A satellite image of Hurricane Katrina, showing a well-defined eye and a dense, swirling cloud structure over the Gulf of Mexico. The colors range from blue (low cloud tops) to white (high cloud tops). The hurricane is positioned in the central Gulf, with the coastlines of North America and Central America visible.

Application of STWAVE for Hurricane Katrina

Jane McKee Smith

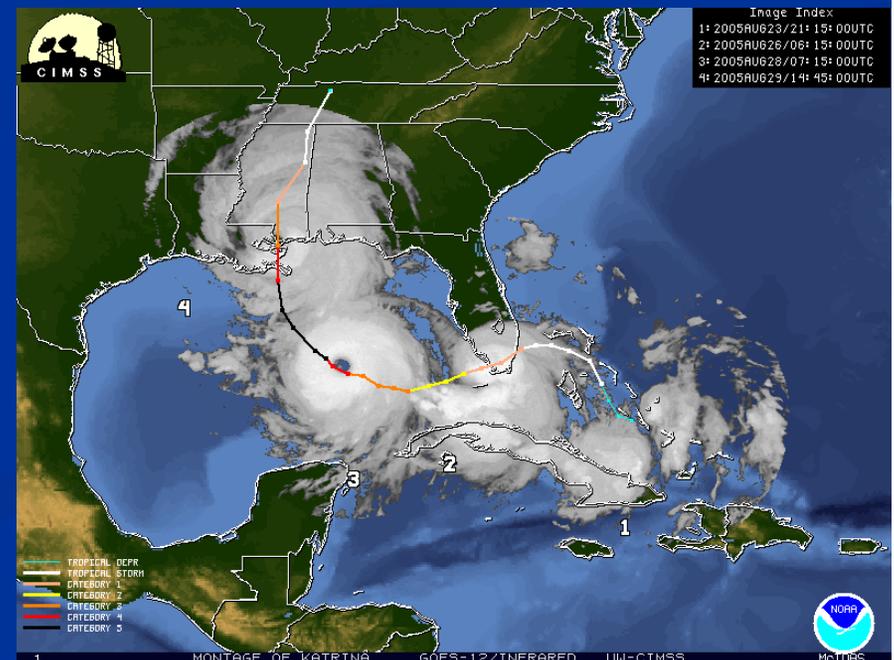
Engineer Research and Development Center

Coastal and Hydraulics Laboratory

US Army Corps of Engineers

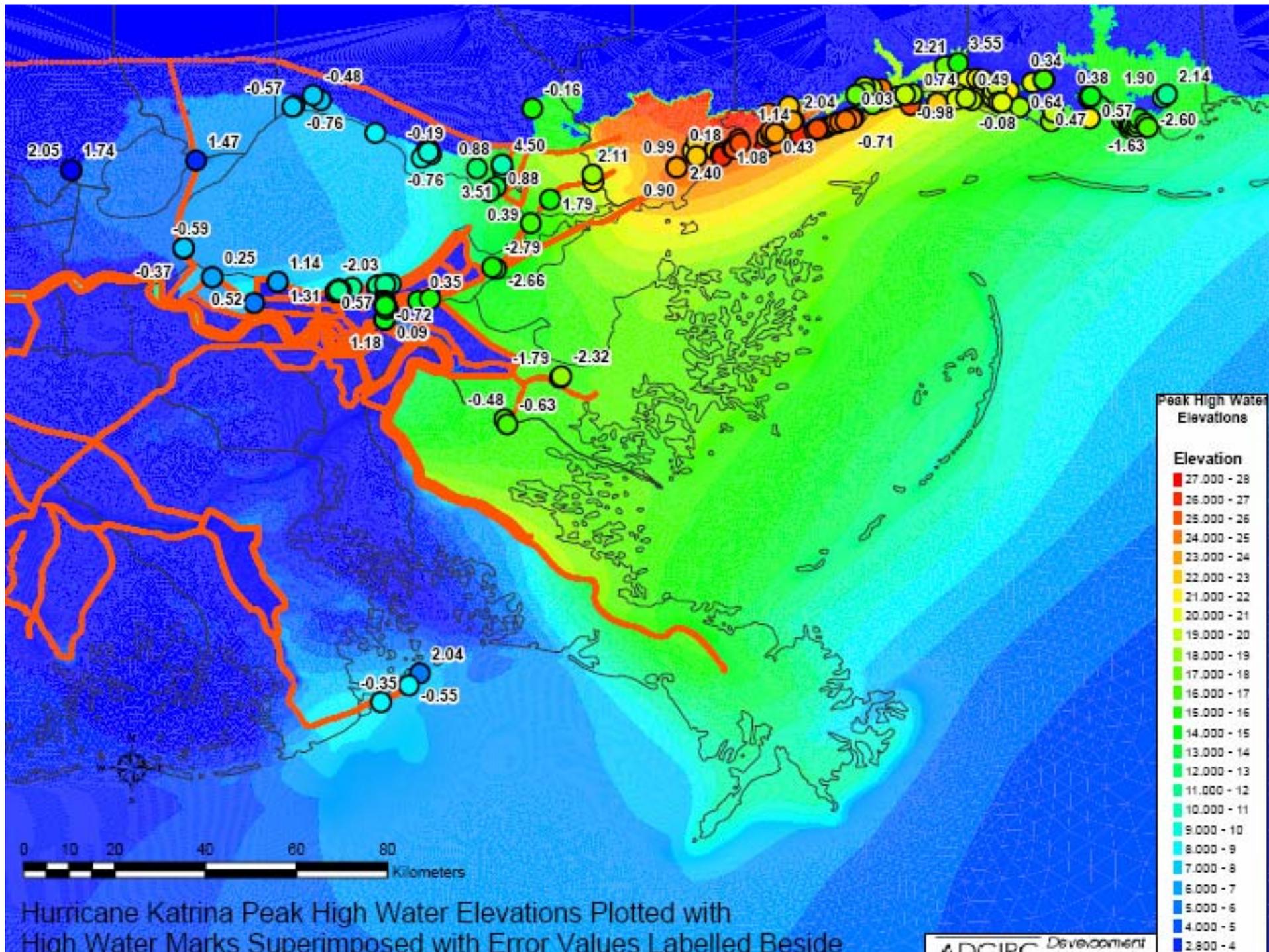
Outline

- STWAVE
- Nearshore wave modeling methodology
- Hurricane Katrina Challenges
 - Bathymetry and datums
 - Validation data
 - Frictional losses across wetlands, barrier island degradation
 - Wind sensitivity
 - Radiation Stresses
- Summary



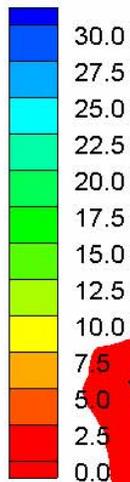
STWAVE

- Steady-state spectra wave model
- Transformation processes
 - Refraction
 - Shoaling
 - Breaking
 - Generation (wind input, white capping, nonlinear interactions)
- Recent upgrades
 - Full-plane (lakes/estuaries)
 - Bottom friction (wetlands)
 - Spatially varying surges and winds



Hurricane Katrina Peak High Water Elevations Plotted with High Water Marks Superimposed with Error Values Labelled Beside

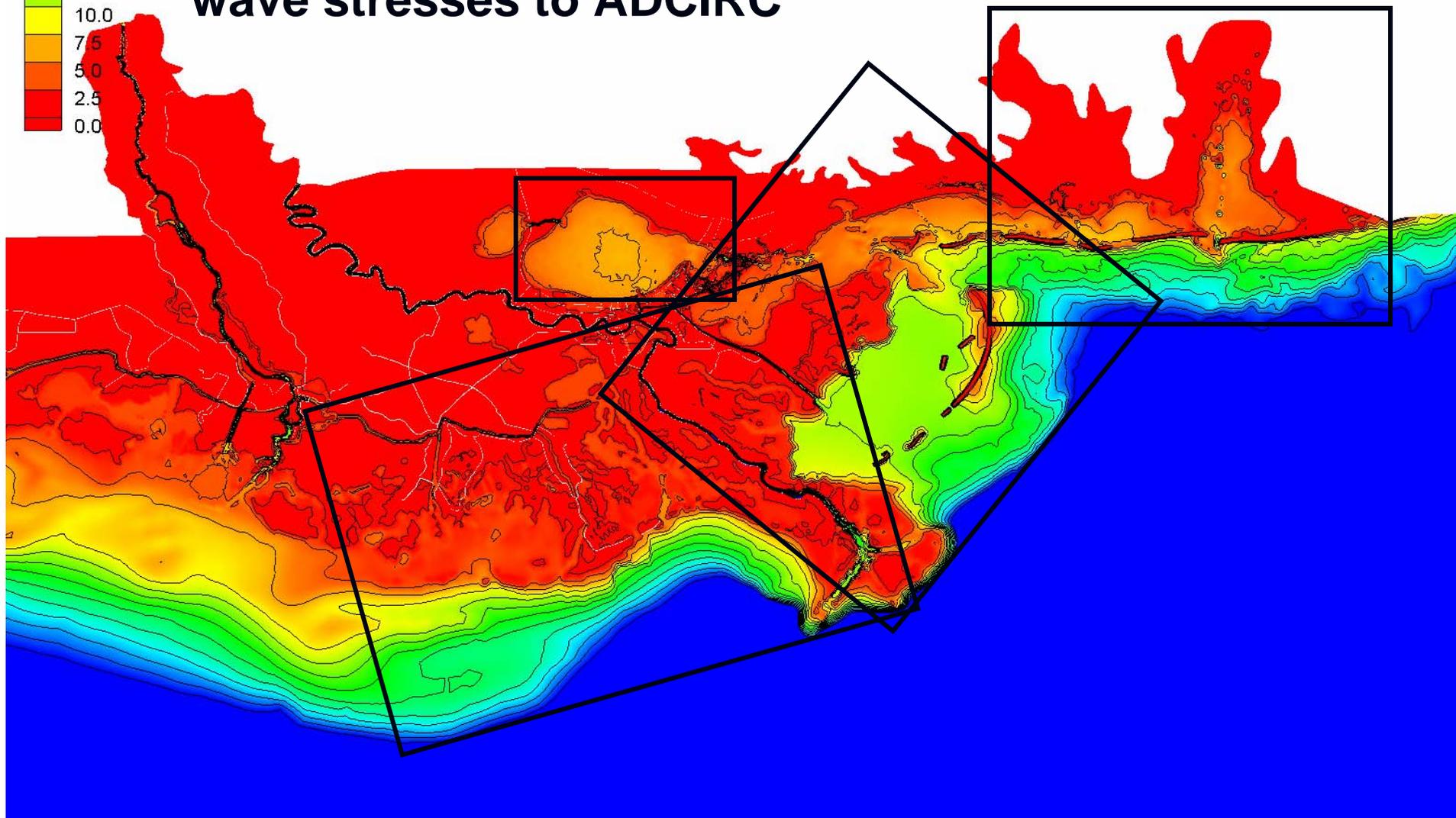
Depth (m)



4 grids, 200-m resolution

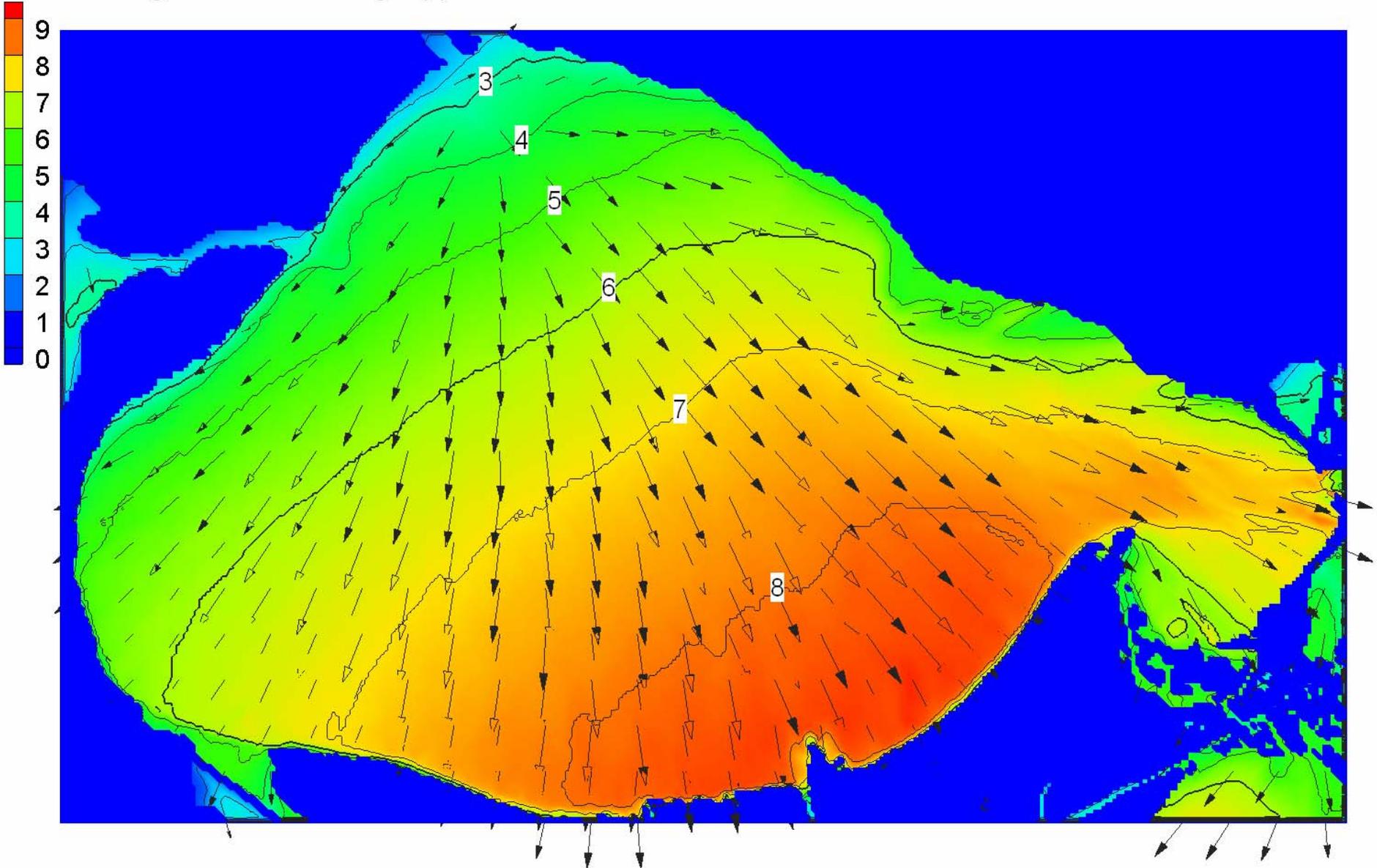
Nested boundary input from WAM

**Surge input from ADCIRC, return
wave stresses to ADCIRC**



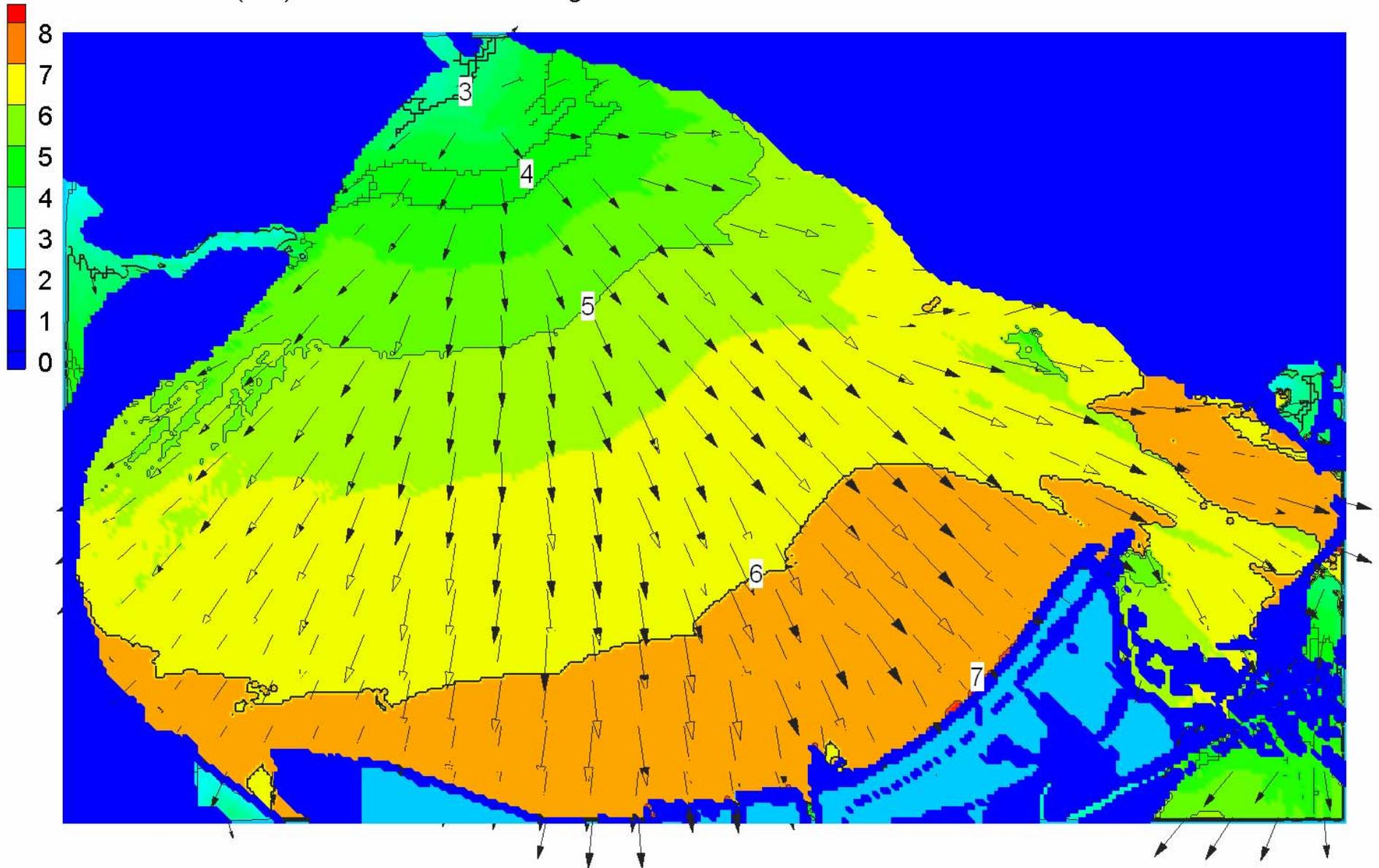
Lake Pontchartrain – Max Wave Height

Maximum Significant Wave Height (ft)

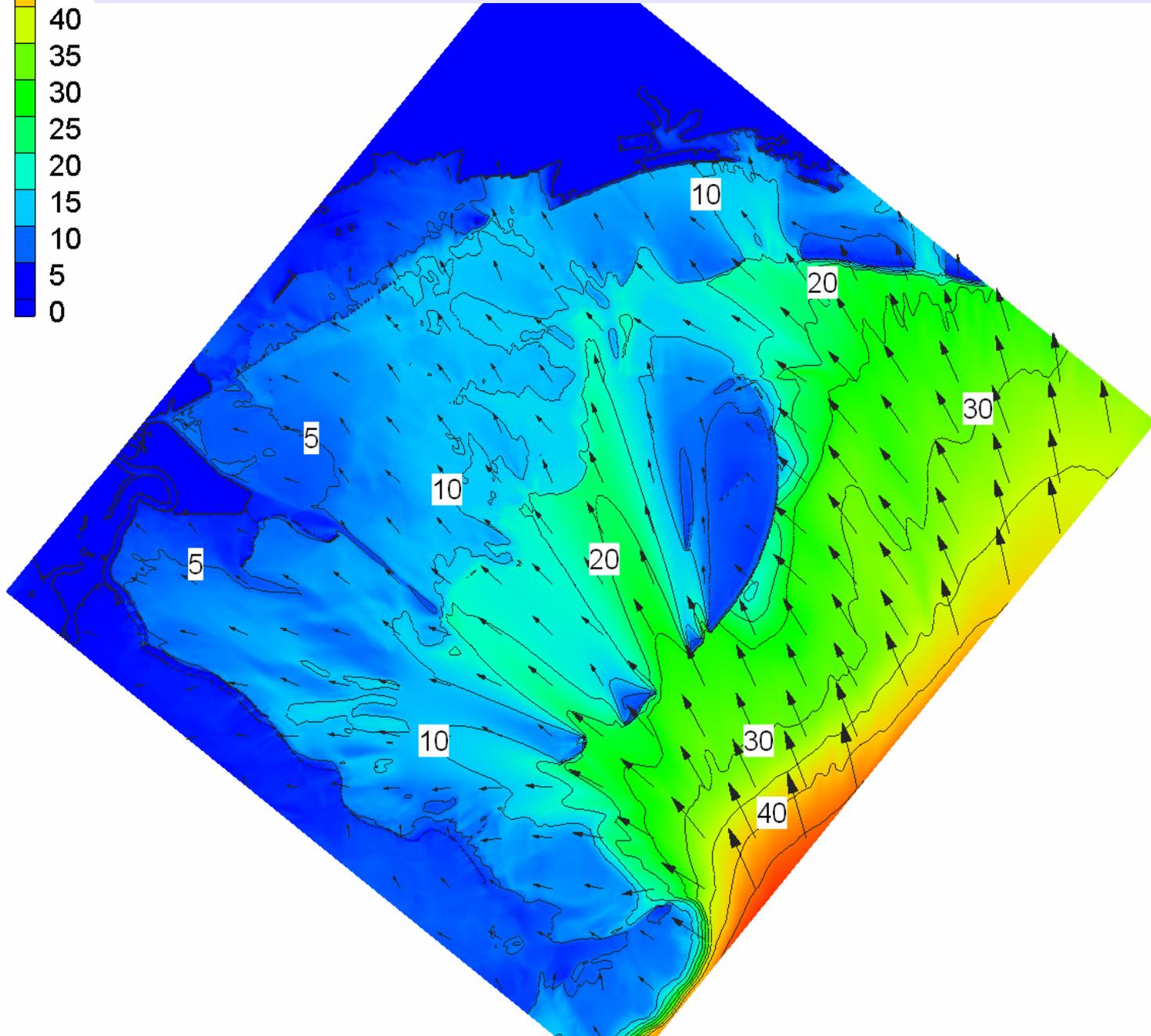
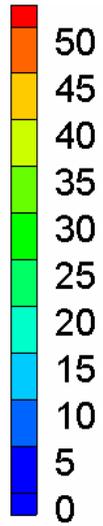


Lake Pontchartrain – Max Peak Period

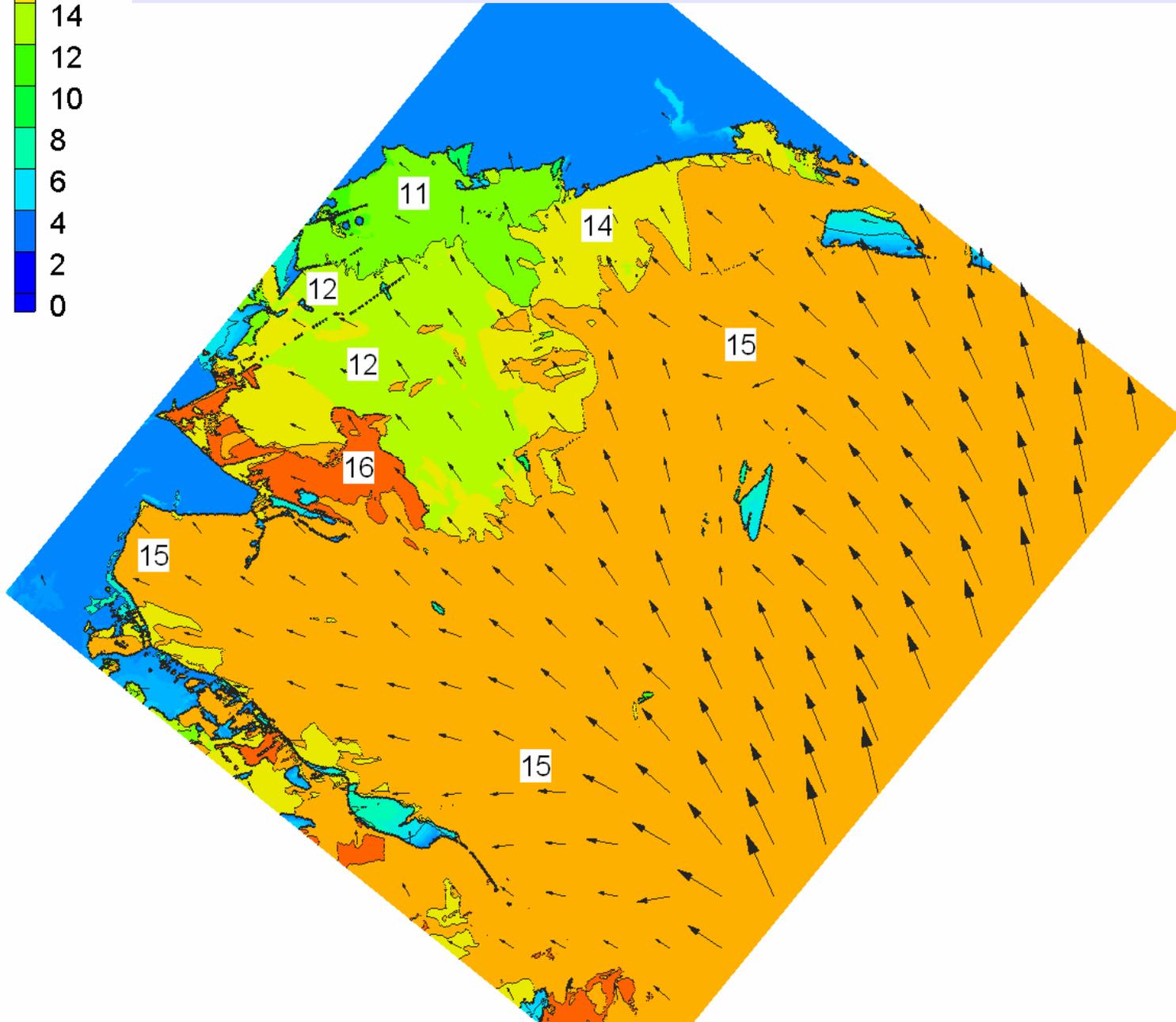
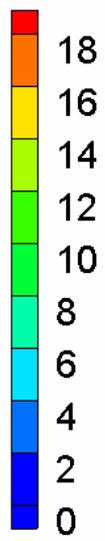
Peak Wave Period (sec) at Maximum Wave Height



Southeast Domain – Max Wave Height



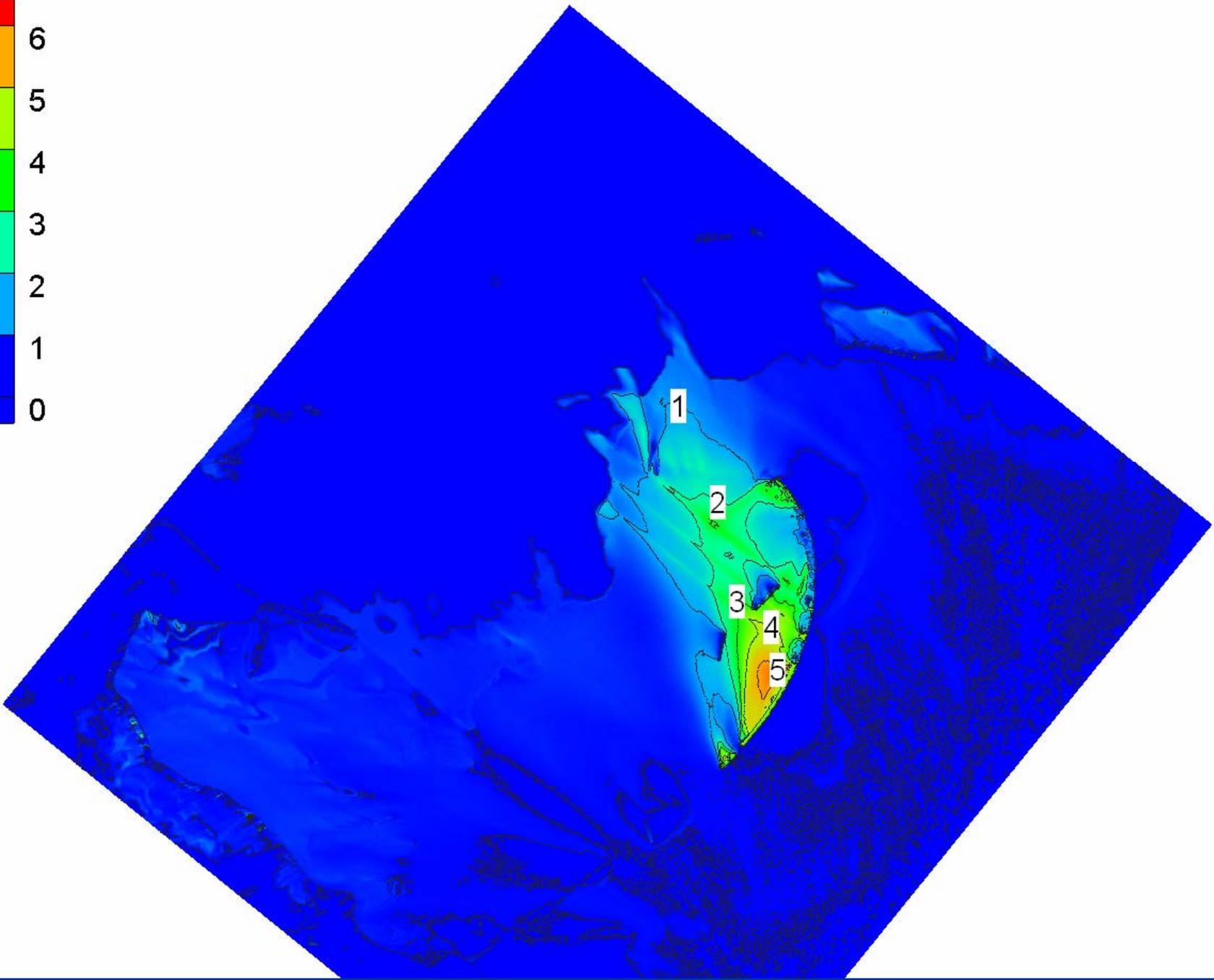
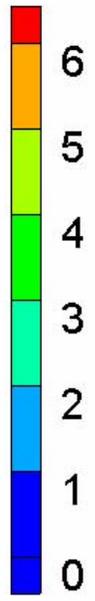
Southeast Domain – Max Peak Period



Nearshore Modeling Challenges

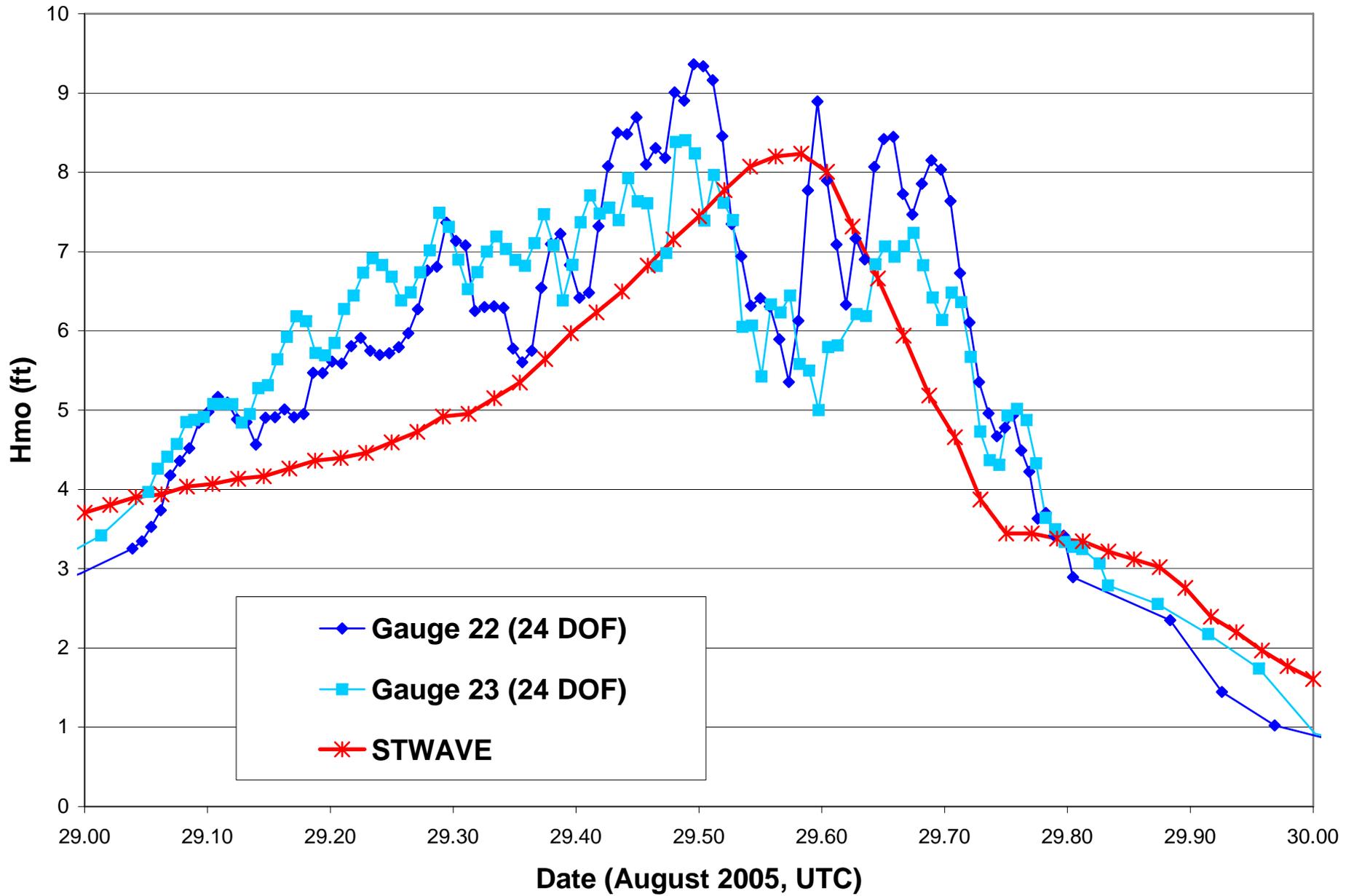
- Bathymetry and datums
 - Subsidence (~ 3 to 4 ft/100 yrs)
 - Surveys relative to local datums
 - Wetland and barrier island loss

Difference in Wave Height (ft); Chandeleurs Degraded - Base



Nearshore Modeling Challenges

- Validation data
 - Only 2 nearshore gauges (Lake Pontchartrain)
 - Didn't function at storm peak



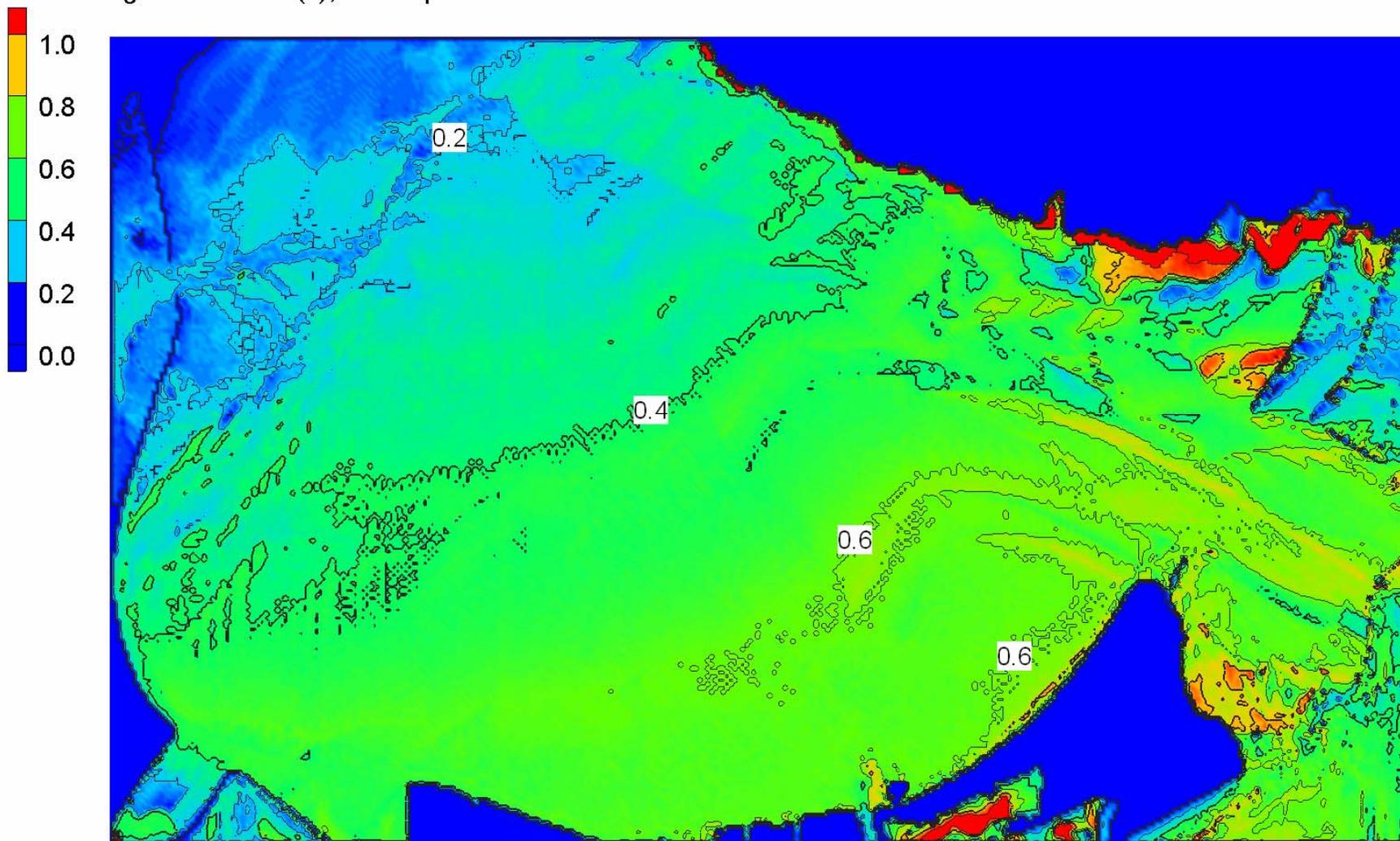
Nearshore Modeling Challenges

- Sensitivity
 - Simulations with +/-5% winds
 - Offshore waves, surges, and nearshore waves all simulated

Wind Sensitivity (± 5 percent)

- Generally $< \pm 1$ ft
- Outside barrier islands $< \pm 3$ ft

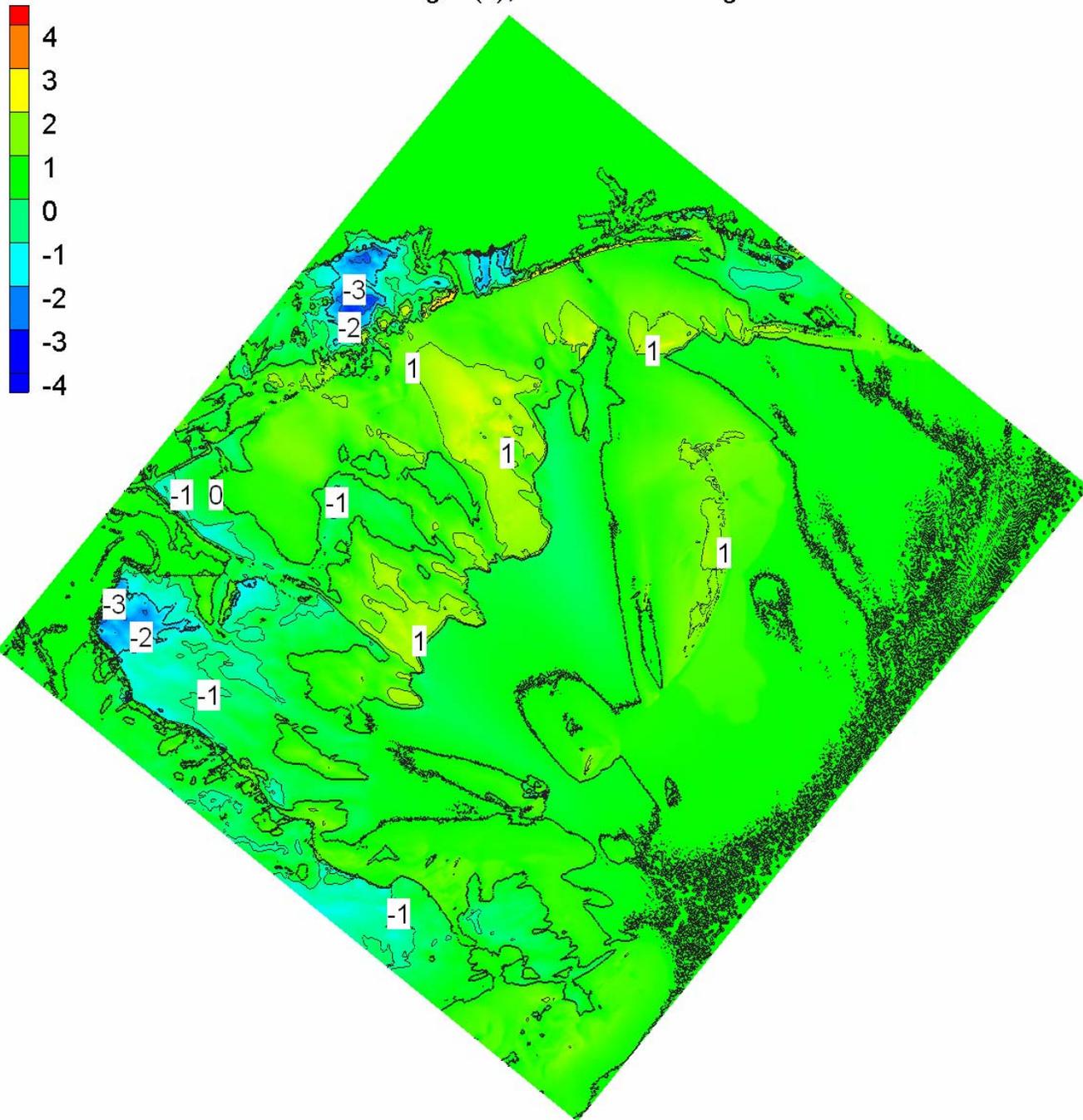
Wave Height Difference (ft), Plus 5 percent winds - base



Nearshore Modeling Challenges

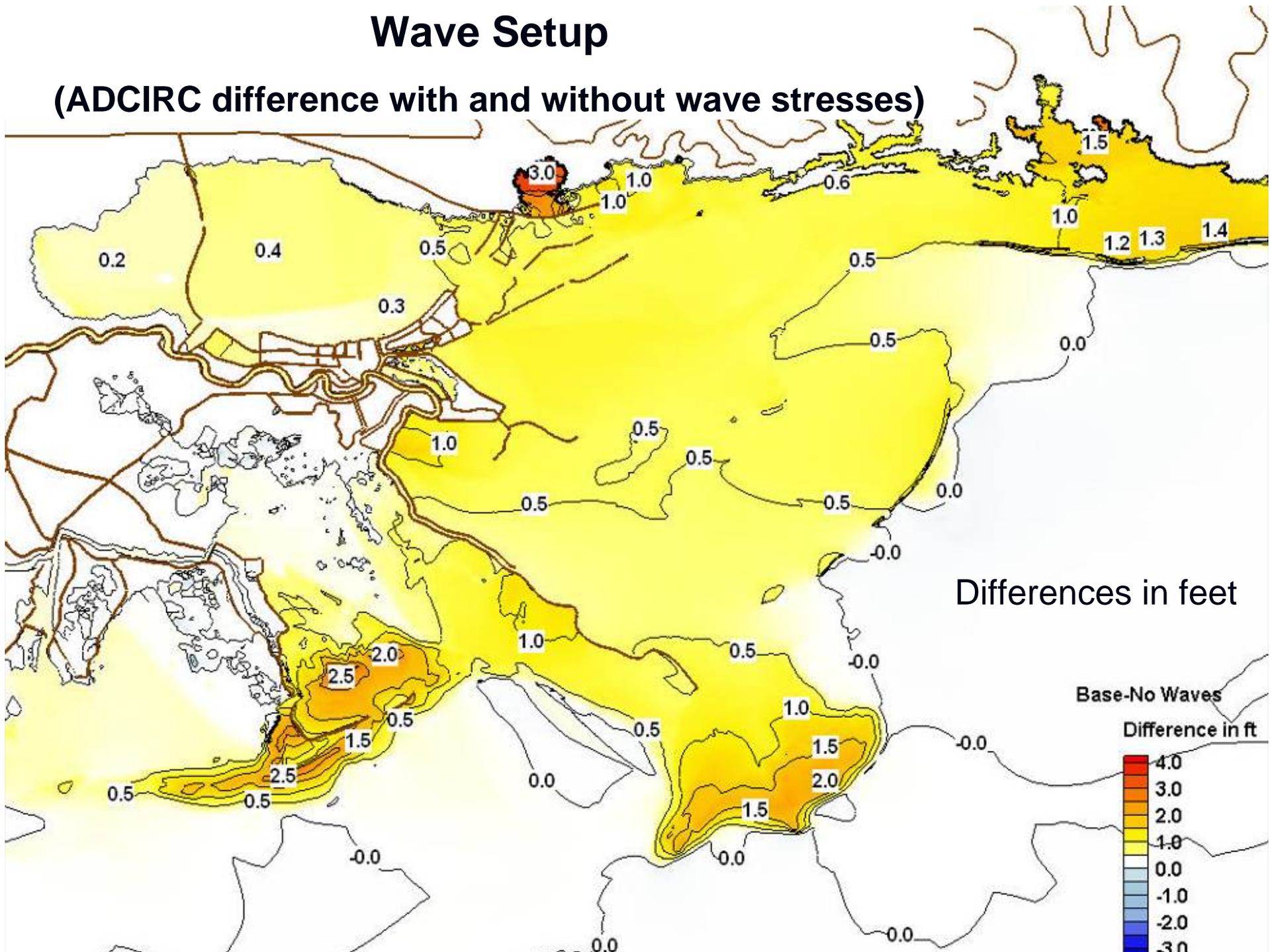
- Frictional losses across wetlands Using USGS vegetation maps (pre & post, Manning n)
- Base
 - STWAVE run with no friction
 - ADCIRC run with constant friction factor

Difference in Maximum Wave Height (ft); Pre-Katrina Roughness - Base



Wave Setup

(ADCIRC difference with and without wave stresses)



Summary

- Forensic evaluation of levee system
- Nearshore modeling challenges
 - Bathymetry and datums
 - Validation data
 - Frictional losses across wetlands
 - Sensitivity
 - Radiation stress/wave setup
- Areas of future work
 - Role of wetland in wave and surge attenuation
 - Understanding and modeling of wave setup contribution