This Week

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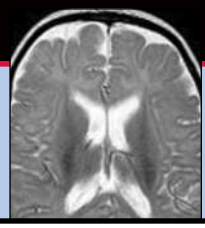
Japan's next-generation facilities



1662
The evolving brain

HURRICANE KATRINA

Scientists' Fears Come True as Hurricane Floods New Orleans

There are times when scientists would prefer to be wrong. Such was the case last week as Ivor van Heerden and other researchers reflected upon the devastation that Hurricane Katrina wrought on New Orleans and the Gulf Coast towns to the east. As director of Louisiana State University's Center for Public Health Impacts of Hurricanes, Van Heerden has since 2002 led a multidisciplinary team looking at what would happen if a major hurricane directly hit New Orleans. The center has studied everything from how the city would flood to how many people might ignore evacuation orders or be unable to flee—almost 1 in 4, they had estimated. "The sad part is that we called this 100%," says Van Heerden.

act upon them," says Rick Leuttich of the University of North Carolina, Chapel Hill, who has helped model how a hurricane could flood New Orleans. "We've had plenty of knowledge to know this was a disaster waiting to happen."

In one sense, Katrina, which left many researchers without homes and laboratories (see sidebar, p. 1657), was a rarity: Few hurricanes that powerful have struck the Gulf Coast in recorded history. At the same time, say hurricane experts, the storm contained few surprises. After speeding across south Florida as a category 1 hurricane, it reached the Gulf of Mexico and began converting energy from the warm, moist air into increased intensity. By Saturday, 27 August, Katrina was a category 3 storm—and still growing.

Timothy Olander, a tropical cyclone researcher at the University of Wisconsin, Madison, recalls waking up the next morning to see that Katrina's central air pressure had dropped from about 960 millibars to below 905 millibars. The storm was now a category 5 hurricane with winds topping 175 mph. "I thought, 'Holy cow. That's an amazing development.' You don't see that rapid intensification very often," he says. Katrina "became one of the strongest storms ever recorded in the Gulf of Mexico–Caribbean region." Two factors, says Olander's colleague James Kossin, fueled Katrina's growth: "phenomenally warm" waters in the gulf and a lack of strong, high-altitude winds that could have dispersed the storm's energy.

On Sunday morning, 28 August, thousands in New Orleans failed to pay heed to an evacuation order or couldn't leave. Although that shocked many, Van Heerden's center had recently polled 1000 randomly chosen New Orleans residents, using social workers to reach poor people, and had found that 21.4% would stay despite an order to leave, many of them because they lacked the means to escape.

Just before landfall, Katrina took a jog to the east, sparing New Orleans from the full force of the storm. Because of the way spinning storms interact with land, "hurricanes often wobble to the right as they come ashore," says meteorologist Hugh Willoughby of Florida International University (FIU) in Miami.

By landfall, Katrina had also shrunk to a category 4 storm. Scientists have a poor understanding of what regulates hurricane intensity, but Kossin and Willoughby note that some data indicate Katrina weakened because it had just undergone a phenomenon called eyewall replacement. The eyewall is the band of intense wind and clouds that forms around the hurricane's eye. Large storms sometimes develop an outer eyewall that starves the inner one of energy until it degrades. ▶

Katrina's wrath. These satellite pictures of New Orleans taken before (*left*) and after (*right and inset*) Hurricane Katrina give a sense of the flooding caused by breaks in the levees holding back Lake Pontchartrain in the north and the Mississippi River.

CREDITS: JEFF SCHMALTZ, MODIS LAND RAPID RESPONSE TEAM/GSFC/NASA; (INSET) NOAA

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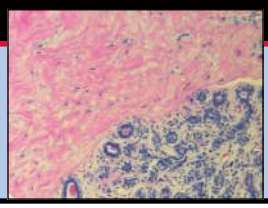
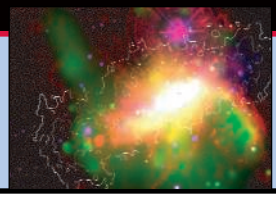
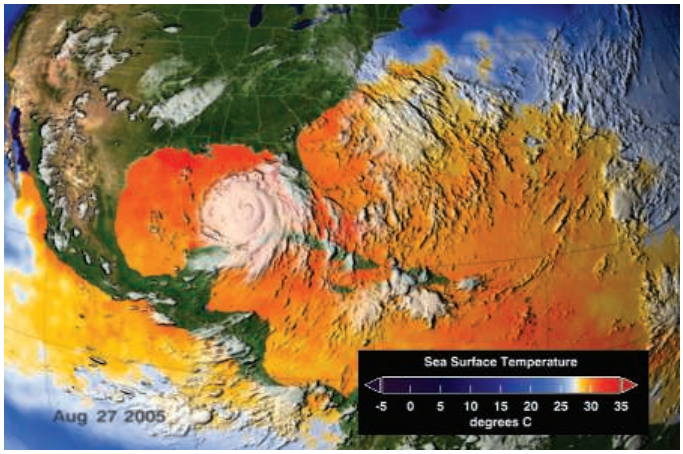




Katrina's wobble and weakening seemed at first to prevent what many have called the New Orleans "nightmare scenario." The city's main threat from hurricanes is a storm surge, the wall of water pushed onto land as the hurricane comes ashore. This surge can rise 8 meters or more as the water goes from deep water into shallow areas and then onto land. Because Atlantic hurricanes spin counterclockwise, the surge tends to be highest on their east side as the winds help any water moving north.

Because much of the city is below sea level, New Orleans is particularly vulnerable to a storm surge moving through the gulf and into Lake Pontchartrain. Over the past few decades, several computer models have shown how strong hurricanes on the right track could cause massive "overtopping" of the levees that, averaging almost 5 meters high, keep the lake from the city. The National Oceanic and Atmospheric Administration's (NOAA's) official storm surge model SLOSH (Sea, Lake, and Overland Surges from Hurricanes) was developed in the late 1960s, and Leuttich and several collaborators have created a more sophisticated model called ADCIRC (Advanced Circulation) that has been adopted by the Army Corps of Engineers and other groups. Last year, in an exercise simulating a direct hit by a slow-moving category 3 hurricane, both models showed that the levees would not prevent the flooding of New Orleans.



In hot water. As Katrina traveled through the Gulf of Mexico, unusually warm waters strengthened it into a monster hurricane.

According to these models, Katrina's storm surge should not have submerged the city. Joannes Westerink of the University of Notre Dame in Indiana, who helped develop ADCIRC, says it estimated that the southern shores of Lake Pontchartrain only rose about 3 meters during Katrina. (The various models estimate that the Mississippi coast received a peak storm surge of about 7 to 9 meters, which would be the highest in U.S. history.)

Instead of overtopping, the catastrophic collapse of several levees—ones that had been upgraded with a thick concrete wall—apparently sealed the city's fate. Stephen Leatherman, director of FIU's hurricane research center, suggests that the lake's raised levels may have increased water pressure to the point that water flowed through the earthen levees on which the concrete walls sat. "Then the whole thing collapses. This is how an earthen dam collapses during a flood," he says.

The devastation from Katrina may reignite interest in bolstering the wetlands south of New Orleans to provide more of a hurricane barrier. As a storm passes over, wetlands and barrier islands along the ▶

Riding Out the Storm

Immunologist Seth Pincus survived Hurricane Katrina, but much of his research may not. Evacuated from Louisiana State University Children's Hospital in New Orleans on Thursday, Pincus left hundreds of fragile blood and tissue samples—representing years of HIV and other infectious disease research—to an uncertain fate.

Pincus, 57, studies the interaction of antibodies and pathogens and directs the hospital's Research Institute for Children. Throughout the storm, he and several hundred other hospital employees stayed to look after 100 remaining patients, as well as research samples belonging to him and colleagues. "We probably held out the longest," Pincus says. "A lot of people in New Orleans wound up abandoning their work. I think every scientist there was worried about what's more important—my experiments or my life."

The low point came 2 days after the hurricane, Pincus says. The staff realized that the lack of clean water, combined with fears of looters, posed a health risk that would force them to abandon the hospital—and the hundreds of research mice and rats that they had managed to save. Rather than let the animals starve, dehydrate, or overheat, Pincus euthanized them with pentobarbital. Then he packed what he could into insulated containers, hoping to keep cell lines and microbial collections cold until they could be transported to Baton Rouge. "Everything I own and do is [normally] in the –80°C freezer and liquid-nitrogen tanks," Pincus says.

In the end, the staff didn't want to wait for the planned afternoon exit convoy and began to leave hours ahead of schedule. "It was so hectic and crazy," Pincus says. "We had to leave probably the most important specimens." Samples packed for the trip, but abandoned, may last for a week, he says. The freezer was still running on generator power when Pincus left—but will automatically shut off unless the New Orleans SWAT team using the building as a command center keeps it running.

Pincus plans to settle in at a temporary base for the Children's Hospital set up in Baton Rouge. Although the National Institutes of Health has extended grant deadlines for flood victims, he wonders how New Orleans researchers will stay competitive, with delays of months and the loss of research samples and animal colonies. Some colleagues, he says, may choose to go elsewhere. "That's the big concern for New Orleans: If we can't get back up and going within 2 to 3 months, anyone who can go anywhere else will."

Pincus tries to remain hopeful. "I may have to start all over again," he says. "But maybe this is an opportunity to take some novel approaches. In some ways, it may even be liberating."

–CAROLYN GRAMLING

CREDITS (TOP TO BOTTOM): NASA/SVS; SETH PINCUS

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coast sap its energy and reduce storm surge. By some estimates, however, up to 100 square kilometers of this buffer disappear each year, largely because the Mississippi River has been leveed and dammed so much that it deposits much less sediment onto the delta. (Katrina wiped out barrier islands herself.)

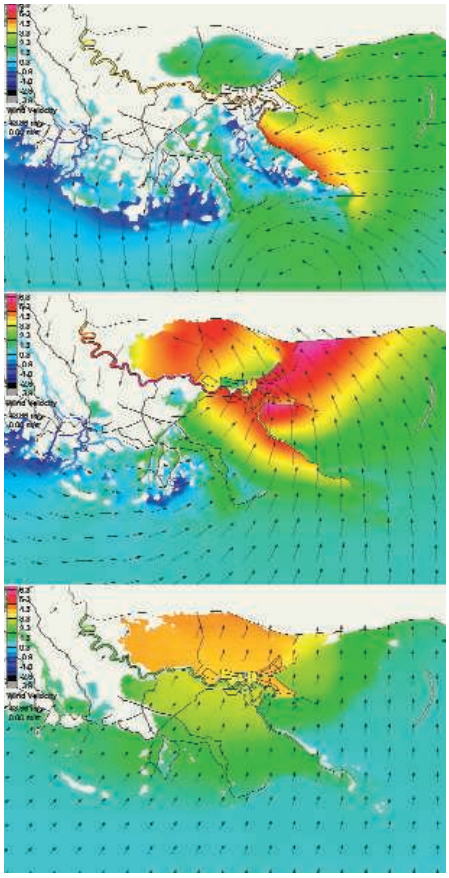
In 1998, a collection of state and federal agencies, including the Environmental Protection Agency and the Army Corps of Engineers, proposed Coast 2050, a $14 billion strategy to restore Louisiana's wetlands (*Science*, 15 September 2000, p. 1860). But the project never won federal funding and hasn't moved beyond the planning stage.

Any renewed debate over coastal restoration will likely have to await the long cleanup and recovery of New Orleans and the surrounding areas, a process that will take months, if not years. Among the research institutions bearing the brunt of Katrina were Tulane University, the University of New Orleans, and Xavier, all of which lost power to most of their campuses. The three universities have canceled their fall semesters and are still surveying damages.

The National Institutes of Health (NIH) has begun working with the medical schools of Louisiana State University and Tulane in New Orleans, which together have about 300 NIH grants totaling $130 million annually. NIH is trying to arrange for temporary lab space at other universities for research teams displaced by the flooding. "It's clear that the time to return to facilities that will be functional is undefined at this point," said NIH Director Elias Zerhouni. "We need to make provisions to continue their research and be able to support them during this interim period." NIH was also working to get generators and other support to help New Orleans–area researchers keep lab animals alive and samples cold.

Farther from the floodwaters, the picture is less bleak. The deluge from Lake Pontchartrain never reached Tulane's National Primate Research Center (TNPRC), situated on higher ground on the opposite side of the lake. Still, Katrina's winds caused extensive damage to the facilities, says Tom Gordon of Yerkes National Primate Research Center in Atlanta, Georgia, who was contacted by one of the TNPRC employees who stayed behind to care for the animals. "In the last days, [the center] took some extraordinary precautionary measures to do what they could," Gordon says.

Also weathering the storm were several major research facilities, including the Laser Interferometer Gravitational Wave Observatory at Livingston, Louisiana, and NASA's Stennis Space Center in Mississippi. Lockheed Martin's Michoud Assembly Facility in New Orleans, which builds the external fuel tanks for the space shuttle, suffered no injuries and only minor wind and roof damage, says June Malone, a spokesperson for NASA's Marshall Space Flight Center in Huntsville, Alabama.



CREDIT: J. WESTERINK/UNIVERSITY OF NOTRE DAME

Deadly surge. A computer model of a fictional category 3 hurricane shows how a storm surge moves from the gulf into Lake Pontchartrain and floods the New Orleans area.

The gulf itself may sustain damage from Katrina. Data are still coming in to NOAA, but two large oil spills from coastal storage facilities have been identified. "We would expect environmental impacts," says Tom Callahan of NOAA's Hazardous Materials Response division.

Katrina scuttled at least one major scientific meeting. The Interscience Conference on Antimicrobial Agents and Chemotherapy was scheduled for New Orleans later this month but will now take place in Washington, D.C., in December. Ironically, New Orleans was also going to host two major hurricane research conferences in the spring.

Even as the New Orleans region and its research institutions struggle to recover from Katrina, many are casting nervous eyes to the gulf. Hurricane season is far from over this year, and researchers say that the United States has entered a period that is likely to bring more major hurricane strikes. "That's scary," says Olander. "Who knows what else is on the way?" **–JOHN TRAVIS**

With reporting by Carolyn Gramling, Jocelyn Kaiser, Eli Kintisch, and Erik Stokstad.

ScienceScope

Committee: Nurture DOD Tissue Bank

An expert panel has recommended that the imperiled Armed Forces Institute of Pathology's (AFIP's) vast tissue bank stay in government hands and be given adequate resources.

AFIP in Washington, D.C., is being closed and its parts transferred as part of the latest round of base closings (*Science*, 2 September, p. 1472). A terse Department of Defense (DOD) recommendation to preserve the 3-million-case repository, however, sparked concerns that it would be mothballed without needed staff and expertise. At a conference last week in Washington, a 12-member panel chaired by former Stanford medical school dean David Korn concluded in a draft statement that the repository is in "excellent condition" and "should be maintained as a vibrant, living" resource and made more widely available to outside scientists. The U.S. government should retain ownership and provide adequate professional and technical staff, the panel said. Congress may need to enact statutory authority to carry out the panel's final recommendations, which were to go to DOD this week. **–JOCELYN KAISER**

Roberts's AIDS Memo Criticized

Supreme Court Chief Justice nominee John Roberts may find himself confronted during Senate hearings by a position he took about AIDS when he worked for President Ronald Reagan.

In a September 1985 memo about an upcoming presidential press conference, Roberts, then an associate counsel at the White House, advised Reagan not to take sides on the question of whether schoolchildren with AIDS could infect their classmates. Two weeks before Roberts wrote the memo, recommendations from what was then called the Centers for Disease Control said casual contact in schools "appears to pose no risk." But in the memo, Roberts called the question a "disputed scientific issue." Reagan apparently took his advice, saying "[M]edicine has not come forth unequivocally and said, 'This we know for a fact, that it is safe.' "

Representative Henry Waxman (D–CA) highlighted and assailed the memo in a 1 September letter to senators Arlen Specter (R–PA) and Patrick Leahy (D–VT), who will lead the Roberts hearings. "There was quite a bit of information back then on the lack of household transmission," says Gerald Friedland, head of the AIDS program at Yale University. **–JON COHEN**

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