply due to the overtopping of the levees.

And I'll show that we also developed animations to show this, in a graphical sense. We can see, as the storm moves through, the wind vectors across there—and it brings the flooding in.

Now, I will say, where we're lacking in the prediction sense is, we—as the National Hurricane Center has shown, we've done a very good job, for Katrina and other storms, in predicting where the storm is going to go. The storm-surge modeling is still, as Dr. Blackwell mentioned, maybe on first or second base. It's making progress. But predicting the consequences, the human consequences—What is the wind damage? We're providing estimates on that, based on the HAZIS model. What will be the number of buildings flooded? What will be the number of casualties, number of rescues needed? We don't have that yet, and that's absolutely important. We're developing those techniques. The universities and other groups are developing those techniques. But, as the person in Saturday afternoon and Sunday and Monday who was in the State—in Louisiana Emergency Operations Center briefing these results, I wish to God that I could have been able to brief that we

needed 20,000 helicopter rescues, that we needed all these medical evacuations. But we—the state of the science is not there yet, and we desperately need to move ahead. If we could have briefed that, then maybe that would have helped the response get rolling a little bit faster.

The second aspect that I'd like to mention is in regard to the—I'm sorry—in regard to what we need to do to prevent these—this devastation, as Max has talked many times before, the battle is won off-season; it's not won when the storm is coming in. We have to work to upgrade our zoning, our building codes, and our building construction practices. That becomes critically important now in the rebuilding phase. Now, more than ever, we must change our practices so that we don't have buildings that'll be so totally destroyed by wind in the immediate wake of the storm.

So, as we're going into the rebuilding, the State of Louisiana had learned a lesson last year from Florida. In the legislative session that immediately concluded this past June, the State of Louisiana had passed House Concurrent Resolution Number 135, which created the Uniform Building Code Task Force, which was to study—which is charged to study the situation and develop recommendations for creating a uniform building code across the state. Ironically, the first meeting of this committee was scheduled to have been held on Wednesday after landfall. I was in touch with the Department of Insurance as the lead—Louisiana Department of Insurance, which is the lead agency, and they said they have scheduled this—rescheduled this for early October. So, it's critically important that we make sure that we rebuild, in the wake of this storm, smarter than we have before.

Thank you.

[The prepared statement of Dr. Levitan follows:]

PREPARED STATEMENT OF DR. MARC L. LEVITAN, DIRECTOR, HURRICANE CENTER/CHARLES P. SIESS, JR. ASSOCIATE PROFESSOR OF CIVIL ENGINEERING, LOUISIANA STATE UNIVERSITY; PRESIDENT, AMERICAN ASSOCIATION FOR WIND ENGINEERING

Mr. Chairman and members of the Subcommittee, my name is Marc Levitan. I am Director of the Louisiana State University Hurricane Center and the Charles P. Siess, Jr. Associate Professor of Civil and Environmental Engineering at Louisiana State University. I am also the elected President of the American Association for Wind Engineering and a member of the American Society of Civil Engineers.

I am appearing today on behalf of the Louisiana State University Hurricane Center. Louisiana State University is the flagship institution of the state, classified by the Carnegie Foundation as a Doctoral/Research-Extensive University. The university has a long history of research in hurricanes, coastal sciences and engineering. The LSU Hurricane Center was founded and approved by the Louisiana Board of Regents in the year 2000 to provide a focal point for this work, with a mission to advance the state-ofknowledge of hurricanes and their impacts on the natural, built and human environments, to stimulate interdisciplinary and collaborative research activities, to transfer new knowledge and technology to students and professionals in concerned disciplines, and to assist the state, the Nation, and world in solving hurricane-related problems. Research efforts that have been translated into practice in support of emergency management agencies include: Implementation of real-time storm surge modeling, improvements in hurricane evacuation planning and operations (particularly contraflow evacuations), and improvements in hurricane shelter analysis and design methods.

LSU Hurricane Center's Role in Preparing for and Responding to Hurricane Katrina

The LSU Hurricane Center has put its research expertise into helping prepare for and respond to Hurricane Katrina. Over the past few years, our faculty, staff, and

students have: helped redesign Louisiana's contraflow evacuation plan, one of the few bright spots in the Katrina Response; worked with many local and state government agencies to provide hurricane shelter assessments and mitigation plans for hundreds of buildings; provided training in hurricane shelter assessment methodology and GIS applications for emergency management, developed hurricane exercises for the Louisiana Office of Homeland Security and Emergency Preparedness and the Louisiana Department of Transportation and Development, and was a partner in the design of last year's Hurricane Pam catastrophic hurricane planning exercise.

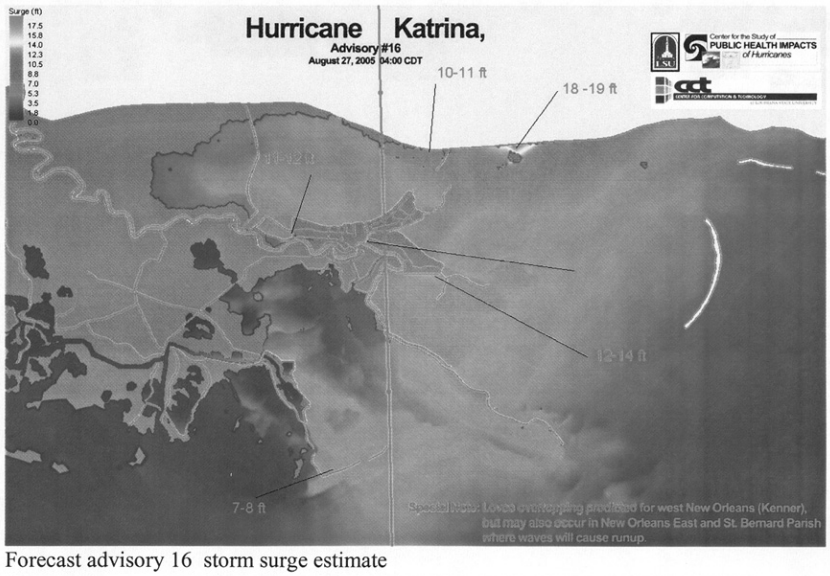
As Hurricane Katrina approached, we were activated by the Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP) on Saturday morning August 27. The LSU Hurricane Center team, along with staff from the Southern Regional Climate Center, Earth Scan Lab, and the Center for the Study of Public Health Impacts of Hurricanes then began providing 24 hour operational support. This support included:

- satellite storm tracking
- local meteorological condition information and support
- storm surge flood estimation
- wind damage estimates

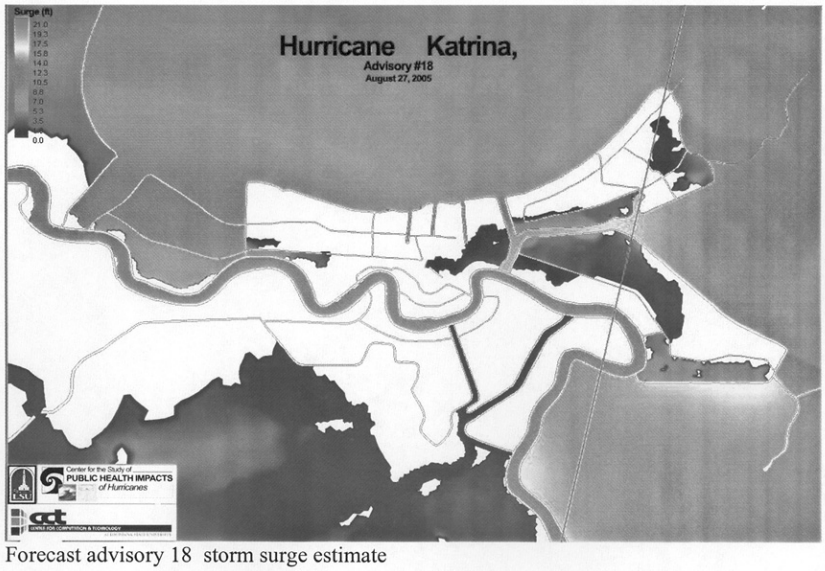
Other support activities included consultations on evacuation and sheltering decisions as the storm was approaching, flood casualty estimates, and mapping/GIS/remote sensing support ever since the storm made landfall, which is still continuing. Maps have been made for many of the major Federal and state agencies, including mapping 911 calls which helped direct rescue crews.

One of the most important facets of this operational support was real-time storm surge modeling. Using the ADCIRC Model, our surge modeling team, funded by the Louisiana Board of Regents, provided surge flooding estimates based on the National Hurricane Center forecast predictions. These models were posted on a web site available to Louisiana emergency managers and the results were included in the regular briefings put on by the LSU team in the Emergency Operations Center. The first model run was based on Advisory 16 and was completed on Saturday afternoon. It indicated flooding in the low-lying areas outside the main levee protection areas, but no overtopping in the city. The model run for Advisory 18 was completed very late Saturday night, and showed overtopping of the levees in the eastern part of the city.

The ADCIRC model is a very powerful tool to examine surge flooding for single track scenarios right now. It is a research product that has been pressed into service to assist with operations, but needs additional work and testing to become a true operational tool. LSU researchers are working right now to update the underlying physical grid to account for the damaged state of the levee systems in New Orleans in case another storm approaches before they are repaired.



Forecast advisory 16 storm surge estimate



Forecast advisory 18 storm surge estimate

The Critical Role of Coastal Protection, Land Use, Zoning and Building Codes in Reducing Loss of Life and Property

Hurricane Katrina has demonstrated numerous failures and shortcomings in how we have managed both the natural and built environments. Coastal land loss, changes in land use and building construction practices, and the continued lack of adoption and enforcement of a modern, statewide building code have all contributed to the Katrina disaster.

No plan to rebuild southeastern Louisiana can ultimately be successful without a comprehensive effort to protect and restore the coast. A large and healthy system of wetlands between New Orleans and the Gulf of Mexico has historically been the first line of defense for the city, protecting it from the worst of the hurricane storm

surges and winds. This buffer has largely disappeared over the last 75 years. Levees on the Mississippi River prevent sediments and nutrients from renewing the land. Construction of canals for the oil, gas and shipping industries has disrupted the natural hydrology and allowed saltwater to penetrate the marshes, causing serious damage. These and other factors have led to the highest rate of land loss in the world. Louisiana loses approximately 25 square miles of protection each year due to subsidence and erosion. A comprehensive coastal restoration program must be put in place and funded immediately, before the wetlands disappear entirely.

Areas that have been protected from flooding by levee systems have witnessed changes in land use and building construction practices that tend to *increase* their vulnerability to floods. Many areas of southern Louisiana traditionally experienced flooding often enough that standard construction practice was to either build on high ground or elevate the structures. The proliferation of flood protection levee systems over the past several decades has reduced the frequency of flooding and, in some cases, lowered the mapped base flood elevation. These changes have led to the development of lower lying areas and construction of homes and businesses using either slab-on-grade or minimally elevated foundations. These structures are now extremely vulnerable to flooding when levee systems fail, when drainage pump systems fail, and/or when events larger than the design flood occur.

The lesson here is clear—when buildings are constructed in flood-prone areas, *whether protected by levee systems or not*, they should still be elevated in order to reduce potentially catastrophic flood losses.

Suppose the majority of homes in New Orleans had been constructed with open parking or enclosed garages beneath the homes, meaning that the elevation of the first floor would be 8 to 10 feet above grade. This change could have saved many lives and many thousands of homes. As I have often heard Jesse St. Amant, Director of Plaquemines Parish Emergency Management say, "Elevation is the salvation from inundation."

One of the most urgent needs in the wake of the disaster is building code reform. We simply cannot afford to spend billions of dollars rebuilding homes and businesses that will not stand up to the next hurricane. Studies conducted by the Institute for Business and Home Safety and several Florida universities concluded after last year's hurricanes that the new Florida Building Code was very effective at reducing hurricane damage. Analysis of thousands of homes showed that buildings constructed to the new code, on average, experienced only about half as much damage and loss as those built to previous codes. Additionally, a much larger percentage of homes built to the new code were undamaged or only minimally damaged so that the structures were still inhabitable.

Louisiana learned a lesson from Florida's hurricanes of 2004, and has begun taking steps toward building code reform. In the Regular Session ending in June 2005, the Louisiana Legislature called for the creation of a Uniform Building Code Task Force in House Concurrent Resolution 135, with the purpose being ". . . to study current laws and regulations related to the construction of buildings and structures, make recommendations regarding legislation that would best ensure adequate maintenance of buildings and structures throughout the state, and to adequately protect the health, safety and welfare of the people." The primary motivation for this legislation was the reduction of catastrophic damage from hurricanes and other severe storms.

The first meeting of the Uniform Building Code Task Force was originally scheduled for August 31, two days after Katrina made landfall. This meeting was canceled for obvious reasons and has tentatively been rescheduled by the Louisiana Department of Insurance to October 4, 2005. It is imperative that this body make recommendations for immediate changes while the longer term solution is under deliberation. One such possibility would be to immediately require all residential construction to meet the requirements of SSTD 10–99, the Standard for Hurricane Resistant Residential Construction, or a variation of that document.

National Windstorm Impact Reduction Program

The recent devastation along the Gulf Coast of the United States brought upon by Hurricane Katrina pointed out the vulnerability of the Nation to severe wind storms such as hurricanes. This vulnerability was recognized by Congress last year when it enacted Public Law 108–360, which authorized the creation of the National Windstorm Impact Reduction Program. The program has been authorized for FY 2006, but as of yet, there is no funding in the relevant appropriations bills.

For Fiscal Year 2006 the law authorizes $22.5 million in spending, spread over four agencies. I urge Congress to appropriate no less than the following funding levels through supplemental appropriations. Specifically, the law authorizes:

- $8.7 million for the Federal Emergency Management Agency;

- $3 million for the National Institute of Standards and Technology at the Department of Commerce;
- $8.7 million for the National Science Foundation; and
- $2.1 million for the National Oceanic and Atmospheric Administration.

This legislation represents five years of work in which stakeholders representing a broad cross section of interests, including research, technology transfer, design and construction, financial communities, materials and systems suppliers, state, county and local governments and the insurance industry, all participated in crafting. This bill presents a consensus of all those with an interest in the issue and a desire to see the benefits this legislation will generate.

The Wind Hazard Reduction Coalition represents associations and companies that are committed to the creation and success of the National Windstorm Impact Reduction Program. The Coalition shares the goals of the Program to significantly reduce loss of life and property damage in the years to come. The Coalition includes professional societies, research organizations, industry groups and individual companies with knowledge and experience in dealing with the impact of high winds.

Members of the Wind Hazard Coalition worked closely with members and staff in the House and Senate in crafting the language contained in H.R. 2608, which became Pub. L. 108–360. I strongly support the results and believe that, if fully carried out, the new law will result in reduced vulnerability to high winds and lead to real and significant reduction in the loss of life and property. The United States currently sustains billions of dollars per year in property and economic loss due to windstorms. The Federal Government's response to such events is to initiate search and rescue operations, help clear the debris and provide financial assistance for rebuilding. With this legislation, the Federal Government can provide increased research funding to mobilize the technical expertise already available to help reduce the significant annual toll on casualties and property in the aftermath of windstorms.

Conclusion

In the wake of this national catastrophe, we must take every advantage of opportunities to prevent this from happening again. Immediate steps include: moving forward with plans to rebuild the coast, our first line of defense against the storm; bold land use and zoning changes to discourage rebuilding in the most hazardous areas; and immediate adoption of new hurricane resistant construction and inspection requirements while permanent changes are under deliberation. Beyond that, Congress should immediately fund Public Law 108–360, which authorized the creation of the National Windstorm Impact Reduction Program but has not been funded to date. This program will provide research and technology transfer to improve building codes and construction practices based on the lessons learned from the recent hurricanes.

Once again, thank you for the opportunity to present the views of the many organizations I am representing here today. I would be happy to answer any questions you might have.

Senator DEMINT. Mr. Curole?

STATEMENT OF WINDELL CUROLE, GENERAL MANAGER, SOUTH LAFOURCHE LEVEE DISTRICT

Mr. CUROLE. Thank you for allowing me the opportunity to testify concerning hurricane preparedness. My name is Windell Curole, General Manager of the South Lafourche Levee District.

No area is more dependent upon the National Hurricane Center and its predictions than Lafourche Parish. I say that because we have a roadway that's only three-quarters of a foot above normal summertime high tide. That roadway leads to Grand Isle, our only inhabited barrier island in Louisiana, and also to Port Fourchon, which supports deep offshore oil production. That same road that leads to this port is the only evacuation route for 6,000 people who are working on offshore platforms.

The work that the Hurricane Center performs is critical, and I've always appreciated their work. They are precise in what they ex-

pect from a storm, but they make clear the accuracy of their predictions and the possible variations.

I've been indirectly advising evacuations since 1982, and, since 1992, directly advising all parish presidents. Training at the National Hurricane Center was invaluable in interpreting the Hurricane Center's projected storm tracks. The most important lesson is that projected landfall cannot be guaranteed. Some conditions allow for more accurate projections, and some atmospheric conditions make projections very difficult. In either case, the Hurricane Center's information is the basis for our actions.

Our job on the local level is to educate people of the risk, direct our people from that risk, and provide the avenues to do so. Our goal is to try to help people understand their risk and to take appropriate action. In the end, it's an individual's decision which controls their fate. It's the individual who makes the decision to leave or stay. In fact, when you order an evacuation, you're ordering the retreat of an untrained army. The retreat of a trained army is a very difficult thing to do. We work very hard to help people understand that it is an individual decision, and that if you do not make the right decision, you will cause your family to suffer. Correct decisions minimize that suffering.

Educating the individual must be central in all emergency preparations on a local level. The problem is to describe a vision of which an individual has no experience, and then have them move, time and again, even when the vision does not materialize.

To develop that vision, I employ historical data, pictures, along with LIDAR and computer-generated images, to illustrate possible flooding and damage. Anniversaries of major storms are highlighted to remind us what has happened, and what could happen again.

We organized a centennial commemorating the Hurricane of 1893, which killed over 2,000 people in Louisiana. And, in fact, Chairman, in that same year, in Tybee Island, near Georgia and South Carolina, there was also a hurricane that killed over 2,000 people in 1893. We produced an award-winning play of that hurricane, which played to sold-out performances that left some members of the audience shaken and emotional. Our mission was to ensure that people do not forget the story or lessons from that storm.

This past year, I strongly encouraged New Orleans television stations to center their hurricane-season specials on the 40th anniversary of Hurricane Betsy, the last powerful hurricane to greatly affect southeast Louisiana.

Yet with all the videos, articles, talk shows, and presentations, some people will never believe, or understand, the extreme threat that a Category-3, -4, or -5 hurricane poses. That segment of the population's lack of understanding must also be part of emergency planning. Comprehensive hurricane protection is a concept which integrates hurricane protection levees, restoration of natural systems, hurricane evacuation routes, and improved building techniques for individuals. Resolutions by parishes and the State Concurrent Resolution in 1999 supports the concept of this integration of infrastructure, along with a reevaluation of hurricane projects, to provide protection for Category-4 or -5 storms.

After Hurricane Georges in 1998, it appeared the State would work on that concept. But they chose to concentrate only on coastal restoration, instead of the broader issues.

On the Federal level, we also had little success. Congressman Tauzin was able to generate committee reports suggesting FEMA conduct certain investigations. However, we had little support from FEMA, which led to no results at that time.

We did eventually lead to positive results with the creation of the Southeast Louisiana Task Force. The Southeast Louisiana Task Force was formed after Hurricane Andrew to improve the coordination of local, State, and Federal agencies. As we watched the horror of the people who did not have the transportation to leave the city of New Orleans after Hurricane Katrina, we saw total failure. But the fact is, had it not been for the continued pressure of the Southeast Louisiana Task Force, people who had the means to leave before the storm would not have been able to do so.

Evacuation studies had indicated that it would take 50 to 72 hours to move people out of Metropolitan New Orleans. But hurricane track errors too great beyond 48 hours, the Task Force championed the reversing of interstate lanes so that almost all lanes were directed out of the city. The Southeast Louisiana Task Force, after years of trying, was successful in convincing the State into instituting contraflow. Before this, some of those people who did get out of the city for Hurricane Katrina would not have been able to get out in time. As bad as the situation was for Hurricane Katrina, it would have been much, much worse had it not been for the work of the Southeast Louisiana Task Force.

Levees, highways, and our natural barriers protect and support an area which provides critical international trade, 25 percent of the Nation's oil infrastructure, major shipbuilding, and the second-largest fisheries in the United States. Protection of these interests also protects the two million people who live and work there. Maintenance and improvement of that infrastructure is critical for the successful planning and execution of emergency plans which minimize the loss of life and property.

Thank you.

[The prepared statement of Mr. Curole follows:]

PREPARED STATEMENT OF WINDELL CUROLE, GENERAL MANAGER, SOUTH LAFOURCHE LEVEE DISTRICT

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Maintenance and improvement of that infrastructure is critical for the successful planning and execution of emergency plans which minimize the loss of life and property.

Senator DEMINT. Thank you.

Mr. Roberts?

STATEMENT OF C. PATRICK ROBERTS, PRESIDENT, FLORIDA ASSOCIATION OF BROADCASTERS (FAB)

Mr. ROBERTS. Good afternoon, Mr. Chairman, members of the Committee. I'm Pat Roberts. I'm President of the Florida Association of Broadcasters. I'm also the Florida Chairman of the FCC State Emergency Communication Committee. Thank you for allowing me to share with you today my perspective on hurricane warnings and preparedness.

Let me begin by briefly sharing some of my experiences and recommendations.

First, I'd like to pay tribute to Max Mayfield, who's an old friend. And the people in Florida trust his judgment. I'd also like to say a special word for Florida's first-responders, under leadership of our Governor, Jeb Bush, and Craig Fugate, the director of Emergency Management.

For the past 17 years, I have served on the Florida Emergency Response Team. I was at the Emergency Operations Center 3 days before Hurricane Andrew arrived in Homestead, Florida. Later that day, when it hit, along with Governor Chiles we were in Homestead to see the devastation.

Hurricane Andrew taught Florida that local/State government need to be better prepared to respond to these type disasters. Andrew also taught us that preparedness was the responsibility of both the public and the private sector. As a result, for the past 12 years Florida has invested in training people, utilizing the latest technology and public disaster-preparedness education programs.

Those efforts have not been limited solely to hurricanes. Florida has taken an all-hazard approach to preparedness and response, and that includes hurricanes, wildfires, flooding, tornadoes, and also terrorist threats.

Without the emphasis on preparedness and response that Florida has had over the past 12 years, our State and local governments, and our residents, would not have gotten through the four hurricanes that hit our state last year. We truly play as we practice, in Florida.

Let me share just a few recommendations:

I feel America must have a more comprehensive and cohesive program among Federal, State, and local governments and our citizens to prepare for natural disasters and terrorism. To accomplish that, America must better equip our cities, our counties, our State and Federal Government to deal with these type emergency. That means more training, more exercises, and utilizing the latest training technologies. It also means we need our states and counties to have state-of-the-art Emergency Operations Centers. The public expects a unified command, from the courthouse to the statehouse to the White House. We need a national emergency-alert system for immediate public warning that allows the President, our Governors, the ability to activate a county, a state, or the Nation.

Currently, the EAS system is most often used in America for the AMBER Alert to help communities find abducted children. I recommend a federally funded, State-based EAS system in a partnership between the FCC and NOAA. Today, the only way the Presi-

dent can speak to the Nation through EAS is by utilizing National Weather Service.

Most importantly, America must also prepare its citizens. I recommend that—an American preparedness media campaign in all 50 states on all hazards. This would include both TV/radio, English, Spanish, and any other appropriate language. If you use the example of the Army National Guard model for an NCSA program involving all 50 state broadcast associations and Puerto Rico, the cost for an American preparedness program like that, based on the Florida model and the Army National Guard, would be in the range of $15 or $20 million. For that, you'd get back well over $100 million of documented air time, reaching every citizen in our country.

In closing, let me share a few personal comments. Broadcasters stand ready to help. Radio, in the time of a disaster, is a lifeline to the residents of the community. They also partner with their local TV stations to get out the news and information. In the future, local TV, with multicasting, will be able to, before and during and after a disaster, to broadcast not only their regular news information over their regular channel, but also a channel on weather, another channel on related information, on how to get help, and, finally, a second-language channel, such as Spanish.

During our hurricanes last year, one of many stations that did outstanding work is WESH, in Orlando, Florida. They not only broadcast, through the storms, their regular information, but they allowed the Telemundo station to translate it into Spanish, and ran it on their subchannel as well as on the Telemundo channel, so that everyone in the Orlando area received vital information.

Last year, for the first time, we activated EAS before a hurricane. That led me, this year, to share with stations in Alabama and Mississippi what they needed to do to help their citizens prior to Hurricane Katrina.

Last year, in Clearwater—last year, Clear Channel Radio, in Punta Gorda, lost the majority of its buildings, but it stayed on the air. Again this year, down in Biloxi, WLOX–TV lost a large portion of its facility, but it never went off the air, broadcasting to its community and helping save lives.

Together, all first-responders are to be thanked and praised.

I'll now be honored to answer any questions the Committee might have.

[The prepared statement of Mr. Roberts follows:]

PREPARED STATEMENT OF C. PATRICK ROBERTS, PRESIDENT, FLORIDA ASSOCIATION OF BROADCASTERS (FAB)

Good afternoon Mr. Chairman and members of the Committee. I am C. Patrick Roberts, President of the Florida Association of Broadcasters (FAB). I also serve as the Florida Chairman of the Federal Communication Commission State Emergency Communication Committee.

Thank you for allowing me to share with you today my perspective on hurricane warnings and preparedness.

Let me begin by briefly discussing the role local broadcasters' play when their communities are threatened, and then impacted by a major storm.

As a hurricane approaches, people get most of their tracking and preparedness information about the storm from television. As a hurricane makes landfall, and in the aftermath, power goes out, our homes go dark, and people are without tele-

vision, cable, satellite, and the Internet. There is limited, if any, cell and hard-wire phone service.

In these circumstances, radio becomes the primary, and in many cases, the sole lifeline and communication tool to a community and its residents. In many cases the local radio stations work with local TV news operations and simulcast the television audio signal to provide a broader range of non-stop news and information to the impacted areas.

In Hurricane Katrina, both large and small market television and radio stations rose to meet the challenges that the storm presented. The ownership of these stations ranged from small, family-owned businesses to major media corporations. Going beyond normal competitive rivalries these stations worked together to ensure that their local communities received critical and timely news and emergency information.

I visited a number of stations in the impacted areas of Mississippi and saw the local news, production, engineering, and management teams of both radio and television stations working around the clock to help their communities receive the latest information on the storm and its aftermath.

The coverage was non-stop, 24-hours a day and commercial free.

What impressed me about each of the stations I visited was the total commitment of these broadcasters to keep their stations on the air and their viewers and listeners informed about their communities.

What made that commitment even more impressive was the number of employees at both radio and television stations who had tragically lost their own homes; yet, they remained at their posts and continued to do their jobs. It was truly inspiring.

My experience in Mississippi is not an isolated one. During my seventeen years as the President of the Florida Association of Broadcasters, I have observed the same level of commitment by Florida's broadcasters each time a major storm has hit our state.

Furthermore, I have seen this same level of commitment from Florida's Emergency Management community when disasters have struck my home state.

Since Hurricane Andrew devastated areas of southern Florida in 1992, the state's Emergency Management teams have developed a unique and comprehensive approach to prepare the state, local governments, and individuals to better deal with the dangers of both man-made and natural disasters.

I'm proud to say that the Florida Association of Broadcasters has been a part of the team to help with those efforts.

Florida has benefited from the strong leadership of former Governor Lawton Chiles and current Governor Jeb Bush in the development and execution of the state's philosophy in dealing with Disaster Preparedness and Response.

Its Emergency Management team, under the leadership of Craig Fugate, is trained and prepared, and continually trains and prepares.

Hopefully, my comments on what has been developed in Florida will provide some insight to the Committee as you explore what the Federal Government, state governments, local governments, and individuals can do to better prepare not only for hurricanes, but for all types of natural and man-made hazards.

"Florida Prepares" is what we call our disaster preparedness efforts in the Sunshine State. I encourage the Committee to review our Preparedness and Response systems and strategies and to recommend a similar approach across all fifty states. I suggest it be developed under the umbrella of "America Prepares."

It is an idea whose time has come.

The notion of an "all hazards" approach is an important one for the Committee to understand because, in the view of the Emergency Managers of Florida, the steps to prepare for, and respond to, are the same, regardless of the hazard.

In Florida we do not differentiate between the different types of hazards that may threaten our residents and visitors.

The developed approach is applicable to hurricanes, floods, tsunamis, earthquakes, tornadoes, chemical spills, a terrorist attack or any other hazard that threatens our communities and our citizens.

Key components of the Florida Preparedness model could form the basis for an "America Prepares" model that would better protect our citizens and their property.

Some of the key components of the Florida model are:

1. *Annual public education media campaigns*. Public radio and television media campaigns developed in both English and Spanish to inform citizens on the necessary steps to take to prepare their families and to protect their property when a natural or man-made disaster threatens their community.

2. *Robust and frequent training exercises for Emergency Managers, Government Officials and First Responders*. These exercises simulate "real-life" situations

followed by critical reviews of the actions taken. Critical after action reviews for an actual event are also conducted and the "lessons learned" are applied to future responses.

3. An *Emergency Alert System (EAS)* that is a true partnership among state governments, local governments, and broadcasters.

4. A *Unified Command* approach wherein all of the players check their egos, logos, and party affiliations at the door. The result is a true team approach to respond to the needs of impacted citizens.

These are by no means the only actions that have led to the success that Florida has had when responding to disasters. However, they are the ones that I feel are most relevant for my appearance before this committee. The following is an elaboration on each of the key components.

Annual Statewide Public Education Media Campaigns

After Hurricane Andrew, the former Director of the Florida Division of Emergency Management, Mr. Joseph Myers, worked with me to develop an ongoing Statewide Hurricane Preparedness Education Program for Florida's residents utilizing broadcast television and radio. The program has been expanded upon and revised annually under the present Director, Mr. Craig Fugate.

Hurricane Andrew was a benchmark event in the history of Emergency Management. Federal, state, and local governments were ill equipped to handle this type of catastrophe and needed to rewrite the book on preparing for, and responding to, these types of disasters. It was also recognized that government could not do it all. Individuals need to take greater responsibility for protecting their family and their property. The role of Public Education was deemed a priority by the State of Florida to help accomplish the "preparedness" goal.

During the past thirteen years, the Florida Association of Broadcasters has produced, distributed and monitored a series of television and radio spots on hurricane preparedness through its Non-Commercial Sustaining Announcements program. The spots are closed-captioned and produced in both English and Spanish. The messages are decided upon by the Division of Emergency Management (DEM) and are updated each year based on changing priorities of the Division.

An example of those changing priorities occurred in 1999 when Hurricane Floyd threatened our state. The Division wanted to address the problems that occurred when a massive evacuation resulted in traffic gridlock that could have put the evacuees in danger had the storm changed its direction. Consequently, FAB produced a series of spots that addressed DEM's revision of its evacuation policy.

Past and present messages include creating a family disaster preparedness plan, special needs preparedness plan, interior counties preparedness plan, preparedness plans for pets, and small business plans. I have provided a DVD to the Committee and its staff that includes a sampling of the statewide television spots produced over the course of the partnership between FAB and the Florida Division of Emergency Management.*

The partnership between the Florida Division of Emergency Management and the Florida Association of Broadcasters is designed to be comprehensive, yet nimble enough to respond to an immediate need.

A case in point occurred in the beginning of July 2003. A series of drownings had occurred in the Florida Panhandle that was the result of rip tides. With the Fourth of July weekend approaching, DEM was concerned that citizens were not aware that they might be at-risk.

On the Thursday before the weekend began, FAB and its producer, Michael Babich, wrote, produced and distributed radio PSAs to its member stations throughout the Panhandle within a six-hour period. The entire production process, including the initial request by DEM, script writing and approval, the recording of narration, post-production, and distribution, was done electronically through e-mail and the PSAs began airing that Thursday evening.

The Florida Association of Broadcasters and the Florida Division of Emergency Management partnership has documented over $15 million in radio and television airtime since the program began in 1993. This does not include educational campaigns independently conducted by our member radio and television stations in their local communities. In fact, almost every broadcast outlet in Florida develops their own hurricane preparedness campaign that builds upon the educational efforts of the Florida Association of Broadcasters and the Florida Division of Emergency Management.

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*The information referred to has been retained in Committee files.

Public Education is an important component of any disaster preparedness effort and Florida's experiences in these efforts are unequalled. I am proud of the partnership between the Florida Association of Broadcasters and the Florida Division of Emergency Management and look forward to continuing our efforts to educate the residents of Florida on the importance of disaster preparedness.

I urge the Committee to consider expanding our statewide public education efforts to a national level and to design an "America Prepares" public education program. These efforts need to be ongoing, not just prior to, or immediately after, a major disaster strikes.

Emergency Alert System (EAS): the Public Warning System

Florida has the model Emergency Alert System in the Nation. The EAS system was upgraded and implemented after Hurricane Andrew. The Florida EAS has two primary entry points, one at the state Emergency Operations Center and a second at the Florida Department of Law Enforcement headquarters.

The state Emergency Communication Committee works with state and local authorities, and the broadcasters, to operate the system. EAS can be activated statewide, regionally, or by a single county.

For years, EAS was not used prior to a hurricane. The National Hurricane Center and local media warned residents. In Hurricane Andrew, EAS was activated to inform residents in south Dade County the location for food, water, and shelter after the storm.

In 2004, EAS was activated twice in Florida before hurricanes made landfall. The first was when Hurricane Charley turned slightly to the east and headed towards Charlotte County in Southwest Florida. Max Mayfield notified Craig Fugate at the Florida State Emergency Operations Center how critical it was to alert the southwest Florida residents that the eye of the hurricane was heading to their coast. Within fifteen minutes the State Warning Point activated the EAS from Naples to Sarasota, in both English and Spanish, informing residents of the need to seek immediate shelter because they were now in the path of the storm.

The second time EAS was activated during the 2004 Hurricane Season was during Hurricane Jeanne. The eye of the storm was very wide and slow moving. For years meteorologists have warned residents the eye of a hurricane generally takes thirty minutes to an hour to pass over an area. This time, due to the size and slowness of the storm, EAS was activated to inform residents it would take several hours for the hurricane eye to pass their area.

Florida's EAS has proven to be a valuable warning tool. It is the only means for delivering one single message at one time on all televisions, radios, and cable channels. The majority of states and counties do not have an operational EAS system tied to their Governor, county management, or any state or local emergency operations center. It is time to do so.

Taking this one step further, the United States needs an Emergency Alert System national program that can be activated by a mayor, county official, governor, or the President. It has a proven track record in Florida for saving lives and keeping the public uniformly informed.

Training and after Action Reviews

Every disaster provides a learning opportunity for those who participate in the response to the event. Unfortunately, that is not the time to find the problems in an organization's preparedness and response systems. Hurricane Andrew, 9–11, and now Hurricane Katrina are the best examples of disasters that overwhelmed governments and communities in the impacted areas.

Florida, like many states, conducts exercises and training throughout the year. Florida, being in the "eye of the storm" more than most, probably has the most experience of any state in responding to these types of disasters.

In fact, a contingent of Florida Emergency Managers and First Responders has been deployed to assist the state of Mississippi in its response to Hurricane Katrina. After viewing those efforts firsthand, and getting reports from local government officials in the impacted areas, I can tell you that Florida's experience has been an invaluable resource for the Emergency Management community and people of Mississippi.

I may be biased, but I think that Florida is the most advanced state in the country when it comes to responding to a disaster.

That being said, it is also fair to say, from a victim's perspective, any government response will never be fast enough.

With that in mind, Florida has trained and learned from experiences in real-life events to minimize the time it takes to reach the victims of these types of disasters. This was continually demonstrated during the 2004 Hurricane Season.

In the words of Florida's Emergency Management Director, Craig Fugate, our teams "do not wait for blue skies" to begin the response to impacted communities, "We move in as soon as it is safe for the first responders."

That is a mindset that needs to reach across all levels of response from the Federal to state to local governments, and to charities such as the Red Cross and Salvation Army.

I realize that this is an easy statement to make; the reality of a situation like Katrina has proven to be more problematic.

Nonetheless, through an increased emphasis on training and after action review, other federal, state, and local emergency management teams will be better equipped to deal with the uncertainties that hazards present when communities are impacted.

Florida undergoes extensive internal reviews of the actions taken both during exercises and real-life events. I have previously mentioned some of the lessons learned from Hurricane Andrew and Hurricane Floyd. There are many others.

For example, Hurricane Charley's late shift towards the east and into Charlotte County illustrated the need to educate the public to pay attention to the entire area within the "projected path cone" and not just the "straight-line" path.

One lesson learned from Hurricane Frances was that supplies such as ice and water need to be positioned in multiple areas around the peninsula of Florida, not just north or south. Trucks with supplies positioned north of the storm during Frances could not make their way to the impacted areas until the slow moving storm passed through, thereby delaying the state's response. DEM corrected this when Hurricane Jeanne came through the same area a month later.

Actual events like those mentioned above can never be truly duplicated in training exercises. However, training tools such as Table Top exercises, Full Scale Field exercises and other training methods are invaluable when response teams are called upon to respond to actual events.

FAB has produced a number of video and multi-media training tools for the Florida DEM and has seen firsthand the results of Florida's training efforts.

Through the use of training tools, Florida has demonstrated how effective training and after action reviews of real-life events are essential to develop and sustain a first-class response team.

These efforts must be valued by all levels of government, paid attention to, and utilized when real disasters strike.

A Unified Command Approach

When Hurricane Charley left a trail of damage across the state of Florida in 2004, the decision was made by the Florida Division of Emergency Management and the Federal Emergency Management Association (FEMA) to form a Unified Command.

This meant all state and Federal assets in support of the impacted counties were now joined together and would be known as "Charley Command."

No longer would the supplies and materials being brought into the impacted area be identified as FEMA or state assets.

As a result, the mission of the response teams became simple and clear.

At a press conference in Punta Gorda, Florida two days after landfall, Craig Fugate, the Florida Division of Emergency Management Director stated that by quickly combining state and Federal assets, "our only mission in life now is to meet the needs of the disaster victims in the communities of this storm."

Consequently, politics and turf battles were minimized and the focus remained on the victims. The teamwork that was built among the local, state and Federal response teams was apparent in the response to each of the four storms. Building that team concept, obviously, did not happen overnight. But the quality of the response that took place during last year's hurricane season illustrates how important it is to develop a unified team that understands it missions and maintains it focus on the victims.

During the 2004 Hurricane season, FAB had camera crews in the State Emergency Operations Center in Tallahassee, the National Hurricane Center in Miami, and in the impacted areas throughout the state. The Florida Broadcasters produced an hour-long documentary entitled "The Hurricanes of 2004," on the coordination between local and state emergency managers, FEMA, and the National Hurricane Center. I have provided a DVD of the documentary to the Committee and the staff.

I encourage you to view the DVD and see for yourself how Florida responded to an extremely difficult set of challenges. I am not implying everything throughout the responses to the four storms always went smoothly. It did not. But the unified approach worked and the citizens of Florida were served in their time of need.

Building the kind of teamwork I described also involves building a level of trust that people will do their job and will not let bureaucracy get in the way of helping victims.

I recently faced that type of situation as Katrina approached the Gulf Coast.

As I mentioned previously, when a disaster strikes most local broadcast stations provide non-stop, commercial free coverage for the duration of the emergency. This includes television stations simulcasting over radio stations. On the Sunday before Katrina made landfall I spoke with broadcast engineers in the Florida Panhandle and in the Pensacola-Mobile market. They shared my concern that Katrina would likely take out all broadcast television and radio stations in southern Mississippi and southern Louisiana.

Based upon my experience with Hurricane Andrew and in my role as Florida's Chairman of the FCC State Emergency Communications Committee, I advised Mobile-Pensacola stations to increase power after the hurricane made landfall to provide emergency information to citizens in the impacted area where broadcast service was inadequate.

I also advised representatives of a group of southern Mississippi radio stations that if they were able to stay on the air they could increase their power to provide emergency information to areas where other stations had been damaged and gone off the air.

I did not wait for formal FCC approval to take that step.

My experience in these kinds of disasters led me to bypass official channels and then to ask for "forgiveness" later. Fortunately, the FCC Chairman's office and Senior Staff agreed with my advice, and encouraged me to take whatever steps I could devise to keep broadcasters on the air.

I should note that the FCC and its staff have been proactive in working with broadcast stations to ensure that emergency information is available to all areas impacted by Katrina.

The reason I mention this is that in times of major disasters, people have to make decisions that may not always follow the proper procedures or protocols.

The intent is not to be reckless or a "loose cannon", but to do what is best for the citizens in the impacted communities based on an individual's or a team's experience. Florida has learned this lesson well and it was continually demonstrated last year during the four hurricanes.

Recommendations for the Future

Over the past thirteen years I have traveled to every major disaster that has struck the state of Florida. I also recently visited the Gulf Coast of Mississippi to assist local broadcasters and view the damage to those impacted communities. My heart goes out to the residents of Mississippi and Louisiana. It is a disaster unlike any I have ever seen.

A comment was made that the damage in those areas was of "biblical proportions". It is an assessment with which I agree. Unfortunately, it will not be the last time a disaster of this magnitude strikes the United States.

With that in mind, I would like to offer the Committee the following recommendations for your consideration, trusting that when future disasters strike, our government, our communities, and our citizens will be better prepared to respond to all types of disasters.

Public Preparedness Education

Our Nation must move forward with plans, beginning with our families and our neighbors, moving to the courthouse, then to the state house and ultimately, to the White House. "America Prepares" must be our focus.

A nationwide "America Prepares" Campaign would encourage and help each individual, family, special needs person, small business and others in our country to develop and implement a disaster preparedness plan.

To do so, we must launch a major nationwide public education disaster preparedness campaign. The National Association of Broadcasters and, more importantly, the State Broadcast Associations in all fifty states and Puerto Rico who have successful Non-Commercial Sustaining Announcements programs are ready to help.

Utilizing the network of State Associations allows for a more regional approach to help citizens prepare for the different types of disasters that affect different parts of our country. A regional approach also encourages more local and state involvement between broadcasters and the Emergency Management community. This approach has worked in Florida and should be duplicated nationwide.

An "America Prepares" Public Education Disaster Preparedness Campaign would include:

- Content with specific information for people to develop and implement a Family Disaster Preparedness Plan
- Fifteen, twenty and thirty second radio and television spots
- Spots produced in English/Spanish/other
- Spots closed captioned for the hearing impaired

Improving the Emergency Alert System (EAS)

Along with better preparing our citizens we must also improve and expand the current Emergency Alert System (EAS). In Florida, EAS can be activated at the county and state level. A national EAS system is needed which can be activated at the Federal Emergency Operations Center and at the White House.

It is important to remember that in the impacted areas, radio and television partners are the lifelines to the affected areas—they are the backbone of the EAS system.

Priority Fuel Status for Broadcasters

When power is lost and broadcasters are on generator power, radio stations simulcast television programming so citizens can stay informed. To maintain that lifeline to impacted communities I strongly urge the Committee to consider recommending priority status for fuel allocations to all radio and television stations, particularly the two primary EAS radio stations in the local operational areas where the disaster strikes.

During Hurricane Katrina there were a number of instances where radio stations were in danger of going "dark" because they were on generator power and running out of fuel. Local broadcasters play a vital role in communicating information to residents when a disaster strikes and steps need to be taken to ensure that they remain on the air particularly when, as was seen during Katrina, the initial response is delayed.

It should also be noted that as we continue to move into the age of Digital Television, broadcasters will be able to expand the informational services they provide to impacted citizens. When future disasters strike, television stations will always provide local news coverage, but through "multicasting" they will also be able to provide even more information to their viewers.

As an example, one sub-channel will be devoted entirely to weather information; another sub-channel would broadcast in Spanish; another sub-channel would provide detailed preparedness information. Citizens will have more information available to them and will be able to better assess their risks and vulnerability. It is critical that broadcasters, after health care and law enforcement, have priority status for fuel allocations.

Better Training Leads to Better Teamwork

Training is another area that needs review. Florida's systems of preparedness and response are perhaps the best in the country and should be reviewed by this committee as a model for other states. The Florida Association of Broadcasters, over the years, has produced enough training materials for the Florida Division of Emergency Management to realize the effects of an increased emphasis in this area. I believe in the concept "you play like you practice" thus witnessing, firsthand, positive results when training is a priority.

Utilizing the latest technology and advancements in training theory can be an effective and engaging way to train Emergency Managers and First Responders to be better prepared to serve our citizens.

Better training also leads to better teamwork. Some of the challenges on the Gulf Coast, particularly in New Orleans, were magnified due to the confusion of roles among the Federal, state, and local response teams. I cannot emphasize this strongly enough—a response to a disaster without a unified team approach is another disaster in itself.

Florida has invested a lot of time, effort and money developing partnerships among different state and local agencies, the Florida National Guard, charities, and the National Hurricane Center. The results of those efforts, while not always perfect, have led to a focus on serving the citizens of the state which is the ultimate goal of any response.

Recognizing the importance of unified teamwork, I urge the Committee to resist any attempt to privatize the National Weather Service. It is critical to have qualified, experienced, independent meteorologists. The chance cannot be taken for profit to replace product or for personal appearance to replace experience.

The National Hurricane Center is an integral part of the Florida team; to take any steps altering this relationship is, in my opinion, a serious mistake and not worthy of serious consideration.

Conclusion

My comments are designed to improve our national efforts in responding to disasters of all kinds, and it is my desire this committee will consider my thoughts and recommendations in the spirit in which they are offered.

I appreciate the opportunity to come before this committee today. Our world is changing dramatically and unfortunately, disasters have become somewhat of a way of life for the citizens of the United States. Therefore, Americans must be better prepared to handle the challenges when disasters strike.

I thank the Committee for the work they are doing, I offer my help to prepare the citizens of the United States for any future disasters, and now, I am honored to answer any questions the Committee may have at this time.

FLORIDA'S EMERGENCY ALERT SYSTEM (EAS)

I. Introduction

When the Emergency Broadcast System (EBS) was first introduced in the 1960s its scope was limited: warn the population of the threat of nuclear attack. Through the years, the EBS became a conduit of passing on life-saving weather information, but the technology became antiquated. Because digital technology was becoming

more reliable, the FCC changed the EBS into the Emergency Alert System (EAS). The EAS would mirror the EBS, but provide a more dependable, bottom-up approach in providing emergency messages. National activations, the only time government can override programming, remains the same. However, state and local emergency management officials and broadcasters may decide what messages should be aired to the public. The EAS brings in technology that was uncommon in the 60s—satellite communications, cable television, paging systems, and cellular telephones. It is envisioned the public will quickly grow accustomed to hearing the shortened emergency message, and then tune to their regular news source for the protective action information.

Each year Florida is impacted by many devastating emergency and disaster events requiring the immediate alerting of citizens and visitors providing them with an opportunity to protect themselves and, time permitting, their property. The Emergency Alert System is an invaluable tool that will help prevent the loss of Florida's most precious resources—its people.

II. Purpose

The purpose of the Florida EAS Plan is to put in place a system for emergency officials to use to announce or transmit an emergency alert to the potentially impacted population.

III. Authorities and References

Title 47 U.S.C. 151, 154(i) and (o), 303(r), 524(g) and 606; and 47 CFR, Part 11, Federal Communications Commission Rules and Regulations, Emergency Alert System (EAS) as it pertains to day-to-day emergency operations. *Note: 47 CFR, Part 11, was amended May 16, 2002. Portions of this state plan have been updated to incorporate the changes.*

All operations of the Emergency Alert System are in accordance with Subpart G of Part 73, FCC Regulations (Title 47, Code of Federal Regulations; The Federal Communications Commission's "EAS Checklist"). This plan is consistent with the provisions of the rules and regulations of the Federal Communications Commission (FCC) and is considered to be a supplement to the National Emergency Alert System Plan.

NUREG 0654, Federal Emergency Management Agency, establishes emergency notification requirements for Nuclear Power Plants.

IV. Plan Implementation and Maintenance

The Florida Emergency Alert System Operational Plan is prepared by the State Emergency Communications Committee in conjunction with the Florida Division of Emergency Management and is based on recommendations from state and county emergency management officials, National Weather Service (NWS), and the broadcast industry. The responsibility of administering this Plan rests with the members of the Florida State Emergency Communications Committee (SECC).

This plan supersedes the previous plans for the State of Florida Emergency Broadcast System effective June 1, 2002.

This Plan should be reviewed at least annually, after each activation of the EAS, or as otherwise needed. The Plan may be amended or modified by a majority vote of the State Emergency Communications Committee.

Acceptance of or participation in the Plan shall not be deemed as a relinquishment of program control or to prohibit a broadcast licensee from exercising independent discretion and responsibility in an emergency situation. Broadcast stations and cable systems originating EAS emergency communications shall be deemed to have conferred rebroadcast authority. The concept of management of each broadcast station and cable system to exercise discretion regarding the broadcast of emergency information and instructions to the public is provided by the FCC Rules and Regulations.

V. Concept of Operations

A. Planning Assumptions and Situation

1. Coordination of the Emergency Alert System is the joint responsibility of the State Emergency Communications Committee, Operational Area Committees, National Weather Service, and Florida's Emergency Management community.

2. This Plan shall be used as a guide for the activation of the Emergency Alert System; the specific event situation may require modification of the system.

3. The success of the EAS depends solely upon the cooperation among the broadcast industry, cable television industry, National Weather Service, and emergency management officials to receive, broadcast, and re-broadcast emergency messages.

4. This Plan must reflect the philosophy and content of the State's Comprehensive Emergency Response Plan.
5. This Plan must be consistent with the EAS process outlined in the State's Nuclear Power Plant Plans.
6. This Plan shall be utilized regardless of emergency/disaster event type.
7. Each Operational Area Emergency Alert System Plan must be consistent with the philosophy of this Plan.
8. This Plan assumes all participants have been trained in the activation of the EAS.
9. The State Emergency Communications Committee recognizes that broadcasters rely on "air time" use to maintain business continuity.

B. Operational Objectives

The EAS program is formulated around two distinct time frames: Preparedness and Response. Preparedness being activities that should be implemented prior to the initiation of the EAS. The Response phase is the real time activation of EAS. The following Operational Objectives must be accomplished to comply with the FCC EAS regulations and to put in place an EAS program to successfully alert Florida's citizens and visitors.

Preparedness Objectives

Objective 1: Broadcasters, and State and Local Emergency Managers must become familiar with the Emergency Alert System.
Objective 2: Local Primary 1 and 2 Station Broadcasters, and State and Local Emergency Managers must conduct or participate in the Required Weekly Test (RWT) of the Emergency Alert System as established by the Operational Area Committee Plan.
Objective 3: Local Primary 1 and 2 Station Broadcasters, and State and Local Emergency Managers must conduct or participate in Required Monthly Test (RMT) of the Emergency Alert System as established by the Division of Emergency Management.
Objective 4: Operational Area Committee shall coordinate activities of the Emergency Alert System with broadcasters, National Weather Service, and local and state emergency management agencies.
Objective 5: Local Primary 1 and 2 Station Broadcasters participate in exercises with local and state emergency management agencies.
Objective 6: Local Primary 1 and 2 Station Broadcasters, Operational Area Committees, and Local and State Emergency Managers must orient the public in the use of the Emergency Alert System.

Response Objectives

Objective 1: National Weather Service or Local or State Emergency Management shall activate the system as quickly as possible upon becoming aware of an emergency/disaster event.
Objective 2: Local Primary 1(LP 1) stations and Local Primary 2 (LP 2) stations must continuously monitor a minimum of two EAS sources.
Objective 3: Broadcasters, and State and Local Emergency Managers should participate in and support the use of the Emergency Alert System during real events.
Objective 4: Broadcasters, and State and Local Emergency Managers should critique the use of the Emergency Alert System after real events.
Objective 5: State Emergency Communications Committee and Operation Area Committees shall modify State and Operational Area EAS Plans based on the results of real-time EAS activations.

C. EAS Priorities

The following are EAS priorities as set forth in the FCC Rules and Regulations: A national activation of the EAS for a Presidential message with the Event code EAN as specified in § 11.31 must take priority over any other message and preempt it if it is in progress.

1. EAS participants should transmit other EAS messages in the following order: (1) Local Area Messages; (2) State Messages; (3) National Information Center (NIC) Messages.

2. Key EAS sources (NP, LP, SP and SR) and Participating National (PN) that remain on the air during a National emergency must carry Presidential Messages "live" at the time of transmission or immediately upon receipt. Activation of the National level EAS must preempt State and Local Area EAS operation.

3. During a national emergency, the radio and television broadcast network program distribution facilities must be reserved exclusively for distribution of Pres-

idential Messages. NIC messages received from national networks that are not broadcast at the time of original transmission must be recorded locally by LP sources for transmission at the earliest opportunity consistent with the message priorities in paragraph (1) of this section.

D. Assignment of Responsibilities

1. The State of Florida Emergency Communications Committee

The FCC appoints the SECC Chair and Vice Chair. SECC members include the Chairs and Vice Chairs of the operational area emergency communications committees and other voluntary members appointed by the SECC Chair. The State Emergency Communications Committee is responsible for:

a. Overseeing the functionality Florida Emergency Alert System.
b. Reviewing operational area plans.
c. Promoting the EAS with Florida Broadcasters.

2. Local Area Emergency Communications Committees

The State of Florida is divided into 12 major EAS Operational Areas based on the broadcast industry's Audience of Dominant Influence (ADI). The ADIs are recognized by the Federal Communications Commission. The operational area committee and vice-chair are appointed by the FCC. Committee members are appointed on a voluntary basis by the Operational Area committee chair. The Operational Area Committees serve as sub-committees of the State Emergency Communications Committee.

However, geographic or demographic influences have created "sub" areas that are recognized by the Operational Area and State Emergency Communications Committees. The Palm Beach Area is subdivided into 10–A and 10–B where "10–A" serves the northern 2/3 area that includes St. Lucie, Indian River and Okeechobee counties. "10–B" serves the southern1/3 area that includes Palm Beach, Martin and St. Lucie counties. The Miami-Dade Area is subdivided into 11–A and 11–B where "11–A" serves the English speaking population and "11–B" serves the Hispanic population. The Key West Area is divided into 12–A (Upper Keys) and 12–B (Lower Keys).

The Operational Area Committees are responsible for:

a. Overseeing the Operational Area Emergency Alert System.

b. Developing and maintaining operational area plans.

c. Promoting the EAS with local Emergency Management Programs and Broadcasters.

d. Participating with the State Emergency Communications Committee.

e. Orientating the public to the EAS program.

3. Division of Emergency Management

The Florida Division of Emergency Management is the State Primary (SP) station broadcasting emergency alert messages and is a source of EAS State messages. The SP is responsible for monitoring the National Weather Service Warning and Forecast Offices (WFO) and county emergency management programs for emergency messages. The SP may assist with either a single or multiple county EAS message activation. Additionally, SP messages may originate from the Governor or a designated representative in the State Emergency Operating Center (EOC). Messages are sent via the State Relay Network. The Division has developed and installed a statewide satellite system (ESATCOM) which will serve as the basis of the EAS communication network. An ESATCOM antennae is (or will be) placed at each LP1 and LP2 station, each NWS WFO, county EM and State EM locations. The ESATCOM is a secure system that requires no authentication code. If the ESATCOM is unavailable, contact will be made via commercial telephone lines and the authentication process must be implemented. As the State Primary (SP) for Florida, the Division of Emergency Management responsibilities are to:

a. Assist the State Communications Committee with EAS program activities.

b. Conduct the required monthly testing of the EAS.

c. Maintain operational capability to provide immediate response to emergency/disaster events.

d. Maintain the ESATCOM system for immediate broadcast of EAS messages.

e. Immediately activate the EAS upon becoming aware of an emergency/disaster event.

f. Orient the public to the EAS program.

4. Local Primary Station 1

Local Primary 1(LP1) radio station (AM or FM) is the source of EAS Operational Area messages. An LP1 source is responsible for coordinating the broadcast of emergency messages from sources such as the NWS or local emergency management offices or SP as specified in its EAS Operational Area Plan. If the LP1 is unable to carry out this function, other sources in the Operational Area may be assigned the responsibility as indicated in State and Local Area Plans. The Local Primary Station 1 responsibilities are to:

a. Continuously monitor a minimum of two sources (SP and local emergency management) of emergency information.

b. Maintain an operational readiness state.

c. Participate with the Operational Area Committee to maintain and enhance the EAS Plan.

d. Conduct the Required Weekly and Monthly tests as outlined in CFR 47 Part 11.

e. Orient the public to the EAS program.

5. Local Primary Station 2

Local Primary 2 (LP) is the Operational Area's second source of the EAS message with the responsibility for monitoring the LP1 station and immediately rebroadcasting the emergency messages. Just as the LP1, LP2 stations monitor the National Weather Service, local emergency management programs and, when available, the State Primary station. The Local Primary Station 2 responsibilities are to:

a. Continuously monitor the LP 1 and, at least, one additional source of emergency information.

b. Maintain an operational readiness state.

c. Participate with the Operational Area Committee to maintain and enhance the EAS Plan.

d. Conduct the Required Weekly and Month tests as outlined in CFR 47 Part 11.

e. Orient the public to the EAS program.

6. Local Emergency Management

It is the inherent responsibility of a local emergency management program to alert citizens to hazardous or disaster events. The EAS is the primary mechanism for immediate notification.

The Local Emergency Management Program responsibilities are to:

a. Assist the Operational Area Committee with EAS program activities.

b. Maintain operational capability to provide immediate response to emergency/disaster events.

c. Upon becoming aware of an emergency/disaster event, immediately activate the EAS.

d. Maintain an operational communications link with the Operational Area LP1 and LP2 and SP stations.

e. Orient the public to the EAS program.

7. National Weather Service

The National Weather Service is responsible for continuously monitoring and analyzing weather systems and issuing severe weather warnings and watches. The National Weather Service coordinates with state and local emergency management offices to ensure a smooth flow of information during operational events.

The National Weather Service responsibilities are to:

a. Assist the Operational Area Committee with EAS program activities.

b. Maintain operational capability to provide immediate response to emergency/disaster events.

c. Maintain an operational communications link with the Operational Area LP1 and LP2 and SP stations.

d. Disseminate all warnings and weather emergency messages through the link for EAS activation.

e. Orient the public to the EAS program.

8. State Relay Network

The State Relay Network is composed of State Relay sources, leased common carriers communications facilities or any other available communications facilities. The Network distributes the State EAS message originated by the Governor or designated official, and serve as the Presidential Entry Point.

9. Federal Communications Commission (FCC)

The FCC is the Federal Agency responsible for the oversight and coordination of all radio, television, and cable television broadcast within the Untied States. This includes the assessment and maintenance of rules and regulations governing the Emergency Alert System. The FCC, also, provides support (technical assistance) to the State Emergency Communications Committee and operational area committees.

E. Emergency Alert System Process

The EAS is activated to warn a potentially impacted populace of an impending or occurring emergency/disaster event regardless of type (weather or other natural hazard, technological hazard, or terrorism). One or more of three agencies may activate EAS, as seen in Figure 1. Conceptually, the following flow chart and steps depict the EAS process.

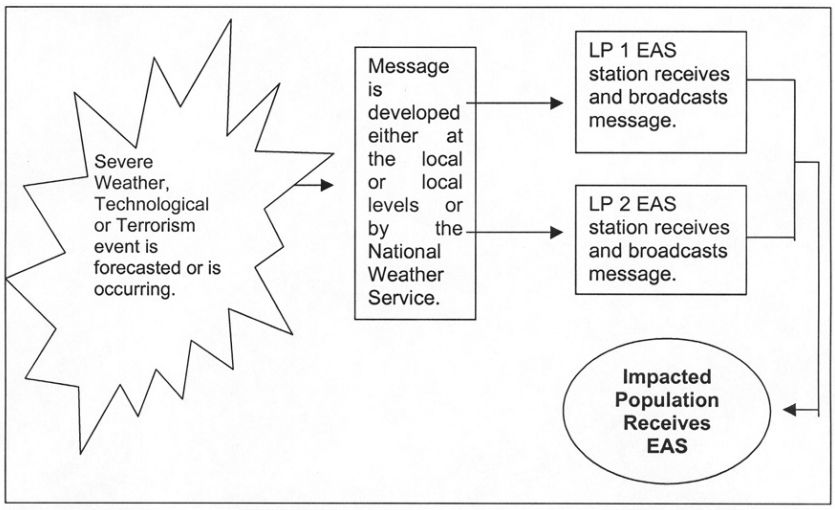

Figure 1: Emergency Alert System Process

1. An emergency or disaster event occurs or is impending, which requires the immediate alerting of people in the potentially impacted area.

2. An EAS activation is initiated by the County Emergency Management Coordinator (or National Weather Service or State Division of Emergency Management). DEM may be required in some cases to assist a particular county in their activation of the EAS process.

In the event of emergencies or disasters (hazardous materials, terrorist event, tornadoes, etc.) local emergency managers have the authority and must immediately advise the population of the dangerous situation by communicating directly with the Local Primary 1 (LP1) station(s).

When a significant weather system covers a large portion of the state, more than one NWS Forecast Office may be required to activate EAS. This situation necessitates close coordination among all affected NWS Offices from the perspective of forecast continuity and EAS activation. Once determined that severe weather will impact the State, the NWS issues appropriate watches or warnings. However, it is important to note that the NWS is limited to the broadcast of only Civil Emergency EAS messages via the National Oceanic and Atmospheric Administration (NOAA) Weather Radio System.

In the instance that an emergency or disaster event (technological or terrorism) impacts Florida on a regional or statewide basis, the State Division of Emergency Management (DEM) must activate EAS to warn citizens.

3. The EAS message is transmitted to the Local Primary 1 Station by local emergency management (or NWS or SP) for immediate broadcast.

4. The EAS message is received by the LP 1 and is recorded or developed (by completing pre-scripted formats) prior to broadcast.
5. Recorded messages are re-broadcast within seconds. The manually received EAS message must be recorded then re-broadcast or announced directly to the broadcast audience. Staffed stations have the option of first receiving the message, and activating EAS at the next break (depending of the severity of the event).
6. Relay Stations receive and re-broadcast the EAS message.
7. The general public receives the EAS message.
8. The public reacts by tuning-in for additional information, as promised.
9. Follow-up emergency public information is broadcast.
10. The public takes protective action during the emergency/disaster event.

F. Summary

In summary, the success of the State EAS is contingent upon:

- The ability of all EAS partners (radio, television, and cable broadcasters, Florida's Emergency Management community, and National Weather Service) to understand and carry-out their responsibilities;
- The State Division of Emergency Management ESATCOM system to function optimally;
- The SECC to aggressively coordinate EAS activities;
- The Area Emergency Committee orienting the public and participating in exercises;
- The public to understand and heed emergency alerting and instructions.

APPROVALS AND CONCURRENCES

C. Patrick Roberts, Broadcast Chair, State Emergency Communications Committee.

David Solomon, Chief, Enforcement Bureau, Federal Communications Commission.

Joseph F. Myers, Director, Florida Department of Community Affairs, Division of Emergency Management.

Robert Goree, State Warning Meteorologist, National Weather Service (Representing all Florida NWS Offices).

Senator DEMINT. Thank you.

I will yield to Senator Vitter for an opening statement.

STATEMENT OF HON. DAVID VITTER, U.S. SENATOR FROM LOUISIANA

Senator VITTER. Thank you, Mr. Chairman. And I'm sorry I was running late. It was because of other Katrina work. But, thank you for holding this hearing. Thanks to all of the folks testifying before the Committee.

Now, Mr. Chairman, at your June 26th hearing on hurricane prediction, I gave an opening statement describing a worst-case scenario, the hypothetical situation of a major hurricane making a direct hit on St. Bernard and Plaquemines Parishes in the city of New Orleans. We used posters showing the National Weather Service's prediction of innundation in these areas. Computer models showed up to 18 feet of water in parts of the city of New Orleans.

At that hearing, I expressed my frustrations with every level of government's policy of basically being reactive to disasters, instead of proactive. And my exact quote was, "We can spend millions now preparing for a disaster, or we can spend billions, later, responding to a disaster." Finally, I said, "It's not if we are hit by a hurricane, but when the disaster occurs."

Well, Mr. Chairman, we now know the "when." August 29, 2 months, to the day, following that hearing. And, unfortunately, all of those predictions and SLOSH models turned out to be true.

What's most frustrating is, this did not have to happen. It didn't have to be this way. Unlike September 11 or the tsunami, to some extent, there was really no element of surprise here. This wasn't just predictable, it was predicted, many times over, in part, by these fine folks before us.

There has been an extraordinary amount of finger-pointing and partisanship since Katrina. In all of this political posturing, some very bright lights have been ignored, and we have some before us today.

I want to thank Director Max Mayfield and his team at the National Hurricane Center. Because of their great work, we knew pretty much exactly where Katrina was going to make landfall, 56 hours before the storm came ashore. And that is astounding, and that's great progress over the last several decades. That's enough time to drive from New Orleans to New York twice, with a good night's sleep both times.

And, Director Mayfield, as you know, hundreds of thousands of Louisianans did load up their families and evacuate. So, thank you for giving them the information that let them do that.

Another bright light here today is Marc Levitan, of LSU Hurricane Center. Marc's team provided data predicting that the levees on Lake Pontchartrain would be topped, a full 36 hours in advance of the storm. New Orleans is a bowl. And, of course, topped levee means widespread flooding.

Another witness here today, Windell Curole, has been expressing his concerns about our situation in preparedness for years. Windell brought this to our attention and helped Congress design the ongoing hurricane protection evaluation currently underway by the Corps of Engineers.

But, again, what's most frustrating is, it really didn't have to happen this way. I hope we understand that, and remember that, as we move from immediate relief to recovery. And I also hope we fully understand why we need to mount this reconstruction and recovery. It's not a matter of simply doing good by the citizens of Louisiana; it's a matter of doing the smart thing for the entire country, both in the reconstruction effort and in making sure we're better prepared in the future.

Again, we can't afford not to rebuild, and this is the smart thing to do for the country. And it's not just a matter for Louisiana or Mississippi or Alabama. The ports between Baton Rouge and New Orleans comprise the largest port system in the world. We provide 36 states with maritime commerce. Midwestern farmers depend on our ports and waterways to get well over 70 percent of their crops to market. Oil and gas, Louisiana and our associated infrastructure provides 20 percent of our Nation's energy. That has provided $140 billion to the U.S. Treasury in the form of energy royalties. And our State of Louisiana also has 16 percent of the Nation's refining capacity. Louisiana provides up to 30 percent of the domestic seafood consumed in this country, and much of the ecosystem and fishing fleet was destroyed.

So, I know we will rebuild, as a national need as well as a priority for my State.

I thank you, Mr. Chairman, for all of your leadership, and I look forward to a good continuation of our hearing from 2 months ago.

Senator DEMINT. Thank you, Senator Vitter. And I know the entire Senate, as well as the whole country, joins me in just telling you how sorry we are what happened to your State and your friends and family. And we will support you in the recovery effort.

As we sit here, Hurricane Rita is now at Category-2 status, and, the last I saw on some of the predictions, headed toward Texas. So, we've got another storm to test out our models, unfortunately.

Chairman Stevens, would you like to begin our questioning?

The CHAIRMAN. I really would. And I thank you very much, because I do have to move on.

I join all of you in thanking Director Mayfield and all of those who have supported us on this effort.

You know, I've got to be a little provincial, myself. One of the reasons that I decided we should have a subcommittee dealing with disaster prediction and prevention was that, the first typhoon in the Arctic, that we know of—in 2003—it touched—almost touched Point Barrow.

You're fortunate, where you all live, because you have the really intensive prediction. We don't have it up where are, on the northwest Arctic coast.

But I do want to ask, and particularly with regard to this—Mr. Mayfield, we've been reading, all of us, about the connection between this increased hurricane activity and global warming—are you ready to comment about that at all? My scientists in Alaska tell me that the connection is not really made yet. Do you have an opinion?

Mr. MAYFIELD. I do, Senator. And there are—you know, this is certainly a hot topic. And I—you know, I've been in meteorology for 35 years now, and I—from my perspective here, we have cycles. And, in regard to hurricanes, there are cycles of active periods and then inactive periods. And, for example, the 1940s, 1950s, and 1960s were very, very active, lots of hurricanes, lots of major hurricanes; and then the 1970s, 1980s and early 1990s, the numbers really dropped down. And then in 1995, it's just like somebody had threw a switch here, and we've had a lot more hurricanes—not a record number of major hurricanes, but close. We've had a lot of activity again. And the research meteorologists tell us that we're in for another 10 or 20 years, or more, of this active period here.

Without invoking global warming, I think that the—just the natural variability alone is what this can be attributed to. And I think the important thing here is that, even without invoking global warming, we need to make sure that we get our country prepared for what we think will be another 10 or 20 years of active hurricane activity.

The CHAIRMAN. Thank you very much.

Mr. Roberts, Senator Inouye and I have been working very closely with Senator DeMint and Senator Nelson, getting ready to put in a bill that deals with a new National Alert System. We hope that we'll get bipartisan support, and active support, from the

whole Congress on that. I want to thank you for what you've done, and the broadcasters.

Let me ask this. The Weather Bureau has a radio that is quite useful to pilots. I wonder if we ought not to see if we couldn't get that kind of a radio back into the average family's hands. I come from the generation when we only had radio. And we had a National Alert System. And we had it tested about every 2 weeks, as I recall. Now everybody has cell phones or computers, that they're using for communication. We don't have a uniform mechanism to contact our people. And what do you think about that, should we find some way to go back to a uniform—it's one thing to have a uniform alert system, it's another thing to make sure that people have the facilities to get that. This alert system we're working on, we'll try to fold in all the means of communication. But what are you and the broadcasters saying about that?

Mr. ROBERTS. Well, as—Mr. Chairman, as you know, broadcast stations have been somewhat frustrated. Every TV and radio station in this country has EAS equipment. Now, in Florida, after Hurricane Andrew, we funded a statewide EAS system. Our Governor has two entry points. We have two primary stations in every operational area. Every county has operational equipment.

Unfortunately, the country doesn't have that. Now, fortunately, after 9/11, Reynold Hoover worked with NOAA and uses the National Weather Service, like the NOAA radios, but he's now able—the National Weather Service is the only Federal agency that can activate every single EAS monitor at every radio station, every TV station, and every cable outlet. So—and I think it would be great if we add the cellular world, Internet—I mean, it's a world—it's the world where we're going.

But I would agree with you, on radio. After the disaster, 9/11, cell phones didn't work within about an hour, because they all got jammed. After a hurricane, radio is the only thing left. And I think we've got to keep it as the basic ingredient. I mean, satellite dishes move. If you—somebody said, "Well, you could use the satellite television." I said, "Well, you know, in a hurricane, dishes move, and, once it moves a little bit, you get nothing else."

So, I think what the whole country needs—I mean, every Governor should be able to warn his people. And the President should be able to warn his people, whether it's a county, because it's a wildfire or a chemical spill, or the Nation, if it's a terrorist attack. And, unfortunately, right now the country has a very inadequate system. Basically, it doesn't have a system. I think four Governors can activate.

The CHAIRMAN. I don't know who to ask this of, but, you know, I live in earthquake country, and we have a building code for earthquakes, and our building code says that you can't get insurance unless you have compliance with it for the earthquake protection. Are we near the point now where we ought to start talking about some different types of building codes and other things to prevent the damage we've seen from this hurricane, or is that possible?

Dr. Levitan, are you involved in that?

Dr. LEVITAN. Yes, very involved. We've made significant improvements. The building codes which are out there right now, if they're

adopted and enforced, would prevent quite a bit of the damage. The study done by Institute for Business and Home Safety, following last year's hurricanes in Florida, of thousands of homes shows that after Florida adopted, 2 years ago, the statewide mandatory building code, buildings built to that code suffered only about half as much damage as the other buildings, and many buildings were undamaged.

We certainly also need to work to improve the building codes, as well. And one opportunity to do that—last year, the Congress authorized the creation of a National Windstorm Impact Reduction Program, but it has not been appropriated. Unfortunately, Public Law 108–360 was authorized for $22.5 million to help do exactly just that, to bring the technologies, to improve the codes where we have, but that has not been appropriated, so I urge Congress to immediately authorize the appropriate funds for that. It will help to improve the codes.

The CHAIRMAN. Thank you. I promise you we'll look into that. I just happen to be in that committee.

[Laughter.]

The CHAIRMAN. We'll look at that.

Last, let me ask you this. We're really dealing with disaster prediction—and you all are involved with that—and prevention. Is there any means of deterring these forces? Have we looked into that? I mean, I remember cloud-seeding and all the rest of the things we went through in the 1950s and 1960s. Is anyone still looking at that?

Mr. MAYFIELD. The Government is not looking at that, Mr. Chairman. We did have the Project Storm Fury going on there for a couple of decades, and the idea was to seed the outside of the eyewall with silver iodide, with the idea of expanding the eyewall, like the ice-skater—if you expand your arms, you'll slow down. But then, along came Hurricane Allen, in 1980, and it went from a Category-5 to Category-3, -5, -3, -5, -3—three different times, all on its own. And if nature can do that on its own, it's very, very difficult to even detect what man has done. So, as far as I know, there are no formal government programs on this. I have heard of a few in the research community that are thinking about it, but I'm not going to hold my breath.

The CHAIRMAN. I'm not going to get into this business about finger-pointing, as the Senator has mentioned. But, in 1997–98 we mandated the creation of a disaster plan for New Orleans. And, at that time, I was informed that level 3 would be the level that we should talk about, because everyone knew if it reached level 4 or 5, the levees in New Orleans would fail. Are we capable of making such a judgment in areas where storms are prevalent, as to what facilities will fail? Could we get a study of what facilities will fail and try to see if we can buttress them up in the event we had a similar earthquake—I mean, a similar hurricane again?

Mr. CUROLE. Yes, definitely there's enough science—there is enough science out there that we can build structures that can do the job for us. But, just like any structure, they're designed for a certain level of protection. We saw the failure along the flood walls. It's very important that we find out exactly what worked and didn't work, as far as structural flood protection.

But I want to remind everybody, our goal when we build these structural protections, it's to buy us time to get out. Our philosophy in building these things is that they protect property. We would prefer getting people out. And that is going to be continuing. Because you can't—no one can tell for sure whether a barge will get loose—a large boat will get loose and run into a structure and cause failure. So, our goal is to build to that level of protection, get our people out. And in all—in most instances, we come out OK. These systems do work.

But, as you mentioned, a Category-3 exercise we had with Hurricane Pam, we just flooded the city with ten feet of water, and we expected this type of problem that took place. Having a Category-4 hurricane, you're bound to run into these problems. But St. Bernard Parish, which had a good, well-maintained system, was overtopped early in the ball game, and it's a Category-3 hurricane system. Plaquemines Parish levee system, well-maintained, well-designed, still was overtopped because the—it wasn't designed for the height of water that Hurricane Katrina put in that area.

The CHAIRMAN. Well, thank you all, again. Thank you, Mr. Chairman, Senator Nelson.

We've had a lot of bad news coming out of this area, the disaster area, but I think we wanted to have this hearing, because is the good news. We had a system for prediction. It was fulfilled.

Mr. Mayfield—Director Mayfield, you and your people did a marvelous job. I think those people that did get away from that storm really owe your lives—their lives to you and your—the people you work with. We've got to find a way to deal with those who can't get out, that's one lesson we've learned from this. But, as far as the ability to predict and to give the message, I think we now have a sufficient time warning on these storms. And I think you've done just one tremendous good job. So, I thank you all.

And thank you for this hearing.

Senator DEMINT. Thank you, Mr. Chairman.

I apologize for losing my voice today. I'm going to turn to Ranking Member Nelson. I know he's got to get out of here in a few minutes.

Senator BEN NELSON. Well, thank you, Mr. Chairman.

And again, Mr. Mayfield, this is something short of a coronation for you today, but your—you and your colleagues certainly deserve all the credit that you're receiving today because of the importance of this forecasting capability, that you showed can, and does, work.

What I'd like to do is, I'd like to explore a little bit more in detail the communications between the National Hurricane Center and Federal, State, and local officials, not so much to point fingers, but to get an understanding of the timeline of the alerts that were issued. I think, obviously, we recognize that early warning can help for early prevention for property loss and certainly the loss of life.

I notice that several conference calls involving the Hurricane Liaison Team occurred. Can you tell me a little bit more about how those calls were structured, who was involved, what kind of information was covered in these calls? I think they're critical.

Mr. MAYFIELD. I'll be very glad to, Senator. And I'll—and I appreciate the kind word for the staff, too.

You know, I've been in meteorology for 35 years, and I've basically spent most of my adult career trying to prevent large loss of life from a hurricane like Katrina. And no one wants to find out more than I do if there is anything that we could have done to have done an even better job.

There's a tremendous amount of coordination that goes on, and there's a tremendous team effort involved. And before I get to the Hurricane Liaison Team, the first level of coordination occurs right before every forecast goes out. We make that 5-day forecast every 6 hours. We'll update that if there's something that's in the forecast that occurs. And, right before that forecast goes out, we have a hurricane hotline call with all of our local National Weather Service offices. We'll explain the forecast, the reasoning behind that forecast. If anyone has any questions, they can speak up right then. So, right before the forecast goes out, the National Weather Service is very, very well coordinated.

Then we turn around and start typing up the advisory as quickly as we can. As soon as that forecast goes out, the local forecast offices turn around and start coordinating with their local—the county and parish emergency managers, on the local level. And I know these folks in the Slidell/New Orleans office, and in the Mobile, Alabama, office, and I know they did their job there.

In addition to that—that's on the local level, now—the Federal and State levels, FEMA has a conference call. In fact, they have invited us to be a participant in—it's a—usually a video-teleconference. In Katrina, it was held at noontime, Eastern time. And it's not only FEMA headquarters, but they'll have the regional FEMA offices; Region 4, in Atlanta, Georgia; Region 6, in Denton, Texas; and, very importantly, the State Emergency Operations Centers. So, for example, they would have Texas, Louisiana, Mississippi, Alabama, Florida, and Georgia State EOCs on that video-teleconference. The National Hurricane Center is an invited participant in that, and I would typically come in and give a very short 5-minute weather briefing on Katrina, ask for questions, and then my part fades out and the emergency managers do their emergency-management talk, you know, where Texas needed to know what Louisiana was doing, and Alabama needed to know what Mississippi was doing. So, that typically occurred.

But the formal video-teleconferences, including the Hurricane Liaison Team and the National Hurricane Center, occurred once a day, but we're continually updating the forecast on a—generally, on a 6-hour cycle.

I hope that answered some of that.

Senator BEN NELSON. Well, I think it does. Is—for example, the weather advisory on Sunday, August 28, 2005, at 10 a.m., that Chairman DeMint read, would that be the kind of advisory that would be available to—and do you know if it was made available—to FEMA?

Mr. MAYFIELD. My understanding of—that particular product that came out of the Slidell Weather Forecast Office was given to their—the folks in their area of responsibility. Primarily, the—you know, they have responsibility for southeastern Louisiana and southern Mississippi. So, everybody within their area—I mean, the hurricane local statement was available to everyone. I mean,

they—anybody could see that. But it was really intended for the people to—in their area of responsibility to create that sense of urgency.

Senator BEN NELSON. Would it be—if the information is most beneficial when it's localized, because the—when it's generalized, it probably isn't that helpful. Is that accurate?

Mr. MAYFIELD. That's correct. And I—the National Hurricane Center, you know, we take the big picture, you know, out for the whole 5-day period. And I don't expect my staff to know, you know, every little—in fact, they probably don't even know all the parishes, and couldn't pronounce them if they did know them, in Louisiana. But that's why it's such a team effort from the national centers and the National Weather Service and those local forecast offices. Real team effort.

Senator BEN NELSON. But there isn't any reason to believe that the emergency people wouldn't have been aware of this particular advisory. They should have been—people should have been aware of this advisory, if you're paying attention to what's happening locally.

Mr. MAYFIELD. Senator, I think that the players in the hurricane program—you know, anytime we even have the mention of a Category-3 or a major hurricane on the Gulf of Mexico headed anywhere near southeastern Louisiana, they're aware that they have a—they could have a real problem there.

Senator BEN NELSON. One final question.

Mr. CUROLE. I'd just add one more comment to that.

Senator BEN NELSON. Oh, yes.

Mr. CUROLE. We were very aware how dangerous the storm was. We often talk, with conference calls and individually, to the National Weather Service in Slidell. And that was no surprise. And the impact of this storm does not surprise any of the managers. We realized the threat that was out there, and the risks, from that powerful storm.

Senator BEN NELSON. The statement, "It was unprecedented," is not the same as saying, "It's unanticipated or unexpected," is that correct?

Mr. MAYFIELD. That is correct.

Senator BEN NELSON. One final thing. My colleague with the same name raised some questions about taking you off the air. And I've heard that these AccuWeather forecasts are very often provided as part of tracking briefings. Do you know whether Secretary Chertoff or Homeland Security or FEMA receives hurricane tracking briefings based on AccuWeather forecasts?

Mr. MAYFIELD. Senator, I've heard that they do look at those, at times. The official Government forecast on hurricanes comes from the National Hurricane Center. All of our forecasts are out there for anyone to look at. We actually now have a verification page on our website. Anybody can go in there and look at the verification on every individual storm, going back for decades. And I'll let our verification speak for itself.

Senator BEN NELSON. Well, the fact that your information is available right now to people who can access it through the Internet and other sources, I assume you think that's valuable informa-

tion for people, because self-help is almost always the best measure of getting help.

Mr. MAYFIELD. And I still remember, actually, last year, coming to the office and asking how many hits we were getting on our website. This was, I believe, during Hurricane Ivan. And somebody said, "Seven thousand." And I said, "That's all?" And they said, "Per second."

[Laughter.]

Mr. MAYFIELD. I think that speaks for itself, too.

Senator BEN NELSON. Well, thank you, Mr. Chairman. To my colleague to my right here, I've teed it up. It's up to you to hit it out of the park now. Thank you very much.

Thanks to all of our witnesses today. We appreciate very much your commitment, your support, and, obviously, your continuing interest. With a partnership like this, I think we have some opportunity to improve where we are by taking it to a new level where we need to go.

Thank you very much. Thank you, Mr. Chairman.

Senator DEMINT. Thank you, Senator.

And since you've teed it up, I'll yield to the other Senator Nelson.

Senator BILL NELSON. Thank you.

And I want to continue on the coronation here. First of all, I just—as a testimony to you, as I was flying back to Washington from my departing airport, I went to a computer that was available, went on the National Weather Service so that I could see what the latest track was. It was about 2 hours old. And it's direct information that is just very good, because, at a point—at that point, I had to decide, Was I coming to Washington or was I flying back to South Florida? And thank you for that information.

Now, speaking of that, I haven't seen the track since early this morning. What's the latest?

Mr. MAYFIELD. Well, the—we put out a special advisory at 2 p.m., updating it to a Category-2 hurricane, 100 mile-per-hour winds. The center was passing just about 50 miles south of Key West, and that's better than having it, you know, closer. Hopefully, the eyewall itself stayed a little bit south of there, although I don't—I'm dying to see a radar loop, myself, here. US–1 went under water, up in the northern part of the Keys, as forecast. And they—at least the last time here, the last advisory, you still had it as a Category-2 hurricane. Hopefully, it'll be in the Gulf of Mexico before it strengthens. But we've still got a big problem ahead of us here over the next 4 days as it gets into the open Gulf of Mexico. And it is forecast to become a major hurricane.

Senator BILL NELSON. Unbelievably, I've heard some rumors that they're trying to cut funding to the National Weather Service. And, for example, some of those old P–3s that fly right into the storm are getting pretty old, and they need a replacement. What can you tell us about that?

Mr. MAYFIELD. Well, the aircraft reconnaissance, there's no doubt that those folks just do a tremendous job for us. NOAA has two P–3s. And our one-and-only Gulfstream IV jet aircraft, that jet doesn't fly through the core of the hurricane routinely, but in the environment around the hurricane, to sample the steering currents. And we flew them repeatedly, back-to-back missions, on Katrina.

They've been flying Rita. They are—we're going to give them a day off here, and then we're going to start back-to-back missions again tomorrow afternoon, as it heads toward Texas.

The Air Force Reserves also have ten C–130's, and, in fact, I want to thank the Congress for the help on those Air Force planes. We're getting ten new J models. In fact, they may all be already at—I mean, they're becoming operational, as we speak, this hurricane season. So, that's a good-news story there. On the Air Force side, we need to get some instruments that have been developed from the NOAA P–3s onto those Air Force planes. And the hurricane supplemental bill last year provided money for that. And so, we're heading the right direction there.

I think one—if I can say this—gap that's been identified is, we—I think—maybe I could say it like this—if you were to ask someone at the NOAA Aircraft Operations Center what's one of their greatest fears, I suspect they'd probably say, "A bird in one of the engines on that jet." With one jet, we're a little vulnerable there. And I think when the impact studies are done, the Hurricane Resource Division will do these impact studies with and without that jet data, and I'm pretty confident that that jet data will be responsible for some of these, you know, good forecasts that we've made so far on the landfalling hurricanes.

Senator BILL NELSON. In an attempt to try to downsize, and consolidating offices, what's that going to do to you?

Mr. MAYFIELD. Senator, I'm a big, big supporter of the local Weather Service Forecast Offices. That's one of the reasons this works. And the fact that the local Weather Forecast Office, like in Slidell, can talk to the emergency-management community that—in the area they're responsible for, that's what—that's been one of the biggest advances, I think, in the National Weather Service during my career. I would hate to see that cut.

Senator BILL NELSON. Me, too.

Mr. Roberts, you are a user of the information from the National Weather Service, and you provide a great service to the public as the means by which it gets out. What is your opinion about privatizing the National Weather Service parts of it in the information provided?

Mr. ROBERTS. Well, I've—for the last 17 years, I've gotten to know Max—and his predecessors, but he has been there, too—at the Hurricane Center. And we know most of the companies you've talked about who might be interested in privatizing, because most of their clients are either corporations or broadcast outlets who hire them.

First of all, I think it would be a sad day that one private-sector company who competes for one of the stations in a market to end up being the, "official" government weather system. I mean, that would be a disadvantage, No. 1, to their competitors in a competitive environment.

Second, once you move it out from under a person like Max, and it becomes a profit-driven situation, I'm not so sure the product doesn't suffer, at profit. And I'm not sure—with all due respect, Max, when you get ready to retire, any of the stations in Florida will be glad to hire him—but I'm not sure, sometimes, some of these systems aren't like some of the anchors on the weather, and

the meteorologists—appearance may have more to do with it than substance. I think it would be a sad day.

I've worked with Max. I've been at our Studio C now for 17 years. I know our people trust the Hurricane Center. I know every station carries that information. And I think it's good having one neutral, credible, respected source of information when you're dealing about disasters the size of Andrew or the size of Katrina.

Senator BILL NELSON. Mr. Roberts, after a disaster, we have seen the FCC, Federal Communications Commission, allow broadcasters to increase their power in order to get out the word of a disaster. Does this need to be handled, in your opinion, favorably by FCC action, or do you think Congress should take some action in this?

Mr. ROBERTS. I actually had a chance to meet with Chairman Martin's staff yesterday. I think they're looking at coming up with a rule that clarifies to everybody, so there is no cloud, that when something like this—a hurricane, we, kind of, know is coming; we may not know how severe. Last year, in Hurricane Charley, everybody was paying the dotted line attention, thought it was going to Tampa. Max kept saying, "It's going somewhere between Naples and Pasco County." All of a sudden, it turned and went into Port Charlotte, as we all know.

I think the FCC is going to look at an advance rule—and if an earthquake hits, we don't have the advance notice—that if your area is impacted, and you're still on the air, you can increase power, as long as you go to emergency mode. If you're in an adjoining market and the stations, like over in Biloxi, that, for a while radio was out over there—I think two stations survived, and the next day we got it up to six—I think they're going to say, "If you're in Mobile or Pensacola, and you'll go to all news and information, no ads, increase your power or whatever you need to do to reach those people." And I think, instead of going after-the-fact and asking for that, the FCC's getting ready to make that a permanent rule, that every broadcaster knows they have the authority and the ability to do that.

Senator BILL NELSON. Mr. Roberts, we had an example of that in one of the four hurricanes in Florida. It was headed for an area of southeast Polk County, which technically was in the Tampa Bay market, but the stations in Tampa knew that they had escaped the brunt. You could increase the power in the stations—in this case, the Orlando stations—that were broadcasting into that area to give them the additional warnings about, "It's headed right this way."

Mr. ROBERTS. It worked very well in Florida last year. And we've been working on it for a long time. And our local FCC offices in Florida are a true team. They're kind of like, with us, like the Hurricane Center is with Craig Fugate, we talk before storms, during them.

And the other thing, broadcasters in Florida are considered first-responders. We're at the county EOCs, we're the State EOCs. We realize our role is to get the information out to the public. And, after the storm, radio becomes the lifeline. Now, the TV station news facilities may be giving them the information, but, without that continuity—and sometimes what bothers me—we were all sitting away—and, Senator, when your state got hit, we thought

about you over there—people forget the people in the impacted area aren't seeing the network newscast, they're not seeing FOX News and CNN, they're listening to their local radio station. If they've got a battery-run television, that's a true lifeline, and I hope, when these things happen—I know our Governor remembers. That's who he wants to talk to first. He doesn't care about doing The Morning Show, in New York. He wants to make sure the person that got hurt knows he's coming and getting people there. I think sometimes we get our priorities messed up.

Senator BILL NELSON. Final question. Mr. Mayfield, 35 years as a meteorologist, do you think that there's a long-term trend of the sea levels rising?

Mr. MAYFIELD. Well, I think that's documented, that it's slowly rising. My problem is relating that to a hurricane and——

Senator BILL NELSON. I understand. And the temperature rising?

Mr. MAYFIELD. There's a natural variability that goes on there in the ocean, just like with hurricanes. In fact, the—if you look at a plot of the increase in temperatures in the main development region in the Atlantic, you'll see decades above normal, a few decades below normal, and we're back in a period with above-normal temperatures. And the hurricane activity follows that. I have a—my—personally, I have a problem with relating the increase in hurricanes to global warming, because there's not an increase globally in the number of tropical cyclones. In fact, some ocean basins, the number is—like the eastern North Pacific, where the National Hurricane Center also forecasts for, the numbers have gone way down.

Senator BILL NELSON. So, over a period of 50 years, you're not concerned about the global temperature rising, causing frequency—greater frequency and ferocity of storms.

Mr. MAYFIELD. I don't think that—the studies I'm familiar with really don't say that we're going to have more hurricanes. There is a study out there that suggests there will be a 5 percent increase in intensity by the year 2080 if there's a doubling of carbon dioxide. So, there is a small—very, very small chance that the intensity will increase. Right now, we couldn't even measure this with the tools that we have now.

Senator DEMINT. Thank you, Senator.

I want to quickly—go to Senator Vitter, but just one quick question for you, Mr. Mayfield. Is it true that you called, personally, the Governors of Louisiana and Mississippi and Alabama prior to this storm hitting?

Mr. MAYFIELD. Yes, sir. I called. I don't do that very often, but I—in fact, I've only done it one other time, Hurricane Lilly, in the—when it was a Category-4 hurricane in the Gulf of Mexico. I called the former Governor of Louisiana in 2002. And this was Saturday night, around 8:30 or 9 o'clock, Eastern time, and I called the—I got hold of the Governor of Louisiana, the Governor of Mississippi. And Governor Blanco, in Louisiana, suggested that I call Mayor Nagin, in New Orleans. I called him, left a message, and he called me right back.

And I have—a lot of people in the media have asked me exactly what I said, and I—you know, with the hundreds of briefings that we did, I don't remember exactly, but the whole purpose of that was just to be absolutely sure that they understood, you know, the

severity of the situation there. And I do remember telling all three of them that, you know, I wanted to leave the National Hurricane Center that night and be able to go home and sleep knowing that I had done everything that I could do.

Senator DEMINT. Well, thank you.

And I know they're calling a vote, but if we can give this another 5 to 7 minutes, Senator Vitter can ask his questions.

Senator VITTER. Thank you, Mr. Chairman.

I wanted to follow up on that question. And you touched on it a little bit, but if you could expand more, How unusual or unprecedented is that sort of call to the Governors and mayors of affected areas?

Mr. MAYFIELD. For me, it's—I had never done that, other than that one telephone call in Hurricane Lilly in 2002. I just, you know, had the feeling that, you know, at times politicians, I think, can be a little isolated, and I just wanted to make absolutely sure that they understood how serious this was.

Senator VITTER. And, in this Katrina timeline and scenario, the things that fall into that category of being pretty unusual and extraordinary were a phone call to the Governor of Mississippi, Governor of Louisiana, a representative of State government, as I understand it, in Alabama, and the mayor of New Orleans. Is that correct?

Mr. MAYFIELD. That's correct.

Senator VITTER. OK. And were any other communications extraordinary like that?

Mr. MAYFIELD. No, the others were just the routine coordination calls, for the most part. I mean, people can call in at any time and we'll, you know, obviously, talk to them, but those were a little special there. And they all seemed to appreciate the call, at the time.

And the—people ask me when we really became concerned about the—you know, the flooding in New Orleans. And the—you know, the answer to that is just: decades ago. This wasn't just—you know, it didn't just happen with Katrina; we've been concerned about that. And every previous director of the National Hurricane Center before me, they have all been united in saying that the greatest potential, you know, for the nightmare scenario and the large loss of life, is in that southeastern Louisiana area.

Senator VITTER. In the call, specifically to the Governor of Louisiana and the Mayor of New Orleans, did you specifically talk about mandatory evacuation orders?

Mr. MAYFIELD. A lot of people have asked me that, Senator, and I wish I remembered exactly what I said. I—with all the—you know, we literally gave over 400 briefings and, you know, the weather—the situation is constantly changing, and I think—I just don't remember if I talked about evacuation or not. I—you know, my mission is to provide the best forecast that we can, and I simply don't remember. If I did, I would gladly tell you.

Senator VITTER. And do you remember any other specifics that you may have touched on, like storm surge, et cetera?

Mr. MAYFIELD. I don't remember, for certain. But in all the briefings that were given—this is a Saturday night, now, and it was, you know, already a Category-3 hurricane, and, you know, on its way to a Category-4—I hope I would have said something to the

effect that, you know, "This is a very, very serious situation with the potential for a large loss of life if," you know, "we don't make the proper preparations."

Senator VITTER. In this very good timeline that accompanies your testimony—I didn't see it here, although it could be here—do you remember exactly where the President's first emergency declaration fits in, which was made, I believe, when the storm was offshore?

Mr. MAYFIELD. I don't remember exactly when the declaration—but by—I remember hearing the media report. That was before the—you know, definitely well before landfall.

Senator VITTER. And was that preceded by any sort of unusual or extraordinary communication, or was that simply the product of these normal advisories and conference calls?

Mr. MAYFIELD. I think that's pretty standard for major hurricanes. I remember that happening in previous storms, too.

Senator VITTER. OK. I know Dr. Blackwell, in his written testimony, has talked about updating the hurricane-intensity grading level to account for more factors besides simply wind, like size, storm surge, et cetera. I'd like to hear, from all of the scientific-based experts, their reaction to that idea.

Mr. MAYFIELD. That has been kicked around for a number of years now. And Saffir–Simpson hurricane scale was never intended to be a stand-alone product. The Saffir–Simpson scale is based upon the maximum sustained wind. It's a 1-minute average wind at a standard elevation of 10 meters or 33 feet.

We've talked about a precipitation index, and one of the—for example, that's very difficult, because one hurricane going over flat area like Florida will produce so much rain, but that same hurricane going over the mountains in North Georgia or the Carolinas will produce, you know, a much different rainfall pattern. So, one size doesn't fit all for precipitation.

We do put rainfall in our advisory products, and then the local offices fine-tune that. We also put the size of the hurricane in the—how far out the tropical-storm-force winds go and how far out the hurricane-force-winds go in our advisory. So, we're addressing those things, but it's very difficult to—for me to understand how you can come up with one index that—you know, I don't think we want to have multiple indices. That, to me, would be very confusing. But we would certainly welcome any ideas from the research community if they could come up with a parameter that encompasses everything.

Senator VITTER. Dr. Levitan, do you have any reaction on that topic?

Dr. LEVITAN. Certainly for, I think, the technical community, and those in the know, that would be valuable. But, on the ground, for the people who get this who aren't, perhaps, as sophisticated in how that message is understood, I think I agree with Max that that may be more confusing, at that level, to having multiple indices.

Senator VITTER. Part of the reason I ask is, clearly, to the public at large, myself included, the shorthand is the number—one, two, three, four, five. And it tends to characterize, in terms of common discussion or understanding, everything about the storm, even

though it, in fact, describes only one finite issue, which is wind speed.

Mr. MAYFIELD. And—you're absolutely right, Senator—and we have really made a conscious effort—in, you know, interview after interview, I really tried to—in fact, with Katrina I tried to compare that with the only three known Category-5 hurricanes to make landfall in the United States, but I said it was much, much larger than any of those three Category-5 hurricanes. So—anyway, the point's well taken. We do need to do a better job on that. And we'll welcome any suggestions on how to do that.

Senator VITTER. Well, I'd just underscore that point. I understand you've been making that effort. I just think, as long as you have this grading system on wind speed, that's what everybody's going to look to, and that's the information they're going to focus on. And, for instance, in this storm, obviously it was a 4 and, at some points a 5, so that's major, but it was so big, that really expanded the destructive force of it way beyond even a typical 4.

Mr. MAYFIELD. Absolutely.

Senator VITTER. I know we have a vote, so I'll cut it short, Mr. Chairman. Thank you.

Senator DEMINT. Thank you, Senator Vitter.

And I know when I was in a Coast Guard helicopter a couple of weeks ago, the captain that was with me said this was equivalent to what would have been ten Hurricane Andrews, as far as the amount of water it pushed ashore, which obviously had my mouth hanging open. But, after seeing the destruction, I could believe it.

You folks do a great job. One of the primary functions of the Federal Government is to protect its citizens. The best protection we have is a good warning system, and, after that, a lot of it's out of your hands.

Thank you for being here today. This is very important testimony.

And this hearing is adjourned.

[Whereupon, at 4:55 p.m., the hearing was adjourned.]

A P P E N D I X

PREPARED STATEMENT OF HON. DANIEL K. INOUYE, U.S. SENATOR FROM HAWAII

In less than a year, we have witnessed two deadly natural disasters that have shocked the world and highlighted the urgent need to prepare adequately for almost unimaginable events. First, the Indian Ocean tsunami brought the world's attention to the terrible toll tsunami can take on vulnerable coastal areas. But so much closer to home, we watched as a disaster of the same magnitude struck our shores along the Gulf Coast.

The causes were different—a tsunami and a coastal hurricane—but the mechanisms of coastal death and destruction are the same. For Hurricane Katrina, we were at least adequately warned of its coming, and I commend our witness, Mr. Max Mayfield, and his colleagues at NOAA—including NOAA's all-hazards warning system—for doing an outstanding job.

But as with the Indian Ocean tsunami, preparation and mitigation response plans, even if they existed, were not well implemented. We must do better, as I know we can. For example, early and closer coordination with local governments and emergency personnel resulted in a timely response to all four hurricanes in Florida last year.

The Gulf hurricane, however, raised the specter that we have long dreaded—that an coastal catastrophe can threaten heavily populated urban areas as well as remote beachfront communities. This prospect, first brought home during 9/11, has raised the bar for government preparation and response at the very moment that the billions we will spend on Katrina recovery and the war in Iraq threaten cuts to the Federal domestic budget.

I am very concerned that this budget pressure will both undermine our ability to improve our response capacity in all areas of the country, and erode the exceptional level of service provided by agencies such as NOAA and the Coast Guard—who I commend for their impressive efforts during Katrina, from prediction and warning to rescue and response.

Even before Katrina struck, we learned that budget pressures were driving the Administration to develop a plan to reduce hours and personnel in local Weather Forecast Offices during the next budget cycle. As our witnesses know, that is *exactly* the wrong thing to be doing at this time. As we did during the Weather Service Modernization, I will work with my colleagues to ensure that no plan that erodes services to our citizens will ever be implemented.

From the Committee's long experience with tsunami, severe storms, fire and other disasters, we know that effective preparation for catastrophic events encompasses a series of linked activities that must be undertaken cooperatively, far in advance of a natural disaster, and with a committed level of funding over the long term.

First, we must invest in improving detection and prediction of all hazards, including tsunami, volcano, earthquake, and weather hazards.

Second, we must develop a warning and mitigation program that involves all levels of government, and all manner of experts, such as we have done the Tsunami Hazard Mitigation program.

In addition, such a program must ensure that people know what to do when they are warned. Federal, state, and local governments, working with outside partners, need to have a coordinated response, and each needs to help educate at-risk communities on how to respond to natural or man-made disasters. After all, no matter *how* people receive a warning, that warning does no good unless people know how to respond.

The United States can do better at preparing for natural and man-made hazards, but we cannot do so by stripping resources from the agencies that provide our core prediction, warning, and response capabilities.

This Committee must fully exercise its oversight authority on this critical point, and I urge my colleagues to join me in this effort. Through oversight, our combined experience, and the help of our expert witnesses, this committee can play a central

role in designing and funding a more effective and robust, detection, warning, and response system for the Nation.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. JIM DEMINT TO MAX MAYFIELD

Question 1. I understand that hurricanes often spawn tornadoes during landfall and sometimes for several days thereafter. Were tornadoes a problem during Hurricane Katrina?

Answer. Tornadoes almost always occur with land-falling hurricanes and can cause major damage, injuries, and death. Tornadoes caused by Hurricane Katrina occurred in Florida, Georgia, Alabama, Mississippi, and Louisiana, as well as in Ohio and Virginia as the remains of Hurricane Katrina moved northeast.

Question 2. Do you have preliminary information on the number of tornado warnings issued by local National Weather Service (NWS) forecast offices during Katrina? Is there any preliminary information on tornado-related casualties or property damage?

Answer. From August 28–30, 2005, local NWS offices issued 237 tornado warnings. The warnings were issued by thirteen weather forecast offices from Louisiana to Virginia and Pennsylvania. Some of the tornado warnings issued by the New Orleans office were for the eyewall of Katrina, not for specific tornadoes. Preliminary data suggest approximately 35 tornadoes occurred in association with Katrina, killing 2 people, injuring 3 and causing destruction hundreds of miles away from where the center of the storm made landfall. Most of the reports received thus far mention downed trees and power lines, and damage to homes.

Question 3. I understand that the NEXRAD Radar System is the primary tool used by NWS forecasters in issuing tornado warnings. Would new technology with faster scan rates currently being researched, such as Phased Array Radar, help to provide better and more advanced tornado warnings during hurricane events?

Answer. Yes, faster scan technologies and improved resolution would help National Weather Service forecasters detect the precursors to tornadoes. NOAA's preliminary research indicates that phased array radar could potentially allow forecasters to issue tornado warnings with an average lead time of nearly 20 minutes (up from the present national average of 14 minutes in 2005). Tornadoes associated with hurricanes tend to be embedded in rain, and are generally smaller and shorter lived than tornadoes associated with thunderstorms. Faster radar scan rates and higher resolution could increase the chances of observing and predicting these smaller tornadoes, and improve our tornado warning capability during land-falling hurricanes. However, it will take many years to test phased array radar and determine whether it is cost effective as a next-generation operational system. In the near term, NOAA will continue its NEXRAD Product Improvement Program, which has already contributed to increased warning time.

Question 4. Can you provide information on cooperative past work between the National Hurricane Center and the National Severe Storm Labs?

Answer. The Storm Prediction Center (SPC), one of the nine centers in the National Centers for Environmental Prediction, is co-located with the National Severe Storm Laboratory (NSSL) in Norman, Oklahoma. The SPC issues tornado watches and local weather service offices issue tornado warnings. The SPC collaborates with National Hurricane Center (NHC) during land-falling storms to ensure the risk of tornadoes is assessed and coordinated within the agency and communicated to the public. The NSSL and the SPC communicate on a daily basis though the jointly managed Hazardous Weather Testbed. In the late 1980s and early 1990s, the NSSL worked with the National Weather Service (NWS) Tropical Prediction Center and Hurricane Research Division on extracting information on tornadoes from NEXRAD weather radar data. The results of this research and development are used today, primarily by local NWS forecast offices, to issue tornado warnings during hurricane events.

RESPONSE TO WRITTEN QUESTIONS SUBMITTED BY HON. DANIEL K. INOUYE TO MAX MAYFIELD

Background: Mr. Mayfield is the director of the National Weather Service's Tropical Prediction Center/National Hurricane Center (NHC) in Miami, FL. In addition to performing basic research, the NHC is responsible for monitoring all tropical cyclones in the Atlantic and Eastern Pacific (east of 140° W latitude), predicting their path, and warning the public. The Central Pacific Hurricane Center in Hawaii has

a similar responsibility for the Western Pacific except that the NHC has the authority to direct all aerial reconnaissance assets, known as the Hurricane Hunters. In his written testimony, Mr. Mayfield commented that we appear to be entering into a period of heightened hurricane activity in the Atlantic.

CLARIFICATION: The National Hurricane Center provides forecast and warnings for hurricanes and tropical systems. Basic hurricane research is done at the Hurricane Research Division of the Atlantic Oceanographic and Meteorological Laboratory and the Geophysical Fluid Dynamics Laboratory in NOAA's Office of Oceanic and Atmospheric Research. The Central Pacific Hurricane Center has responsibility for the central Pacific from 140 degrees longitude westward to 180 degrees longitude (the International Dateline). The U.S. Joint Typhoon Warning Center (located in the Department of Defense) has responsibility for U.S. interests for the western part of the Pacific, that is, west of the Dateline.

Question 1. You issued, from all accounts, accurate warnings. You also warned local officials. What sort of reaction did you get from FEMA and local officials upon issuing your warnings?

Answer. Our forecasts and warnings were well coordinated with the emergency management community, including the Federal Emergency Management Agency (FEMA). We only have the expertise to comment on the actions taken by NOAA.

Question 2. You have been through many hurricanes. In your experience, what are the typical Federal reactions pre- and post-hurricanes?

Answer. The responsibility of the National Hurricane Center is to provide the best possible meteorological information and forecasts for hurricanes. The National Weather Service (NWS) forecast track error for Hurricane Katrina was better than the 10 year average. After the storm made landfall, the NWS provided high quality forecast and warning services to the affected areas. We only have the expertise to comment on the actions taken by NOAA.

Question 3. In your prepared remarks, you commented on the increasing number of hurricanes occurring in the Atlantic. Is there also a similarly heightened cyclone activity in the Pacific?

Answer. No, the activity in the Northeast and North Central Pacific has decreased in recent years. There appears to be an inverse relationship, with respect to hurricane activity, observed in the Pacific and Atlantic basins. The long-term average number of hurricanes in the Atlantic is approximately 6 per year, and about 9 per year in the Northeast and North Central Pacific. While the Atlantic has been more active during the last decade, experiencing about 8 hurricanes per season (compared to the average, 6), the Northeast and North Central Pacific has averaged only 7 hurricanes a season (compared to 9). In contrast, during the mid-1980s to the mid-1990s the Atlantic was relatively quiet (5 hurricanes per season), and the Pacific averaged 11 hurricanes per season. The 1997 and 2002 hurricane seasons were particularly active in the Pacific basin, and correspond to the quietest seasons in the Atlantic during the last decade; this is a result of the influence of the El Niño phenomenon. El Niño, a warming of the equatorial eastern Pacific waters, causes changes in global weather patterns. El Niño tends to cause quiet Atlantic and busy Northeast and North Central Pacific hurricane seasons. The 2005 hurricane season continues the inverse trend in hurricane activity in the Atlantic and Pacific basins; there have been 12 hurricanes in the Atlantic, compared to 7 hurricanes in the Northeast and North Central Pacific.

Question 4. How does coverage of the Pacific compare with the Atlantic in terms of NOAA resources? How many Hurricane Hunters are based in the Western Pacific? Is the staff of the Central Pacific Hurricane Center comparable to the staff of the NHC?

Answer. Forecast and warning services for the central Pacific region are high quality. Although the last direct hurricane to strike the Hawaiian Islands occurred in 1992, when Hurricane Iniki struck Kauai, other hurricanes approached Hawaii in 2005, 2003, 2000, 1998, 1997, 1994, and 1993.

NOAA Aircraft are stationed at the NOAA Aircraft Operations Center, MacDill AFB in Tampa, FL; the U.S. Air Force Reserve Hurricane Hunters are stationed at Keesler Air Force Base, in Mississippi. If forecasters at the Central Pacific Hurricane Center believe a hurricane will impact Hawaii, they may request reconnaissance aircraft. The aircraft then fly to Hawaii to provide detailed in-situ observations to improve the forecast of the track and intensity, both by providing data for the forecasters and also providing data for better initialization of the numerical guidance models.

The Central Pacific Hurricane Center (CPHC) functions both as a local Weather Forecast Office and as a national center for aviation, marine, and hurricane programs in the Pacific. As a result of this combined mission, the CPHC has no dedi-

cated hurricane forecasters. When a tropical cyclone enters or forms in the central Pacific (140° W to 180°), additional forecasters (certified as hurricane specialists) are called in to provide the extra staffing required to meet the hurricane forecast products and services needs. The number of additional staff called in increases as the possible threat of the hurricane impacting Hawaii increases.

Question 5. What types of resources are needed to better track cyclones in the Pacific—buoys, aircraft, etc.?

Answer. Additional observations and directional wave information would contribute to further improving hurricane intensity and track forecasts in the Pacific. Hurricane track forecasts in the Pacific continue to improve. In 1984, in the Central Pacific Ocean the 48-hour track forecast had an average error of about 250 nautical miles. By 2004, the 48-hour track forecast error was reduced to about 150 nautical miles. The Global Earth Observation System of Systems (GEOSS), a 10-year international endeavor of which the United States is a member and NOAA, the National Aeronautics and Space Administration, and U.S. Geological Survey are key participants will address observational enhancements to improve hurricane forecasting. GEOSS includes a number of different data collection systems such as buoys, satellites, and surface base weather instruments.

NOAA also works to continually improve its numerical weather forecasting models to improve track and intensity forecasts in the Pacific. To improve the model guidance, in collaboration with many scientists and developers in the domestic and international operational Numerical Weather Prediction (NWP) centers, NOAA's Environmental Modeling Center (EMC) develops state of the art numerical modeling systems. Through continued collaboration between NOAA's Geophysical Fluid Dynamics Laboratory (GFDL) and EMC, NOAA's high-resolution hurricane models, which have provided track and intensity guidance over the past 10 years, are being continually improved and upgraded. Predicting hurricane intensity remains one of our main challenges. For example, even though the forecasters may know conditions are favorable for hurricanes to intensify, there are sometimes large errors in the intensity forecast in the Pacific and Atlantic due to rapid intensification. Through NWP advancements, the 2005 research version of NOAA's high-resolution model, when run on data from several 2004 hurricanes, improved some intensity forecasts when compared to the forecasts provided by the 2004 version. To further advance hurricane prediction, especially hurricane intensity and size forecasts, NOAA is developing the Hurricane Weather and Research Forecasting (HWRF) system. The HWRF system uses a collaborative approach among the research community and will apply advanced model physics as HWRF combines the atmosphere, land, and ocean into an integrated model. Our goal is to couple an advanced wave model with a dynamic storm surge model to better predict coastal impacts of waves and storm surge as well as predict hurricane intensity and size.

Included in the President's $17.1B reallocation package for Hurricane Katrina relief and recovery, submitted to Congress on October 28, 2005, is $54.6M in funding for NOAA, containing several enhancements to hurricane forecasting and modeling activities. Among the NOAA requests are investments to complete an accelerated implementation of the HWRF System, add enhancements to the Global Forecast System to improve forecasting of hurricane intensity and structure, and add a third P–3 Hurricane Hunter aircraft.

Background: All of the witnesses would agree that better coordination among federal, state and local partners would result in more lives saved through storm preparation, planning, and response. While the NHC has established federal, state, and local Hurricane Liaison Teams that activate before each hurricane, and Florida has developed its own mitigation program, there is no specific comprehensive national program aimed particularly at storm hazard mitigation at the federal, state and local level. However, this committee has created them in other legislation we have passed. Such a model would be appropriate to look at given the failure of response in Katrina.

Though this Disaster Subcommittee is a new creation, we have long been active here at the Commerce Committee in addressing weather issues. Most recently we included a new Coastal Vulnerability Assessment Program in the Tsunami Preparedness Act, which the Senate passed. We have also enacted the Inland Flood Warning Act of 2002 and the National Windstorm Impact Reduction Act of 2004.

Question 6. Given that Katrina has highlighted the need for better storm preparedness at all levels of government, wouldn't the multi-agency and federal-local structure of many of these programs make sense to emulate?

Answer. We believe the existing structure for the hurricane program can work well, by focusing on increased efforts in public education, preparedness and prediction. Hurricane Katrina was an extreme event. While we know Katrina will not

be the last catastrophic storm to make landfall in the United States, we believe the existing structure can work well, as exemplified by the response to the four major hurricanes that hit Florida in 2004. Because there is always room for improvement, we should continue to take in lessons learned from Katrina and work to make the system more efficient.

Question 7. Please explain the benefits of adopting this model of integrating research, technology, hazard mitigation, and community preparedness in one program to help organize preparedness for severe coastal storms.

Answer. NOAA works with Federal and university partners to coordinate research efforts; with federal, state and local emergency managers for preparedness and education efforts to understand the potential impact from these storms; and with the public at large to provide forecasts and warnings in a timely fashion to allow people to take action. NOAA and other Federal agencies are part of the National Hazards Mitigation Plan, where all aspects of natural hazards are addressed. The National Hurricane Operations Plan, compiled each year by the Office of the Federal Coordinator for Meteorological Services and Research, address hurricane program activities across the Federal Government.

NOAA has increased our efforts to integrate research and technology, as demonstrated by the Joint Hurricane Testbed (JHT) under the United States Weather Research Program (USWRP), which was formed in late 2000. The mission of the JHT is to facilitate the transfer of new technology, research results, and observational advances of the USWRP, its sponsoring agencies, the academic community, and the private sector for improved operational tropical cyclone analysis and prediction.

Question 8. Shouldn't we establish a Severe Storm Hazard Mitigation Program, similar to the one we established for Tsunami, to ensure all the right federal, state, and local entities are working together toward the same goal before the hurricane appears on the horizon?

Answer. Federal, state, and local governments have been aware of the threats associated with hurricanes for decades. These threats have been receiving increased attention, even before last year's record breaking number of U.S. land-falling storms and this year's catastrophic impacts. We believe all appropriate federal, state and local entities are currently working together toward the same goal. For example, the work of the Office of the Federal Coordinator for Meteorological Services and Research addresses hurricane program activities across the Federal Government, and the ever-increasing number of participants attending the annual, privately-run National Hurricane Conference attests to the heightened awareness and increased emphasis being placed on the potential impact from hurricanes.

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