Hurricane Katrina – Simulations vs. Reality and Lessons Learned for New Orleans

Hassan Mashriqui, Ph.D., P.E.

Hurricane Center, Louisiana State University Baton Rouge, Louisiana

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ADCIRC Modeling Team (Collaborators)



LSU HURRICANE CENTER

Addressing Hurricanes and Other Hazards and Their Impacts on the Natural, Built and Human Environments









AT LOUISIANA STATE UNIVERSITY

School of the Coast & Environment

ADCIRC – 2D Hydrodynamic Model

Input & Output

- Hurricane Wind Velocities input
- Atmospheric Pressure input
- Location of the "eye" input
- Surge or Sea Surface Elevation output
 Speed or Velocity (Currents) output

West Atlantic/Gulf Coast Domain



SuperMike – 1024 CPUs



2005 - Storms Simulated at LSU

- * Hurricane Wilma
- * Hurricane Rita
- * Hurricane Katrina
- * Hurricane Emily
- * Hurricane Dennis
- * Tropical Storm Cindy
- * Tropical Storm Arlene

National Hurricane Center (NHC) Advisories and LSU Hurricane Center Surge Forecasting for Hurricane Katrina

National Hurricane Center (NHC) Advisory Information			LSU Surge Analysis Information				
Advisory Number	Advisory Date:Time (UTC)	Time to Landfall (h)	Date:Time (UTC)	Elapsed Time (h)	New Orleans Flooding		
16	8/27/05 0900	51	8/27/05 1930	10.5	NO		
17	8/27/05 1500	45	8/27/05 2000	5	NO		
18	8/27/05 2100	39	8/28/05 0300	6	_{YES} - 33 hr		
22	8/28/05 1200	24	8/28/05 2000	8	YES		
25	8/29/05 0300	9	8/29/05 0930	6.5	YES		
31	8/30/05 1500	-27	Post Storm		YES		

Advisory # 18, Saturday 2200 (CDT)



@ Morning, Sunday 28 August

NO MARGIN OF ERROR

LSU scientists took projected tracks of Hurricane Katrina on Saturday evening and produced a frightening scenario: A wall of water surging in from all sides pushing up against the urban levees. Wave action is seen topping levees in Kenner, eastern New Orleans and along the Mississippi River-Gulf Outlet.

WATERFLOW

PUMPED-UP LAKE

Easterly winds in advance of the storm could pump water from Lake Borgne and from Breton and Chandeleur sounds into Lake Pontchartrain, raising the lake's surface by 12 feet.

Lake Pontchartrain

6 GOING ASHORE

As Katrina moves inland and the winds come from the north, the high Lake Pontchartrain waters could stream across St. Charles Parish and turn east along Airline Highway into Kenner.

NOECO

DESTREHAN

LULING

11 OVER THE TOP

Waves equal to half the surge height or more would top the surge water and could overtop levees on the south shore of Lake Pontchartrain and around Chalmette.



7

Wet int

HARAHAN

METAIRIE

ESTWEGO



\$10

NEW ORLEANS

GRETNA

HARVEY

could be inundated by 10-11 foot storm surges.

SLIDELL SOAKED

Large parts of Slidell

PROJECTED PATH

THE BETSY SCENARIO

WATER FLOW

Hurricane force winds are projected to top levees in eastern New Orleans, pushing water into the 9th Ward, the Michoud area and even into Mid-City.

SLIDELL

Lake Borgne



Unprotected areas in Plaquemines Parish could flood first Monday.

Katrina's Track



Model Validation

ADCIRC Validation: Surge on Lakefront west of 17th St. Canal 11 to 12 ft



Agreeing on High Water at New Orleans Yacht Club near 17th St. Canal





ADCIRC Surge Forecast Accuracy as Katrina Approached (meters)										
Zone			Forecasts: Hours to Louisiana Landfall (NHC Advisory)							
West to East	No. Obs.	HWM (SE)						[-27] (31)		
Orleans Metro	20	3.63 (0.43)						3.49		
		RMSE						0.33		
		% Error						9		
East Orleans	9	4.18 (0.50)						4.18		
		RMSE						0.63		
		% Error						9		
St. Bernard	14	4.86 (0.59)						4.52		
		RMSE						0.72		
		% Error						15		

Lessons Learned for New Orleans

Katrina Surge Snapshot



"The Funnel"



Katrina Surge & Wind Vectors



Katrina Surge & Flow Vectors



Katrina's surge animation







Katrina Surge Height and Velocity on MRGO near Bayou Bienvenue



IHNC Katrina Flow vectors



Hurricane Katrina 2005



Velocity Profile and Failure Locations



Where they died





We noticed the vulnerability in July 2004 during Hurricane Pam FEMA exercise

> --- and I gave a special presentation to emergency managers in New Orleans on 19 May 2005

"The Funnel" - Crescent City's Trojan Horse - 19 May 2005



Hurricane Pam 2004



Conclusions

 Technology saved lives, about 85% evacuation for Katrina

Future use

- predicting levee overtopping and failure
- guiding pre-landfall flood-fighting efforts
- staging post-landfall breach closure equipment and supplies

Conclusions (Cont.)

1. MRGO & the Funnel allowed storm surge to reach New Orleans 2 to 3 times faster than if the storm surge had traveled through wetlands.

2. Man-made canals such as MRGO, GIWW and IHNC allowed the surge to propagate into the heart of the city and appear to have increased current velocities in the vicinity of earthen hurricane protection levees.

3. Fatalities in the Lower Ninth Ward were higher than other areas of the city, in part because the fast-arriving storm surge gave residents less time to respond.

4. Beyond its direct impact, the MRGO has destroyed much of the wetlands to the east of the channel that act as a buffer to storm surge.