Hurricane Katrina: It's All About Geography

Have you ever known a time when society needed geographic science and geographers more than in the aftermath of the worst natural disaster in our country's history, Hurricane Katrina? In the October 2004 issue of *National Geographic Magazine,* an article titled "Gone with the Water," by Joel K. Bourne, Jr., described a hypothetical doomsday scenario for New Orleans posed by a severe August hurricane that kills those who do not evacuate as Lake Pontchartrain spills over its levees. The article is chilling prophecy, right down to daring roof-top rescues by helicopter! *Scientific American* published a feature article in 2001 entitled "Drowning New Orleans." The opening paragraph reads: "Major hurricane could swamp New Orleans under 20 feet of water, killing thousands. Human activities along the Mississippi River have dramatically increased the risk, and now only massive reengineering of southeastern Louisiana can save the city."

Geographers are aware of the codependent Mississippi River and its delta region, thanks largely to the benchmark work by Louisiana State University (LSU) geomorphologists and land-change scientists. For instance, Richard Kessel documented how the sediment budget for the lower Mississippi River was altered by engineering structures (dams, levees, dikes, revetments). Jess Walker and collaborators documented the concurrent loss of wetlands on the Louisiana coast. Kam Biu Lu and students studied stratigraphic records of hurricane deposits to better understand the historical frequency-magnitude of the largest coastal storms. Others studied the human dimensions of environmental change in the delta region and New Orleans. After Katrina, Craig Colten spoke eloquently on National Public Radio and wrote in the *New York Times*. Interviews with Colten and many others covered a number of geographic topics, including the vulnerability of New Orleans to hurricane activity as well as plans to reestablish coastal wetlands and rebuild damaged areas of the city.

On August 30, the day after Hurricane Katrina struck the Gulf coast, USGS research wildlife biologist Tommy Michot and USGS geographer Chris Wells conducted a post-hurricane flight to photograph and assess damage. Their primary focus was assessing the impacts on ecosystems, including fish kills, the destruction of rookeries, and the endangerment of seagrass beds that provide habitats for fish, birds, and shellfish. They documented the devastation of Louisiana's islands that serve as the first line of defense for hurricanes.

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But human drama overshadowed the significant and predictable physical changes on the landscape. Katrina was not the end of the story. Hurricane Rita as the fifth most powerful hurricane to strike the Gulf Coast since August 2004, was the first time two category five storms passed across the Gulf in the same season. Millions of area residents fled inland to escape the storm. Geographers were involved in real-time efforts to evaluate and respond to Katrina. ESRI created a clearinghouse of maps, imagery, and data for those affected and first-responders. Using a variety of satellite and aerial photography obtained by the Federal Emergency Management Agency, geographers provided coordinates and maps to pinpoint exact areas where people needed rescue. GISCorps, an international volunteer organization for GIS professionals, also sprang into action. Begun in 2003, the group has attracted nearly 900 members from forty-five states and thirty-three countries. In the first week following Katrina, the GISCorps volunteers generated new maps every twelve hours, including those seen on news conference broadcasts. Geographer Talbot J. Brooks, Director, Center for Interdisciplinary Geospatial Information Technologies at Delta State University, worked with GISCorps, FEMA, and other agencies to implement GIS technology at the Jackson, Mississippi, Emergency Operations Center.

The AAG organized an online clearinghouse and established a fund to support geography departments and others impacted by the storm. All during the Labor Day weekend, many of the AAG staff worked straight through the weekend and holiday to create, maintain and staff the Katrina Emergency Clearinghouse. The AAG's rapid response garnered notice in many quarters, including the *Chronicle of Higher Education,* the listservs of the ACLS, and many others. Departments and others in need in the affected regions are sending lists of needed items (such as books, other publications, maps, and electronic materials) or services (including remote sensing, emergency mapping, special expertise, etc.), and the AAG posted those lists on the clearinghouse as a way of linking colleagues interested in helping out with those in need. Also, the AAG established a special fund which goes towards rebuilding departments and assisting others in the hardest hit areas.

As just one example of the need to rebuild departments, the University of Southern Mississippi Geography office at Long Beach was destroyed, as was their GIS lab in Ocean Springs. The SMU Geography program on the Mississippi Gulf Coast has grown over the last several years. With the damage to the infrastructure of the whole coastal region, it will be difficult, if not impossible, for SMU geographers to support their Gulf Coast students for some time to come. LSU Geographer Robert Rohli sent the following message to AAG Executive Director Doug Richardson: "I am writing to express my sincere thanks to you and

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others for all that the AAG and geography departments have already done and are willing to do to help the people here on the Gulf Coast. Now that my electricity has been restored and I've had a little time to check my e-mail inbox, I'm floored by all of the offers to help. I've never been prouder to be a geographer." Many other similar messages were received.

The Mississippi River delta is a complex deposit of several delta lobes of sediment that has accumulated over the last 5,300 years. Artificial levees, cutoffs, dikes, dams, and revetments control the lower Mississippi River. After a devastating flood in 1927, levees along the Mississippi River were raised, sealing the fate of the delta region , forcing the river to flow more directly to the Gulf. Without engineering controls, the river would follow a course 160 km shorter to the Gulf via the Atchafalaya River. The Mississippi River is aggrading and its river bed lies at elevations distinctly above much of the floodplain. One can easily witness this predicament by standing on the river levee in New Orleans within walking distance of Bourbon Street.

Portions of the delta are not being replenished with sediment. The coast is being eroded by wave action and subsidence due to compaction of deltaic sediments (from the weight and oxidation of organic sediment), and by deflation caused by the massive removal of oil and gas reserves. More than 13,000 km of canals are carved through the coastal freshwater wetlands for petroleum exploration and ship traffic. Artificial canals allow the intrusion of saltwater, killing the freshwater wetland vegetation that holds the banks in place. Since 1932, 4,900 km2 of coastal wetlands were lost; 2,000 km2 since 1956. The total loss caused by Katrina alone is going to be staggering. Louisiana continues to lose one hectare of coastal land every eighty-two seconds. The loss of coastal wetlands translates to a worsening of flood hazards from hurricane storm surge as the wetland buffer is lost. Unfortunately, efforts at reclaiming wetlands have not been successful, nor have politicians made it an issue.

The link between global climate change and increasing storm intensity is under study. *Nature* published a study by Dr. Kerry Emanuel, MIT scientist, August 4, 2005 (pp. 686-88). He established a "total dissipation index" to rate the potential destructiveness and intensity, integrated over the lifetime of tropical cyclones. He relates the marked increase in tropical cyclone intensity as "...highly correlated with tropical sea-surface temperatures, reflecting well-documented climate signals...and global warming." Among several conclusions, he states: "...the near doubling of power dissipation over the period of record should be a matter of some concern, as it is a measure of the destructive potential of tropical cyclones." Katrina passed over Gulf of Mexico waters which were at a record 32° to 34°C (90°–93°F)! Hurricanes feed on the latent heat of evaporation, enhanced by such temperatures. And the warmth extends to depth, so that as the hurricanes do their mixing of waters which used to bring up dampening cool water, the mixing now brings up more warm water!

Earlier in the year, geographer Steve Leatherman gave a presentation to the National Academy of Sciences Disasters Roundtable on the increasing severity of Atlantic hurricanes. Steve directs the International Hurricane Research Center and Laboratory for Coastal Research at Florida International University. Early in the August hurricane season, well before Katrina, Steve predicted more severe hurricanes were likely to arrive this year. Drs. Bimal Paul (Kansas State University) and David Legates (Delaware) served as "experts" in the National Geographic Society's EdNet online community for teachers and students who wanted to ask questions about Hurricane Katrina.

As former USGS Director Chip Groat wrote recently in EOS (September 20, 2005), for scientists to react to Katrina by chortling, "I told you so," is not enough. Rather, geographers are "on the ground" and making a difference. All of us should urge the USGS to adopt the nine goals presented as a science strategy for geography in the USGS, 2005-2015, outlined in USGS Circular 1281. I quote only the three most directly relevant to the Hurricane Katrina situation:

Goal 3: Understand past, present, and future environmental consequences of land change to support better management of their effect on people, environment, economy, and resources.

Goal 4: Improve the scientific basis for vulnerability and risk assessment, mitigation, response, and recovery related to the human and environmental dynamics of land change.

Goal 5: Develop credible and accessible geographic research, tools, and methods to support decision making related to the human and environmental consequences of land change.

The physical and human dimensions of Hurricane Katrina and these record-setting 2004–2005 tropical storm seasons are all about geographic science—a global-scaling forced by severe storms, of vulnerability science, and land-change spatial analysis, as well as contributions from social theorists of how poverty dictates choices for the disadvantaged. If ever a time existed to strengthen links between geography and users of its research, this is it. Let us seize the moment for the benefit of our fellow citizens in New Orleans and the affected Gulf Coast region. Look for special sessions on Hurricane Katrina at the 2006 AAG Annual Meeting in Chicago.

Thanks for all you do for geography. ■

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