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HURRICANE PREPAREDNESS IN THE GRAND STRAND

FIELD 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

AUGUST 10, 2005

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ONE HUNDRED NINTH CONGRESS

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HURRICANE PREPAREDNESS IN THE GRAND STRAND

WEDNESDAY, AUGUST 10, 2005

U.S. SENATE,
SUBCOMMITTEE ON DISASTER PREVENTION AND PREDICTION,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
Myrtle Beach, SC.

The Subcommittee met, pursuant to notice, at 9:00 a.m. at the Springmaid Beach Resort and Conference Center, Myrtle Beach, SC, Hon. Jim DeMint, Chairman of the Subcommittee, presiding.

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

SENATOR DEMINT. Well, I'd like to call to order the first field hearing of the Disaster Prevention and Prediction Subcommittee. This is a Subcommittee that I'm Chairman of. It was formed after the tsunamis but in recognition that our country needs to do a lot more to be prepared for disasters, whether they be natural or otherwise, and that we do whatever we can to prevent the loss of life and property damage.

So, this morning the Committee will be hearing testimony about the state of preparedness in the Grand Strand, and hopefully we can get suggestions on things that we can do to be more prepared and, in any way we can, to prevent the loss of life, economic loss, and damage to property. So, I appreciate all of my witnesses being here today.

You know, as we witnessed last year in Florida, hurricanes can have a tremendous impact on life and property. The four major hurricanes that made landfall were all among the top ten most costly hurricanes in history and accounted for a total of over $21 billion in combined insured losses. And this is more than the insured losses from the World Trade Center and the Pentagon attacks in 2001.

Unfortunately, from what we've heard from witnesses before in this Subcommittee, we can expect seasons like last years to be the norm for possibly the next two decades. Just last month, the Subcommittee heard from Max Mayfield, Director of the National Hurricane Center. He discussed NOAA's 2005 hurricane season prediction, which, at the time, called for 12 to 15 tropical storms, of which 7 to 9 would become hurricanes, which would be a pretty active season.

Unfortunately, as we all learned last week, NOAA's May prediction most likely underestimated the total number of tropical storms we're going to see this year. Instead of the 12 to 15 storms

predicted in May, it's more likely we're going to see 18 to 21 storms this season, and 9 to 11 of them are going to be hurricanes.

While the brunt of this year's and last year's hurricane season were focused on the Florida and Gulf Coast, we can't expect it to continue indefinitely. With the forecast for an increasing number of hurricanes for the next two decades, we can expect that, sometime in the near future, we will see a major hurricane make landfall in or near the Grand Strand. The state and local governments have been working hard to prepare for the possibility of a major hurricane making landfall here.

I hope those of you who are here from out of town took note of the blue and white evacuation signs. I know the locals know which arteries they need to take to get out of town in the event of a major storm making landfall here in the Grand Strand.

I know that the state and local governments appreciate the threat posed by these storms and are doing all they can to prepare for the storms. But a lot of the preparation falls to citizens.

Everyone should have a family hurricane disaster plan that stocks the necessary supplies in the event that you have to shelter in place during a storm or if you lose power. Homeowners and builders should consider using disaster-resistant building materials that will help protect their homes from the rain associated with hurricanes. If a homeowner can keep the rain out of their house during a storm, the damage would be much less severe.

If the Federal Government, the state and local governments, and, most importantly, local citizens work together, we can dramatically reduce the damage caused by these storms.

This morning, we're going to hear from a number of witnesses who will help provide insights into how we can better prepare our communities. I'm looking forward to the comments of Jim Gandy, South Carolina's weatherman, on how our local communities can better prepare for storms that will impact our communities in the coming years. He has advised governors on preparing for storms, and I'm looking forward to his insights.

Also appearing this morning will be Dr. David Prevatt, from Clemson's Wind Load Test Facility, to discuss how the winds associated with hurricanes impact structures. Clemson's work to model the impact of severe storms provides important discoveries into how we can better construct our buildings to resist severe storms.

Living in a coastal community exposed to hurricanes, I'm sure many of you have watched The Weather Channel's Storm Stories or have seen the on-air meteorologist, Jim Cantore, report from the field. I appreciate him being here this morning. He has been in the eye of many storms, and I know he's going to have important perspectives on what these communities—what our communities could do to better prepare.

Also appearing this morning will be Paul Whitten, the Public Safety Director for Horry County. Mr. Whitten is responsible for planning and preparation that ensures that, when a storm does impact the Grand Strand, that the community is prepared. I will be interested to hear how he works with the various governments and community groups to ensure that Myrtle Beach is prepared for one of these storms.

Finally, we'll be hearing from Mr. Brad Dean, President of the Myrtle Beach Chamber of Commerce. The economy of Myrtle Beach depends, to a large degree, on the vitality of the tourism industry, which is directly impacted by local and regional weather, particularly the threat of hurricanes. Mr. Dean will be discussing local industry's preparation for hurricanes and the impact that those storms have on local businesses.

In the past, we've seen periods where hurricane activity was as high as it is now, but development was not nearly as dense in our coastal communities as it is today. Tourism and coastal businesses are an essential part of the Grand Strand and South Carolina's economy. We must work today to ensure that we are prepared for a storm when it hits and that we can recover quickly and get back to business as soon as possible.

While these storms are dramatic events when they make landfall, they are relatively rare events. Day in and day out, visitors should enjoy the beautiful beaches we have here in Myrtle Beach and enjoy all that South Carolina has to offer.

With that, I'll ask our witnesses to make their opening statements. And if you could confine your statements to five minutes, I'd appreciate it. If you've got a longer statement, we will make it part of the official record.

And that is, I think, an important note. The purpose of this Committee is to collect official information that we can submit to all the Committee staff who are developing legislation. It gives us, certainly, the information we need to convince other Senators to follow our lead on whatever needs to be done from developing new legislation. So, this is part of the official record, and it's an official hearing, and I appreciate all of you taking part in it.

Why don't we start with Mr. Dean? And we will take statements from everyone. I'll ask some questions, and then, I mentioned to some of the panelists, if you have questions of others or comments that you'd like to make in addition to what someone else has said, we want to get all the information we can before we leave today.

So, Mr. Dean, if you'll start us off, I'd appreciate it.

STATEMENT OF BRAD DEAN, PRESIDENT/CEO, MYRTLE BEACH AREA CHAMBER OF COMMERCE

Mr. DEAN. Thank you, Mr. Chairman. And let me, if you'll indulge me, begin with my professional obligation, as President of the Chamber, welcoming you and all the panelists and visitors here today to the Grand Strand. We certainly are delighted to see them. And it's one of the few times where we are excited and pleased to see Jim Cantore arrive. Normally when Mr. Cantore arrives, it is not with good news, so we're welcoming him, as well, today. Thank you all for being here.

Mr. Chairman, as you know and indicated in your opening comments, travel and tourism is one of the Nation's largest industries, certainly the largest industry in South Carolina. Whether you measure that by retail sales, employment, or economic outlook, it is certainly an important industry for the Southeastern United States and the United States in general.

Here in South Carolina, tourism is big business. It's a $15 billion industry. And the Grand Strand, the area from Little River, North

Carolina, to Georgetown, is one-third of the State's tourism economy. Though it is an industry made up of small businesses, it is truly big business in South Carolina. And the economic impact extends far beyond the coastline. Tourism pays for bridges, for roads, for economic development; it even pays for schools. So, what's good for tourism is good for South Carolina. And, certainly, what's good for tourism is good for America.

There has been much debate within the tourism industry and outside the tourism industry on the recent release of the five-day forecast. The five-day forecast, because of its inherent inaccuracy, especially in light of the very accurate three-day forecast, caused much concern. And I can tell you from the perspective of the Myrtle Beach Area Chamber, where we handle hundreds of thousands of phone calls from prospective visitors each year, just the mention of a tropical storm that could make its way to the Eastern United States will start the phones ringing. And the minute that the Carolinas or Myrtle Beach, in specific, is mentioned as part of that potential five-day forecast track, it is not at all uncommon to receive hundreds of calls each hour, with visitors not sure if they should come. That has clearly been a trend that we have seen, and it has not changed. If anything, that has grown in the sensitivity—some might call, the panic—associated with potential five-day forecasts causes many potential visitors to call and express concern and perhaps change vacation patterns.

Bear in mind that a big day in tourism along the Grand Strand is $40 million a day. And that doesn't count the millions of dollars of state and local taxes. So, the slightest change in forecasting can very well cause millions of dollars of economic impact. Although I would go so far as to say, Mr. Chairman—and I think I speak for the entire tourism industry when I say that the issue here today is not economics. Certainly, the most important factor that we all must consider, and I think would all agree, is safety—safety of visitors, safety of residents—and securing the safety and well-being of those who are here, and planning to arrive here. So, the ultimate discussion is not about the economic impact, but what we do to minimize that, as well as to maximize the safety and well-being of our residents and visitors.

We find that the accuracy of forecasting with the three-day forecast has enabled our local emergency planners—most notably, Mr. Whitten and those who work with him, as well as the American Red Cross and other local agencies, as well as businesses—sufficient time to plan for and handle storms that may be approaching the coastline and could eventually fall here. But we don't, certainly, want to rely on what has worked in the past.

We understand—let me be very clear—we understand that the five-day forecast is here to stay. One of our chief goals is to work with NOAA, the National Weather Service, the community of meteorologists, as well as emergency planners, to ensure that, if we are to use a five-day forecast, it should be as accurate as possible. We believe that an accurate five-day forecast will not only enhance the safety and well-being of our residents and visitors, it could also enhance tourism, because tourism, in some respects, lives and dies off of weather, good or bad. But we believe that the five-day forecast will be far more useful when its accuracy is improved. And, though

I certainly recognize that it is improving, and has improved in the recent years it has been used, we would hope to see the day, sometime soon, when the five-day forecast is every bit as useful as a three-day forecast in projecting exactly where landfall may be.

Mr. Chairman, let me also echo your comments and say that I certainly agree with you, when we look at the pace of development. We have heard that hurricanes are likely to be more frequent along the coast of South Carolina, and particularly the Eastern United States. One other trend that is clear and not going to change anytime soon, and one that we welcome, is the growth of visitors and residents along the coast of South Carolina. This is a high-growth area. One doesn't have to travel too far from where we're sitting today to see development that is geared toward that projected growth.

So, with more people coming to the coast, and more storms expected, your point is very well taken, and I applaud you, your Subcommittee Members, as well as Chairman Stevens and Senator Inouye, for hosting such hearings to address what we need to do in the future to maximize safety and minimize the economic impact of this.

There are a lot of suggestions that can be made, and we will hear some of those today. But we do believe that a proactive approach to development to prepare for the eventual storm that we have not seen in any recent year that would make landfall here, as well as striving to improve the accuracy of the forecasting models, will benefit all—residents, businesses, and government.

We believe that, here along the coast, and particularly in Horry County, we have demonstrated a model that has worked extremely well, with a close, ongoing, collaborative partnership between local government, state government, businesses, as well as public and private agencies, who work seamlessly to plan for, prepare for, and, ultimately, handle storms and the after-effect of storms.

I would note that the economic cost of a hurricane starts long before it would ever make landfall and lasts sometimes weeks or months after it has made landfall. But we cannot simply look for the days before and after the storm, but, rather, to be prepared for and handle all such effects that we would see with a large storm approaching the coast of South Carolina.

Again, let me reiterate that safety certainly should be our top concern. And none of us, particularly those of us in the tourism industry, would ever suggest that anything other than safety is most important. But we certainly strive to balance that with the economic impact that a storm could have, even if it's only projected along the coast. When it comes to this, I assure you, the tourism industry will someday be the biggest proponent of the five-day forecast that'll let us put behind us, perhaps, past disagreements over forecasting models and simply strive together to work to make sure that those which are used and publicized are as accurate as possible.

Again, I want to thank you, Mr. Chairman and your Subcommittee, for hosting this hearing along the Grand Strand. I also want to take the opportunity to thank those at NOAA, the National Weather Service, and the community of meteorologists. They probably feel, sometimes, that the tourism industry does not appreciate

the work they do. We do, in fact. What they do is very important work, and it is essential to the safety and well-being, not only of our visitors and residents, but of our tourism economy. We believe that when we continue the collaborative effort, ongoing discussion, thorough analysis, and the involvement of individuals like those on this panel today, that we will find solutions to enhance the potential effectiveness of our preparation and prepare for those days when storms do arrive here, even with more residents and visitors along the Grand Strand.

Again, Mr. Chairman, welcome to the Grand Strand, and thank you for your time today.

[The prepared statement of Mr. Dean follows:]

PREPARED STATEMENT OF BRAD DEAN, PRESIDENT/CEO, MYRTLE BEACH AREA CHAMBER OF COMMERCE

Summary

Tourism is a major industry along the Grand Strand and in South Carolina. The state's tourism industry accounts for $15 billion of economic impact, in addition to over $1 billion in state and local taxes. The Grand Strand accounts for nearly one-third that amount. Grand Strand tourism peaks in the summer, with as many as 500,000 daily visitors spending in excess of $40 million.

The use of the five-day hurricane forecast has a negative impact on tourism, as it projects possible strikes with a broad "cone of uncertainty" that spans hundreds of miles. The result of the five-day forecast is two-fold: it unnecessarily projects a path that is far from certain, potentially scaring tourists away; and it can lead to such consistently inaccurate results that residents and visitors accumulate a false sense of security through experience based upon the consistent inaccuracy of the five-day forecast.

The five-day forecast was implemented with little or no input from the tourism industry, but it appears this forecast is here to stay. Ultimately, the solution is not eliminating the five-day forecast but, rather, improving it. If the five-day forecast were as accurate as the three-day forecast is today, the tourism industry would welcome its use. The best possible solution is improved weather forecasting, yielding a five-day forecast with a high level of accuracy.

Because we are so significantly impacted by weather and weather patterns, a weather forecast is a key part of our local tourism trends. Some estimates indicate that as much as 40 percent of our visitor base during any week during the summer is dependent on the immediate weather forecast. This is not surprising when one considers that 44 percent of the annual visitor traffic to the Myrtle Beach area comes from North and South Carolina.

A few years ago, when we first learned of the proposed five-day hurricane forecast, many Grand Strand residents and businesses became concerned. Knowing that the three-day forecast was far from perfect, we were justifiably concerned with the planned use of the five-day forecast. How could the National Oceanic and Atmospheric Administration (NOAA), a division of the Department of Commerce, expect to implement this with little or no input from the tourism industry, the very industry that stands to gain the most from accurate weather reporting and, likewise, stands to lose the most with inaccurate weather forecasting. After all, NOAA's mission statement (see Exhibit A) includes mention of "improve economic efficiency by providing the best watches, warnings and forecasts." We were told this change was necessary for the United States Navy to protect its large fleet off the coast of Florida and, furthermore, that emergency planners along the coastal regions of the United States preferred the five-day forecast. I think I can safely speak for the tourism industry when I say that we had no concerns, then or now, with the use of the five-day forecast by the U.S. Navy nor emergency planners. After all, both must plan in advance far before individual citizens need to do so.

What was most concerning was the large margin of error incumbent in the five-day forecast. By their own admission, meteorologists with NOAA and the National Weather Service described the massive area of strike probability a "cone of uncertainty." This area, which can encompass hundreds of square miles, is accurately referred to as such, since the use of this five-day forecast has revealed a high degree of inaccuracy (see Exhibit B).

I have enclosed a document, obtained from the NOAA website, which shows a graphic representation of the average accuracy of various hurricane forecasts over a 10-year period. Two observations are clear and indisputable:

(a) the three-day forecast is far more accurate today than ever before;

(b) the five-day forecast is far less accurate and not nearly as reliable as the three-day forecast.

Recent examples of these observations have been witnessed by many. Hurricane Charley, a serious storm that caused much damage in the Southeastern United States, made landfall near Punta Gorda, FL, despite a forecast track that pointed toward Tampa Bay, FL, an area nearly 100 miles north of the actual landfall. Early forecasts of Tropical Storm Bonnie showed forecasted paths of southern Florida, then later Texas and Louisiana, before the storm followed an awkward path in the Gulf of Mexico and ultimately made landfall along the Florida panhandle.

Proponents of a five-day hurricane forecast will no doubt point out that the five-day forecast in both of the storm situations mentioned above included a wide area, wide enough to encompass geographic areas that needed to prepare for such a storm. But this inherent inaccuracy is the very root of the problem.

Once the national media have publicized the five-day forecast, areas with little probability of serious storm threats will necessarily be included in the five-day forecast "cone of uncertainty." It is not uncommon for more than one state to be included. At the Myrtle Beach Area Chamber of Commerce, it is quite common to receive many phone calls from distressed visitors seeking to change or cancel their vacation plans once the first mention of the Myrtle Beach area or even "the Carolinas" is made with respect to a possible hurricane path.

If only the visitors from states other than North and South Carolina unnecessarily change their vacation plans to the coast of South Carolina due to a hurricane, the economic costs can be in excess of $25 million per day. Please bear in mind, this refers to one single vacation destination in one single state.

But, the ultimate cost is not economic but, rather, in human life and safety. With so much inherent inaccuracy in the five-day forecast, meteorologists are transformed into a modern-day, high-tech version of "Chicken Little," unintentionally announcing the sky may be falling. This is through no fault of their own but, rather, through the customary use of the five-day forecast published by NOAA. Though some meteorologists have spoken out publicly against the use of the five-day forecast, its use continues.

Proponents of this forecast argue for its publication, essentially noting that "any information is better than no information." They rightfully note that the potential safety and protection of life and property justifies the use of the five-day forecast. These arguments may seem logical at first but ignore the damage that a consistently inaccurate hurricane forecast can cause. A forecast that is more likely to be wrong than right may only serve to prompt residents and visitors to ignore such a forecast, or worse yet, to believe that weather forecasting in general is inaccurate. This is despite a very accurate three-day forecast which has proven to be a reliable tool that allows public safety personnel more than enough time to evacuate the Grand Strand which, when at its peak, is one of the busiest vacation destinations in the entire Nation. And that is done despite this area being the Nation's most popular vacation destination with no direct access to an Interstate, yet with 93 percent of our visitors driving here. Despite large numbers of visitors in automobiles and insufficient infrastructure for visitors to leave the area, the three-day forecast has proven more than sufficient to manage the safety of our visitors and residents.

With an amazingly high level of accuracy in the three-day forecast, and a disappointing level of inaccuracy in the five-day forecast, it is easy to understand why many in the tourism industry were surprised and somewhat disappointed when the five-day forecast became a common forecasting tool. Nevertheless, this genie is out of the bottle and not likely to return.

So, it is appropriate for us to work together, in a collaborative manner, to seek the best possible outcome, and that is an outcome that all involved in this discussion can agree to: the clear, indisputable need for improved weather forecasting. Those of us in the tourism industry who have been the staunchest opponents of the five-day forecast would become, perhaps, its biggest proponents if the level of accuracy were increased to a level similar to that of the three-day forecast. Improved forecasting would be far less likely to unnecessarily harm a coastal tourism economy in any state. Further, an accurate five-day forecast would be more reliable in the eyes of individual citizens whose safety must come first, before any economic loss or promise of economic gain.

I am reminded of the old saying that "change is not always better, but to be better, one must be willing to change." Clearly, the five-day forecast has not proven

to be a better forecasting tool, even by the admission of those who use it regularly. Some meteorologists have even spoken out against the use of the five-day forecast, noting their clear preference for an accurate three-day forecast. Furthermore, this change has caused unnecessary concern and economic loss since its implementation. For the benefit of all, including the safety of our residents and our visitors, improved weather forecasting that increases the accuracy of the five-day hurricane forecast will be better for all involved, ultimately enhancing the safety of our citizens and the vibrancy of our national tourism economy.

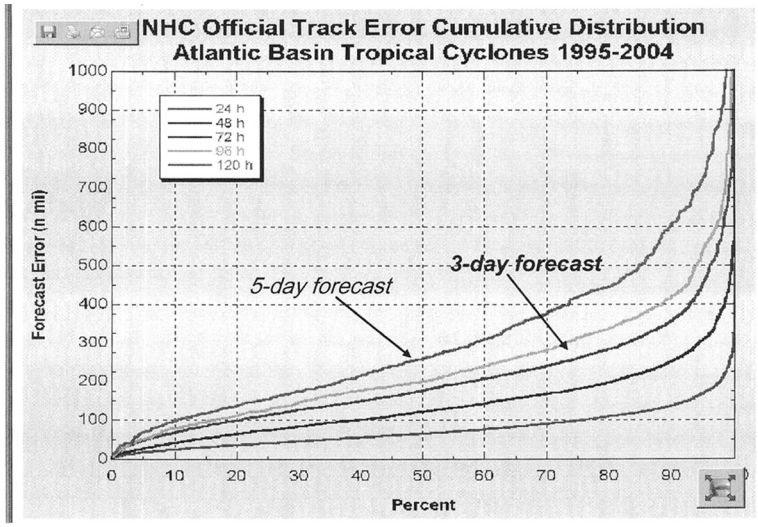
EXHIBIT A

National Oceanic & Atmospheric Administration
U.S. Department of Commerce

Mission

To save lives, mitigate property loss, and improve economic efficiency by issuing the best watches, warnings, forecasts and analyses of hazardous tropical weather, and by increasing understanding of these hazards.

EXHIBIT B



Explanation: diagram shows the percentage of official forecasts having an error less than the value along the y-axis. For example, to determine the fraction of 24 h forecasts having an error smaller than 100 n mi, find 100 n mi on the y-axis, and read across the diagram until this value intersects the red (24 h forecast) line.

Source: NOAA website

Senator DEMINT. Mr. Cantore, I think this is the first time I've ever seen you when you weren't standing in 50- to 80-mile-an-hour wind. So, it's——

Mr. CANTORE. Well, Mr. Chairman——

Senator DEMINT.—it's good to have you with us today.

Mr. CANTORE.—I've got to tell you, it's a nice break, to be honest with you. And Mr. Dean, I'm sure, agrees with me, that you'd rather see me in a suit and tie, too. No question about it.

STATEMENT OF JIM CANTORE, ON-AIR METEOROLOGIST, THE WEATHER CHANNEL

Mr. CANTORE. But I thank you for having me. And, you know, I've been doing this for about 13 years. And I just want to share with you some of the things that I've seen over the past, maybe some things we can improve on.

This does not cover any post-hurricane issues, obviously, which I would suggest be discussed, as well, because I think getting people back in, is perhaps just as important as getting them out of harm's way, as well.

All right, let's talk about some hurricane facts that I just wanted to share with you. To this day, there is no way to accurately predict any tropical intensification fluctuations. In other words, let's just take Irene, that's out there now. That was supposed to be a hurricane by now. It is not. It's barely hanging on as a depression. And, as a result of that, the steering is influenced heavily by the size of the storm. So, this is something that, until we get better science in this area, you've got to realize that we're dealing with an animal that's going to change on us, in where it's going.

We are in, as you mentioned, Senator, an above-average phase of hurricane development, because, if you will, this multi-decadal phase—if you go back into the 1960s and 1970s, we had above-average years then—starting back in 1995, we have had above-average years of hurricanes. There's no reason to expect that to weaken. We expect the current trend to continue, as you mentioned.

Inland flooding is the number-one killer in land-falling tropical systems. So, as we prepare to get people off the coast, we have to also keep them out of harm's way in where we think that rainfall may be heaviest inland, as well.

And a strengthening and accelerating land-falling hurricane could be a nightmare. Charley—out of all of the four last year in Florida, Charley was the only one that was accelerating and deepening upon landfall. And the people that I talked to in Orlando, and the people that I talked to in Daytona, remember Charley more than they remember Frances and Jeanne, which came in on their side of the coast, as far as damage is concerned. So, that's a nightmare. And people, believe it or not, still believe that they can't have anything like that happen to them. Nobody's going to argue there.

You know, we cannot discuss evacuation without enlightening everyone to the tremendous psychological impact that occurs within people as they prepare for an evacuation, what it is we're asking of them, to leave the comfort of their dwelling and, in many cases, everything they have worked for, while seeing images of past hurricanes wreak havoc on the coastline. Not knowing when they can

come back to life as they know it, many in Florida have not done that, and may never do that. And we're asking them to sit in traffic for hours while a storm may or may not be worthy of leaving in the first place. Having to deal with the enormous psychological stress of evacuation, not to mention what they could find in return.

So, what do we want to do? We want to tell people to get out of harm's way and reduce the stresses of getting out of harm's way, because we know they're already heavily stressed, just the emotional, you know—the impacts from what they see on TV, what they hear on radio, and whatnot.

Here's what's good that I see out there. Enhanced technologies have created greater awareness. Satellites are better. Radars are better. Cell phones and high-speed Internet gets everybody access to the information that we use on The Weather Channel. People know it's coming. Our problem is not making people aware of the fact that it's coming. Everybody knows that it's coming.

The EOC, the Emergency Operations Center meetings seem very timely when I'm on the coastline. They're already meeting, in many cases, and planning meetings. And we know when those meetings are. And the public information officers, the PIOs, who basically represent what is coming out of the EOC, make themselves very available to the media. The last two hurricanes, in Emily and Dennis, I covered, I actually had them call me on my cell phone. They were very willing to do so. So, we appreciate that.

And the coast has experience. We've been in above-average hurricane seasons now since 1995, and with video and certainly all these emergency operation procedures that have been in place, and continue to be in place and improved upon, you know, it's just a matter of getting it done.

The bad and the ugly. We run out of gas. We're asking people to leave, and then we don't have the necessities in place to get them out of harm's way. That is what I call a "disaster in a disaster."

Plywood, generators, gas cans always seem to be in short supply. I wonder why hardware stores can't just be on standby with extra supplies that are needed for hurricane preparedness, and bring those in, even if they have to sell them right off the truck, because now we've postponed preparedness with people. And, to anybody who's ever tried to put up a piece of plywood in 30-mile-an-hour wind, it's very hard and it's very difficult.

People still have to sit in traffic for hours when evacuating. This is the big one. This is the thing that I think needs to be addressed the most. Shelter information—where, when they open, et cetera—often arrives late. If it wasn't for my friends at the Red Cross, I would have a hard time getting that information. It's often the last thing to get to us, "Oh, and by the way, here are the shelters."

Media coverage has tripled in the last ten years. So, what we do there is risk a mixed message. The more media out there covering it, I think you risk a mixed message.

My recommendations—all EOC communications must be strong within EOC and to all media outlets. I look at this like me and my wife. We tell our kids to do something, and we agree upon it, usually it gets done. If there's disagreement with us, and that message is sent to them, then it doesn't get done. So, we almost have to

have a strong family unit within the EOC in the communications that they send out to all the media.

As far as evacuation orders, when they are given, there has to be some way to get those people out on all lanes of highways and Interstates. I know this is a tremendous undertaking, and maybe even impossible in some areas. But if we ask someone to sit in traffic for eight hours to go ten miles, like we did in Florida, they're not going to leave again, regardless of the strength of the hurricane. So, evacuations and getting the routes open to get them out is very, very critical.

Like I said, PIOs need to be accurate, complete, and effective communicators. I've seen that a lot lately. When they come out, they're pretty much the word of the EOC, and they're very willing to talk to us, which is great, and we appreciate that.

I mentioned earlier, we can't have a "disaster within a disaster." We evacuated the whole East Coast during Hurricane Floyd, and a lot of people sat in traffic for hours and hours and hours, and they didn't even have to leave at all. So, a lot of unnecessary evacuation there. And what I call," Gas Mania 2004," when the ports of Florida were closed down too early and people couldn't get gas, what that caused people to do, even this year during Hurricane Dennis, is to go buy five and ten gas cans, fill all those up, and we ran out of gas again. So, we can't run out of gas if we're asking people to leave.

And all the media, regardless of how much we have out there, need to have a succinct and consistent message. More media means we risk that. And people need to know as soon as possible when they can or cannot return. Some of the hardest stresses on you, I think, are not knowing when you can come back to whatever you have left. It's kind of like if you go to the doctor's and you're waiting to hear on a test, a certain test—the longer that takes, the more stress builds up. So, any information, in the meantime, of when people can come back, even if it's a month, two months, an estimate, I think, is better than not saying anything at all.

So, I conclude with this. There has never been a perfect forecast, to the best of my knowledge. State-of-the-art technology gives us a better lead time to prepare for natural disasters. Strong support for these advances is essential. So, technology needs to be continually improved upon.

And if we effectively communicate our message and we have the necessities in place for a stressed community to process, prepare, and protect themselves and their families, I would like to see the day—and I do see the day—that hurricane evacuation goes as smooth as a fire drill.

Thank you.

Senator DEMINT. Thank you.

Mr. Prevatt. Dr. Prevatt. Sorry.

STATEMENT OF DAVID PREVATT, PH.D., PE, ASSISTANT PROFESSOR AND DIRECTOR, WIND LOAD TEST FACILITY, DEPARTMENT OF CIVIL ENGINEERING, CLEMSON UNIVERSITY

Dr. PREVATT. Well, gentlemen, thank you. My name is David Prevatt. I am an Assistant Professor of Civil Engineering at Clemson University, and Director of the Wind Load Test Facility. I appreciate this opportunity to appear before the Subcommittee and to testify.

I must admit that I come here as an advocate, on behalf of the researchers and of this community, for an increase in Federal support for science and technology research to develop hurricane mitigation and risk-assessment measures. Hurricanes, as we have heard, are large, costly natural disasters that cost billions to recover from and, let's not forget, causing misery and suffering to millions of people.

The fact is, about 50 percent of the U.S. population now lives in a hurricane-prone coastal area, yet Federal support for hurricane research only amounts to about $5 to $10 million per year. In all, over the 20th century, a mere $50 million has been directed to hurricane research.

On this, we have, from Hurricane Hugo in 1989, Fran, Bonnie, of course, Floyd, that Jim talked about, and the 2004 hurricanes. These are figures from the EMD—South Carolina's EMD—$1.6 billion in damage to our state, alone. Now, this money is not counting the insurance payouts, costs of agricultural damage, small-business association loans, and unrealized taxes and business losses, not to mention the other indirect losses that we probably can't account for.

So, despite this painfully slow lack of funds, we have made progress in South Carolina and in the states. Research has led to the creation and adoption of the latest IBC 2000 building code by South Carolina and other states. This code contains provisions that significantly increase the chance of survival of buildings.

The knowledge—part of our research at Clemson University has been the instrumentation of houses along the coast of Florida, North Carolina, and South Carolina. What we do here is set up portable wind towers to monitor the wind speeds, and we also install sensors on houses to measure the wind pressures on those houses.

What we have found is this. Lots of—a small bit of asphalt shingles and sheathing, like this, results in some degree of damage to your roofing system, without any structural damage. And, finally, this can result in complete, almost total, destruction of your interior contents, failed wall systems, and costs resulting in about 80 percent of your insured value.

So, one of the problems that I see is that we look for, no longer, just the structural problems, but there are other building envelope problems that are required to be fixed.

The knowledge is available now to design and construct structures to resist 100 percent of the hurricanes, 100 percent of the time. However, no one wants to pay for that, and no one, probably, would want to live in that kind of building. So, what is needed for us is to use the knowledge to continue our code development to

study policy implications that can result in solutions that the community—that the Grand Strand is willing to pay for.

Here is one of the houses that we have instrumented. Part of the techniques we are doing is comparing—if you look at the right-most corner of the picture, you'll see three metal sensors. Those duplicate the wind pressures.

Next slide, please?

We've done models of that house, and in—we can use those models to put it in the Wind Load Test Facility's wind tunnel, and, therefore, compare full-scale and model-scale data. This is giving us, for the first time, knowledge about how buildings in suburban areas are loaded by the wind, and, therefore, we are going to be able to improve our designs and perhaps not have to be as conservative, sometimes, in our code development.

Simple low-cost measures that homeowners can do to improve their houses are provided in my written testimony.

I see three urgent problems that we need to resolve. And this would only be solved through collaboration with researchers and the Chambers and communities-at-large.

First, we need to reduce the vulnerability of critical facilities and hospitals and evacuation centers in hurricane zones. We can all recall, in Hurricane Charley, the catastrophic failure of the Turner Arcadia Civic Center in Central Florida which lost a roof and a large masonry wall while it was sheltering 1,200 persons. This is something that we must avoid. In addition, over a dozen hospitals were damaged during the four hurricanes that made landfall in 2004. Most of that damage was not to major structural systems, it was to building envelopes, loss of windows, loss of wall claddings and roof claddings, but the hospital still had to be evacuated.

The other issue I have—and perhaps Jim and I can discuss this afterwards—is finding practical alternatives to mandatory evacuation of hundreds of thousands of coastal residents at the threat of a storm. I am from Trinidad and Tobago. I live on an island. Evacuation is not an option. When a hurricane approaches, you batten down the hatches and you stay in your building once you're outside of that storm-surge zone. The idea behind us all placing hundreds of thousands of people in cars for ten hours at a time, to me, is not necessarily the only solution, or perhaps the best solution for that. Many have commented that the possibility of a fast-moving accelerating storm can cause significant loss of life if that affects those people in their cars on the Interstate.

And, third, the idea of developing affordable structural systems to improve the poor performance of residential construction. In particular, the idea of the residential construction is the segment of the construction industry that really does not perform that well because the structures are primarily not engineered structures. Clemson University researchers did tests on—that led to—this is a manufactured home built in accordance with the HUD guidelines of 1994. It survived in that Port Charlotte manufactured-home park unscathed. All that damage comes from the older manufactured homes. This was a direct result of research and collaboration with the construction industry.

And in Horry County itself in 2000, we did some tests on those houses that were flood-damaged and FEMA bought in 2000, and

here it was—we actually installed load cells and literally broke this thing apart and found out what would the capacity be before and after hurricane retrofits. This type of research is necessary and important for us to continue to develop and learn from this what is existing.

Here again, we see one of the houses where we just simply pulled it up to find the uplift capacity. We would recognize that those are not plywood or OSB sheathing, but plank roofs. When we tried to fail that with our wind-pressure test chamber, it couldn't fail, because the design or the construction of a plank roof requires two nails at every single plank. That structure failed at about 450 pounds per square foot, as opposed to the 60 to 80 pounds per square foot that plywood would fail.

We, as the community, have made the choice to use plywood, for other reasons, so, therefore, we need to make the choice that if we have an idea of what the strength of a material is, then we must be able to say, "Well, what will we, as a community, want to tolerate, in terms of failure and damage?" It is up to the communities themselves to ask these questions of me, of us researchers, of the Federal agencies, to decide what to do.

The fact remains, we need to build stronger buildings and safer homes and businesses. We also need critical facilities that are designed to higher standards so that they would survive this storm and serve the community when the community needs them the most. Basic engineer—wind engineering research can provide the information necessary to adjust design and construction methods so as to more efficiently increase the resistance of the built environment to hurricanes.

The Wind Load Test Facility at Clemson is a resource for South Carolina and the country—as it is an internationally-recognized center that consistently provides knowledge and information that affects our public policy and building codes. An increase in Federal funding for wind engineering research would allow research to be performed whose results would improve our understanding of hurricane-induced damage. That better understanding can be incorporated into building codes, into practice, into public policies so that hurricane damage can be better managed by the local community and by national agencies.

I urge you and the Committee to consider the needs of South Carolina and the country, and ask that you support increased Federal funding for wind engineering research. The benefits of such research to the country would be significant, and the Wind Load Test Facility at Clemson would have the opportunity to apply to a much larger source of funds for monies than what is currently available.

Chairman DeMint, I look forward to working with you and your staff on hurricane issues, whether the issues be public policy concerns, technical engineering decisions, or wind-related matters.

That's the end of my testimony. Thank you.

[The prepared statement of Dr. Prevatt follows:]

PREPARED STATEMENT OF DAVID O. PREVATT, PH.D., PE, ASSISTANT PROFESSOR AND DIRECTOR, WIND LOAD TEST FACILITY, DEPARTMENT OF CIVIL ENGINEERING, CLEMSON UNIVERSITY

1. Introduction

Chairman DeMint and members of the Subcommittee, my name is David Prevatt, and I am a professional engineer and an Assistant Professor of Civil Engineering at Clemson University. Since 1990, I have been doing research to mitigate the effects of hurricanes to low-rise coastal structures. I also direct the Wind Load Test Facility, which is a research laboratory focused on research to mitigate the effects of hurricane wind loads on low-rise buildings. We are actively involved in creating basic knowledge and developing practical solutions for use by engineers and homeowners to improve the resistance of buildings to hurricanes, thereby minimizing damage and reducing loss.

I very much appreciate the opportunity to appear before this Subcommittee and to testify in this hearing. In this testimony I will first present an engineer's view of the potential for catastrophic hurricane damage facing our South Carolina coastal communities. Next, I will present my observations of structural damage during the 2004 hurricane season and present recommendations that can reduce the vulnerability of buildings. Finally, I will discuss what the engineering research community is doing to reduce wind damage to and vulnerability of buildings in hurricane-prone areas, and how the research community's results affect public policy.

For almost a generation (1965 to 1994), the frequency of hurricanes in the North Atlantic Tropical Cyclone Region was relatively low and few hurricanes made landfall in the U.S. Concurrently during this period, there has been urban development along vulnerable U.S. coastlines, and as a result, about 50 percent of the U.S. population now lives in hurricane prone coastal areas. Hundreds of miles of once empty coastlines are now major population centers with trillions of dollars of buildings and infrastructure exposed to the risk of hurricane damage.

Mitigating hurricane damage is of special concern to Americans living in our coastal communities including the coastal communities of South Carolina. Public and private support for science and technology research is urgently needed in order to address the mounting economic losses and manage the risks from future hurricanes.

Currently, Federal support for hurricane research lags woefully behind support for other natural hazards. In 2000, Margaret Davidson of NOAA-Coastal Services comparing the research funding for earthquake risk with hurricane risk provided data showing that while the total damage from earthquakes in the 20th century was only about half the total damage from hurricanes ($47.97 billion to $100.7 billion), the research funding for earthquake reduction was seven times greater than funding for hurricane research (>$350 million for earthquake as opposed to $50 million for hurricane research).[1]

The scenario in the 21st century will be different; more property is at risk from hurricanes and more lives that will be affected.

Four Questions to Consider:

- What will it mean to the Myrtle Beach (and Charleston) tourism industry and to the State of South Carolina when (not if) a large, powerful hurricane makes landfall?
- What would be the impact of such a disaster on the lives of many full-year residents who rely on the tourism, timber and fisheries industries for employment?
- If strengthening all buildings will minimize future losses, what should engineering science and technology researchers do to support coastal community efforts to protect itself from the threat of future hurricane damage?
- Is the community better served by spending already limited resources on inevitable post-hurricane repairs or instead, systematically investing in scheduled "pre-hurricane" Improvements to buildings?

The Grand Strand may face as a minimum, $3 billion to $4 billion in damages and an extended recovery period lasting 6 to 8 months or longer. In 1990, participants who attended the ASCE-sponsored Hurricane Hugo—One Year Later Conference[2] may recall that the city of Charleston was still picking-up and repairing

[1] Alvarez, Ricardo (ed.) "Proceedings of the National Hurricane Hazard Reduction Act Meeting," Feb. 2000, International Hurricane Research Center, Florida International University.

[2] Sill, B.L. (Clemson Univ); Sparks, P.R. eds. Source: Hurricane Hugo One Year Later, ASCE, 1991, 293p.

its buildings during those deliberations 12 months after Hugo. Although the loss to the forestry and fisheries industries may as yet be beyond our control, as engineers we can and should do something to improve the resistance of our built infrastructure to withstand hurricanes and minimize loss. Furthermore, as illustrated by the Northridge (1994) and Loma Prieta (1989) earthquakes, Hurricane Andrew (1992), and other natural disasters many small businesses close—never to reopen—because of the inability to reconstruct and service customers and clients in a timely manner.

2. Hurricane Catastrophe Potential for South Carolina

I have come here to advocate on behalf of the researchers and this community for an increase in Federal support for science and technology research to develop hurricane mitigation and risk management activities. With the predicted upswing in frequency and intensity of hurricanes over the next few decades, and the growing populations living in vulnerable coastal cities, losses from hurricanes will escalate in coastal communities unless we can better understand—and manage—the effects of hurricanes on the built environment; understanding that can only result from federally funded basic wind engineering research.

Horry County, South Carolina, has enjoyed impressive growth in its population over the past 15 years, increasing approximately 44 percent from about 145,000 in 1990 to about 210,000 today. The Grand Strand region is a significant contributor to the economic well-being of the state. However, hurricanes and the threat of hurricanes continue to be detrimental to this tourism-based economy. Comprehensive and sustained efforts to alleviate this threat will be needed to support the regional tourism-recovery program being developed by state and local leaders. The effort should focus on: (1) improving the performance of all buildings, both residential and commercial to maintain functionality of the community, and (2) managing expected losses that will occur.

Myrtle Beach will suffer economic losses if the hotels along the Grand Strand are not full of paying guests because of a lack of basic services, infrastructure and because the swimming pools facing the beach are filled with sand. But while I expect hotel buildings would sustain some damage, single family residences are the structures most likely to be damaged significantly. Wind loads on low-rise buildings—wood-framed structures in particular—have received more attention recently because of the large economic losses they have sustained during hurricanes in the last 10 years. Residential construction continues to bear the brunt of damage to the built environment from hurricanes.[3]

The main reason for the poor performance of this building type is that residential structures are typically not engineered to resist loads. Rather, the construction methods have been developed empirically over time. I use the term "engineered structure" to described any structure in which all of its components have been designed in a rational manner, using latest information on the expected loads, and knowledge of the material strengths. Such structures are designed to have a reasonable margin of safety. It is through technology transfer of fundamental research knowledge to the practicing engineers and code officials that the latest knowledge becomes available and improved building methods implemented.

Another concern for the Grand Strand region and South Carolina is the performance of the critical facilities during a hurricane. As I will describe later in this testimony, hospitals, evacuation shelters, police and fire stations remain vulnerable to damage and some of these will not be functional during or after a hurricane. Also, mandatory evacuations of hundreds of thousands can be a problem with large coastal populations. Many experts have stated that a fast moving storm could result in large loss of life among persons in traffic jams trying to evacuate.[4]

Based on the above observations, hurricanes cause damage due to one of three reasons:

- A hurricane exceeded the design requirements of the community.
- Structures were poorly designed.
- Structures were poorly constructed.

Research performed at the WLTF addresses all three reasons:

1. For what hurricane should a community be designed? The knowledge exists to design and construct structures to resist 100 percent of the hurricanes 100

[3] Rosowsky, David; Schiff, Scott, What are our expectations, objectives, and performance requirements for wood structures in high wind regions? Natural Hazards Review, v 4, n 3, August, 2003, p 144–148.

[4] Reinhold, Tim (2005) Testimony Given at Disaster Prevention and Prediction Hearing: Severe Storms and Reducing Their Impact on Communities.

percent of the time; however, no one wants to pay for—or occupy—such structures and, therefore, hurricane damage will occur. The WLTF recognizes that a community's willingness to rebuild after a hurricane is reflected in building code requirements. Viz., lower requirements would result in frequent rebuilding while higher requirements would require less rebuilding but larger initial costs. Thus, the building codes reflect a community's willingness to spend money on rebuilding. The WLTF's research considers varying design and construction requirements according the needs of a community, effectively participating in the development of public policy.

2. Poor design. Students that have participated in the WLTF in their studies have a solid understanding of wind effects on the built environment. The vast majority of these students work as structural engineers after graduation and incorporate what they have learned about wind into their design decisions.

3. Poor construction. Some research at the WLTF studies existing structures so as to identify if they are vulnerable to wind events that are smaller than that specified in the building code, and—if they are deficient—the most efficient manner of rehabilitating structures to resist the required loads.

For the above reasons, we need to build stronger buildings and safer homes and businesses, and we need critical facilities that are designed to higher standards so they would survive and be able to serve the community when the community needs them the most. Basic wind engineering research can provide the information necessary to adjust design and construction methods so as to most efficiently increase the resistance of the built environment to hurricanes.

3. An Engineer's Observations from the 2004 Hurricanes

The 2004 hurricane season provided a real-time laboratory for me and other researchers from across the country. WLTF researchers and students set up field experiments in 3 of the 4 storms (Hurricanes Charley, Frances and Ivan) and we conducted post-hurricane investigations to observe and document damage. Our research involved collecting wind speed data and posting it to the World Wide Web and instrumenting houses to measure wind pressures on roofs.

Generally, we observed that houses built under the latest codes or deemed-to-comply documents and which were not directly exposed to storm surge did not fail catastrophically. Instead, houses experienced the failure of building envelope components, (roofing, wall cladding, windows, and doors); the same failures that have been occurring for over 50 years.

We found that small breaches in the building envelope, especially in the roofing systems and soffits can provide paths for water leakage that results in extensive water damage to the interior walls, ceilings and to building contents. Such minor failures (loss of asphalt shingle and underlayment) to one Pensacola house resulted in water damage to about 80 percent of all interior finishes on the ceiling and walls. Drying out of water-soaked buildings to prevent mold growth and decay after the envelope has been breached became BIG business after the Florida hurricanes. Some of the less durable materials, insulation, gypsum sheathing and acoustic ceiling tiles cannot be dried out and must be removed and replaced.

We observed numerous engineered buildings that suffered little damage and retrofitted non-engineered houses also performed satisfactorily. In Charley, a major success story was the good to excellent performance of newer manufactured homes that were built in accordance with 1994 HUD guidelines. Most of these survived with minimal damage, while adjacent older manufactured homes that did not have wind-resistant construction were destroyed.

Failure of building envelope systems had a more dramatic impact on hospitals and critical facilities during these storms. From Mobile, AL to Ft. Meyers, FL, more than a dozen hospitals were damaged or were evacuated due to the effects of the 2004 hurricanes. Charlotte Regional Hospital in Port Charlotte and the Navy Hospital in Pensacola both sustained damage to their roofing systems and windows. The Martin Memorial Medical Center in Stuart, FL, lost its elevator penthouse in Hurricane Frances and suffered further roofing damage and water damage from Hurricane Jeanne three weeks later. Even the Medical University of South Carolina in Charleston suffered significant damage during a minimal-strength Category 1 Hurricane Garston.

In addition, during the 2004 storms, numerous fire stations and evacuation shelters were not able to maintain function throughout or after the storms, including the spectacular failure of the Turner-Arcadia Civic Center in Central Florida that suffered a masonry wall and roof collapse while 1,200 persons were sheltering from Hurricane Charley. The failure of hospitals, critical facilities and evacuation shelters placed additional burdens on the already stretched civic institutions which had

to consider removal of sick patients, interruption of emergency protection services (fire stations and police stations). When we recall that most of these facilities did not experience forces near their design levels, we begin to realize the enormity of the problems facing us today.

It is my expectation that we would see similar building failures here if a hurricane made landfall in South Carolina. With buildings located among our forested areas, tree damage may also be a factor here. South Carolina needs buildings with structural and building envelope components that are designed and constructed so that they do not fail prematurely in winds below their design wind speed. Unfortunately, as illustrated by Hurricane Hugo, South Carolina should expect significant amounts of damage to occur at wind speeds below design wind speeds.

3.1 Practical Construction and Retrofit Recommendations

South Carolina has adopted state-wide, the International Code Council's (ICC) International Building Code (IBC) 2000 building code. This document provides the most current available information and best-practice design to construct wind-resistant buildings. Provided legislation is not enacted so as to weaken code provisions, the IBC provides appropriate standards for the construction and retrofit of coastal houses.

The extensive damage to the building envelope during high wind events can be reduced by providing durable flashing materials in window openings and continuous water barriers in walls and roofs. These recommendations are good practice and should be installed whether in a high wind zone or not. Furthermore, the following table presents options for reducing the vulnerability to wind damage.

While some options may at first appear radical, with the right research and benefits/costs analyses it is possible to determine appropriate systems for our changing and growing coastal communities.

4. Research at the Wind Load Test Facility

Since 1991, research at the Wind Load Test Facility (WLTF) has made great contributions to improving building codes and increasing our understanding of wind forces. The facility was founded with Federal funds obtained from FEMA under the Stafford Act as part of the post-Hurricane Hugo mitigation effort.

I believe our most important contribution to the state is the role we play in the education and training of future civil engineers. We have produced over 60 engineers who did their Masters and Ph.D. projects at the WLTF. Many of these men and women continue to work as civil engineers within South Carolina. Through their research, our graduates became sensitized to wind engineering issues and to the vulnerability of the state's infrastructure and they (we) continue to spread the message that we have the know-how to construct hurricane-resistant structures for our communities.

We use the atmospheric boundary layer wind tunnel to conduct studies to determine wind loads on residential construction and non-engineered structures. Our current research focus remains on the wind loading of buildings within suburban neighborhoods because so little information is available to designers. Science and technology advances at universities have made significant improvements in the instrumentation and data collection of loads on buildings. Recent research collaborations by Clemson University, Florida University and Florida International University on the Florida Coastal Monitoring Program[5] have provided full-scale data in real-time, on near-ground level wind speeds that is helping NOAA's Hurricane Research Division verify the accuracy of wind speed predictions. In addition, wind pressure data collected from actual residential buildings allows us to determine the loads on the roofs. This work has also provided a means to validate results of wind tunnel studies against full-scale data.

We are grateful for the financial and other support of many organizations, including the South Carolina and Florida Sea Grant Consortia, FEMA, NOAA, the Florida Department of Consumer Affairs, the Institute for Business and Home Safety and the South Carolina Department of Insurance.

Through our full-scale destructive testing of houses in Horry County before and after installation of hurricane retrofits, researchers were able to determine how much strength was being added to the structure using various retrofit techniques. The houses were made available because they were bought by FEMA following the extreme flooding in Hurricane Floyd.

With our wind tunnel testing program and related research, we will develop design methods for critical building components and connections applicable to wood-framed structures. Our missile impact tests have been used to test the impact re-

[5] *http://users.ce.ufl.edu/6fcmp/.*

sistance of lightweight plastic composites and aluminum shutters. Our research remains focused on developing cost-effective methods for reducing damage; the damage mitigations methods should provide the greatest reduction in damage for the least cost. However, the ability to develop methods is limited by the lack of funds for performing the necessary research.

While the construction cost of an individual home does not justify extensive wind tunnel testing or engineering input, the design professional needs to have an idea of the wind loads to which a house is susceptible. Knowledge of loads is the basis for sound engineering design. There has as yet been little incentive for the housing industry to undertake the research needed to refine these loads because home builders perceive any modification to design loads as increasing the cost of a house and is, therefore, bad business practice. Therefore, the research at the WLTF provides a valuable and unique contribution to knowledge of hurricane-resistant construction, not only for South Carolina, but for the entire country. The knowledge and information from research performed at the WLTF is used to improve deemed-to-comply building codes by incorporating more engineering knowledge into our houses.

Four areas of ongoing WLTF research are:

- Understanding the full-scale wind load and validation of wind tunnel techniques.
- Condition and risk assessment of critical facilities, evacuation shelters and hospitals.
- Load path investigation for wood-framed roofing structures.
- Performance-based design criteria for building envelope components.

5. Summary

The cost of hurricanes is something that we must bear as a community. It is fitting that the community be involved in the mitigation efforts. The increasing numbers of large, more complex coastal cities and urban centers with unprecedented wealth and industry concentrated in small geographical locations makes it important that serious consideration be given to designs of all construction that are capable to withstand the onslaught of hurricanes.

The increasing annual amounts of damage from hurricanes and the inherent danger to millions of residents have created a greater incentive to understand the load regime and performance of residential buildings in suburban neighborhoods. Government funding is needed for the broad generic research that will lead to improved loading information and the subsequent development of improved construction techniques. This improved information would be incorporated in the country's building codes.

However, providing improved building techniques and enforcement of building codes is only part of the solution. A strong political resolve must also exist that will improve the construction and performance of the country's buildings. In addition to improved building codes, incentives or policies that encourage consumer demand for better-constructed buildings are required. The WLTF recognizes the need for participating in the development of public policy that will promote hurricane understanding.

Our coastal communities should be able to rely upon the continued efforts of Clemson's Wind Load Test Facility and allied testing laboratories and universities to develop the understanding of wind load, knowledge of structural performance of our buildings and to perform the engineering research that leads to cost-effective solutions for improved building performance. Our efforts cannot continue indefinitely without the commitment to support hurricane research and the support of coastal communities and organizations in South Carolina.

The good news is that Hope is around the corner! Ongoing related efforts at other (academic, etc.) institutions, and the wind engineering community have led to the National Windstorm Impact Reduction Act of 2004, H.R. 3980, being passed by the 108th Congress. When appropriated this bill would increase available annual funding for wind engineering research to about $22 million.

By providing research that helps us forecast, prepare for and understand hurricanes, the engineering research community continues to make a valuable contribution to a more sustainable and hurricane-resistant community on the coasts of South Carolina and beyond. The WLTF at Clemson is a resource for South Carolina and the country as it is an internationally recognized center that consistently provides knowledge and information that affects public policy and building codes. An increase in Federal funding for wind engineering research would hopefully improve the ability of the WLTF to perform research that would benefit South Carolina and the rest of the country.

Senator DEMINT. Thank you, Dr. Prevatt. Very interesting.
Mr. Whitten.

STATEMENT OF PAUL D. WHITTEN, DIRECTOR, HORRY COUNTY PUBLIC SAFETY DIVISION

Mr. WHITTEN. Yes, sir.

Thank you for the opportunity to appear. I truly appreciate the opportunity to share my thoughts on hurricane preparedness in South Carolina, and specifically on the Grand Strand. I also wish to state that these statements are mine alone and do not necessarily represent the opinions of the Horry County Government.

I've been involved in the hurricane preparedness and response business since 1992, when I responded to Hurricane Andrew in South Florida. Since then, I've also worked at the State Emergency Management Division for South Carolina, where I served as the state's first hurricane program manager.

In 1997, I moved to Horry County, where I became the Emergency Management Director, and, as such, I dealt with several storms at the local level, also. In 2000, I became the public safety director dealing with this, again, still on a larger level.

We cannot continue to ignore the threat that hurricanes pose to our coastal communities. A number of factors are combining to create a potentially serious tragedy.

The two biggest factors I see are the growth of our coastal communities. Horry County has experienced a tremendous surge of population. Many of the new residents are from areas that do not experience hurricanes, and, since they do not have any experience, they have no practical knowledge in dealing with storms. In addition, one of the fastest-growing segments of our population is the 55-and-older demographics.

As you also stated, we're in an increased period of hurricane activity. A lot of the hurricane experts believe that this period is going to see us up to possibly 21 main storms this year.

If we honestly face this reality, we realize we must begin to better prepare our communities. To accomplish this, I believe we must consider implementing the following actions to the Grand Strand.

The number-one priority is the development of a southern connector. The southern part of the Grand Strand must have an effective evacuation route. We continue to put people at risk by not having a good evacuation route for tens of thousands of our residents living in Surfside Beach, Garden City Beach, and the Waccamaw Neck and surrounding areas. Research indicates that too many people fail to evacuate because they do not want to get caught in the huge traffic jams that have been mentioned.

I believe South Carolina has one of the most effective hurricane plans in the Nation. The South Carolina Emergency Preparedness Division provides the Governor with the information and recommendations that guide the state through the evacuation process. And, while South Carolina has implemented many innovative traffic procedures, such as lane reversals and counterflow operations, the reality is that the lack of actual road infrastructure still hampers every evacuation on the Grand Strand.

The second issue I think we need to tackle is the development of a real mitigation program. Historically, the Federal Government

has spent a tremendous amount of money on post-disaster assistance. However, we must acknowledge that it's better and more cost efficient when we emphasize pre-disaster mitigation. We have seen progress in this area, especially with the requirement for state and local mitigation plans, but without funding these plans are difficult, if not impossible, to implement.

In addition, we must be smarter about developing in high-risk areas. Through the National Flood Insurance Program, the Federal Government spends a tremendous amount of money on repetitive lost properties. These are properties that are in flood-prone areas, and we continually pay to repair these properties, to the point that it would be more cost effective to acquire and demolish them.

The third issue is the development of a medical evacuation program. One of the biggest unsolved problems facing coastal communities is our inability to adequately manage what I refer to as a medical-community evacuation. Horry County has numerous nursing homes, assisted-living centers, hospitals, and bed-bound citizens in a potential evacuation zone. The resources just do not exist in the local area to conduct an evacuation of these citizens.

We've been working on this issue since Hurricane Bertha in July of 1996. Despite efforts to address this issue, I believe we are still not capable of implementing a full evacuation of this medical community. In the event of evacuation, such as the one caused by Hurricane Floyd in 1999, this would put us in the position of probably leaving some of our most vulnerable citizens in the evacuation zone during a major hurricane.

Since Hurricane Hugo hit in September of 1989, South Carolina has made tremendous progress in preparing for the next hurricane. I'm impressed by the dedication of the government agencies and the private organizations that worked together in this effort. However, I've seen the impact that a storm can have on communities. Preparing a community's infrastructure is an obvious goal of local government; but until the business community is restored, recovery is not complete. Many times, this is a neglected component in the process.

In addition, I've been with families that have had their lives and homes destroyed by the impact of a major storm. Walking through a house with a family that has had six feet of flood water in their home, you realize the devastation that occurs both to the structure and to the family unit. Even if we had been able to assist them in rebuilding, I can't help but thinking that prevention is a better solution.

I learned, many years ago in this business, that landfalling hurricanes have predictable consequences. And predictable is preventable. We must guide to ensure a teamwork approach, including the Federal Government, state government, local governments, private agencies, and individual citizens. This teamwork must focus on the entire cycle of disaster, with a special emphasis on mitigation. We've worked, in a number of times, with agencies such as the Clemson University's Wind Load Test Facility that Dr. Prevatt discussed and showed. We initiated that process literally days after Hurricane Floyd started, when we realized we were going to be acquiring houses. We wanted to make them available to the Clemson University Wind Load Test Facility to conduct research. We see the

benefits of that research at the local level and fully support their efforts.

I appreciate the opportunity to come to talk to you today. And if you have any questions, I'll be glad to answer them.

Thank you.

[The prepared statement of Mr. Whitten follows:]

PREPARED STATEMENT OF PAUL D. WHITTEN, DIRECTOR, HORRY COUNTY PUBLIC SAFETY DIVISION

Thank you for the opportunity to appear before this subcommittee. I truly appreciate being able to share my thoughts on hurricane preparedness in South Carolina, and specifically on the Grand Strand. I also wish to state that these statements are mine alone, and do not necessarily represent the opinions of Horry County Government.

We cannot continue to ignore the threat of hurricanes to our coastal communities. A number of factors are combining to create a potentially serious tragedy. These factors include:

1. The growth of our coastal communities. Horry County is experiencing a tremendous surge in population. Many of the new residents come from areas that do not experience hurricanes, and have no practical knowledge about dealing with storms of this nature. In addition, one of the fastest growing demographics in our area is the 55 and older group.

2. An increased period of hurricane activity. Many hurricane experts believe that we are in a period of increased hurricane activity. This year we are already on our 9th named storm, and the National Hurricane Center is projecting this season to see up to 21 total named storms.

If we honestly face this reality, we realize we must begin to better prepare our communities. To accomplish this, I believe we must consider implementing the following actions for the Grand Strand:

1. DEVELOP A SOUTHERN CONNECTOR

The southern part of the Grand Strand must have an effective evacuation route. We continue to put people at risk by not having a good evacuation route for tens of thousands of our residents living in Surfside Beach, Garden City Beach, the Waccamaw Neck and surrounding areas. Research indicates that too many people fail to evacuate, because they do not want to get caught in huge traffic jams.

I believe South Carolina has one of the most effective hurricane plans in the Nation. The South Carolina Emergency Management Division provides the Governor with the information and recommendations that guide the state through the evacuation process. And while South Carolina has implemented innovative traffic procedures, such as lane-reversals, and counter-flow operations, the lack of actual road infrastructure still hampers every evacuation.

2. DEVELOP A REAL MITIGATION PROGRAM

Historically, the Federal Government has spent a tremendous amount of money on post-disaster assistance. However, we MUST acknowledge that it is better and more cost-efficient when we emphasize pre-disaster mitigation. We have seen progress in this area with the requirement for local Mitigation Plans, but without funding, the plans are difficult, if not impossible, to implement.

In addition, we must be smarter about developing in high-risk areas. Through the National Flood Insurance Program, the Federal Government spends a tremendous amount of money on repetitive-loss properties. These are properties that are in flood prone areas, and we continually pay to repair these structures, to the point that it would be more cost effective to just acquire and demolish them.

3. DEVELOP A MEDICAL EVACUATION PROGRAM

One of the biggest unsolved problems facing coastal communities is our inability to adequately manage what I refer to as the medical community evacuation. Horry County has numerous nursing homes, assisted living centers, hospitals, and bed-bound citizens in the potential evacuation zone. The resources just do not exist in the local area to conduct an evacuation of these citizens.

> We have been working on this issue since Hurricane Bertha in July 1996, and despite efforts to address this concern, I believe we are still not capable of implementing a full evacuation of the medical community. In the event of an evacuation such as the one caused by Hurricane Floyd in 1999, would put us in the position of probably leaving some of our most vulnerable citizens in the evacuation zone during a major hurricane.

Since Hurricane Hugo hit in September of 1989, South Carolina has made tremendous progress in preparing for the next major hurricane. I am impressed by the dedication of the government agencies and the private organizations that work together in this effort. However, I have seen the impact that a storm can have on communities. Repairing the community's infrastructure is an obvious goal of local government, but until the business community is restored, recovery is not complete. Many times, this is a neglected component of the process.

In addition, I have been with families that have had their homes and lives destroyed by the impact of major storms. Walking through a house that has been flooded 6′ of water, you realize the devastation that occurs, both to the structure and the family's emotions. Even when we have been able to assist them in rebuilding, I can't help thinking that prevention is a better solution.

I learned many years ago that land-falling hurricanes have predictable consequences, and predictable is preventable. We must strive to ensure a teamwork approach, including the Federal Government, state government, local governments, private agencies and individual citizens. This teamwork effort must focus on the entire cycle of disaster, with an emphasis on mitigation.

Thank you for coming here today and providing the opportunity to hear these issues and concerns.

Senator DEMINT. You can count on the questions. We'll get to that after Mr. Gandy's testimony.

STATEMENT OF JIM GANDY, CHIEF METEOROLOGIST, WLTX–TV, COLUMBIA, SC

Mr. GANDY. Well, thank you very much, Mr. Chairman. And thank you for inviting me to address this hearing.

I'm Jim Gandy, and I'm the Chief Meteorologist at WLTX in Columbia, South Carolina. I've been a professional meteorologist for 30 years. I've been here in South Carolina for 21 years, so I've seen a few hurricanes hit the coast of our state.

I want to say that, first of all, I'm really encouraged by what South Carolina has done. It has learned some hard lessons, and it has taken steps to address what has been learned. And you've already heard quite a bit from these gentlemen here. And I want to say that here in South Carolina we're very fortunate to have a facility doing the research that's being done at Clemson University. And what the state has been doing to address some of the problems is admirable. We've learned some lessons. And I think what I'll probably end up doing is summarizing what you have already heard from these gentlemen.

But let me just say that I was here during Hurricane Hugo, and there were some lessons to be learned from Hurricane Hugo. There is a critical need to address communications after the storm has passed. Hugo wiped out phone service. And if another hurricane of that nature hits our coast, it's going to wipe out phone service and wireless communications. It's going to be difficult for the state agencies to communicate. So, that's something that needs to be done at both the state and local level.

Also, there is a frustration, not only from Hugo, but from just about every hurricane that we encounter, with evacuations. That's something that's going to have to be addressed.

From the public perspective, the most important information I keep hearing from the public is the extent of the damage. Now, the officials are the first to go into the damaged area. So, the earliest assessment that we can get of the damage needs to be communicated to the public, because they're sitting, waiting to go back, and they want to know. They need to know what the dangers are if they do go back. And they need a reasonable estimate as to when they can return to their property. That's a real frustration I hear from the general public, "When can I go back?" And I understand the pressures on public officials to tell them that. And it's hard sometimes to assess what the damage is and how soon people can safely go back into their communities.

The basic infrastructure needs to be restored as soon as possible after the storm, because when people go back, they're going to need food, they're going to need water. That needs to be addressed.

And building codes need to be strengthened in all coastal communities. Much of the damage to homes and property comes from flying debris, so whatever we can do to reduce flying debris is going to help reduce the damage that's experienced by buildings.

Let me make a few comments about some of the lessons that we learned from Hurricane Floyd.

Floyd turned out to be the largest peacetime evacuation in U.S. history. Close to three million people were evacuated during Floyd. And here in Myrtle Beach—being in Columbia, I heard the details of that evacuation. And during Floyd it was taking people 14 to 15 hours to drive from Myrtle Beach to Columbia, which is normally about a three-hour drive, or a little bit less.

There is a need for lane reversals, and it needs to become effective as soon as the mandatory order is issued. There is a need to coordinate those evacuations with other states, because one of the problems with Floyd, people were evacuating into future evacuation zones, making that evacuation even more difficult.

A plan needs to be established to make sure that there is enough fuel available for people to make the trip inland. The best example of that was Interstate 16 in Georgia, going west from Savannah. There is not a lot there. But the Interstate became gridlocked. People were running out of fuel, and the Interstate was essentially becoming a parking lot. So, that's something that we need to address.

People need better information about where to go for shelters. Shelters are available. The problem is trying to get that information to the public. And I think that's where not only local officials can help us, but the media needs to be better at communicating that information. And we can do that.

Television is changing. It's no longer television meteorologists you're looking at; we're true broadcast meteorologists. We now broadcast on many different platforms—television, cable, telephone, radio, and now wireless communications. In Columbia, we're the first TV station to have our website available to those who've got PDAs. And that's where we can broadcast a lot of information. Because if you take a look at the evacuation plan here in South Carolina, those people are moving from the coast, they're heading toward the central part of the state. It's all focused on Columbia. And when we can broadcast to those people evacuating where those shelters are, that, I think, will be a big benefit.

This is a problem that I have, personally. Senior citizens, those in assisted-living areas and residents of nursing homes, they need to be evacuated before the warning is issued. And the reason for that is because they're the last people who need to be sitting in traffic. So, my recommendation is that they be evacuated during a hurricane watch, which is usually issued about 36 hours before hurricane conditions are expected. That's a tough call, but it's something that needs to be done.

Other lessons. You've heard about South Carolina's plan for lane reversals, and the current one was developed under the auspices of Governor Mark Sanford, and I applaud the effort. It looks good, and I think it will work. And I think we've done the right thing here in South Carolina. The authority for those lane reversals rests with the Governor's office. In Louisiana, it does not. And that problem was accentuated during Hurricane Ivan. The authority for lane reversals comes from the local parishes. The problem is, it has to be coordinated with the state police. It was not, during Hurricane Ivan. And when the mandatory evacuation order was given for New Orleans, it resulted in gridlock. The order was given and made at 7:30 in the morning. The lane reversals were not implemented until the middle of the afternoon. New Orleans, having over a million people, you can imagine what the roads were like, trying to get out of New Orleans. So, that's something that we need to address.

Hurricane Andrew and Hurricane Charley have something in common. They highlighted the need to strengthen building codes. We are all familiar with the damage that Hurricane Andrew did. What it did was, it highlighted the need to strengthen the building codes. What Hurricane Charley did was, showed us the benefit—and you just saw an example of that—of the manufactured home that survived a hit by Hurricane Charley. Now, we may not be able to prevent all of the damage, like Andrew. Andrew was just a very powerful storm. But that's rare. A storm like Charley is probably more likely. And if we can survive those storms, we can greatly reduce the damage that's caused by these storms. And so, the message is clear, I think, from Charley, that if you can reduce the amount of flying debris, there's a greater chance of reducing the damage.

We just completed doing a study. We just rewrote our hurricane plan at our TV station. One of the things that we found, which was kind of interesting, there are now—in just the Census figures—from 1970 to the year 2000, the population of coastal South Carolina grew by more than 70 percent. There are now more than a million people living on the coast of South Carolina. That's as many people that live in the coast of Georgia and North Carolina, combined. So, we've seen a tremendous growth in the population.

On top of that, on any given weekend before Labor Day, the population of coastal South Carolina is two to three times that. You're looking at two to three million people along the coast of South Carolina.

Our worst nightmare is going to be a storm that approaches before Labor Day. After Labor Day, it's not as bad, because a lot of people have ended their vacations and kids are at school, so you don't have quite the problem after Labor Day that you do before Labor Day.

So, I'm going to accentuate your remark by saying that there is a critical need for some kind of Interstate system that connects the Grand Strand with Florence and I–20 so we can get people out. And that's in addition to what we already have to get people out of the Grand Strand.

One comment that I'd like to make concerning global warming. We know that that is taking place. Exactly how it's going to manifest itself is difficult, but we do know that sea level is rising. That's going to affect coastal communities. More importantly, new research has just come to light—and I was just exposed to this last week when I was in Washington, D.C.—and that research indicates that, by the middle part of this century, major hurricanes could be stronger because of the warming of ocean waters, so that what you're looking at is: a major hurricane, when it occurs, is more likely to be stronger than the major hurricanes that we're seeing hitting today. A good example of that would be Hurricane Hugo, where the maximum sustained wind was estimated at 138 miles-per-hour. That same type storm hitting in the middle part of this century is more likely to have winds of 150 miles-per-hour. So, that's something we need to plan for in the future.

And, finally, let me just say that we do a pretty good job on radio, but we could do better. State and local agencies need to work with the media. We are the eyes and the ears for the public and whatever information that can come our way is generally broadcasted very quickly. We're a very efficient way of getting information to the public. And any kind of partnership that could be strengthened, I think, is going to be done in trying to make these evacuations smooth.

Thank you, again, for allowing me to——

Senator DEMINT. Thank you, Mr. Gandy.

[The prepared statement of Mr. Gandy follows:]

PREPARED STATEMENT OF JIM GANDY, CHIEF METEOROLOGIST, WLTX–TV, COLUMBIA, SC

I am Jim Gandy, Chief Meteorologist at News19 WLTX in Columbia, South Carolina. I have been a professional meteorologist for 30 years and have worked in Columbia for 21 years. My experience with hurricanes dates back to my childhood in Florida which was one of the reasons I became a meteorologist. I have worked tirelessly as a meteorologist trying to inform and prepare the public about hurricanes for many years.

I want to thank Senator Jim DeMint and the Committee, for inviting me to testify before you today. I hope that the comments that I make will be useful in helping improve preparation for hurricanes along our coast. Further, I wish to state that the testimony I am about to give reflect my opinions and are not necessarily the views of WLTX Television.

Let me begin by saying that most communities recognize the danger posed by hurricanes. Most have done an effective job preparing for such events and executing their plans. However, we continue to learn as each storm presents unique dangers.

SOME LESSONS FROM HURRICANE HUGO

No other storm affected South Carolina in the Twentieth Century like Hurricane Hugo. It was the strongest hurricane to strike the state since 1893 which produced over 2,000 fatalities in the low country of South Carolina. The state and communities were poorly prepared to deal with destruction on such a large scale. It took years to recover from the experience. It is a fact that a similar storm will strike the state in the future and there are some lessons to be learned from Hugo:

1. There is a critical need to address communications in the aftermath of such a storm. Phone service was completely eliminated after Hugo. Only ham opera-

tors were functioning and they provided the critical communications link in the storm's aftermath. Today that would extend to wireless communications as well. A major hurricane is likely to disrupt phone service, cable service, and wireless communications. The forms of communications that are most likely to survive would be ham operators and satellite phones. Therefore, it is imperative that local and state agencies have access to multiple communications platforms. Redundancy is critical to making sure some form of communication survives.

2. A frustration expressed by evacuees during Hugo was the lack of communication between officials and the public. There were many complaints that authorities were not passing along any information. Thus, a public information office needs to be established at either the state or local level to quickly pass information to the media and public. Evacuees are patient when they have information, but they become restless with a lack of information. The most important information to communicate to the public is the extent of damage, the dangers that might be present, and a reasonable estimate as to when they can return to their property.

3. The basic infrastructure needs to be restored as soon as possible after the storm. People returning to their property will need access to food and water quickly to begin the rebuilding effort.

4. Building codes need to be strengthened in all coastal communities. Much of the damage to homes and property comes from flying debris. This is often the result of a building disintegrating in the face of strong winds. The State of Florida seems to be the farthest along in light of Hurricane Andrew and the hurricanes in 2004.

SOME LESSONS FROM HURRICANE FLOYD

Hurricane Floyd resulted in the largest peacetime evacuation in U.S. history. More than 3 million residents fled their homes due to the potential danger from this storm. The experience was an unpleasant one for many who ultimately did not need to evacuate. Many tell stories of it taking 14 to 15 hours to travel from Myrtle Beach to Columbia. This is normally a 3 hour trip or less. Of the lessons learned from Floyd these include:

1. There is a need for lane reversals to become effective as soon as the mandatory evacuation is ordered. This usually occurs when the National Hurricane Center issues a hurricane warning. States need to prepare to implement the lane reversals as soon as the hurricane watch is issued or 12 hours before the need for mandatory evacuation. People will hesitate to evacuate if it takes 15 hours to make what is normally a 3 hour trip.

2. There is a great need to coordinate evacuations with other states. This is in an effort to avoid evacuating into other evacuation zones. This problem aggravated the evacuations during Floyd causing even longer delays.

3. A plan must be established to make sure there is enough fuel available for people to make the trip inland. Sections of Interstate 16 in Georgia became a parking lot because stations were running out of gas.

4. People need better information on where to go to take shelter. This lack of information often leads to evacuees traveling much longer distances than needed to escape the storm. The media needs better and timelier information on which shelters are open and where they are located. Wireless communications now permit this information to be communicated even when people are not near a television.

5. Senior citizens, those in assisted living areas, and residents of nursing homes need to be evacuated during a hurricane watch. Many of these people may encounter undue hardships if caught in the normal evacuation delays. These people are more likely to need medical help during an emergency.

OTHER LESSONS FOR SOUTH CAROLINA

The State of South Carolina now has a detailed plan for lane reversals and the procedures for implementing the plan. This was done as a result of Hurricane Floyd as the request of Governor Mark Sanford. The plan is comprehensive, flexible, and relatively quick to execute. Furthermore, the authority to execute the plan rests solely with the Governor's office.

The importance of where to place the authority was highlighted during Hurricane Ivan in 2004. Louisiana gave the authority to order lane reversals to the individual parishes. The order was given in Hurricane Ivan, but it was not coordinated with the state police. This resulted in a massive traffic jam in New Orleans when the

mandatory evacuation order was given. It took more than 12 hours for the situation to improve. There were two fatalities in this evacuation and numerous complaints about the delays. These delays were often too great for the elderly trying to evacuate.

South Carolina's plan has been tested in mock simulations, but it has yet to be tested in real-time. I believe that it will test well and that it will ease the delays of a mandatory evacuation. It is my opinion that the State of South Carolina is on the right track. If it has flaws, these may not become apparent until reality strikes. However, the plan will not fail from lack of trying.

Hurricane Andrew and Hurricane Charley highlighted the need for South Carolina to strengthen its building codes. Both of these hurricanes hit Florida, but they showed what needed to be done and what can be done.

Most structures were completely destroyed when Hurricane Andrew struck south Florida in 1992. The resulting surveys convinced the state to strengthen its building codes particularly with respect to manufactured housing. The new standards took effect in 1994 and were put to the test 10 years later.

Hurricane Charley roared through Punta Gorda in 2004. The manufactured homes built before 1994 were often completely destroyed or heavily damaged. Meanwhile, the post-1994 homes suffered minor damage except in cases where they were hit by disintegrating mobile homes built to pre-1994 standards.

The message is clear. Any time you can reduce the amount of flying debris there is a greater chance of reducing the damage.

OTHER CONCERNS

The population along the South Carolina coast grew by more than 70 percent from 1970 to 2000. There are now more than one million residents in the coastal counties of South Carolina. However, on any given weekend from Memorial Day through Labor Day there are some 2 to 3 million people enjoying our coasts. My worst nightmare is trying to evacuate in the face of a major hurricane through the Labor Day weekend. Any problems we have now would be greatly magnified.

Hilton Head and Charleston both have an Interstate exit to other Interstates. No such Interstate exists for the Grand Strand. The state has done the best it can under the circumstances. However, there is a critical need for an Interstate connecting the Grand Strand with Florence and Interstate 20.

There is also an increasing threat to coastal communities from global warming. Research indicates that by the middle of this century, sea levels will be higher and major hurricanes may be stronger.

The increase in sea level will come from several sources. As the waters of the Atlantic warm there will be a rise in sea level from thermal expansion. In addition, the melting of glaciers and the thinning of the polar ice will add to the rise of sea level. The sinking of some land areas near the coast will only add to the rise of sea level.

In addition to threats from the rise of sea level, the strength of major hurricanes may increase as the Atlantic waters warm. It has recently been demonstrated that the depth of warm waters impacts the strength of hurricanes. Hurricane Camille moved over a deep and very warm eddy as it approached the Gulf coast. The energy available from this warm pool helped create the giant it became.

Finally, state and local agencies need to work better with the media. The media becomes the eyes and ears for the public. It is the fastest means of communicating with the public and most versatile. Most television stations broadcast on many different platforms such as television, cable, Internet, radio, telephone, etc. These are the communication experts and they need to be used more effectively. This can be and should be done by better cooperation between the government agencies and media.

This concludes my remarks concerning the threat from hurricanes. I wish to again thank Senator DeMint and the Committee for allowing me to appear before you today.

Senator DEMINT. I want to ask a few questions. I'm thinking, like here in the Grand Strand, is it impossible for a hotel to be certified to withstand a Category 5 hurricane, and that if the preparations with water reserves, alternative power, would it not be even a good marketing tool for that hotel to be able to say, "We're evacuation-proof. You can stay here and watch the storm." And I suspect

that would require vinyl on glass, shatterproof, all that kind of stuff.

But I'm just wondering, just to start the discussion, should we build all of our preparation on the idea that we're going to evacuate, or can we, as Dr. Prevatt has suggested, through research and construction techniques, even come—have a scenario where if you're in one structure, you have to get out of here; but if you're in another one that has been certified, that you don't—which might create some—just market-force incentives for hotels and even residential areas, builders, to use research that's already existing, because, apparently, from the slide you showed, I mean, we know how to build a structure to withstand a storm, that it's just not done.

The cost of this is not just an advantage. Everyone who lives on the coast is paying a premium through their insurance, constantly. And those rates go up and up and up, raising the cost of living here, which I think is something we need to look at.

And so, I'd just like to start with the idea, is it possible to certify structures so that evacuation would not necessarily be the only means to keep people safe? And, Mr. Gandy, you apparently want to say something, so——

Mr. GANDY. I'm familiar with the South Carolina coast, and I think, here in the Grand Strand, the main focus there—and correct me if you disagree—but I think the main focus there, if we can get them out of the storm-surge area, then I think that's a really good idea. Because here in—along the Grand Strand, the storm surge is not going to be as great as, say, down in the Low Country. And let me give you—you're familiar with the situation out in the Low Country—Hilton Head, particularly. That may not work for Hilton Head, but it could probably work here in the Myrtle Beach area. And if a major hurricane—say a Category 4 or Category 5 hurricane—were to hit down there, the storm surge potentially could go all the way to I–95. Now, that's pretty far inland. And if Hurricane Hugo had hit Savannah instead of Charleston, Hilton Head Island would have been completely submerged.

So, I think, if we're going to do that, we need to look at particularly where the storm surge is going to be. And if you get them out of the storm surge, then I think you've done a good job.

Senator DEMINT. Yes, that would have to be part of the certification process——

Mr. GANDY. Yes.

Senator DEMINT.—I guess, but the——

Dr. Prevatt?

Dr. PREVATT. Senator DeMint, this is—the idea of evacuation for wind is something that has come from who knows where. You know, the primary reason was for storm surge. And wind is just—people sort of look at their neighbor and say, "Well, if you're evacuating, I'm evacuating, too," and everyone jumps in their cars and—you know, and I heard from the South Carolina emergency management people yesterday in Columbia that said people were evacuating not just one car, but they were evacuating two and three cars and the boat. They wanted to get everything out of harm's way.

[Laughter.]

Dr. PREVATT. Now, one of the things, I think, why certified buildings would be a very good idea is, looking at the Florida experience, based on the work that Florida DCA and RCMP are doing with their windfall insurance money funding, I think, in addition to improving the safety of the buildings in Florida, it is an additional marketing tool that perhaps Mr. Dean might want to consider. At some point, Florida may be able to state categorically that, "This building and this residential community, this resort, is certified for a Category 5. Why not vacation here instead of other places?" And that is certainly something that I can see using as a marketing tool.

Senator DEMINT. Myrtle Beach could use that against the Low Country.

[Laughter.]

Senator DEMINT. "Vacation here. We're evacuation-free."

Dr. PREVATT. But, you know, and I think of it even in terms of the question of evacuation of hospitals and those nursing homes, that, yes, I may have outlying buildings that I say there are critically ill people that do not need to be there. They can move to a more sturdily constructed building. And instead of staying on the ground floor, if you have sufficient power, you go up. You do vertical evacuation, come away from the windows. I have looked at studies for the Medical University of South Carolina recently in which they wished to upgrade a few of their major facilities that aren't duplicated in other areas of the state, and they say, "These things need to be here. We're not going to move someone on kidney dialysis machines and put them in a car or in an ambulance." You know?

And so, yes, there are things that we can do. For instance, if I look at hotels around here, one might consider impact-resistant glass or a film on your glass to improve that strength. And one would use more durable materials in your exterior wall systems. It's typical to use EIFS, but they don't work very well in wind conditions. You know?

But these things certainly, I believe, we can design it. It's a question of, Do we want to pay for it? And encouraging people, everybody, that you need to pay for these up front——

Senator DEMINT. Let me ask, because you mentioned more research dollars, which sounds clearly like there may be some opportunity. But it doesn't appear that the market is using the research that's available today. I mean, if we've got things we know we can do in construction that can virtually make a home hurricane-proof, that doesn't seem to be—at least I don't see that as something that's going on, to any large degree. Is that not true, or, I mean——

UNIDENTIFIED PANELIST. It's more cost than anything.

Senator DEMINT. Yes.

Mr. Dean, do you see that here, that folks are building to a certain code?

Mr. DEAN. Yes, Mr. Chairman. And I think your point's very well taken. There is information that's nice to know, there's information you need to know. And, in this particular case—and I think the Doctor indicated earlier—the research that is being done would certainly enhance improvements, but, from the perspective of a home builder or, particularly, a business along the coast, if it's a foregone

conclusion that during a certain level of storm you're going to evacuate, and if your insurance rates don't necessarily distinguish between benefits of having such or not—and they don't always do it—then it becomes an issue of, Is it really advantageous to do so?

Now, turn that around from a problem into an opportunity, to your previous question. If, in fact, a certain level of code could prevent a resort from having to evacuate in a storm, where the storm surge is not going to be an issue for that particular area, and if it did provide incentives, now there would be an incentive to do that. And, to your point earlier, it would become very marketable.

So, I think the answer to your question is that the information is being used, but it's not advantageous such to the point that businesses need to——

Senator DEMINT. Well, maybe if insurance companies don't recognize it, property taxes could. So, you could look locally—I think that Mr. Cantore may have been the one that mentioned that most of the deaths are from flooding when people are moving around, not necessarily from in a structure. Am I right, or is——

Mr. CANTORE. Well, inland flooding.

Senator DEMINT. Yes.

Mr. CANTORE. Whether it be the mountains of North Carolina, with Frances and Ivan, you know, where they had 30 inches of rain. You know, you take a system that's supposed to be in the tropics, and you put it over the mid-latitudes or in the United States, and you can have some big problems with flooding. And that is—you know, we get people away from the coast. We get them out of the storm-surge zones. But we just have to make sure we don't put them in an area that can flood, or a low-lying area. That was my big concern.

Senator DEMINT. What would have to take place, Mr. Whitten—and you mentioned, certainly the elderly, those who are in a medical situation—if you're going to have someone in a retirement home, assisted living, some kind of medical building, it has to be in a certified Category 5 storm or you can't do it. I mean, does it make sense to continue to allow people to open and put folks in these homes if we know that, practically, we're not going to be able to evacuate and that they are not safe at storm levels?

Mr. WHITTEN. Well, and I think you're hitting the exact issue. And I'm going to give you a little bit more detailed answer. The evacuation zones in South Carolina are built exclusively on the hurricane surge. They're not wind-based at all. They are all hurricane surge. And based on some of the data you've heard about, the inability to adequately or accurately forecast intensity, we have to take some allowances for that.

The reality is, we have some nursing homes that are very well built. I believe they have taken those extra steps to increase the strength that their building can withstand a wind event. But if they're in the surge zone, then they still need to evacuate.

Senator DEMINT. Even with the vertical evacuation idea that Dr. Prevatt mentioned?

Mr. WHITTEN. Well, the problem is, the existing ones—most of our existing ones are single-floor.

Senator DEMINT. Right.

Mr. WHITTEN. And the other thing that I am—I would like to throw in the conversation is, we talk about that structure being able to survive a storm, but the Governor has got to be able to provide infrastructure. If I can't get you clean water, sewer, I can't get you electricity or telephone service, you're okay, you've survived, and your structure might be fine, but you've got a problem about living. We've seen, after storms, especially on the coast where you have the surge, you see roads that get washed out. And that was a big issue in Folly Beach after Hurricane Hugo, and some other places. The road washes out from underneath, so it's unsafe. If I can't deliver public safety—if I can't get ambulances and cops and fire trucks around, you might be down there, but, if you have an emergency, I can't get to you. And that's a basic obligation of local government. And so, from my perspective, I'd rather you not be in that position, because what happens, if you come out, your house is fine, but the community has got a lot of problems and you get hurt, we're committing a lot of resources trying to get aid to you.

Senator DEMINT. Well, again, this—following this line of questioning—and it may be a question of a paradigm of evacuation—and rather than the millions of dollars of moving people out and ultimately moving people where they don't even know where they're going, could it—would it not be possible to have enough areas designated that may be able to have reserve water supplies, reserve power, that, even if the roads were out within a half a mile of almost every resident, there was—there could be sources of support? Knowing that nothing is perfect, but, given the fact that people moving along the highways, running out of gas, elderly people being evacuated—would it not be at least a compatible or complementary strategy to look at building the capabilities to—for people to withstand the storm where they are, or near where they are, that they should move to a vertical evacuation building within a mile of their home, and if we had maybe 30 of those on the Grand Strand—I'm not sure, but I guess it's something we need to question.

Mr. WHITTEN. I think there's some value to that. And we even have worked with that. Max Mayfield has said, "You run from the water and you hide from the wind." And that's one of the things that we try to push when we have an evacuation, is, "This is the evacuation zone. You need to leave. If you're outside the zone, you take some adequate precautions that were discussed"—basically, you protect your windows, and you do some basic things—"we recommend you stay." Unfortunately, a lot of those people, who haven't been here, have never—are from an inland state, possibly—they don't even want to risk it, so they add to that congestion on the road.

Senator DEMINT. We also have mandatory evacuations and that even—I know it happened to me last year. I ended up down here two days, and then I was—at least the Governor said I had to leave.

[Laughter.]

Senator DEMINT. And I probably should have called and asked if that really applied to everybody, so, it is a confusing message. If you might have a situation where you're actually safer staying if you're outside the surge——

But let me ask a question just about construction. I know I saw some pictures of a high-rise condo project on the Gulf, and one of the storms that came through, that we would have assumed that this structure could have withstood it in any hurricane, yet the surge, the water, worked its way under the foundation, since it was in a sandy foundation, and this whole thing collapsed. I mean, fortunately, the people had gone. But, as I look down the coast here, I would assume that a storm came through, all these large buildings would be okay. Do any of us have any idea if these are built with a foundation that could withstand that kind of undermining? Do we know that?

Dr. PREVATT. My sense is yes. But, with certainty, I can't say that. But the experience has been that engineered structures like the high- or mid-rise buildings do, in fact, perform satisfactorily during any hurricane that we have survived. That one was certainly a unique case.

But the idea—or the problem, should I say, with those buildings primarily is the wall-cladding, the roofing systems, and the windows that get damaged. Once those things fail, a lot of water and wind enter the structures, and that, in fact, can cause more damage than the——

Senator DEMINT. Well, we know how to put roofs on homes and buildings that could withstand, and we know how to develop shatterproof glass. I guess the question is, we're just not really using them——

Dr. PREVATT. Because——

Senator DEMINT.—So we have to evacuate.

Dr. PREVATT.—because we are not willing to pay for it up front. We prefer to wait until after the event and get the post-hurricane money, as opposed to the pre-hurricane retrofit.

Senator DEMINT. And I guess the incentives, as Mr. Dean has suggested, that insurance costs do not really reflect any kind of expense that will make these virtually hurricane-proof. So I guess it is easier to say, "Well, we'll just let the insurance pay for it." But the economic impact of that, as well as, I think, the potential safety problems of putting that many people on the road, is enough for me to at least question if evacuation is the best primary strategy.

Mr. DEAN. I think, Mr. Chairman, because evacuations are a foregone conclusion in so many situations, that we really haven't incentivized that. Clearly, our collective mothers' advice that an ounce of prevention is worth a pound of cure would enable a healthy discussion to evaluate, is there a better way to approach it? I think the recent construction on the Grand Strand has certainly addressed some of those concerns that you've alluded to, but there are older properties that, when they were built, we didn't know the information we have today.

Senator DEMINT. Right.

Mr. DEAN. And I suggest, as we continue to grow and develop, not only along the coast of South Carolina, but the coast of the Southeastern United States, more and more of this information would be used, and, if used as an incentive to advantageously approach this, I think you would find, not only a lot of support amongst residents and businesses, but also local and state government.

Senator DEMINT. I see, I guess, some construction holes, and I assume this is being built to accommodate a certain level of surge so that we assume those structures might make it through a storm.

Well, I could keep this questioning going for a long time, because I think we're kind of onto something that we need to explore a little more. And I do think the research and the possible incentives for construction alternatives to evacuation and perhaps certain types of restrictions that might suggest that if you're building medical facilities, that if they need to withstand the surge where they are, and a lot of that we could do.

Before—I need to wrap up pretty quickly, but I want to make sure that none of you have a quick comment that you want to make based on other things that have been said. We really don't have time for another five minutes, but just an observation or something that you'd like to make sure we carry back. I mean, you've all come a long way, which I greatly appreciate. It has been, I think, incredibly good information to help us develop a consensus of some ideas. But a few comments.

Yes, sir?

Mr. DEAN. Mr. Chairman, again, thank you for holding this hearing here and for taking the time to be with us. Thank you, to the other panelists. And we appreciate your interest in this issue that is so important, not only to the Grand Strand, but to the entire coast of the United States.

I would also be remiss, Mr. Chairman, if I did not thank you and your counterparts in the South Carolina Congressional Delegation for your efforts to improve the infrastructure. It has been touched on here today, but we all know that Interstate 73 will not only bring job growth, it will eventually save lives. And though that is not a part of this committee, your efforts as part of the Environment and Public Works Committee certainly give us hope that the infrastructure in South Carolina will dramatically improve in the near future, and that ultimately will improve the safety of our residents.

Again, we thank you for your interest in this. It's very important to the coast of South Carolina and other areas, and we appreciate your leadership in such matters.

Senator DEMINT. Anything else?

Mr. CANTORE. Mr. Chairman, in 1900 we lost approximately 8,000 people in Galveston because we didn't leave the beach. People underestimate the power of water. It weighs 60 pounds a cubic foot. That's when it's not moving. You know, I think there are some great ideas about getting people out of harm's way, but to be anywhere close to a surge where we are basically cutting off people, masses of people and buildings, is a dangerous proposition.

Senator DEMINT. I think that's a good thought. It would be a good warning to have. I think that the difference between water and wind is probably an important distinction.

Dr. PREVATT. Mr. Chairman, I think the research community is doing all it can. You know, I have my vehicles ready, and we are ready. We're doing the reverse evacuation in every single hurricane to collect the data that people will need to develop better buildings.

More importantly, I think it is important for the engineering researchers, the civics facilities, as well as the emergency managers

to speak to each other, to develop the right mix of research, building code, and policy that would provide those incentives for changing the way we build. We chose to use plywood instead of plank roofing. You're right. We chose to build weaker houses. We can choose to go the other direction.

UNIDENTIFIED PANELIST. Absolutely.

Mr. WHITTEN. Right.

Senator DEMINT. Thank you.

I want to do something—Mr. Whitten, you may want to say something, but I want to say something about you. I'd like to make a little presentation. Mr. Whitten, if you would come around here.

One of the things we're doing on our tour around the state during our August break is to recognize people, organizations, and governments, who are helping move South Carolina forward. And the disaster preparedness here in Horry County and the technology that has been used has been recognized, really, all over the country. The progress that you're making, is one way we think is moving South Carolina forward. And so much of what we talk about in politics and in the news is often negative or some kind of disaster that's coming through. We don't talk enough about the good things that are happening and the progress we're making.

And so, this South Carolina "On the Move Award" is awarded to Horry County for the Emergency Preparedness Division. And, Mr. Whitten, I'd like you to accept it on behalf of all of Horry County.

[Applause.]

Senator DEMINT. I appreciate all of the witnesses who appeared today. I promise you, we'll use every bit of information you've given me. And it's certainly a lot of insight into what we need to do to move this forward. So, I can't thank you enough, and, all of you who came and sat through this, I appreciate it.

And so, this hearing is officially over. Thank you.

[Whereupon, at 10:18 a.m., the hearing was adjourned.]

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