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

Tulane Engineering Forum
New Orleans Hilton Riverside
Friday, June 2, 2006

ADCIRC Modeling Team (Collaborators)

LSU HURRICANE CENTER

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

Center for the Study of PUBLIC HEALTH IMPACTS of Hurricanes

ADCIRC Simulation

CENTER FOR COMPUTATION & TECHNOLOGY AT LOUISIANA STATE UNIVERSITY

School of the Coast & Environment

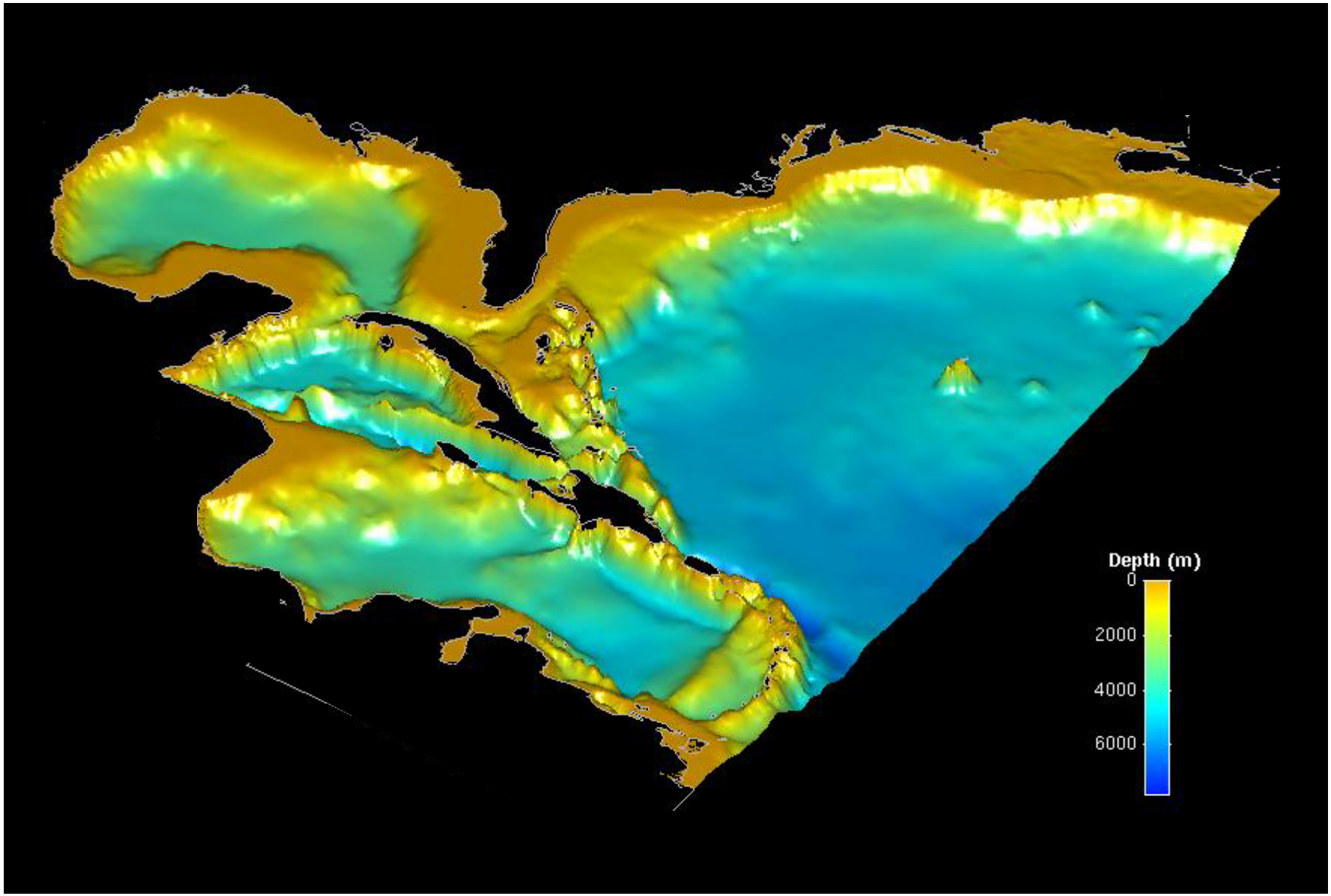
ADCIRC – 2D Hydrodynamic Model

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

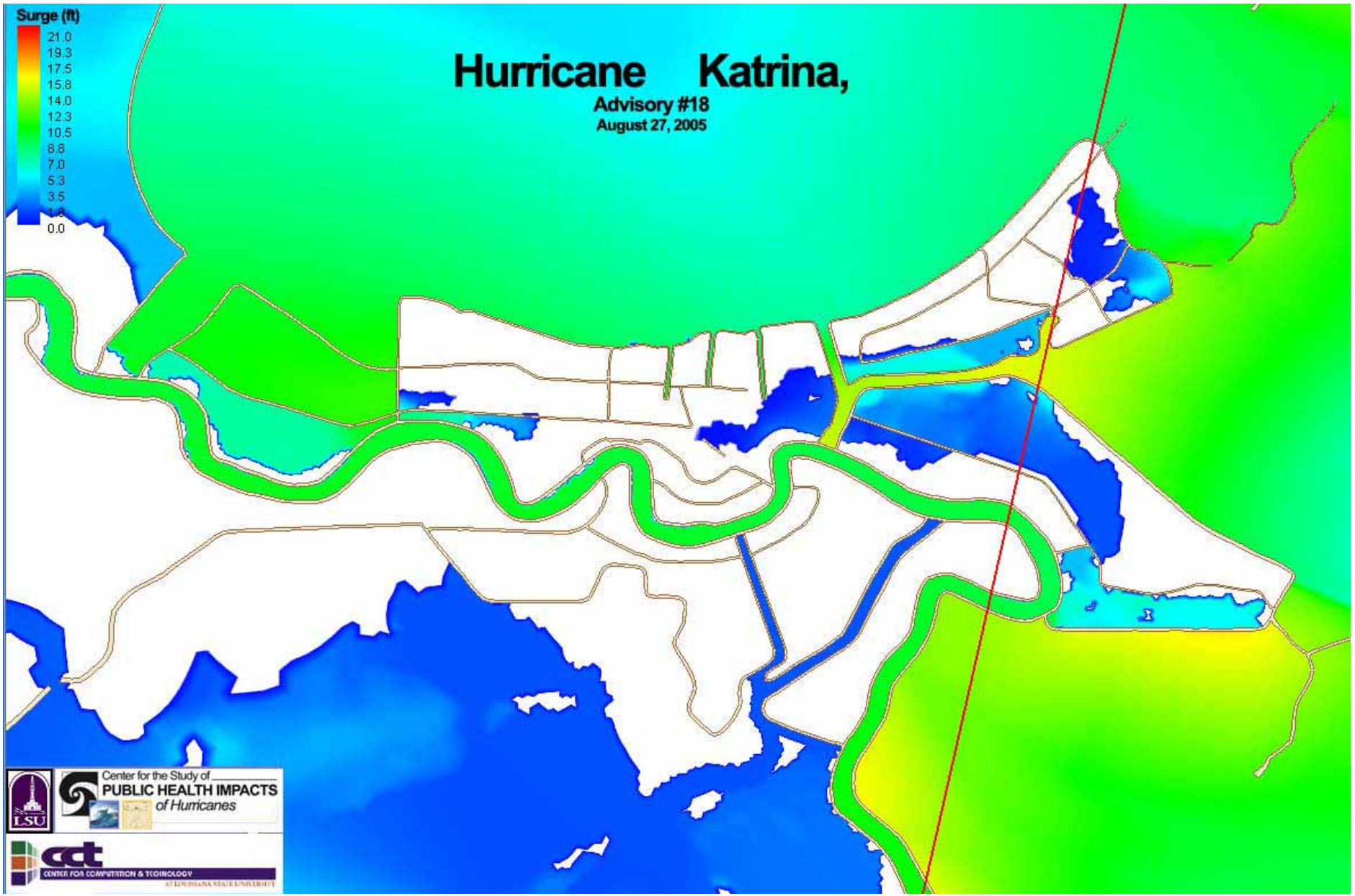
2005 - Storms Simulated at LSU

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

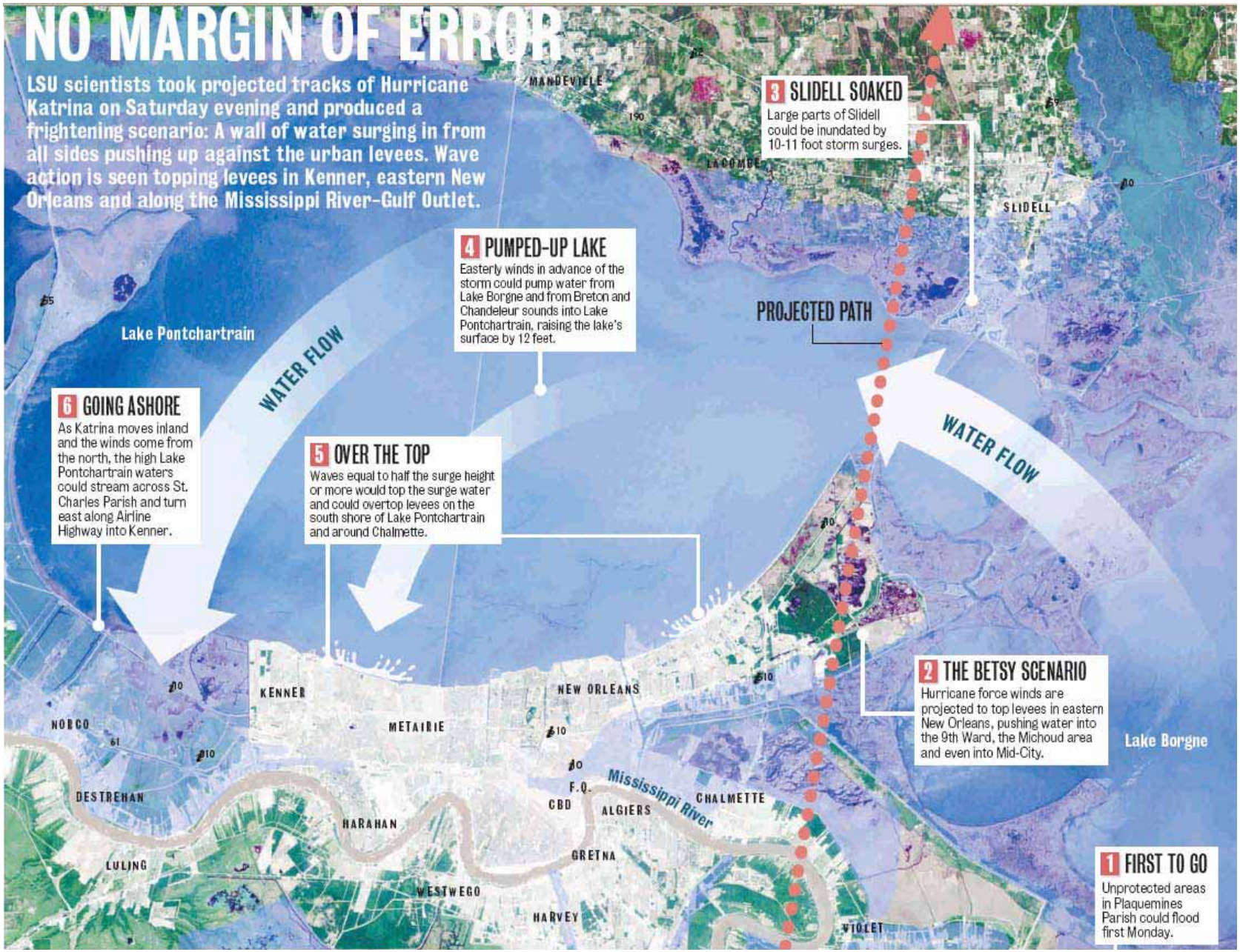
National Hurricane Center (NHC) Advisories and LSU Hurricane Center Surge Forecasting for Hurricane Katrina

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

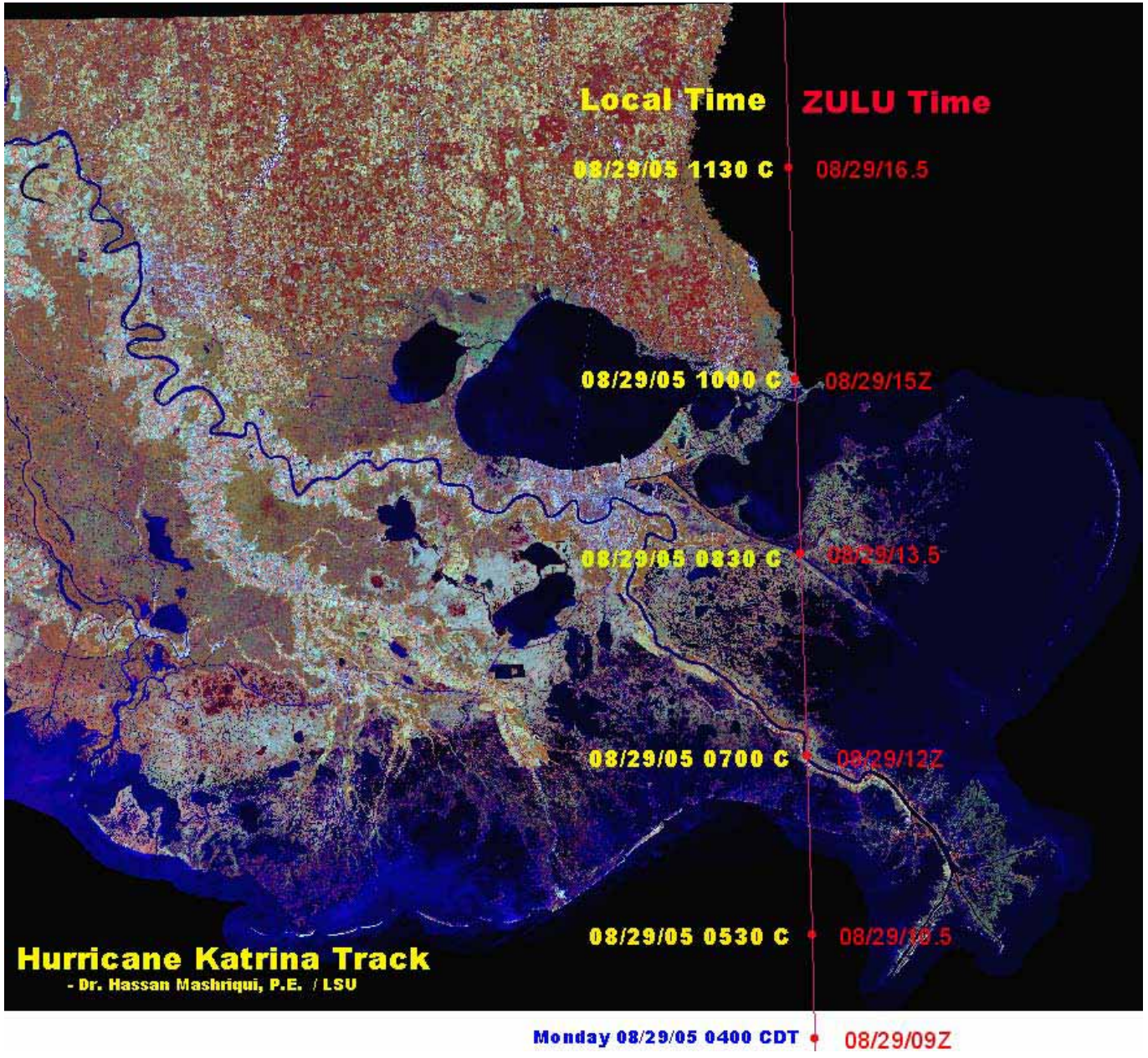
Advisory # 18, Saturday 2200 (CDT)



@ Morning, Sunday 28 August



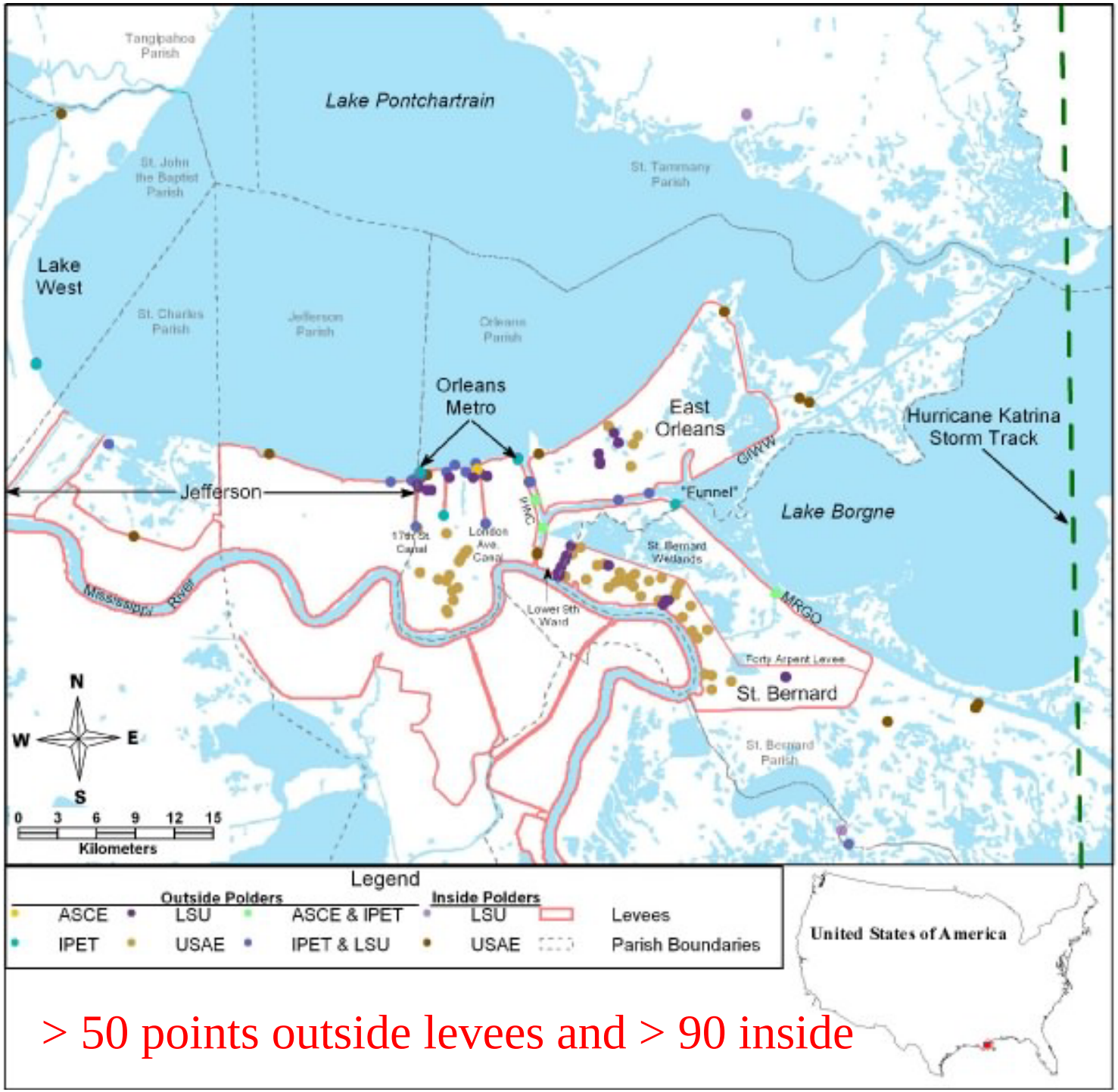
Katrina's Track



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

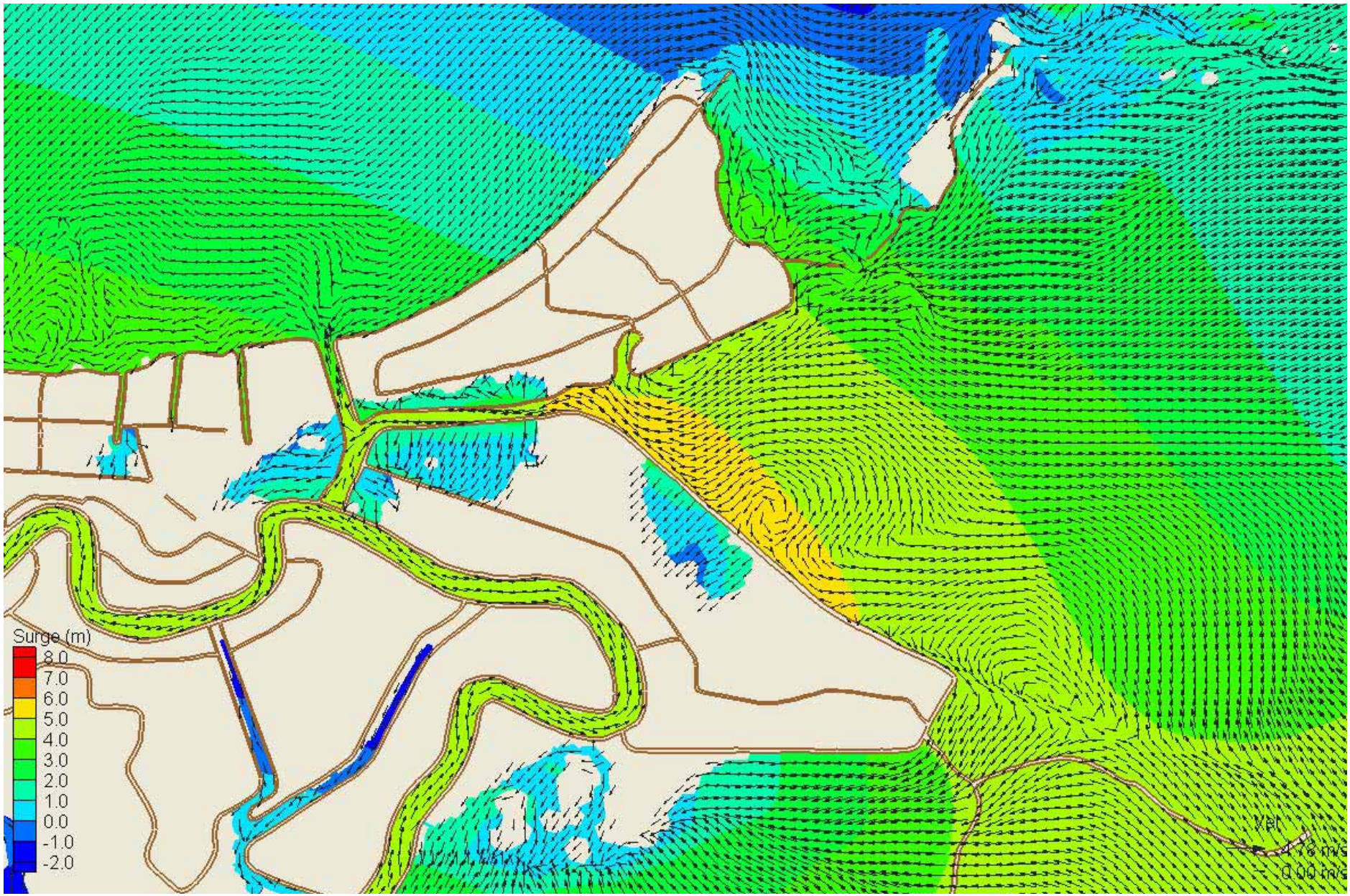


> 50 points outside levees and > 90 inside

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*

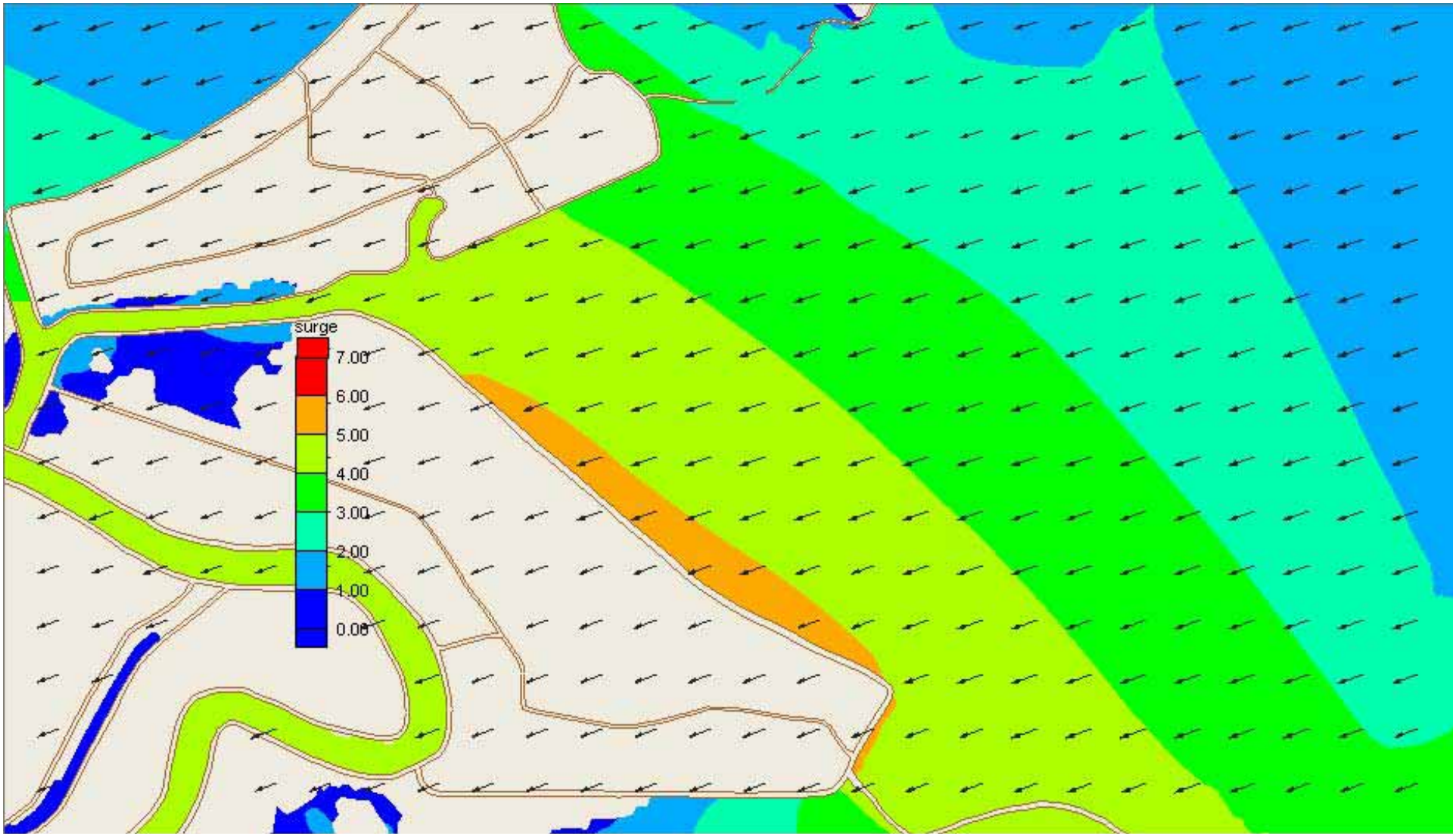
Lessons Learned for New Orleans

Katrina Surge Snapshot

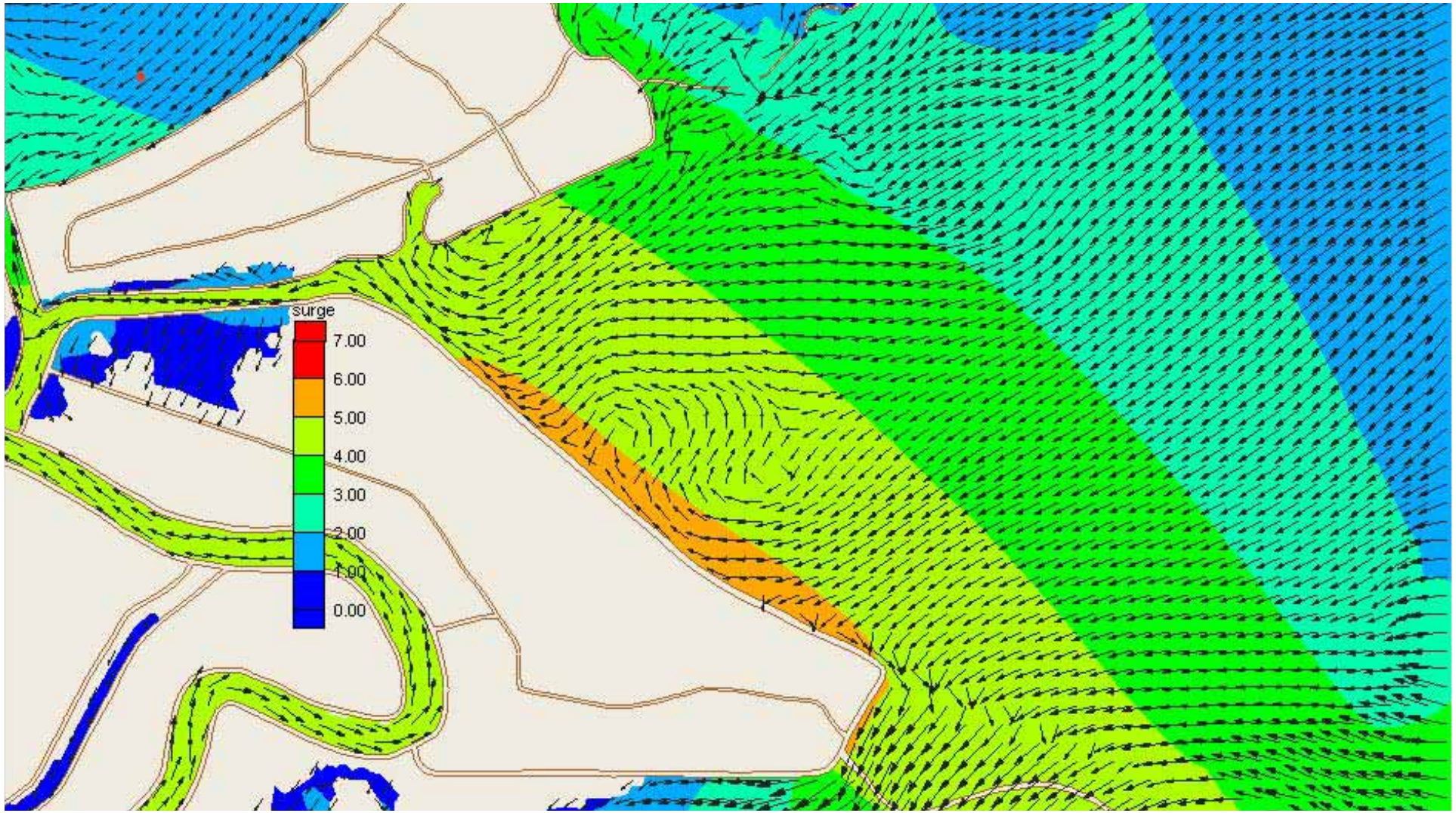


“The Funnel”

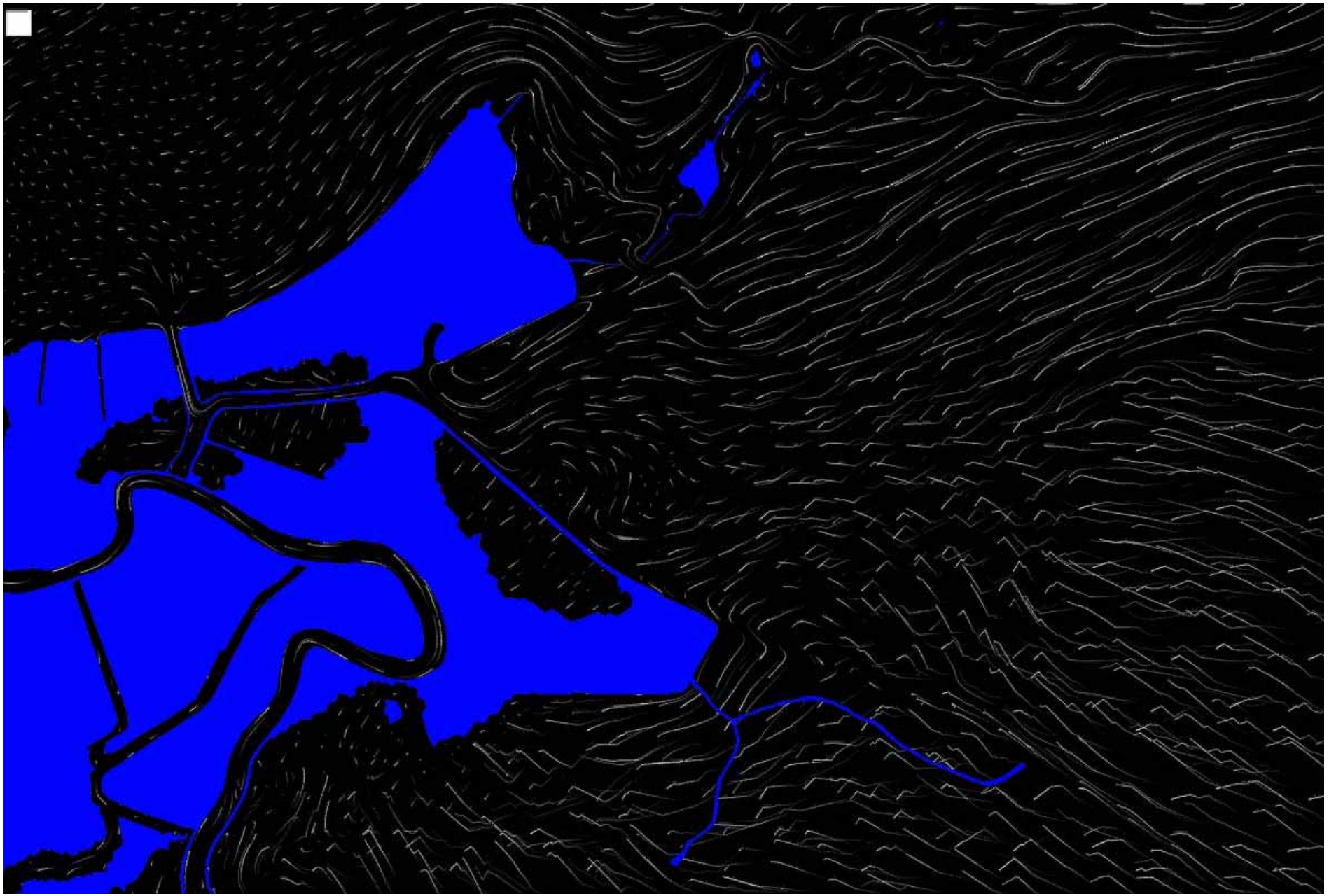
Katrina Surge & Wind Vectors

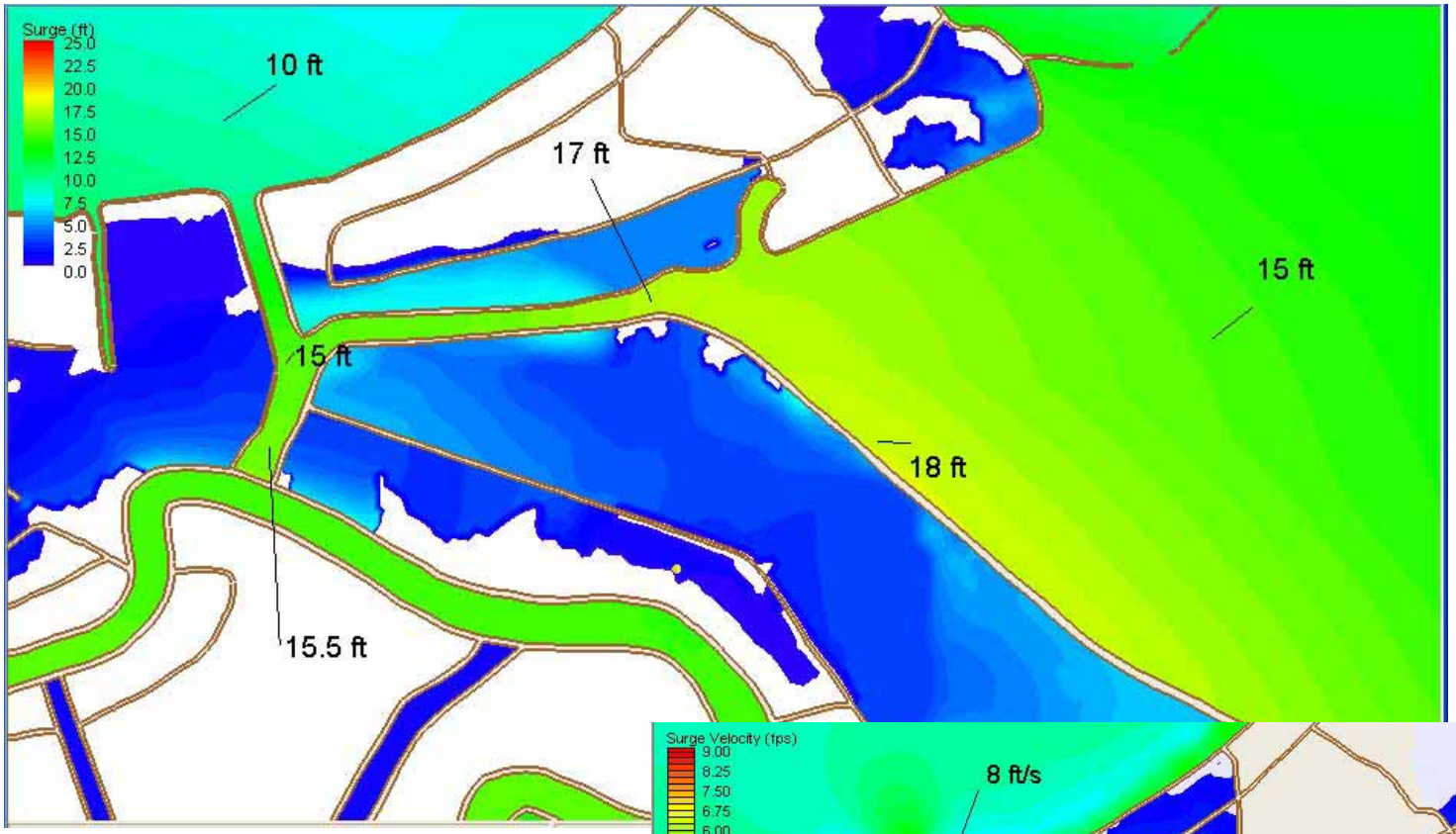


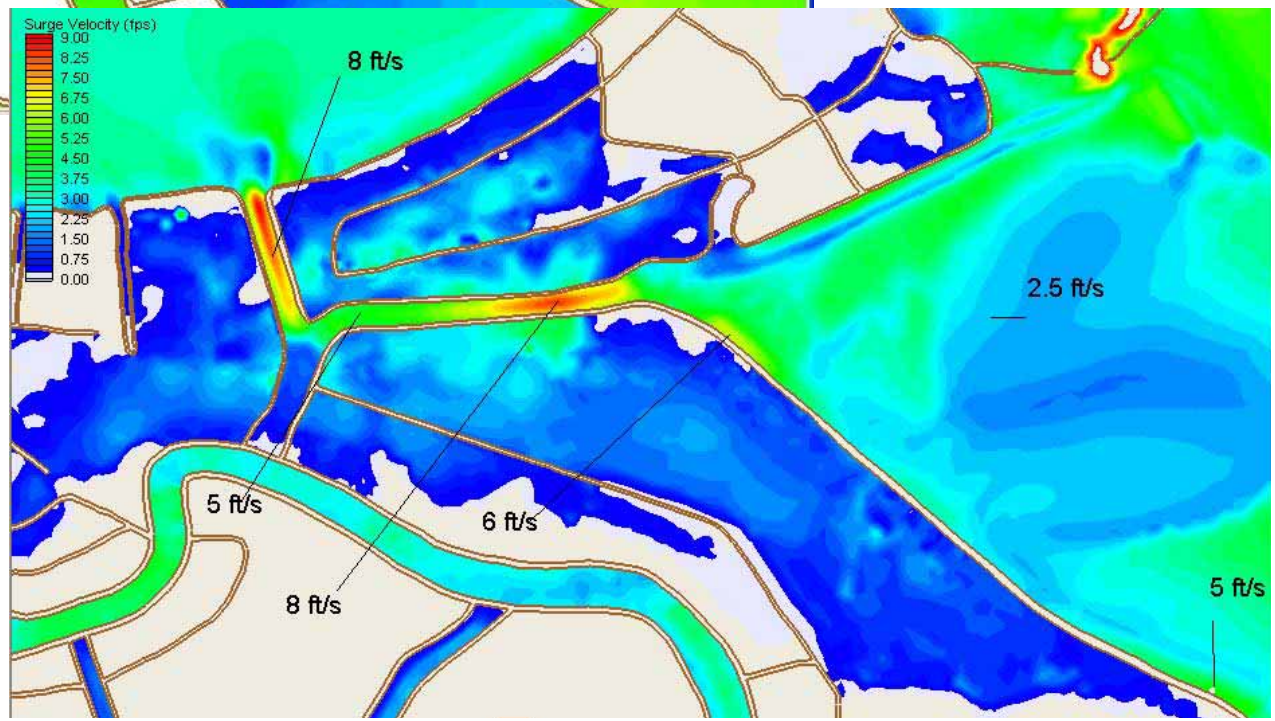
Katrina Surge & Flow Vectors



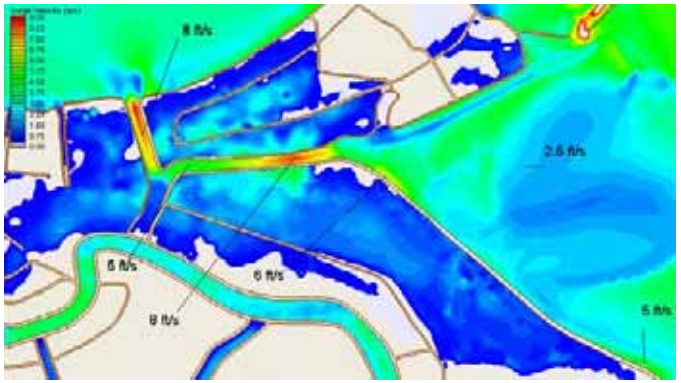
Katrina’s surge animation



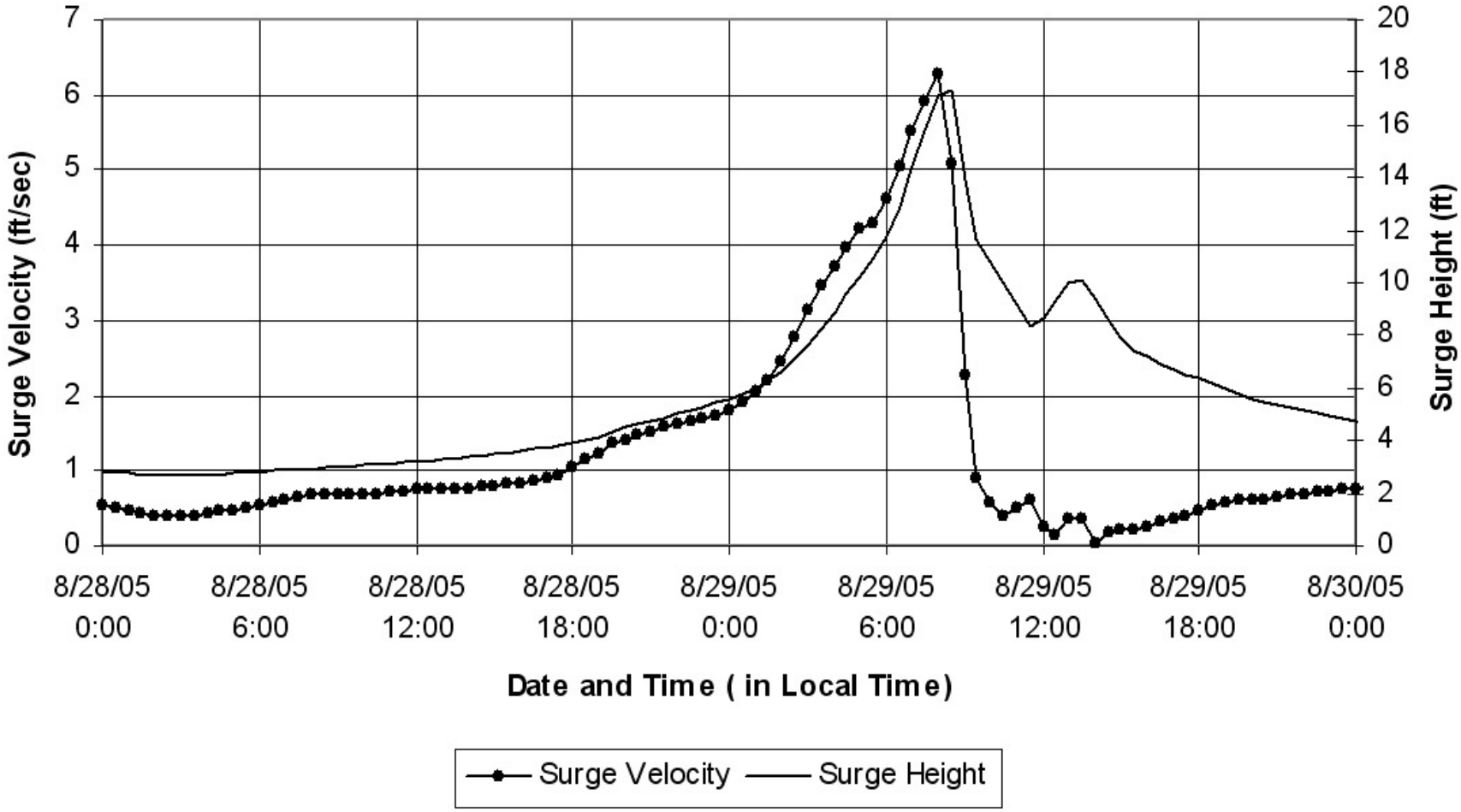




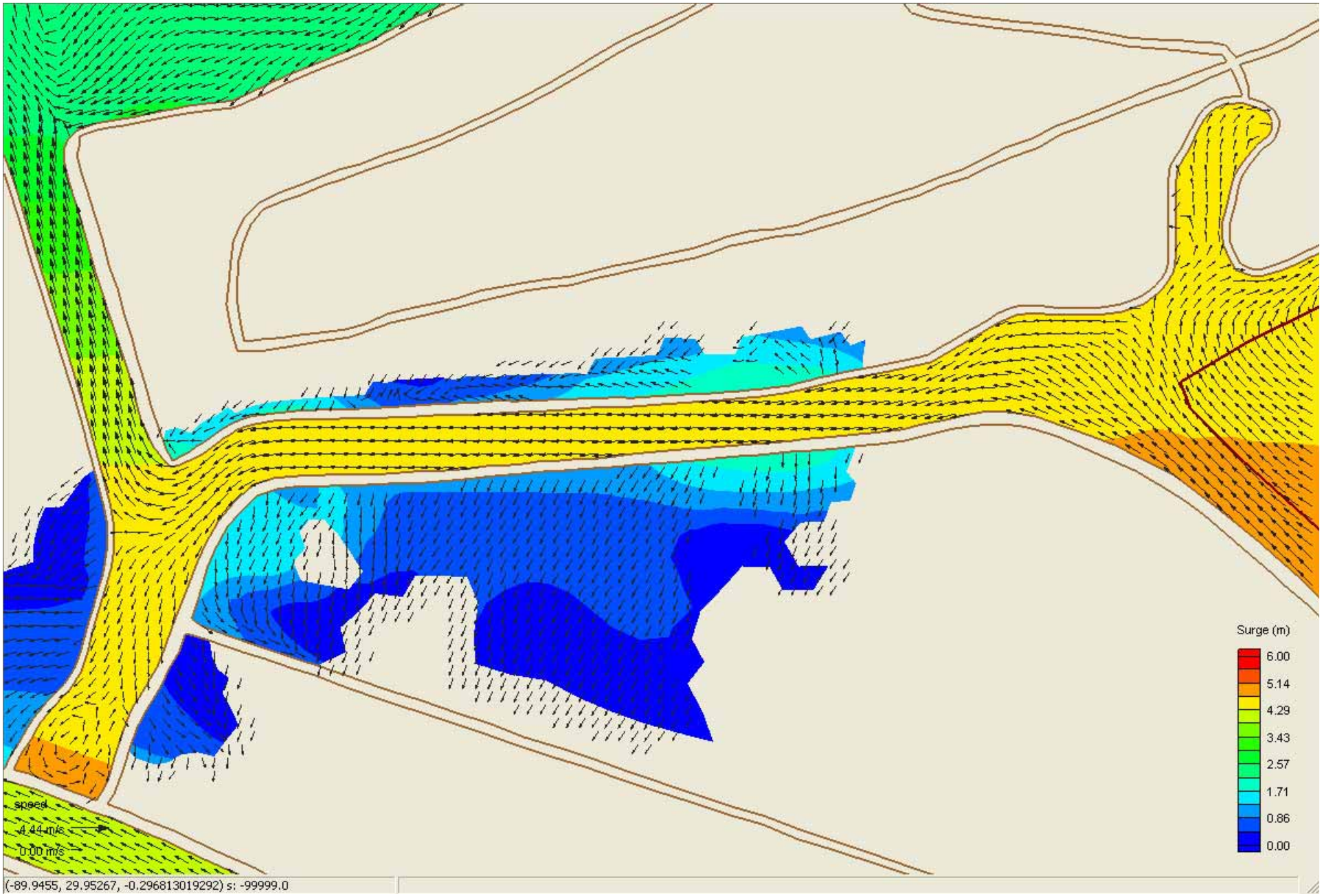
MRGO & FUNNEL (Approx.)



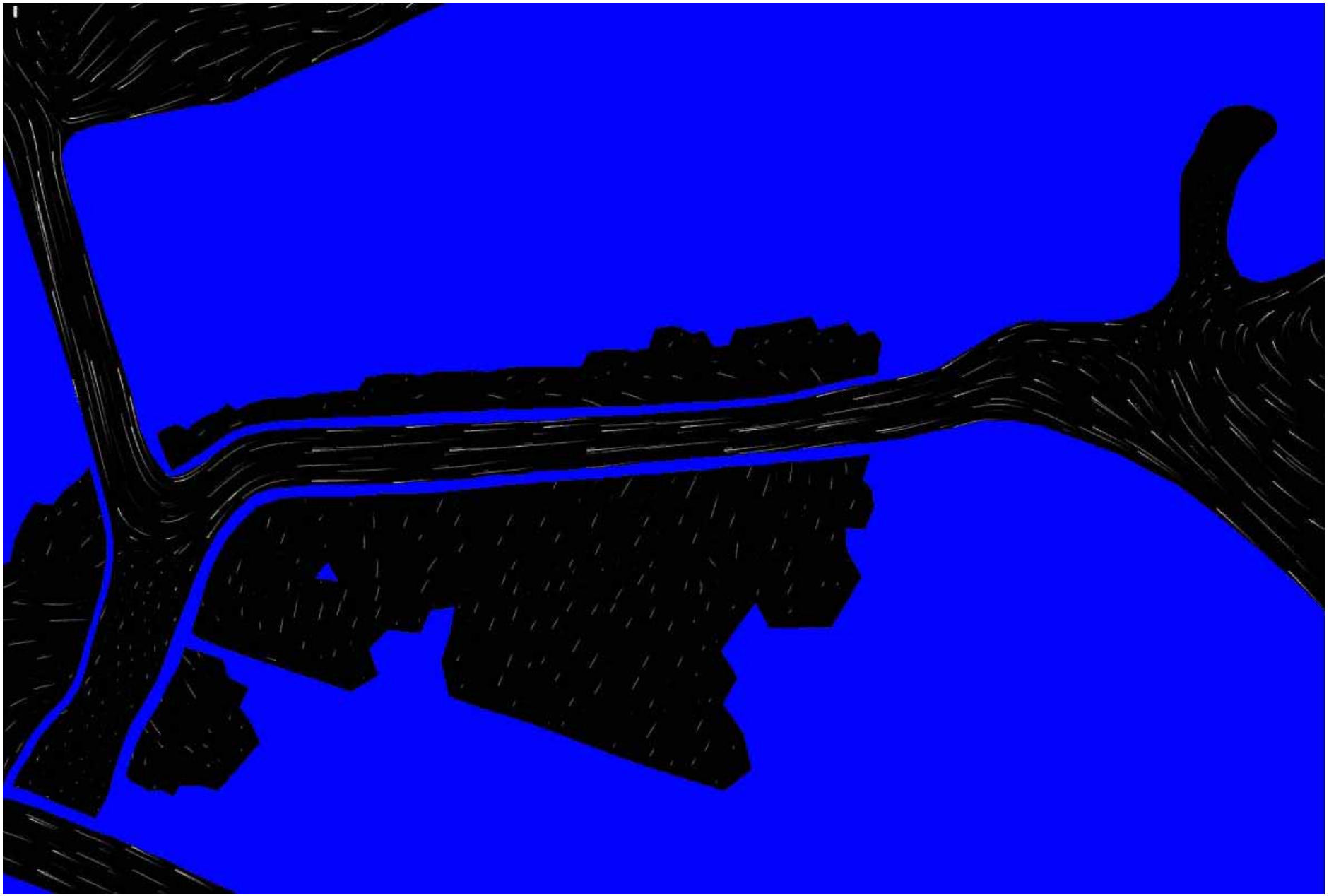
Katrina Surge Height and Velocity on MRGO near Bayou Bienvenue



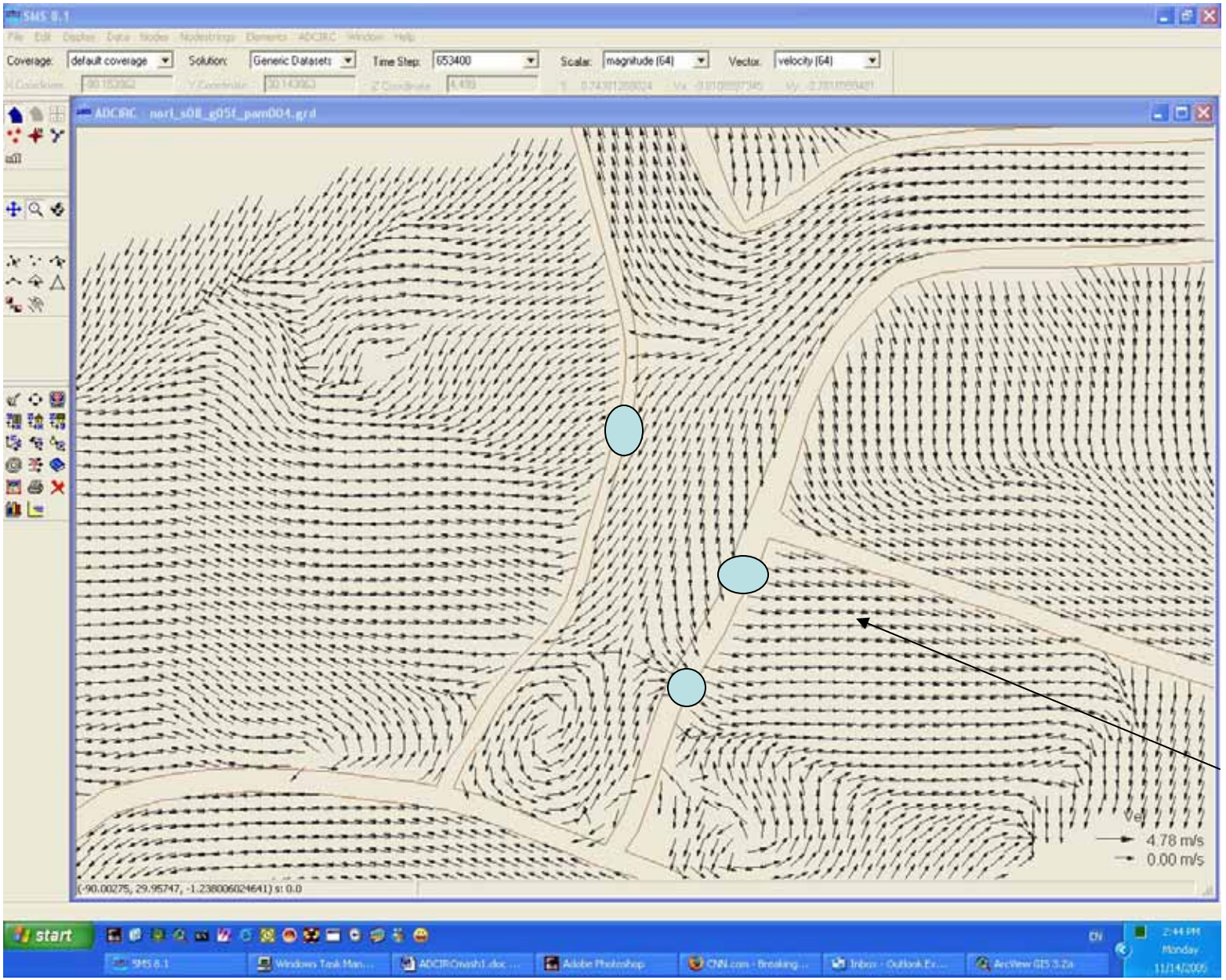
IHNC Katrina Flow vectors



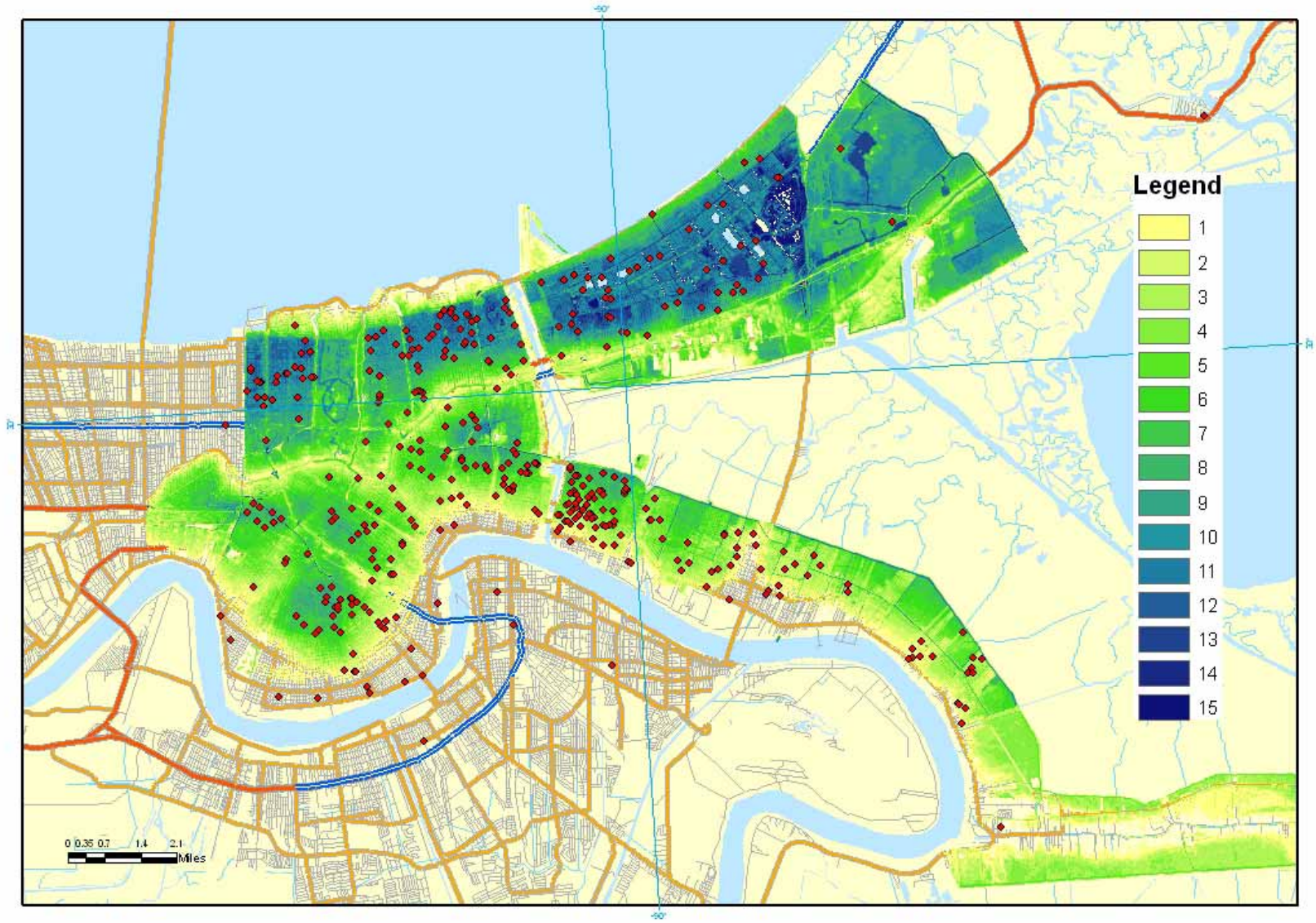
Hurricane Katrina 2005



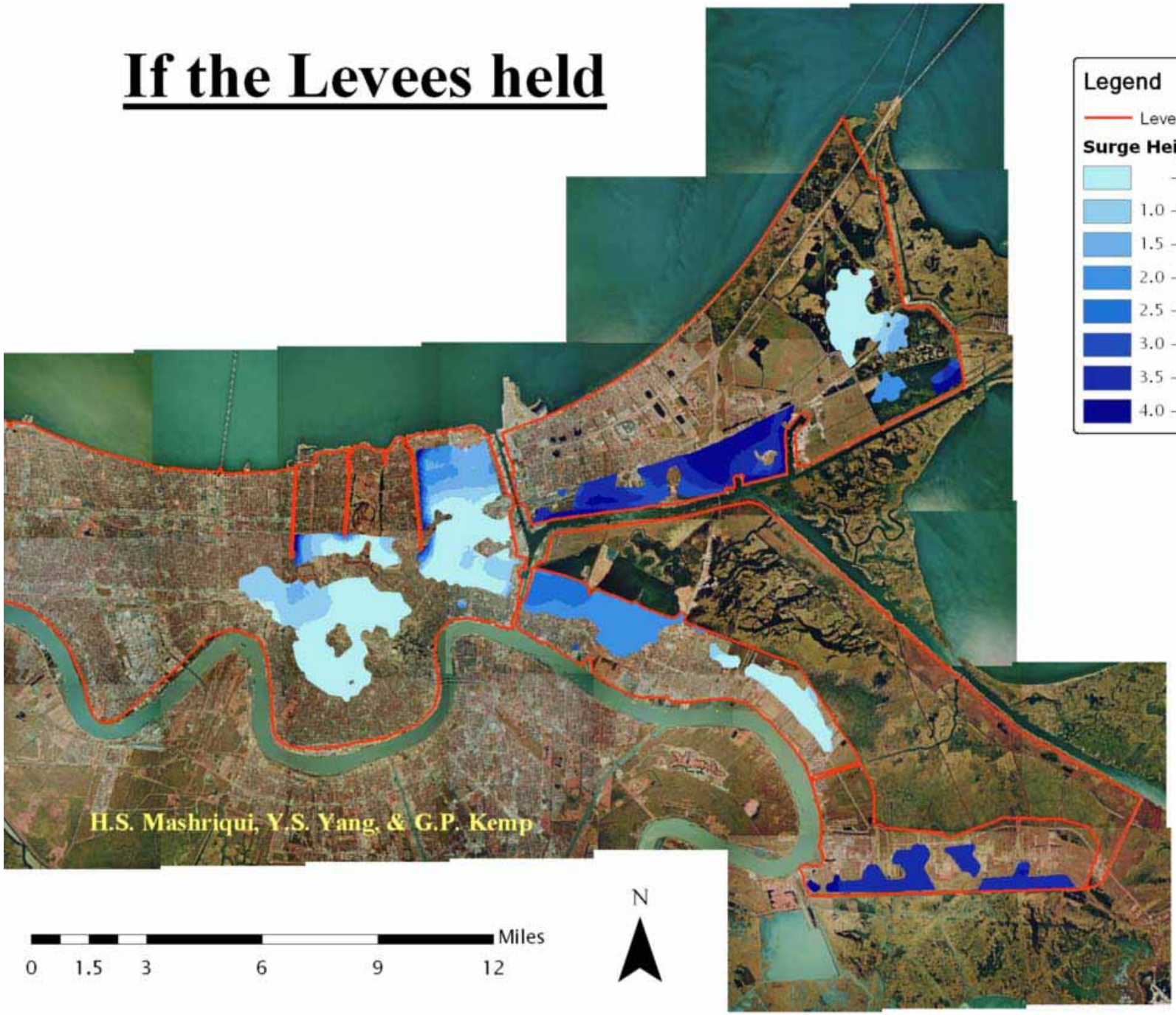
Velocity Profile and Failure Locations



Where they died



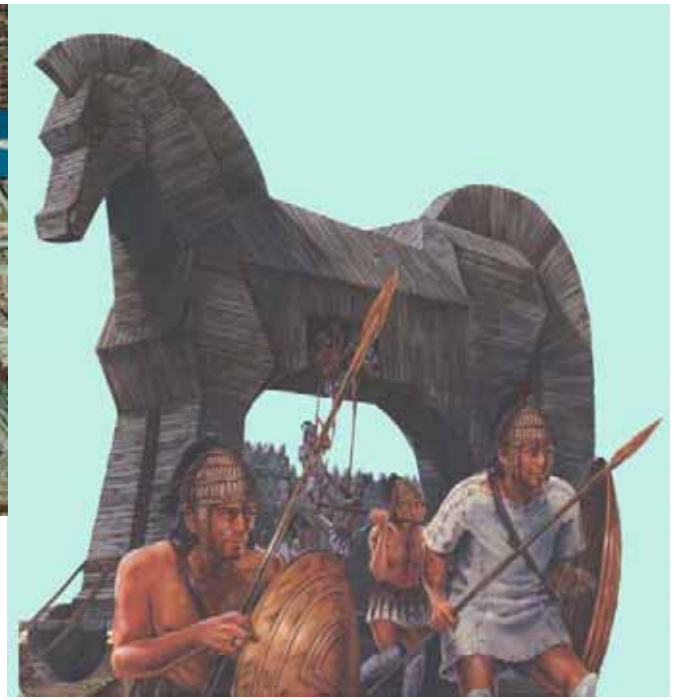
If the Levees held

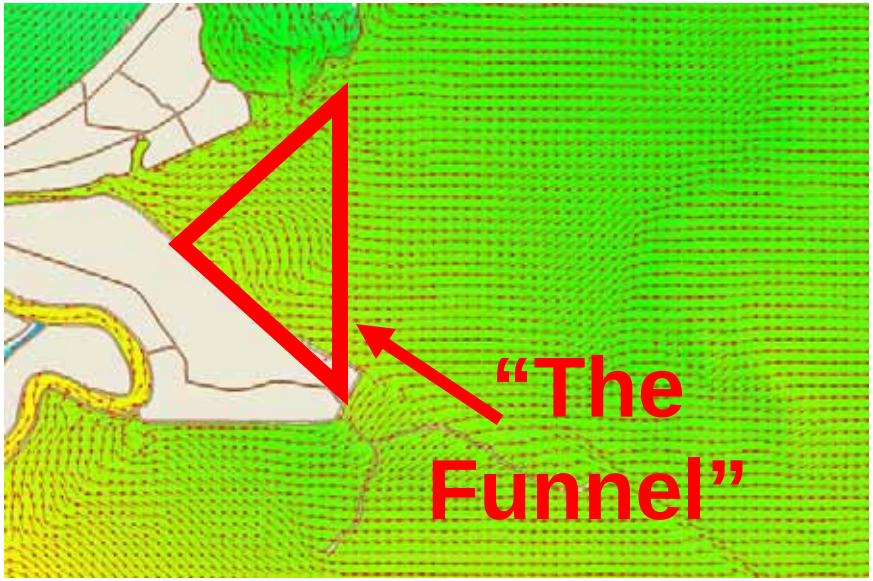


We noticed the vulnerability in July 2004 during Hurricane Pam FEMA exercise

--- 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





Betsy 1965

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.