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EARTHQUAKE ENGINEERING TO EXTREME EVENTS
A Summary of MCEER Reconnaissance Efforts

MCEER RESPONSE

Hurricane Gustav Reconnaissance: Damage Survey using the VIEWS™ System

Walter Svekla and Enrica Verrucci, ImageCat, Inc.

This reconnaissance trip, undertaken following Hurricane Gustav, was funded by the National Science Foundation and MCEER. It provided the team with a unique opportunity to collect and compare aerial and ground remote sensing data following Hurricane Gustav with similar data collected after Hurricane Katrina. Members of the Remote Sensing Institute participated in an extensive NSF/MCEER-sponsored reconnaissance effort following Hurricane Katrina (see Womble et al., 2006). A companion MCEER Response report examines the emergency preparedness and response of the acute care hospital system in New Orleans, including organization differences between Hurricanes Katrina and Gustav.

Hurricane Gustav was the third hurricane of the 2008 Atlantic hurricane season. It made U.S. landfall at 9:30 a.m. CDT on Monday, September 1, 2008, near Cocodrie, Louisiana, about 70 miles southwest of New Orleans, Louisiana, as a Category 2 hurricane. The National Hurricane Center (NHC) estimated an 81% chance that Gustav would strike as a Category 3 hurricane or higher. Government officials and the public were prepared for the worst, since they had been severely affected three years earlier by Hurricane Katrina. A few hours after landfall, Gustav weakened into a Category 1 hurricane and continued to dissipate as it moved through Louisiana and into Arkansas.

Image © 2008 Stormpulse.com – Ibis v2.1. NASA base imagery

Figure 1. Path of Hurricane Gustav from August 25 through September 2, 2008.

Imagery from NOAA

The National Oceanic and Atmospheric Administration (NOAA) Remote Sensing Division acquired airborne digital imagery of the coasts of Louisiana, Mississippi, and Alabama between September 2 and 7, 2008, after Hurricane Gustav made landfall. The imagery shows, for the most part, undeveloped and inundated marshlands and barrier islands. Surface conditions in a large number of images are obstructed by significant cloud cover.

Post-event imagery can be used to identify areas that were not severely affected by the hurricane, equally important information for setting response priorities. Despite expectations of and preparations for the worst, many areas, especially in the sheltered regions to the southeast of New Orleans, experienced little to no flooding despite proximity to water (see Figure 2).

Though Gustav made landfall with wind speeds just below those of a category 3 hurricane, it rapidly weakened to a category 1 storm within four hours. Expectations for wind-induced damage were not realized, though wind damage was observed. Figure 3 displays some relatively small structures damaged by extreme winds.

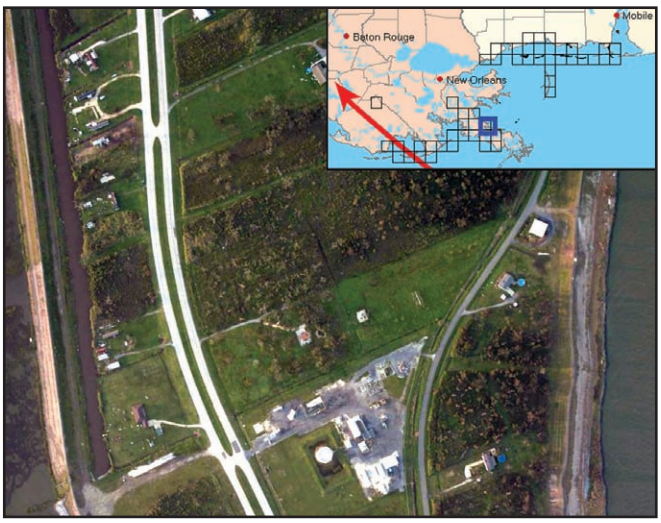

Figure 2. Empire, LA, Highway 23 NOAA image C24702972

Figure 3. Triumph, LA NOAA image C24702090

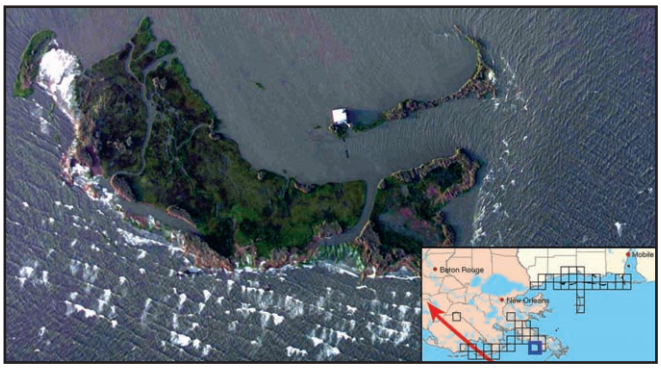

Figure 4. Bay Coquette, LA NOAA image C24702496

Increased wetland and marshland inundation is observed on the more exposed west side of the Mississippi Delta. Figure 4 shows significant inundation of low-lying coastal areas and the near complete isolation of what appears to be a coastal residence. White caps indicate the relative depth of submerged topography.

VIEWS™ Field Data Reconnaissance System

ImageCat deployed to the Louisiana and Mississippi Gulf Coast on September 2 and 3, 2008, utilizing the VIEWS™ Field Data Reconnaissance System. VIEWS™ is a notebook-based field data collection and visualization system developed by ImageCat with financial support from MCEER. It integrates pre- and post-disaster remote sensing imagery with real-time GPS (Global Positioning System) readings and map layers, and operates in conjunction with a High-Definition Video (HDV) digital camera and digital video recorder. After first being deployed for earthquake field reconnaissance following the December 2003 Bam (Iran) earthquake (Adams et al., 2004), this system has been used for damage assessment support in a number of recent disasters, including tsunamis, hurricanes, tornados and wildfires. The MCEER website has a complete list of reports from these reconnaissance missions in the Remote Sensing Institute section of its website at *http://mceer.buffalo.edu/research/Remote_Sensing/Reports.asp*. As a versatile data collection platform, the VIEWS™ system can be used in surveys conducted on foot or in vehicles, including boats, cars and even airplanes.

The ImageCat team reached Louisiana on September 2, 2008, just one day after landfall, and aerial imagery collected during this deployment represented one of the first sources of information in the aftermath. The deployment covered urban centers reported to be the most affected by the media, in the state of Louisiana (New Orleans, Mandeville, Slidell and Lacombe) and along much of the Mississippi Gulf Coast, including Waveland, Gulfport, and Biloxi. In this deployment, ImageCat aimed to identify and capture the impacts of storm surge. The vulnerability of the Gulf Coast to future events was substantially increased due to massive

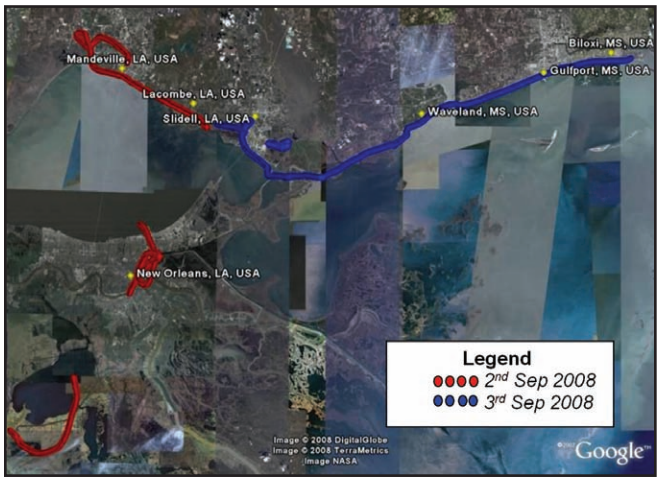

Figure 5. ImageCat aerial deployment routes.

coastal erosion induced by Hurricanes Katrina and Rita during the 2005 hurricane season. Figure 5 displays ImageCat's aerial deployment tracks.

New Orleans

The storm and following heavy rains forced water over the top of some levees; other levees also experienced seepage. Nevertheless, no major wind-induced damage or flooding was observed in this area. The Industrial canal in the city's Ninth Ward neighborhood (figure 6), whose failure after Katrina contributed to major flooding in the city (approximately 80 percent), held up well against Hurricane Gustav's extreme winds and surge.

Lacombe – Mandeville and Slidell

These areas experienced limited flooding, both in urban and rural areas. VIEWS™ aerial data, acquired the day after the hurricane made landfall, showed many flooded areas (Figure 7). The storm surge penetration and resulting inundation were due mostly to topography. This area is widely characterized by wetlands and therefore is prone to flooding. Even so, no evidence of soil erosion was visible in this imagery.

Gulf Coast – from Waveland to Biloxi

No major flood or damage is reported in this area. Minor effects of coastal erosion as well as sand deposits were promptly removed from motorways. This area was reported to be fully in service just two days after landfall.

Conclusions

ImageCat deployed to the affected areas with expectations, perhaps, of observing more widespread and severe water and wind damage and was struck by what was and was not observed so soon after the event. The ImageCat team was able to quickly deploy and engage in aerial reconnaissance of the affected areas. The same was not true after Hurricane Katrina, when failed control towers and zero visibility caused by cloud cover forced post-storm reconnaissance to be conducted on foot at a much later time for many areas.

Figure 6. New Orleans 9th Ward - Minor wind-induced damage.

Figure 7. Lacombe, LA - example of flooded urban area.

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Walter Svekla and Enrica Verrucci
ImageCat Inc.
400 Oceangate, Suite 1050
Long Beach, CA USA 90802

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This report is also available from *http://mceer.buffalo.edu/publications/Reconnaissance/08-SP08/default.asp*.

References

Adams, B.J., Huyck, C.K., Mansouri, B., Eguchi, R.T., and Shinozuka, M. (2004). "Application of High-Resolution Optical Satellite Imagery for Post-Earthquake Damage Assessment: The 2003 Boumerdes (Algeria) and Bam (Iran) Earthquakes," *MCEER Research Progress and Accomplishments: 2003-2004*, MCEER-04-SP01, MCEER, University at Buffalo.

MCEER's collection of remote sensing reconnaissance reports is available at *http://mceer.buffalo.edu/research/Remote_Sensing/Reports.asp*.

For More Information

MCEER
University at Buffalo, State University of New York
Red Jacket Quadrangle
Buffalo, NY 14261
Phone: (716) 645-3391
Fax: (716) 645-3399
E-mail: *mceer@buffalo.edu*
Web Site: *http://mceer.buffalo.edu*

Staff

Editor: **Jane Stoyle**
Illustration/Photography: **David Pierro**
Layout/Composition: **Michelle Zuppa**

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University at Buffalo
State University of New York
Red Jacket Quadrangle
Buffalo, NY 14261