

# Category 5 Louisiana Coastal Protection and Restoration

Vicksburg, MS

March 2- 3, 2006

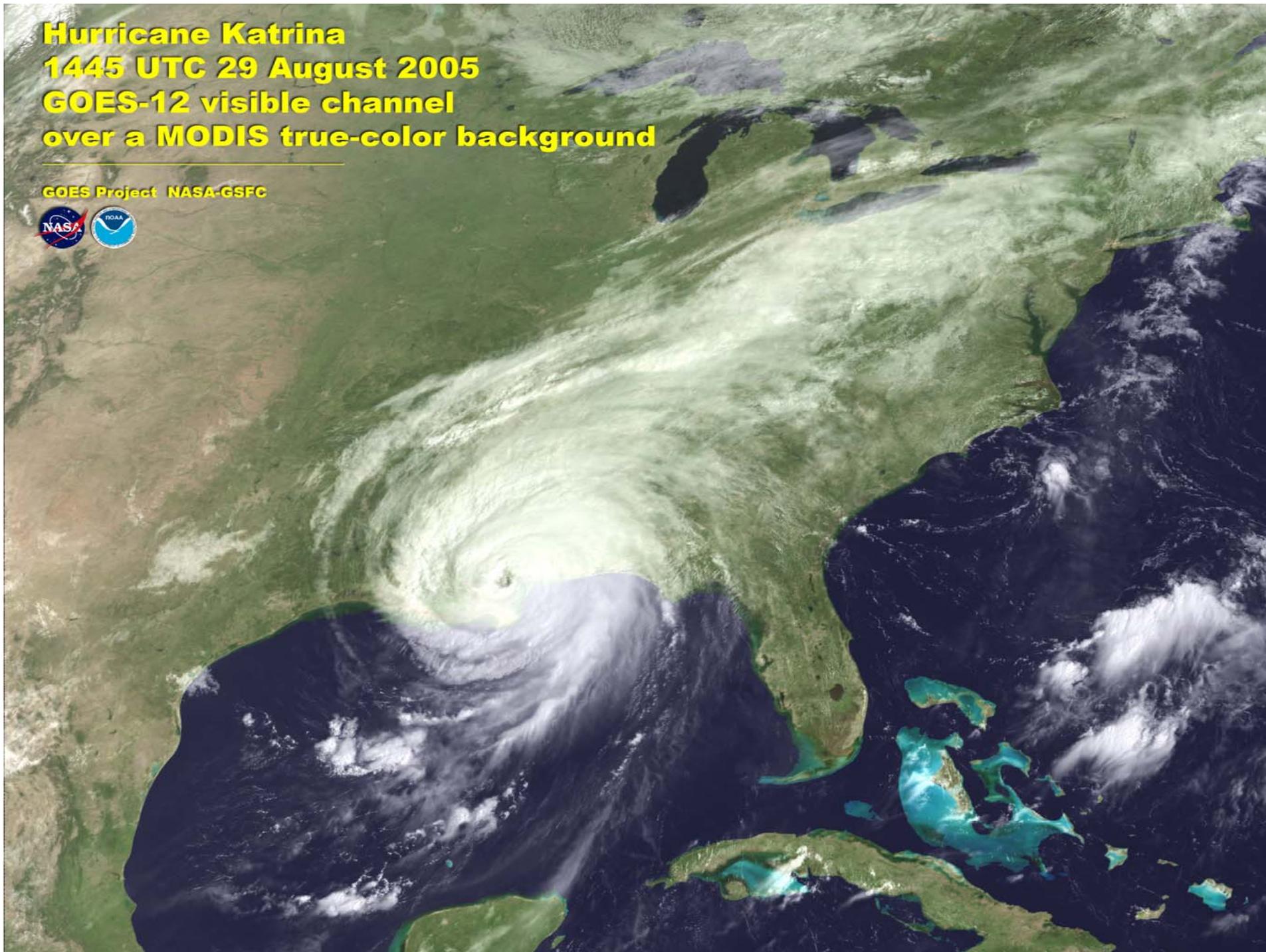
## Design Storms



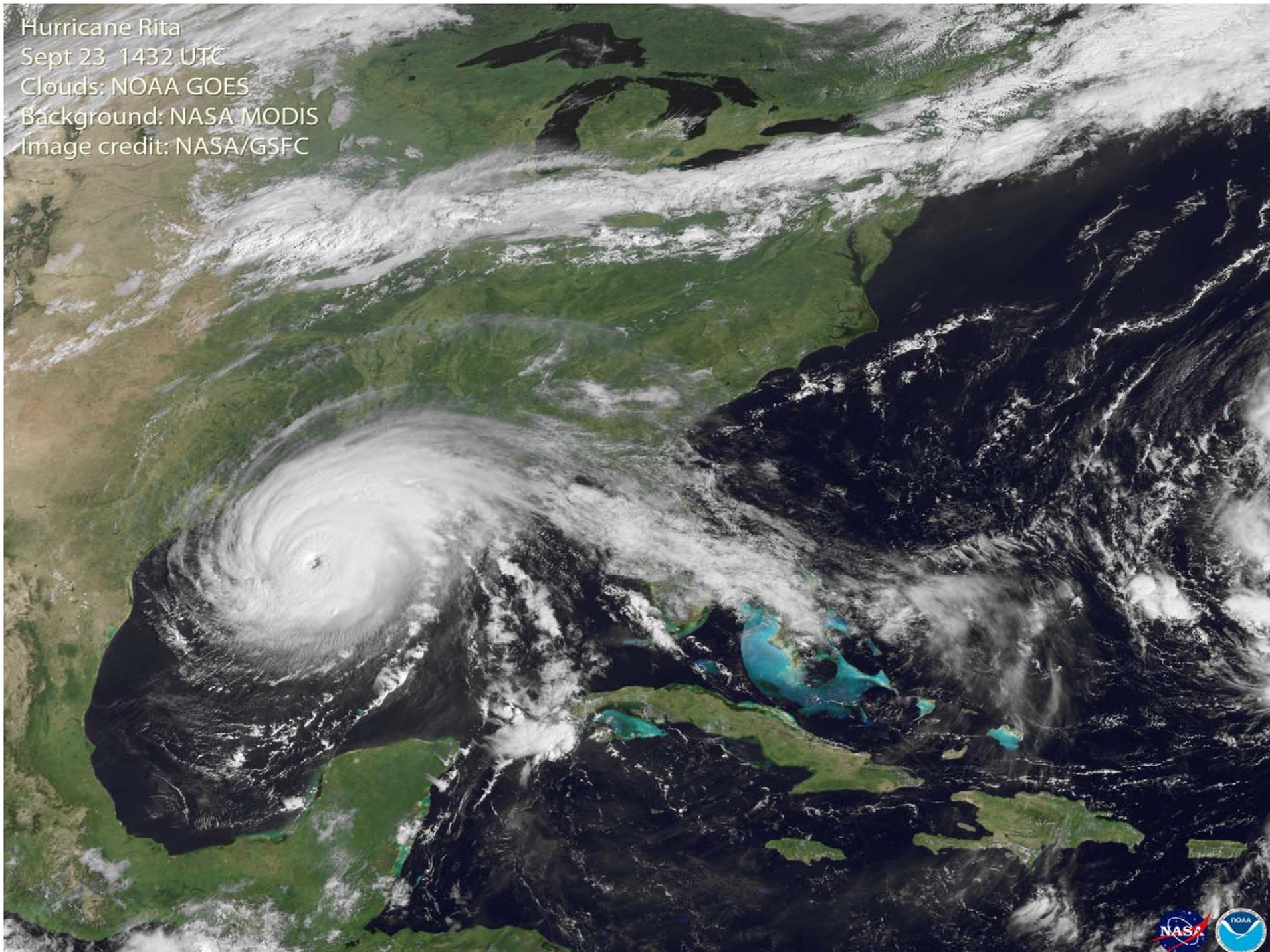
US Army Corps  
of Engineers

**Hurricane Katrina**  
**1445 UTC 29 August 2005**  
**GOES-12 visible channel**  
**over a MODIS true-color background**

GOES Project NASA-GSFC



Hurricane Rita  
Sept 23 1432 UTC  
Clouds: NOAA GOES  
Background: NASA MODIS  
Image credit: NASA/GSFC



# Public Law 109-103

Energy and Water Development Appropriations Act, 2006

## DEPARTMENT OF THE ARMY

### Corps of Engineers--Civil

The following appropriations shall be expended under the direction of the Secretary of the Army and the supervision of the Chief of Engineers for authorized civil functions of the Department of the Army pertaining to rivers and harbors, flood control, shore protection and storm damage reduction, aquatic ecosystem restoration, and related purposes.

## INVESTIGATIONS

....That using \$8,000,000 of the funds provided herein, the Secretary of the Army, acting through the Chief of Engineers, is directed to conduct a comprehensive hurricane protection study at full Federal expense to develop and present a full range of flood, coastal and hurricane protection measures exclusive of normal policy considerations for south Louisiana and the Secretary shall submit a feasibility report for short-term protection within 6 months of enactment of this Act, interim protection within 12 months of enactment of this Act and long-term comprehensive protection within 24 months of enactment of this Act: *Provided further*, That the Secretary shall consider providing protection for a storm surge equivalent to a Category 5 hurricane within the project area and may submit reports on component areas of the larger protection program for authorization as soon as practicable: *Provided further*, That the analysis shall be conducted in close coordination with the State of Louisiana and its appropriate agencies.

.....long-term comprehensive protection within 24 months of enactment of this Act: *Provided further*, That the Secretary shall consider providing protection for a storm surge equivalent to a Category 5 hurricane within the project area and may submit reports on component areas of the larger protection program for authorization as soon as practicable.....

# Saffir-Simpson Scale

Category 1      74 – 95    mph winds

Category 2      96 – 110   mph winds

Category 3      111 – 130   mph winds

Category 4      131 – 155   mph wind

Category 5      155+    mph winds

# Design Storms

- Maximum Possible Intensity Hurricane
- Probable Maximum Hurricane
- Katrina – Like Hurricane

# Maximum Possible Intensity Hurricane



# Hurricane Intensity

Knutson and Tuleya (2004) in a detailed GCM modeling study predict:

**1. 6% increase in hurricane maximum intensity** with an 80% increase in CO<sub>2</sub>. This is line with theoretical estimates by Emanuel.

**2. 18% increase in mean precipitation rate** within 100km of the storm centre.

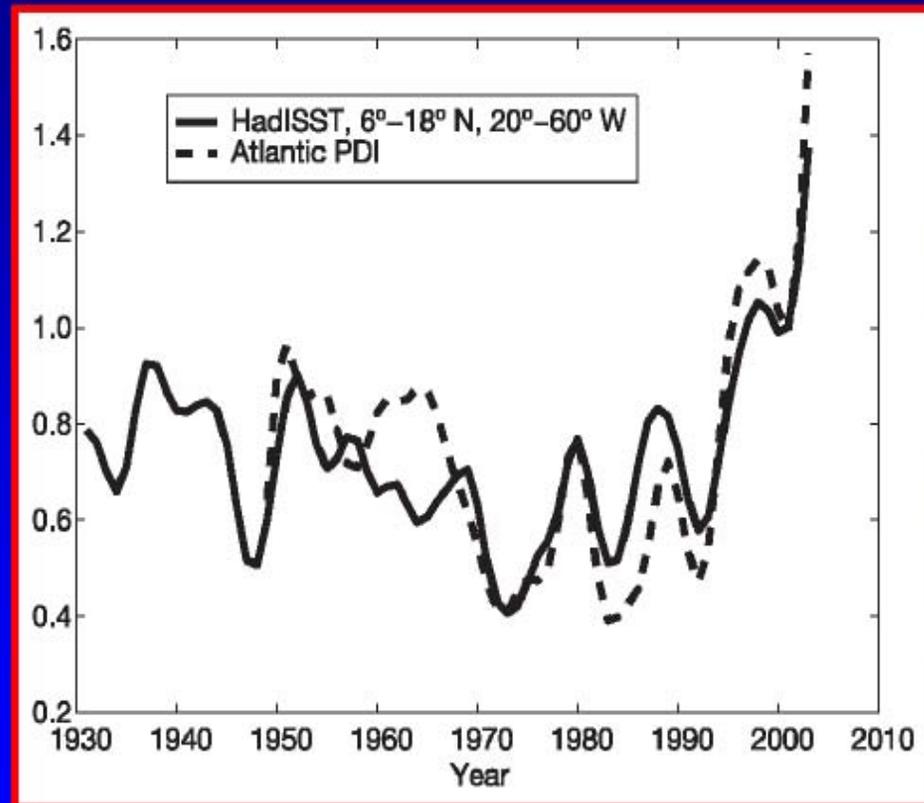
*These changes may not be detectable for a few decades.*



## Hurricane Intensity (2)

Emanuel (2005) in a paper in *Nature* present results showing that:

The annual 'power' of Atlantic hurricane activity has increased by **100%** over the past 30 years.

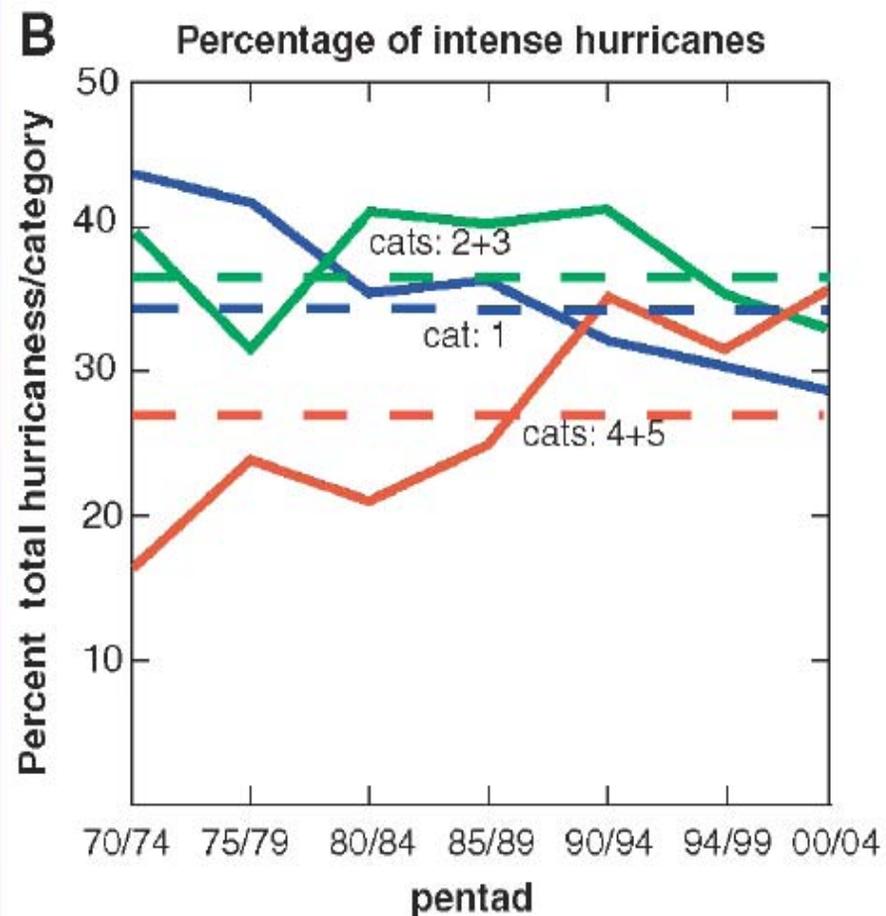




# Hurricane Intensity (3)

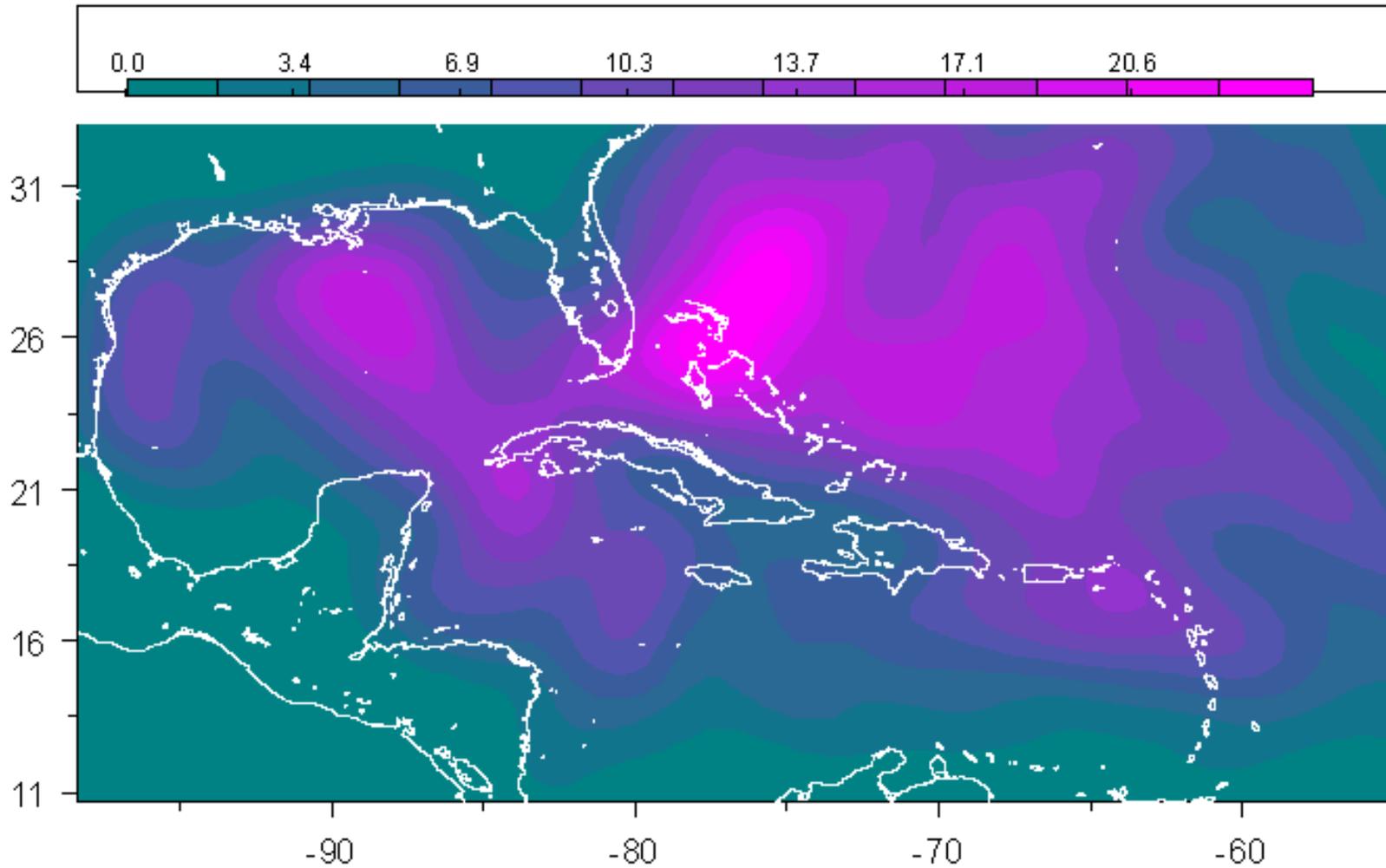
Webster et al. (2005)  
in a paper in *Science*  
show that:

The number of Cat 4  
and 5 strength  
hurricanes  
worldwide has  
increased from  
about 11 per year in  
the 1970s to 18  
annually now.



# Probability of a Major Hurricane

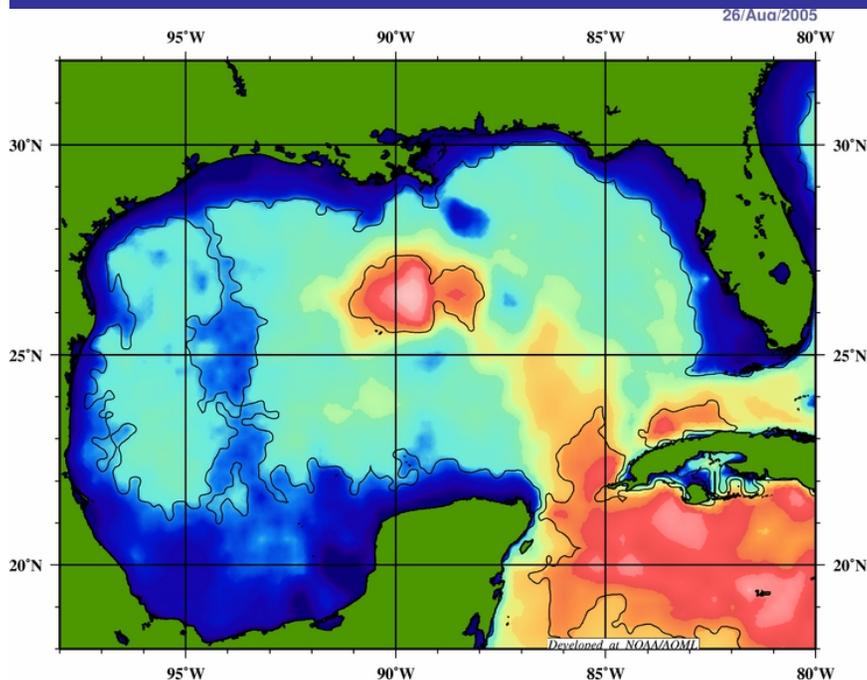
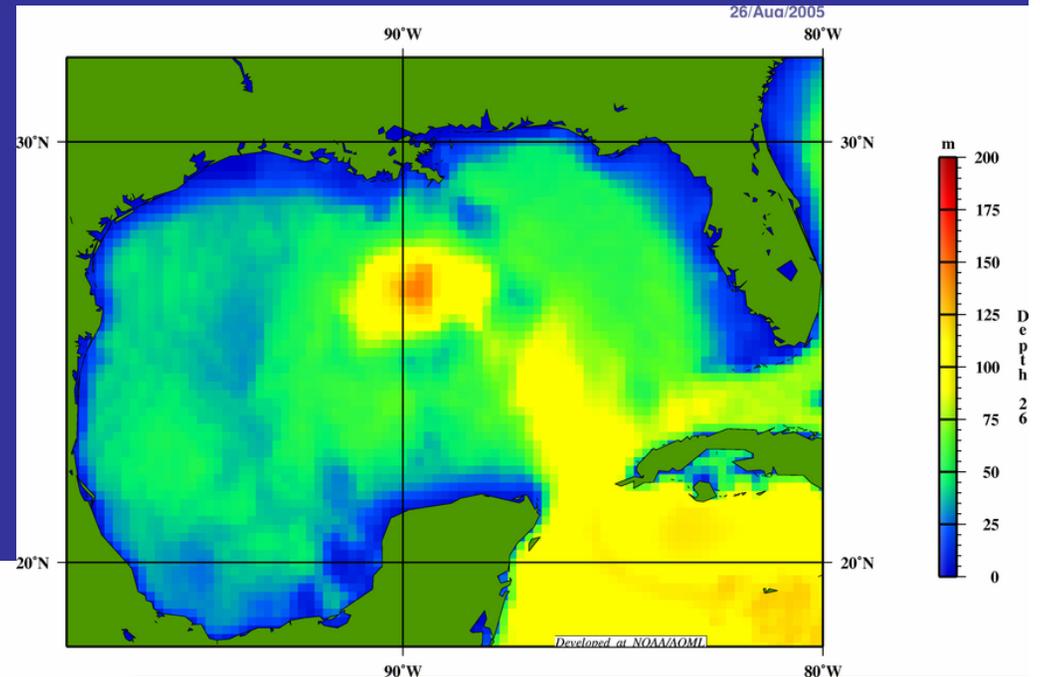
Entire Season



Major hurricane probabilities are not spatially homogeneous.

# Role of The Loop Current

Depth of 26C Isotherm



Oceanic Heat Content

Beven

# Probable Maximum Hurricane

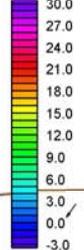
The **PMH** is a hypothetical steady state\* hurricane having a combination of values of meteorological parameters that will give the highest sustained wind speed that can probably occur at a specified coastal location. From values of the parameters, a wind field is specified which is termed the "**PMH** wind field." One of several possible uses of the values of meteorological parameters is to compute maximum storm surge at coastal points when the hurricane approaches along the most critical track. The PMH wind field is also a factor to be considered for calculating wind load. The **PMH** is a rare event. As with the SPH, frequency could be determined for a combination of meteorological parameters used to develop any specific PMH wind field and then combined to determine the recurrence interval for that total event. Other combinations of parameters would give different PMH wind fields, and frequencies could be determined for each. Frequencies would have such a large uncertainty as to make the effort meaningless

# Hurricane Katrina

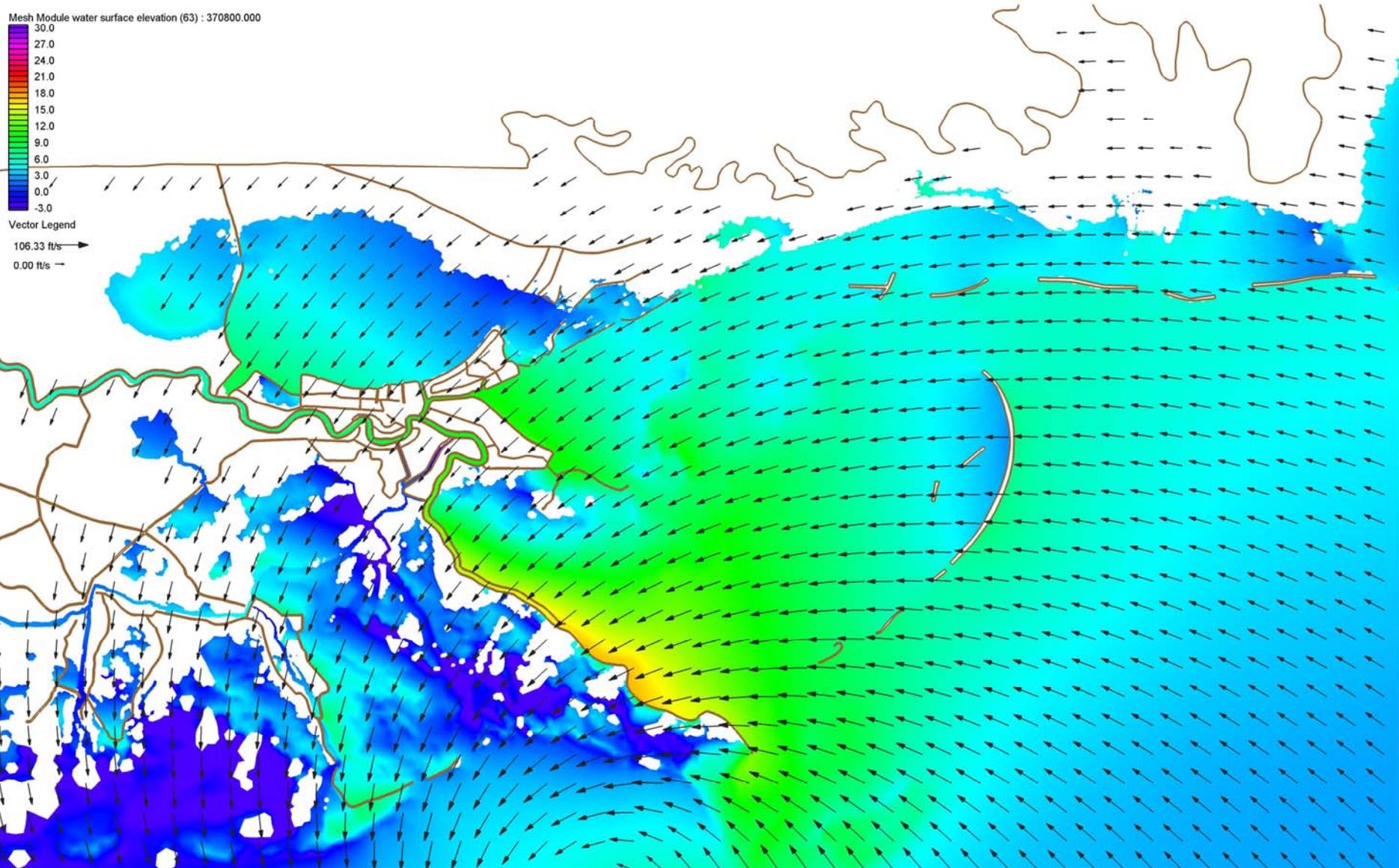
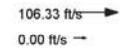
The next few slides show snapshots of ADCIRC computed storm surges using the PBL Windfield Model to simulate Katrina Winds

8/29/10Z

Mesh Module water surface elevation (63) : 370800.000

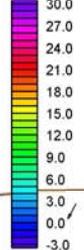


Vector Legend

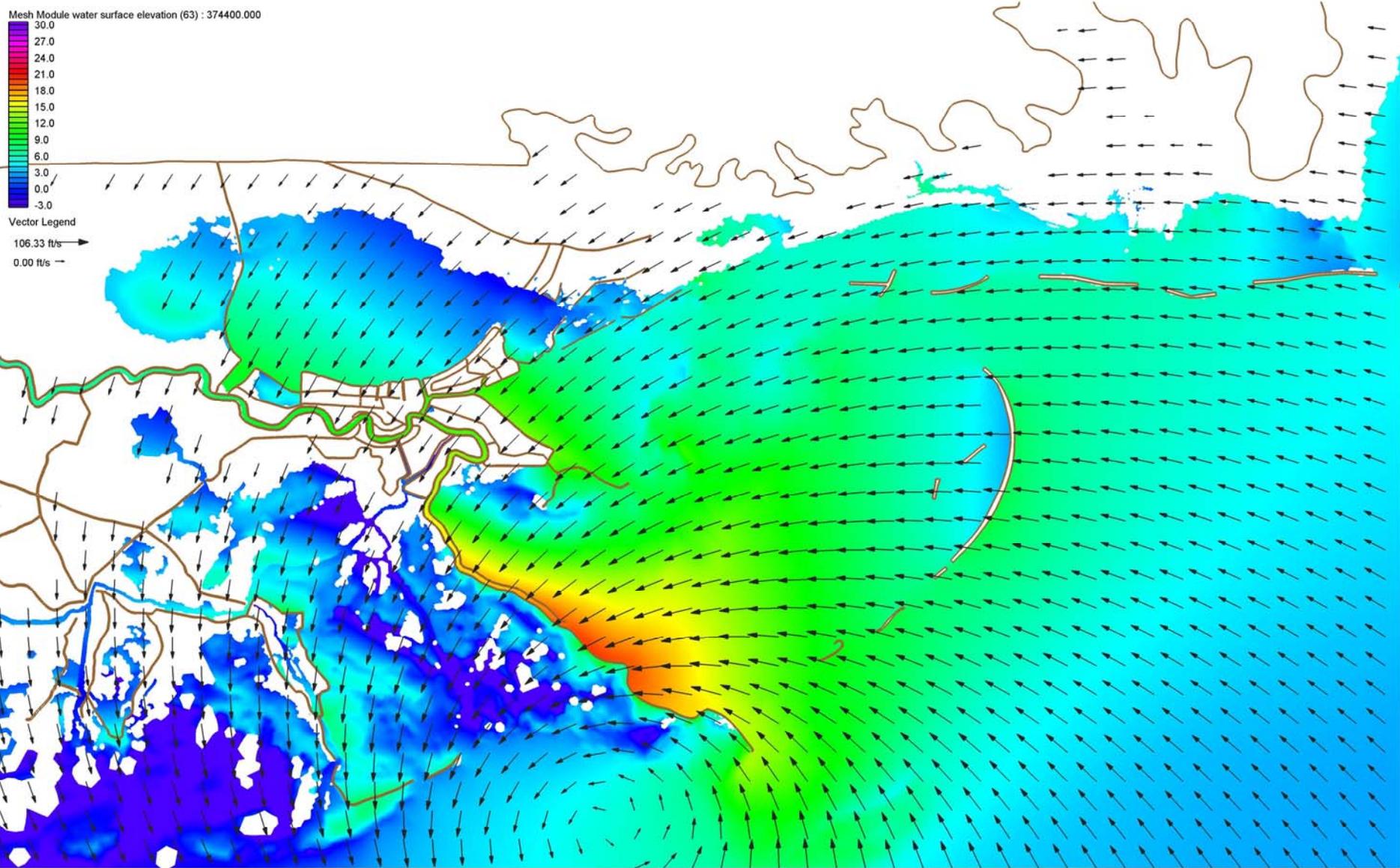
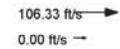


8/29/11Z

Mesh Module water surface elevation (63) : 374400.000

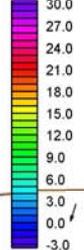


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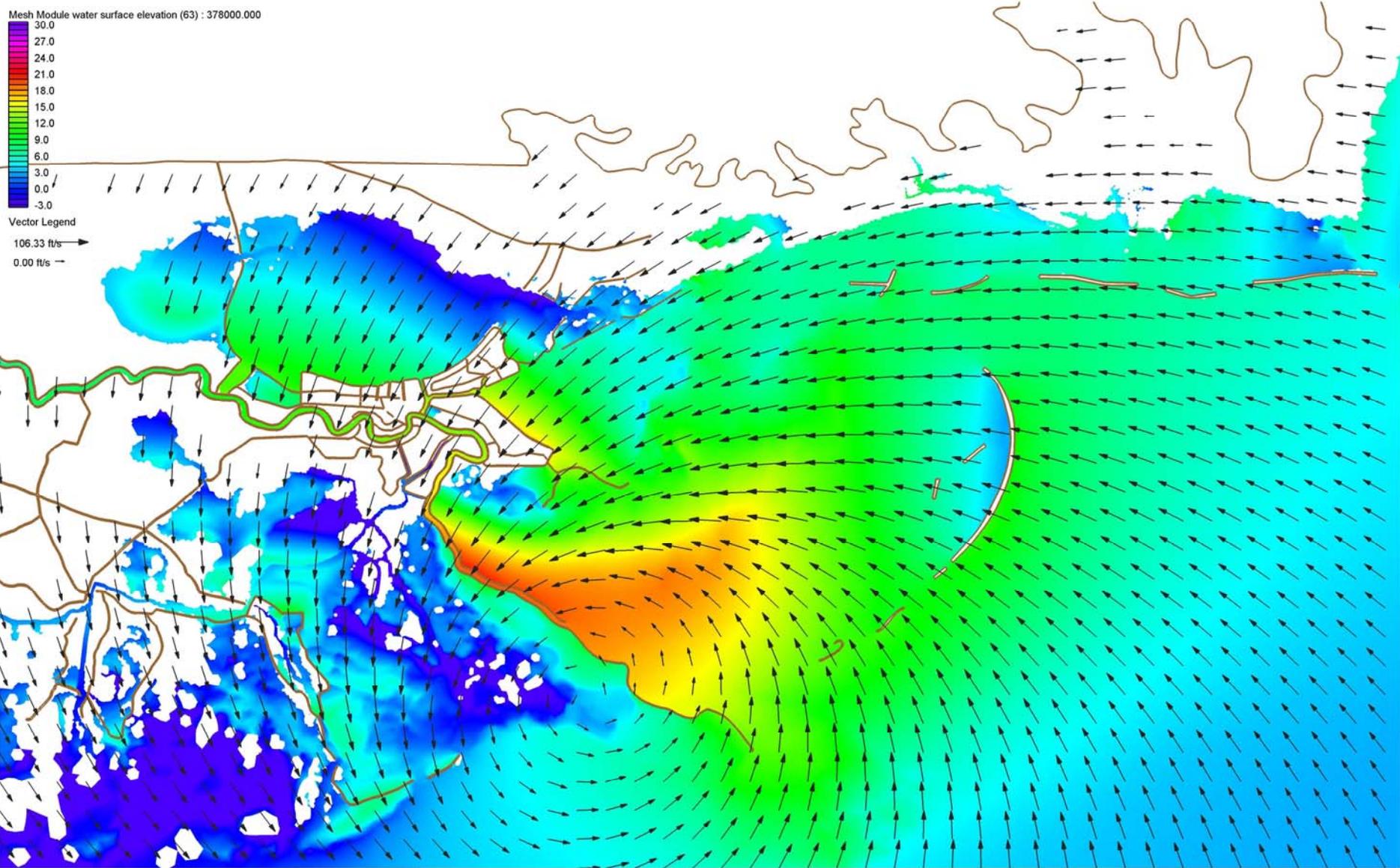
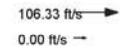


8/29/12Z

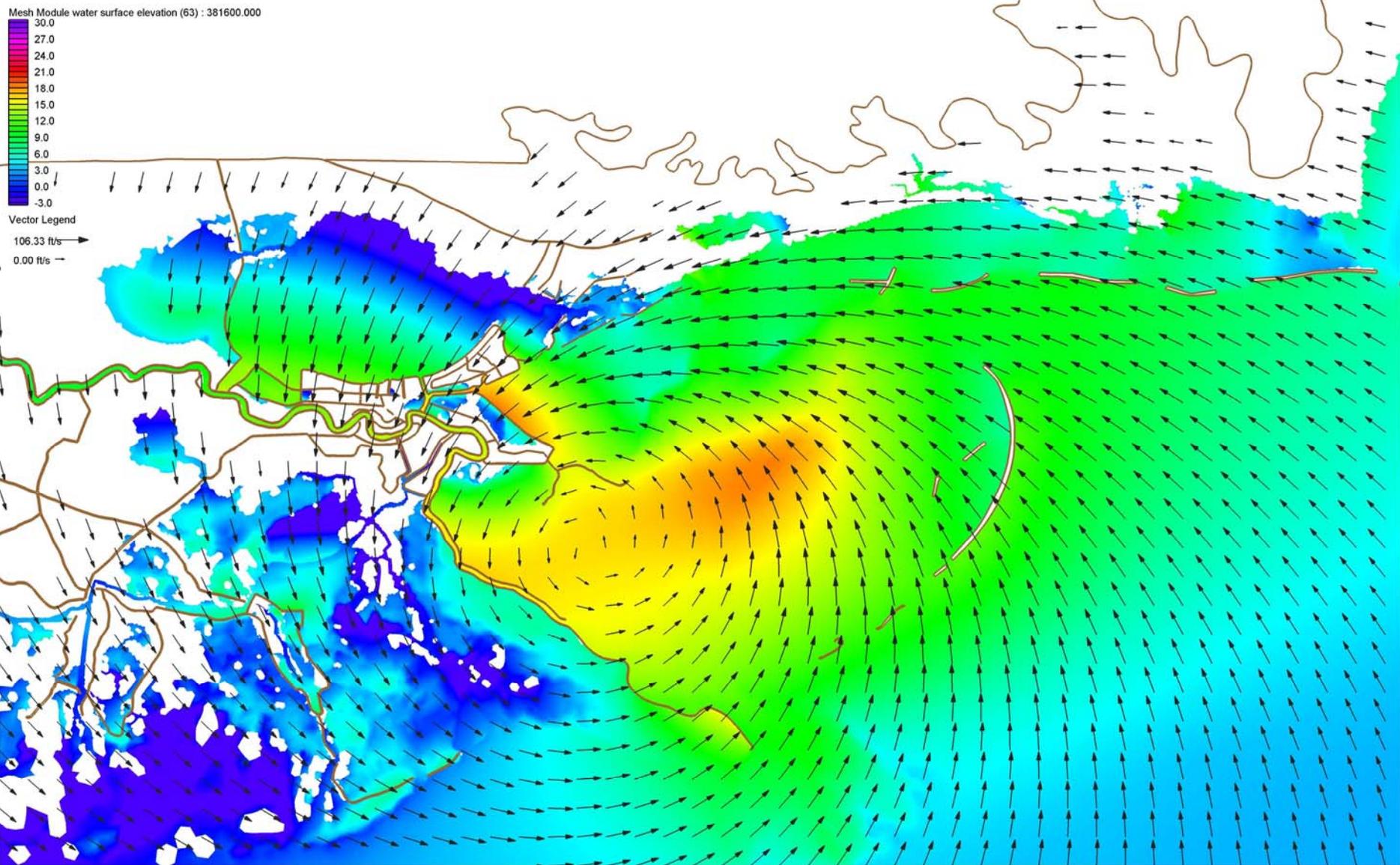
Mesh Module water surface elevation (63) : 378000.000



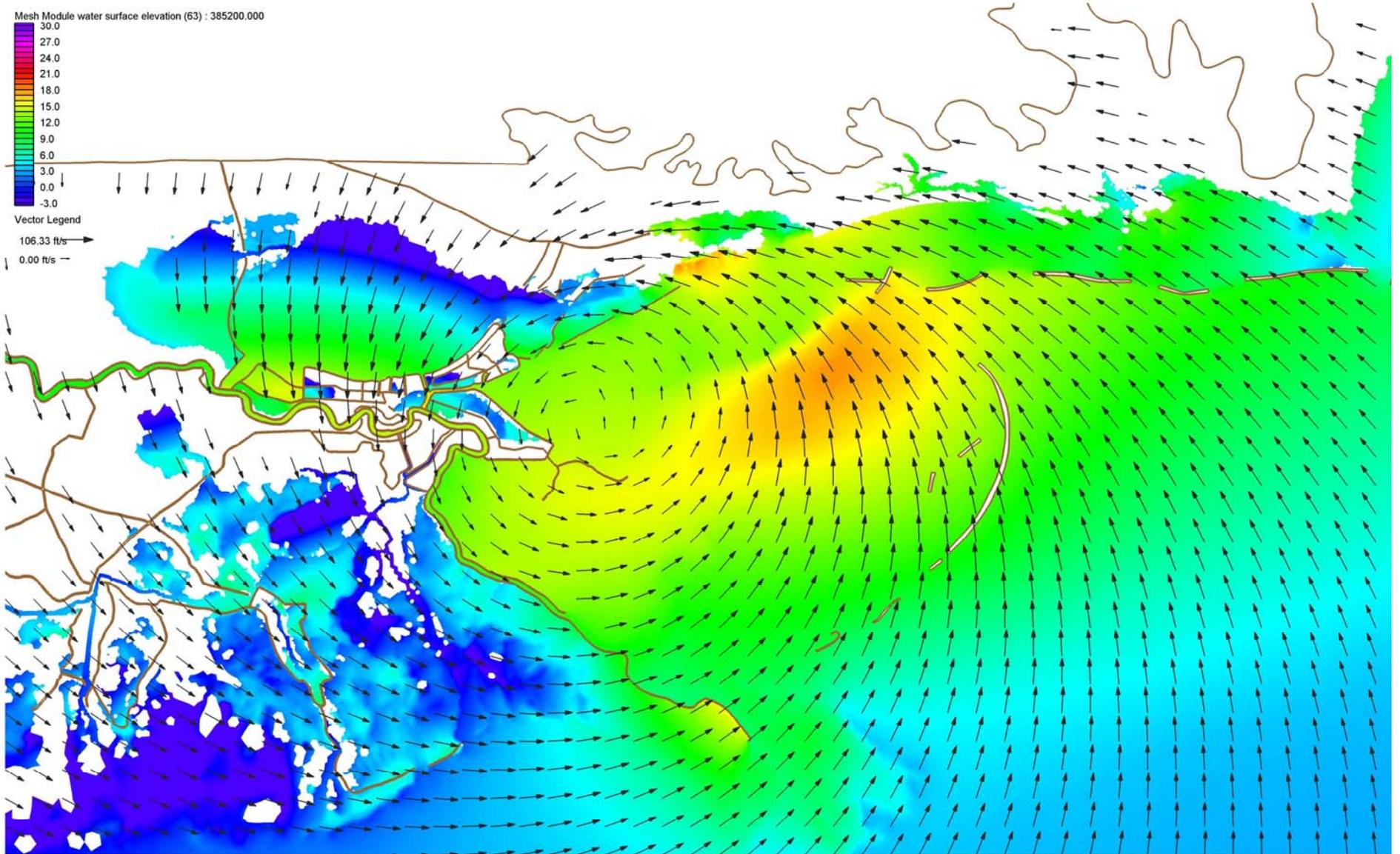
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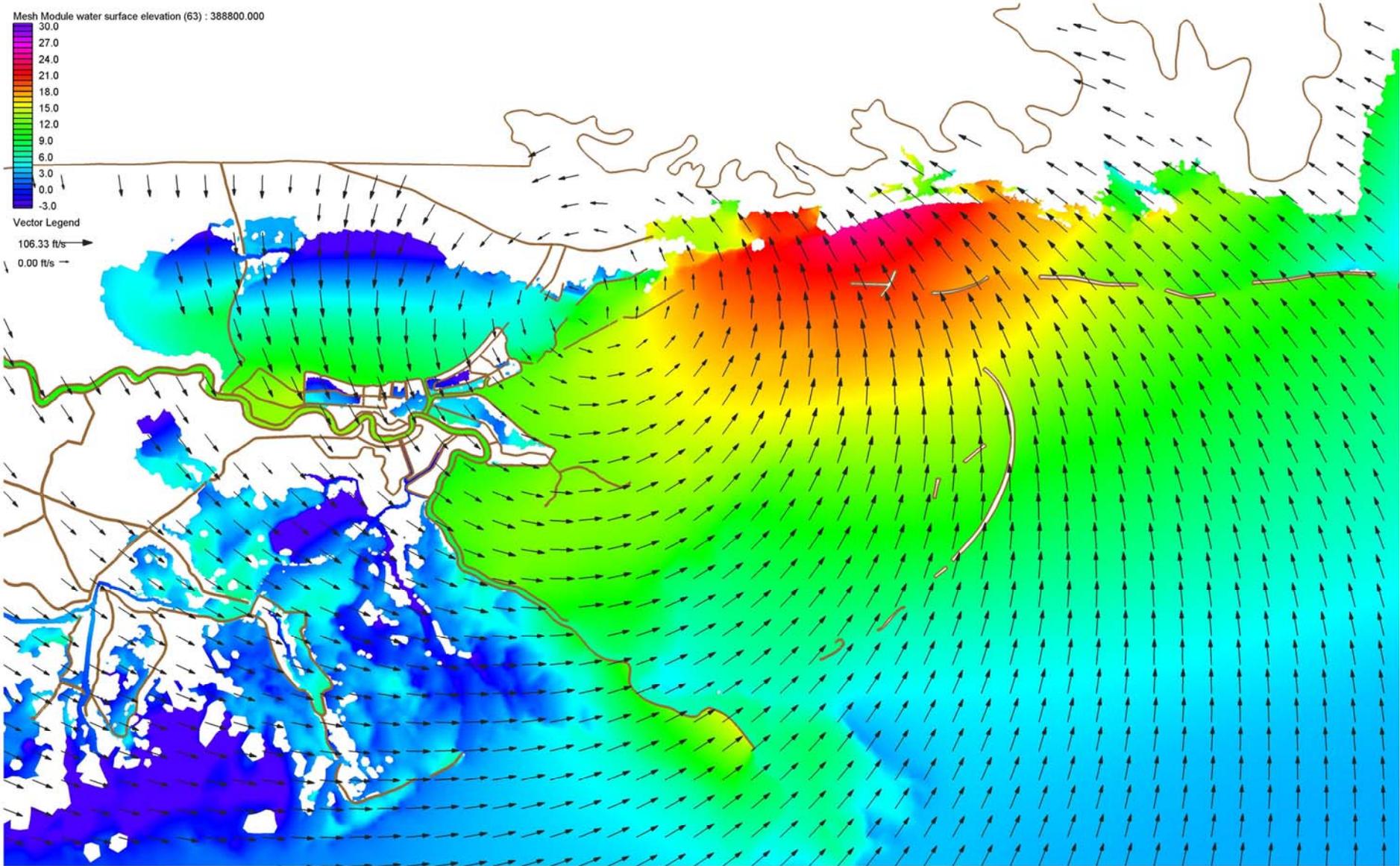
8/29/13Z



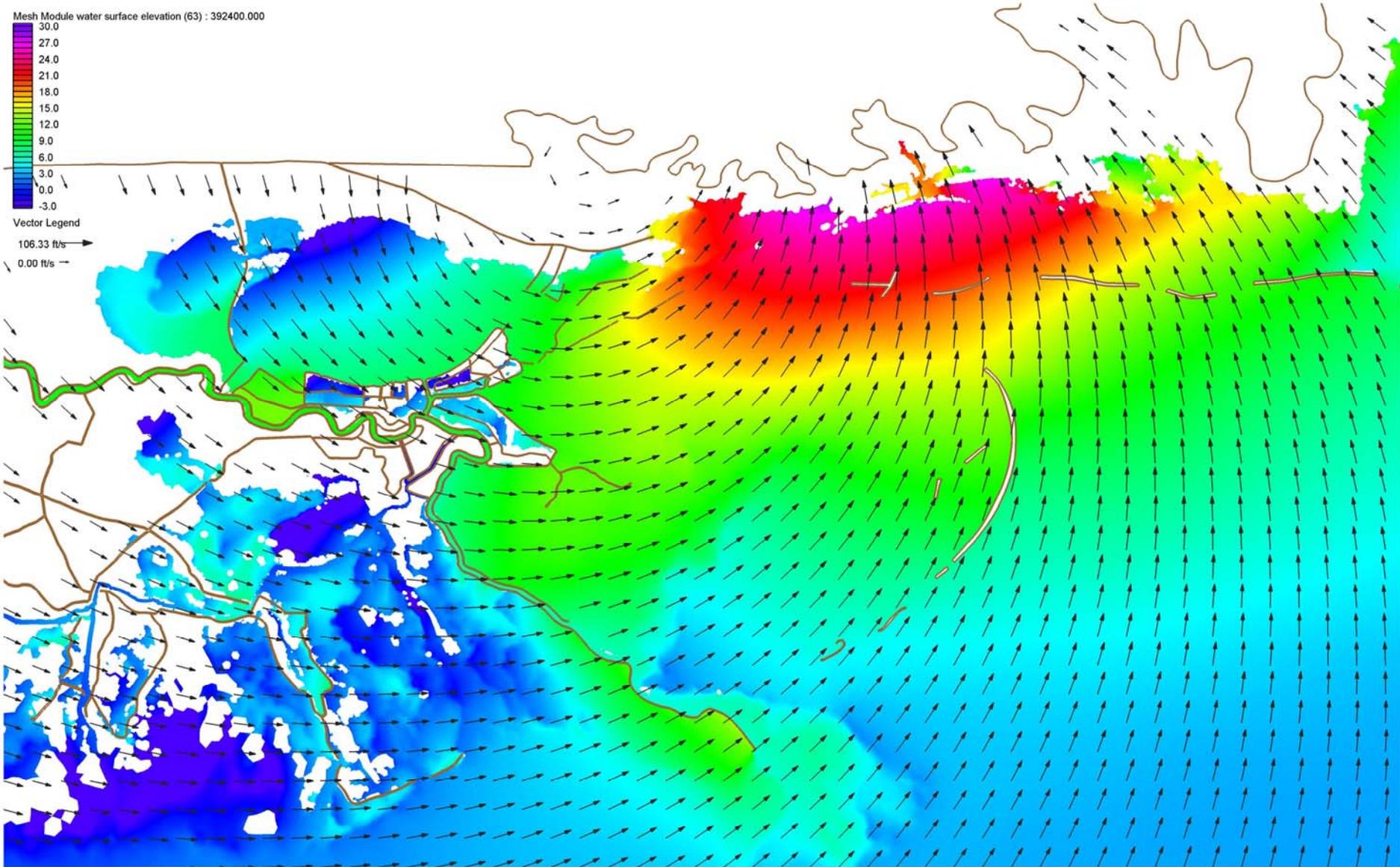
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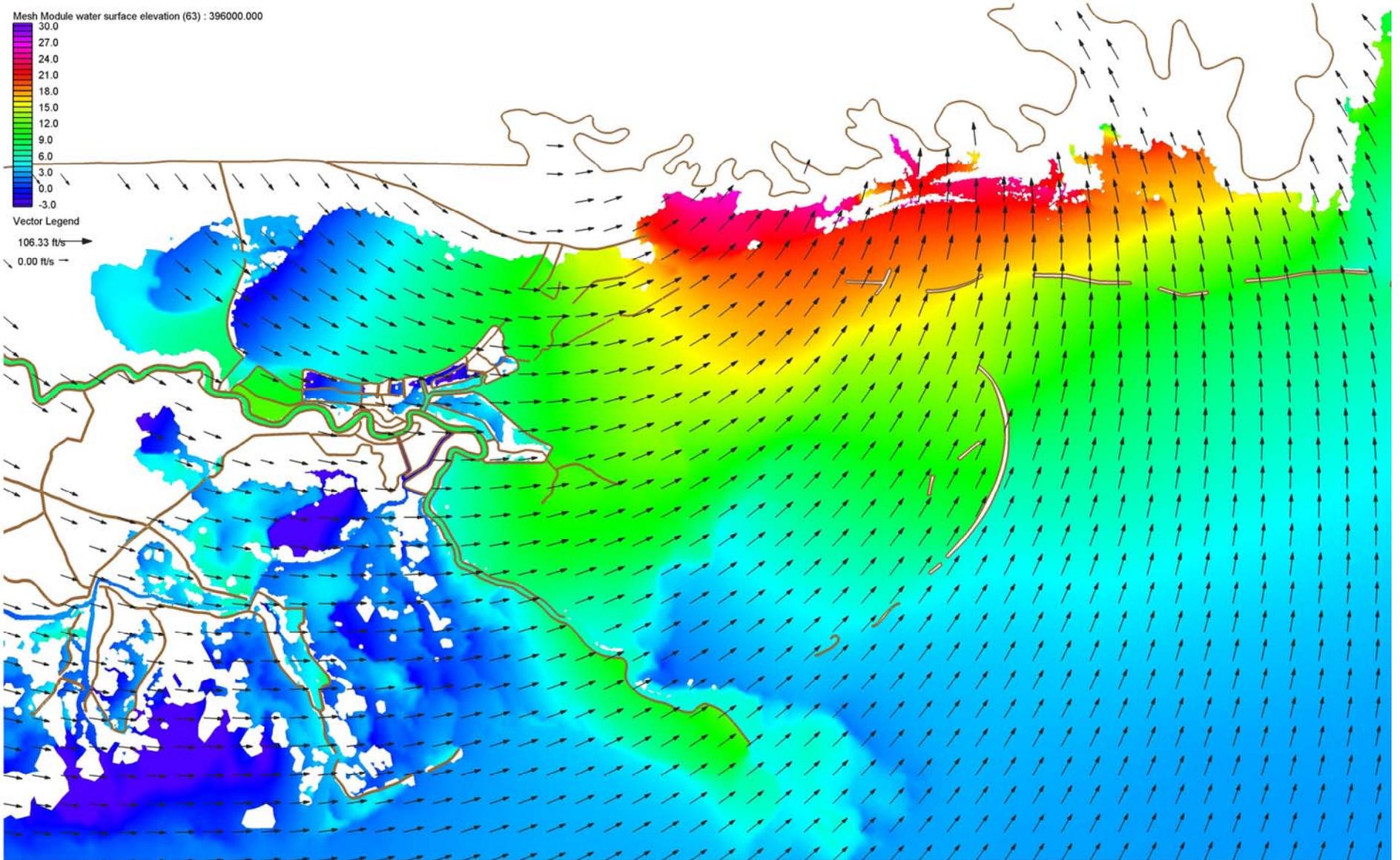
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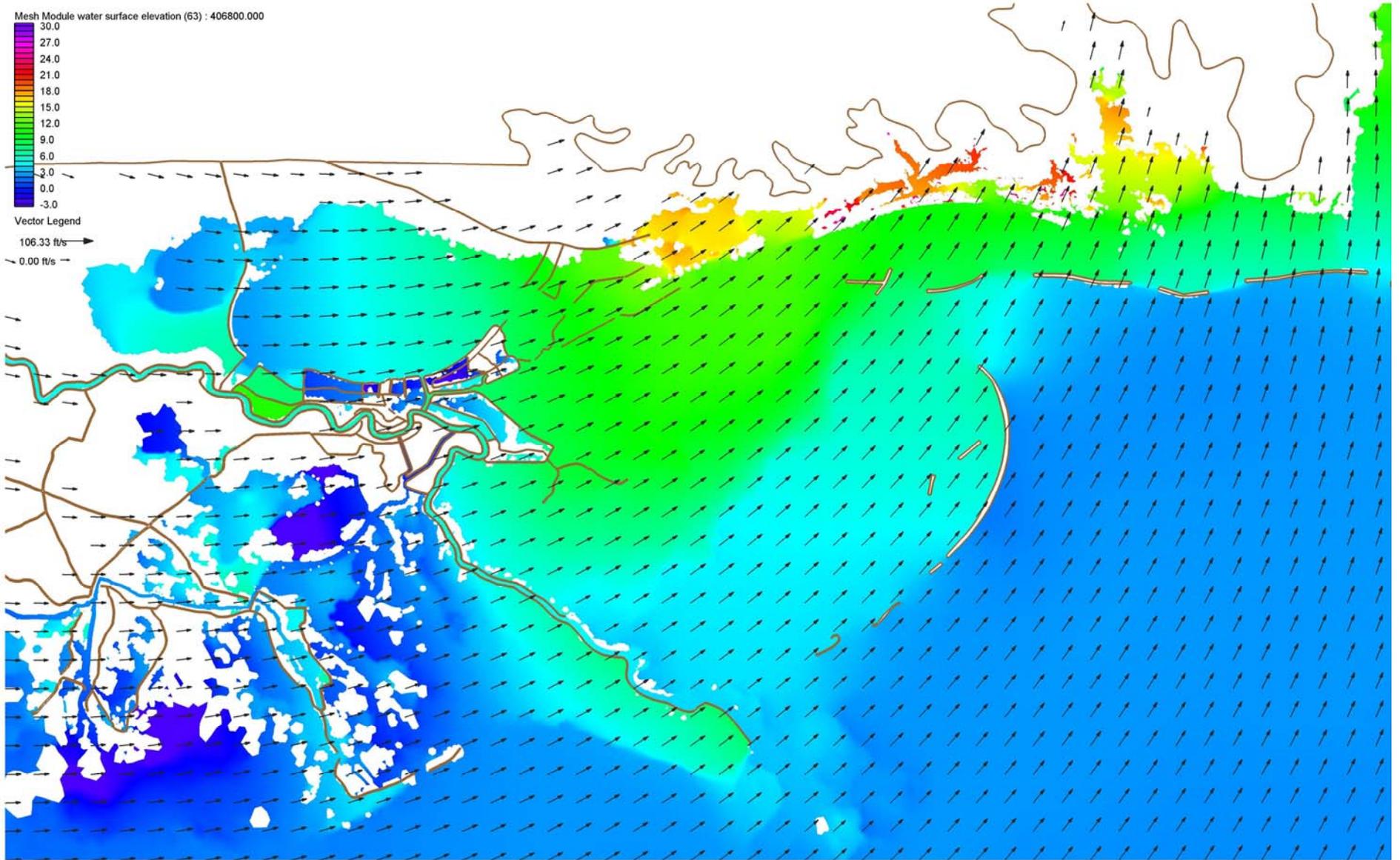
8/29/16Z



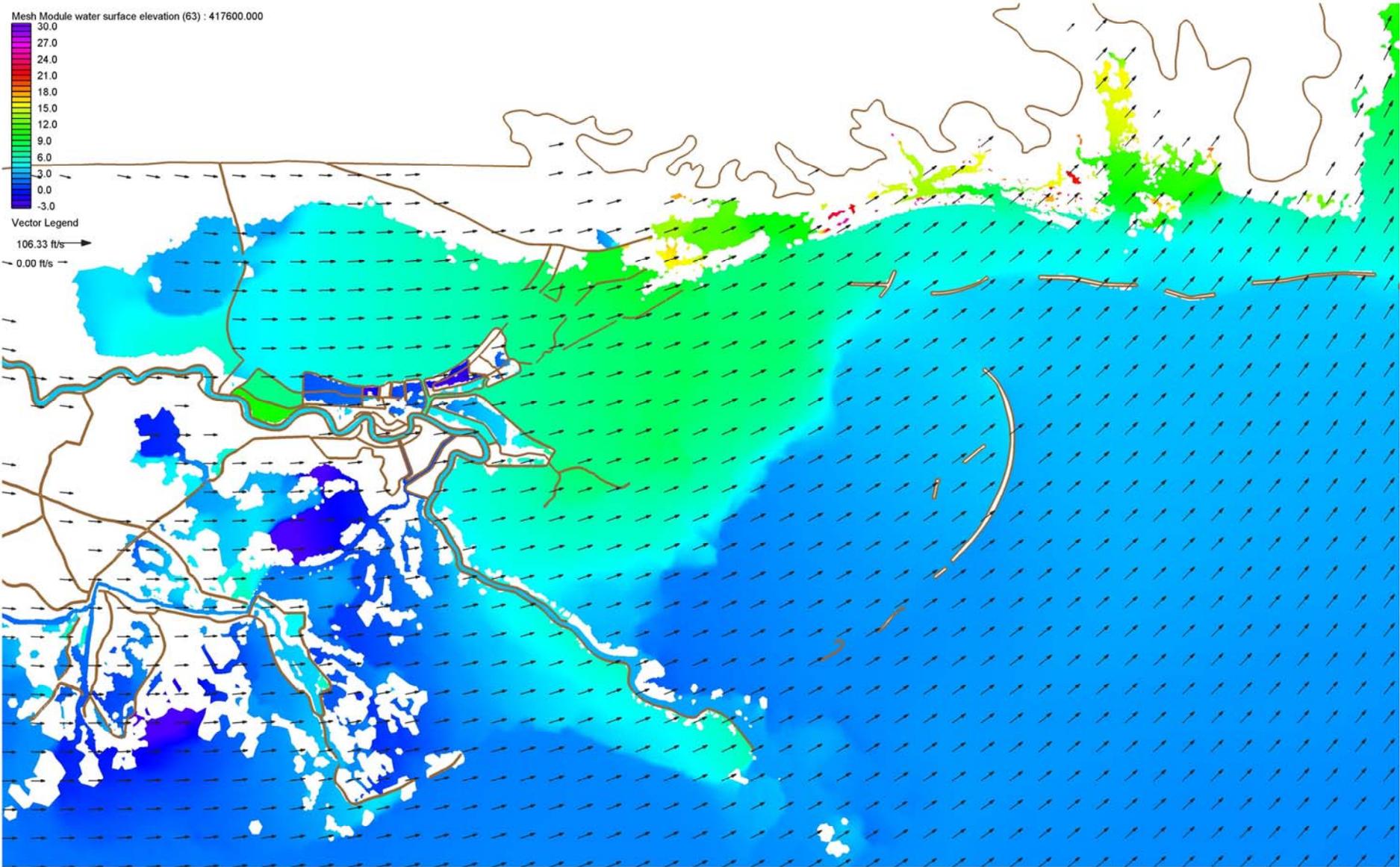
8/29/17Z



8/29/20Z



8/29/23Z

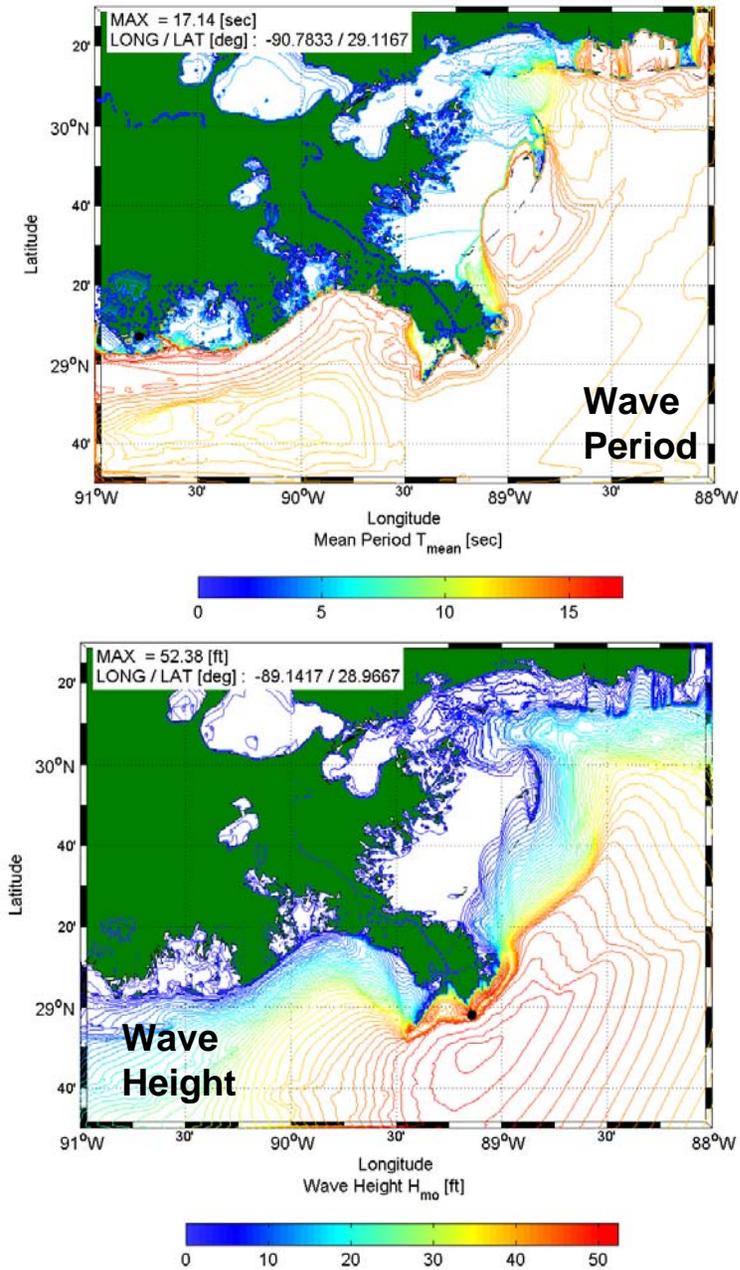


# ADCIRC Simulation Hurricane Betsy 1965

[s08-betsy.avi](#)

# Waves

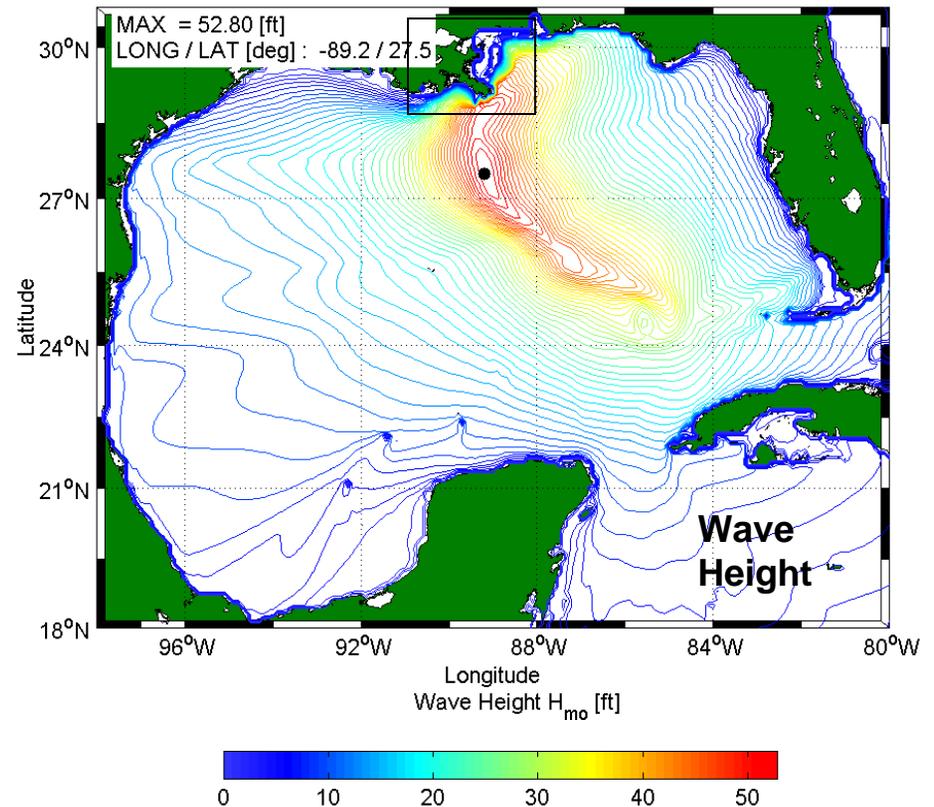
## Regional-Scale WAM Model



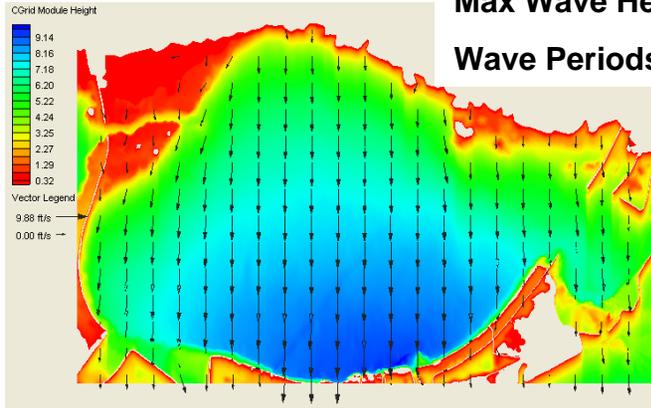
## Nested Offshore Wave Modeling Approach

- Lateral boundary conditions for regional-scale model from the basin-scale model
- Winds from higher-resolution regional wind fields

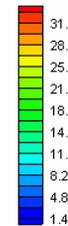
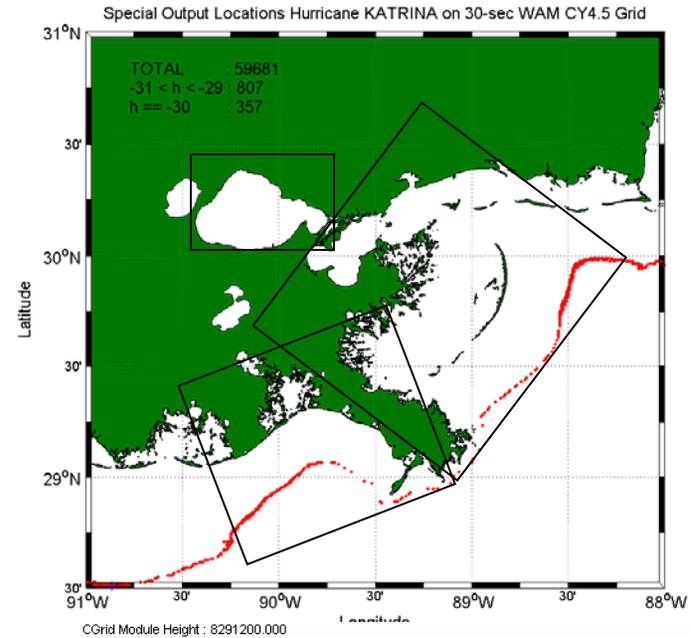
## Basin-Scale WAM Model



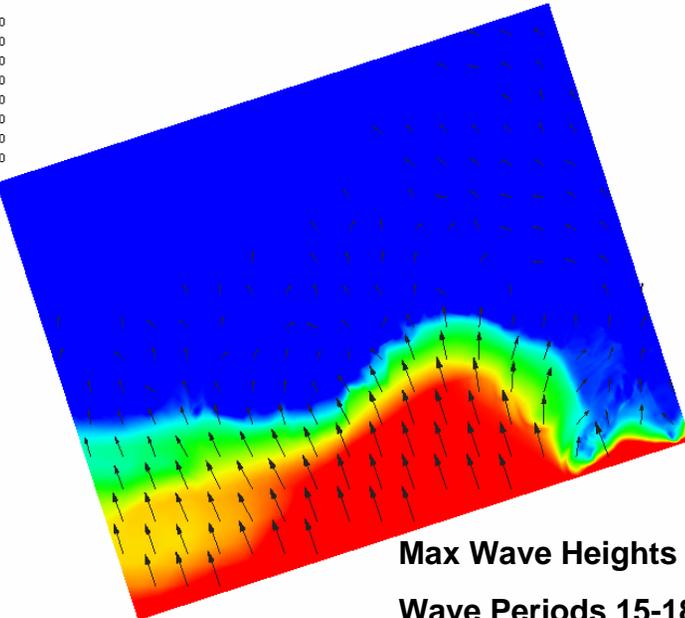
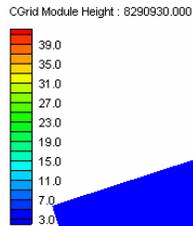
# Nearshore Wave Modeling



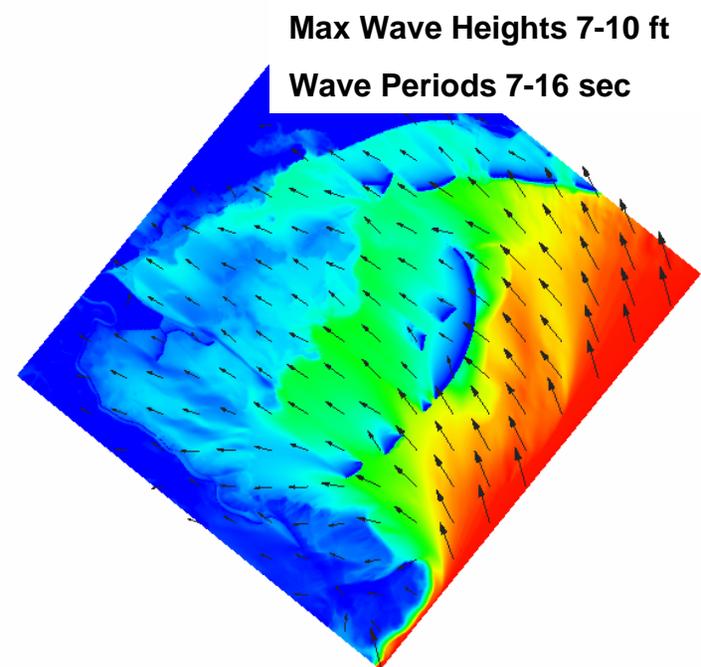
**Max Wave Heights 8-9 ft**  
**Wave Periods 7-8 sec**



**Max Wave Heights 7-10 ft**  
**Wave Periods 7-16 sec**



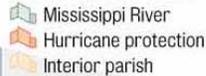
**Max Wave Heights 10-13 ft**  
**Wave Periods 15-18 sec**



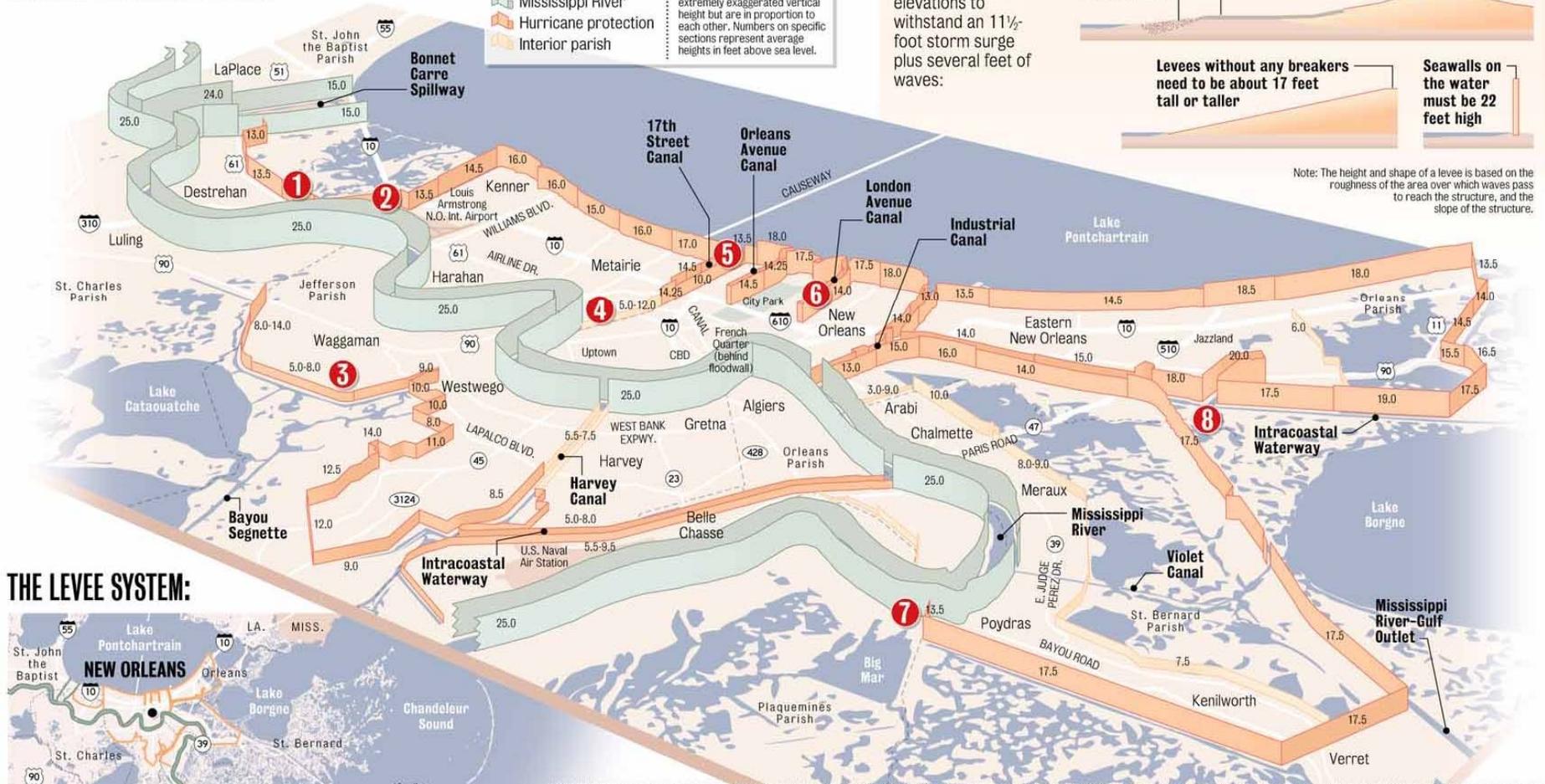
# Examination of Federal Levee/Floodwall System

## BARRIERS OF EARTH AND CONCRETE

Levees and floodwalls that protect against flooding from both the Mississippi River and hurricanes are built by the Army Corps of Engineers and are maintained by local levee districts. The corps and the local districts share the construction cost of hurricane levees, while the Mississippi River levees are a federal project. Local levee districts also build and maintain nonfederal, lower-elevation levees with construction money from each district's share of property taxes and state financing.

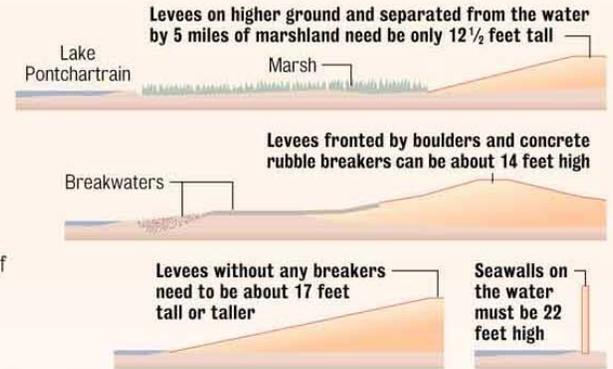
**LEVEES AND FLOODWALLS**  
  
 Mississippi River  
 Hurricane protection  
 Interior parish

Notes: Levee and floodwall elevations are drawn with an extremely exaggerated vertical height but are in proportion to each other. Numbers on specific sections represent average heights in feet above sea level.



## HEIGHT ISN'T EVERYTHING

Different factors permit Lake Pontchartrain levees of varying elevations to withstand an 11½-foot storm surge plus several feet of waves:



Note: The height and shape of a levee is based on the roughness of the area over which waves pass to reach the structure, and the slope of the structure.

Graphic from Times Picayune