STORM WARNING

UF ENGINEERS ARE HELPING TO MORE ACCURATELY PREDICT HURRICANES' DESTRUCTIVE FORCES

BY AARON HOOVER

Hurricane forecasting has come a long way since the days when killer storms blindsided coastal residents. Thanks to new research and new technologies, one day in the not-too-distant future, residents may get advance warning not only of a hurricane's projected track but also its wind speeds when it reaches their street and the damage it may inflict on their neighborhoods.

New predictive maps will give emergency managers a street-by-street idea of where to evacuate first, and insurance companies an advance preview of where to concentrate their adjusters. Days before the first storm cloud darkens the sky, cities may already have an estimated damage figure, and maybe even a federal aid application in the works.

The data that will go into these new maps and models are being assembled by federal labs, research institutes and universities, including the University of Florida. In a project as likely to influence building codes as hurricane damage modeling, UF civil engineers are working with engineers from Clemson University in South Carolina to gather the most complete data ever assembled on ground-level wind speeds — the kind that are most damaging to buildings. In a separate project, they're contributing to a publicly accessible, county-by-county and neighborhood-by-neighborhood model for hurricane-related insurance losses.

The research can be heavy on number crunching, but the ground-level wind project is anything but a desk job. To gather the data, the UF and Clemson engineers haul towers equipped with an array of monitoring equipment directly into a storm's path. The researchers have been chasing hurricanes with these towers since 1998, but they scored their greatest success with Hurricane Isabel, which smacked North Carolina Sept. 18, 2003.

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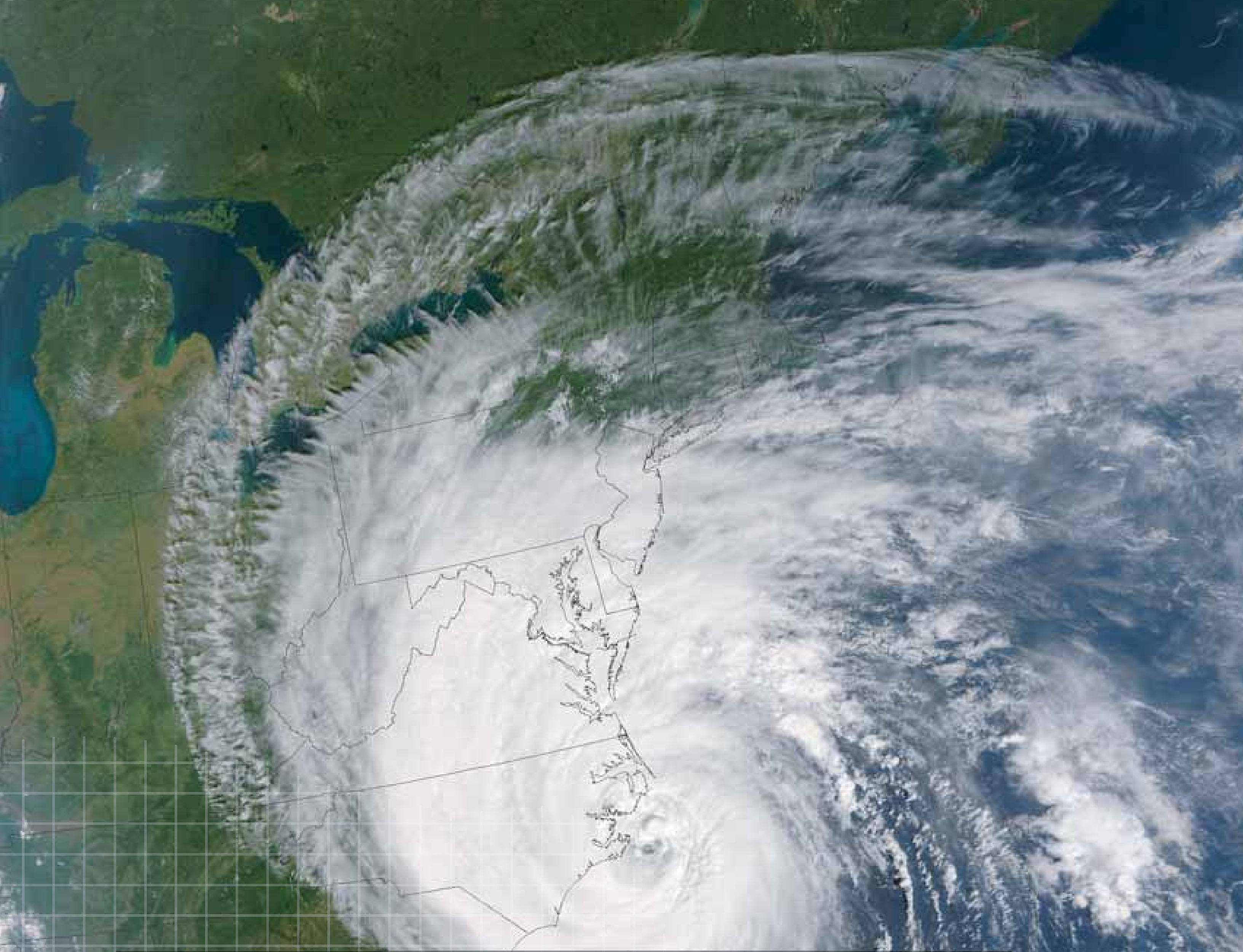

Charting the Storm

The eye of Hurricane Isabel makes landfall over eastern North Carolina.

Inset map shows Isabel's path as well as the location of information gathering sites.


Bryan Dick

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Days before the storm neared the United States, civil engineering doctoral student Forrest Masters had an inkling of what lay ahead. "I really felt this is a storm we were definitely going to chase," he recalls.

At first, Isabel looked like a behemoth, strengthening into a Category 5 storm, the most powerful in the Saffir-Simpson scale, in the mid-Atlantic. As it closed in on the United States mainland, however, it weakened, slowed and jogged toward North Carolina or points north.

Masters, 26, who has worked on the project since his undergraduate days and is a veteran of eight previous deployments, sprang into action. He and another graduate student, Luis Aponte, and six undergraduates loaded up the team's van and two trucks with water, food and equipment and hitched up the trailers holding the two wind towers.

Together with Kurt Gurley, associate professor of civil engineering and head of the project, the team left Gainesville for North Carolina late Monday afternoon, Sept. 15. A similar team, headed by Clemson civil engineering Professor Tim Reinhold, and also towing two trailers, departed Clemson about the same time.

Over the next 36 hours, the team scouted several locations for the towers, settling on a site in Wilmington and a state park in Atlantic Beach. The Clemson team deployed its towers at Frisco, near Cape Hatteras on the Outer Banks, and Elizabeth City, farther inland. They also installed measurement instruments on a Wilmington home.

Practice made the job of erecting the towers routine. Trained crews unfolded each tower from its trailer and erected it in fewer than 30 minutes. Once up, the 5,500-pound structures stand more than 33 feet high and serve as platforms for instruments measuring wind speed, wind direction, barometric pressure, humidity and rainfall. The towers are designed to withstand winds exceeding 200 miles per hour, conditions that would accompany a severe Category 5 storm.

When Isabel moved ashore on the Outer Banks early Thursday afternoon, members of the UF and Clemson teams were in motels in Wilmington. Masters and several members of the Clemson team were bunkered at a U.S. Coast Guard station in New Elizabeth north of the eye landfall.

Everyone was well out of harm's way — a priority of the project, Gurley says.

"It sounds exciting and exotic, but it's not like the movie *Twister* at all — it's not like we're watching cows fly by," Gurley says. "There are people who do take risks in hurricanes, but we're not in that category."

Although the researchers were safely hunkered down, they had a bird's eye view of the storm thanks to a new real-time reporting system Masters developed that worked better than anyone anticipated.

Hurricane trackers rely primarily on data collected from devices dropped from airplanes called dropsondes, as well as onshore and offshore weather monitoring stations, radar and other systems. But the delay between when the data are gathered from these devices and when they become available can be substantial. For example, the fastest ground-based weather monitoring stations upload information once hourly. When conditions get rough, monitoring stations also sometimes fail as a result of damage from debris or power loss.

To overcome the delays and potential breakdowns, Masters linked the weather-monitoring devices on each tower with a laptop computer and a cellular phone. Every 15 minutes, the laptop connected to the Internet through the cell phone and uploaded "high resolution" data summarizing wind speeds, wind directions and other measurements.

Safe in their rooms, the UF team surfed to a web site to monitor the deterioration of conditions as Isabel came ashore. They were pleased to discover columns of flawless numbers flowing from the towers. Among other things, the data revealed the highest wind speed (101 miles per hour) ever recorded by the team.

Team members weren't the only impressed viewers. Officials at the National Oceanographic and Atmospheric Administration, or NOAA, and the National Hurricane Center also tapped into the Web site and used the data to create an experimental wind map. In fact, at one point during the peak of the storm, the UF towers were the only monitoring stations that remained functional, said Reinhold, the Clemson professor.

Mark Powell, a Miami-based NOAA atmospheric scientist, says the UF data made the map, called H*Wind, the most accurate real-time map ever created of an approaching hurricane's wind speeds and forces.

"We've never had high-quality information like this actually during an event," Powell says "It was just incredible how well these towers worked."

The Federal Emergency Management Agency uses information from the H*Wind map to estimate the types of structural damage that may result from hurricane wind damage. Thanks to the data from the towers, NOAA was able to provide timely advance projections of peak wind velocities in numerous population centers along Isabel's path. Since FEMA has an inventory of the structures along each track, it was able to project damage with greater accuracy.

But the real-time data is only the first way the information the towers collected will prove useful.

More than a month after Isabel, the team was still crunching the hundreds of thousands of pieces of data recorded by the towers. Because the towers were situated just north and south of where Isabel's eye made landfall, the data is proving quite comprehensive. By filling a longstanding knowledge gap about hurricane wind speeds and forces near the ground, the information could highlight weaknesses in current codes aimed at protecting buildings in hurricanes.

That will be especially true when the information is merged with similar data from another part of the UF-Clemson project. The researchers have installed wind pressure sensors on more than thirty homes, mostly in Florida, that have been retrofitted to make them more hurricane worthy. The goal is both to determine the effectiveness of these retrofits and to gather data on how real hurricanes affect homes. Although researchers have only collected data on seven houses to date — none of it from storms that reached hurricane strength — Reinhold said the findings so far indicate there may be big differences in hurricane stresses on homes depending upon whether they are located in suburban, wooded or open settings. These differences could result in different building codes for different environments.

"We might have multiple sets of wind pressure coefficients, depending on the setting," he says.

Twin satellite towers at Wilmington and Nag's Head, meanwhile, will provide the first data on the width of hurricane gusts, a crucial figure when it comes to damage, Gurley says. "If a typical house is 50 feet long, and if a typical lateral gust of wind is 10 feet or 20 feet versus 100 feet, that tells us about how wind would affect the house in terms of causing damage," he says.

The result is especially powerful when combined with other hurricane research. For example, Gurley is working on a separate effort, sponsored by the Florida Department of Insurance,

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to create a publicly available model that predicts hurricane dollar damage in each of Florida's 67 counties. Gurley's role in the effort, led by Florida International University's International Hurricane Research Center, is to correlate wind speed to building damage, factoring in the type of construction used on the building. The end result will be a model that can predict losses, which helps state government officials better regulate insurance rates.

"The model will give the risk exposure for insurance companies A, B and C within the same zip code at three different values, depending on the types of structures they insure," Gurley says.

Once linked, the insurance, wind and other models could have a powerful impact.

"NOAA could say 'This is where the storm will go. This is the intensity; then, we could use the data sets we're collecting now to say, 'Given that info, this entire coastal region is subject to the following extreme cases of wind speeds, and given that the majority of homes along this part of the coast are timber frame or concrete block, then we can expect the following level of damage to occur,'" he says.

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Members of the UF-Clemson team brave harsh winds and rain to observe the hurricane.

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Costliest United States Hurricanes, 1900 — 2000

1	Andrew	1992	$34,954,825,000
2	Hugo	1989	$9,739,820,675
3	Agnes	1972	$8,602,500,000
4	Betsy	1965	$8,516,866,023
5	Camille	1969	$6,992,441,549
6	Diane	1955	$5,540,676,187
7	Frederic	1979	$4,965,327,332
8	Floyd	1999	$4,666,817,360
9	Unnamed	1938	$4,748,580,000
10	Fran	1996	$3,670,400,000

Source: National Hurricane Center

A screen shot shows the data collected by devices on the towers. This stream of data gave researchers a never-before-seen, real-time display of the forces exerted by Isabel on the area.