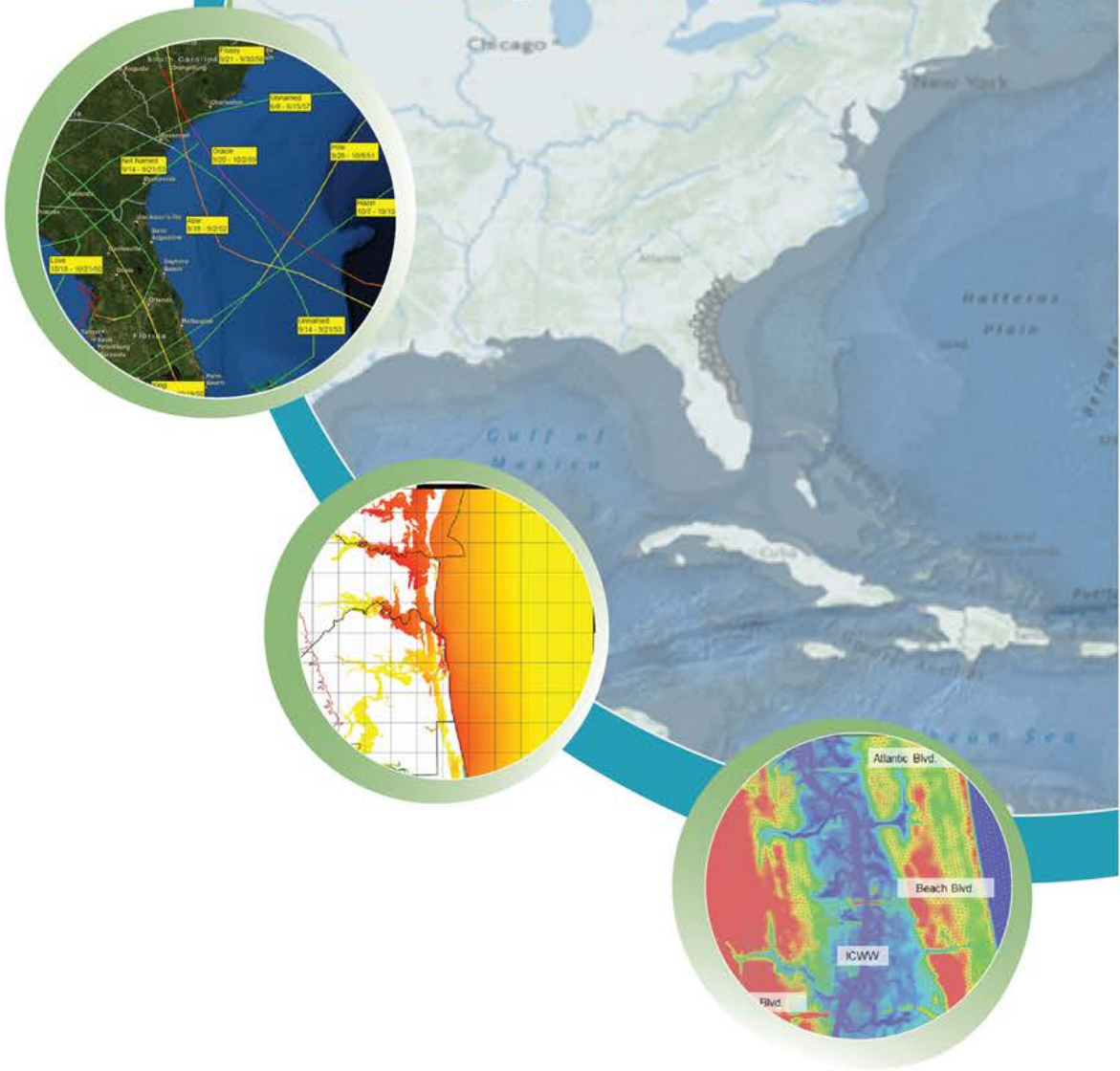
TAYLOR ENGINEERING, INC.

Delivering Leading-Edge Solutions

Offshore and Nearshore Wave Modeling within the East Coast Central Florida and South Florida Storm Surge Studies



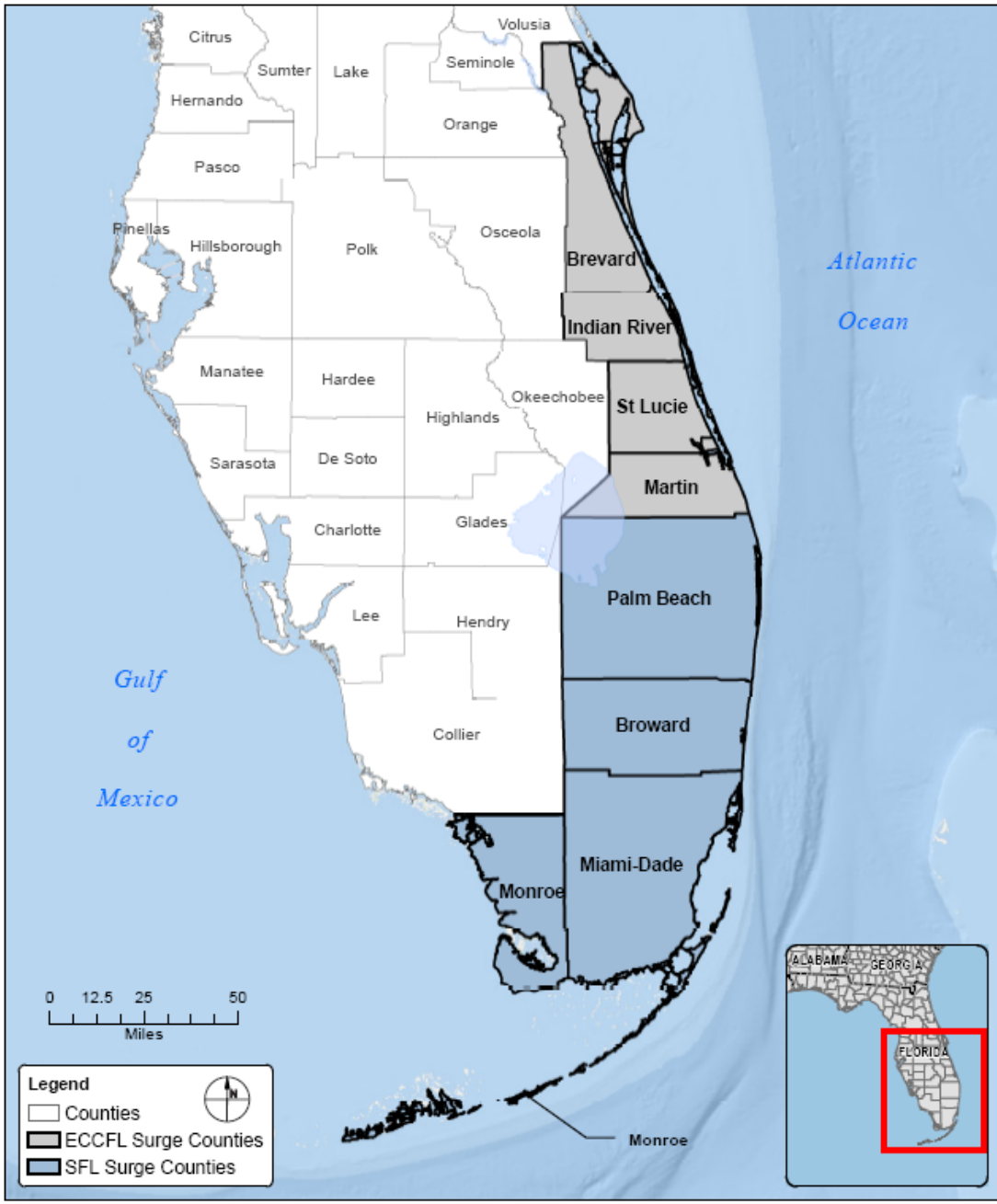
Presented by: Christopher Bender, Ph.D., P.E., D.CE

November 9, 2015

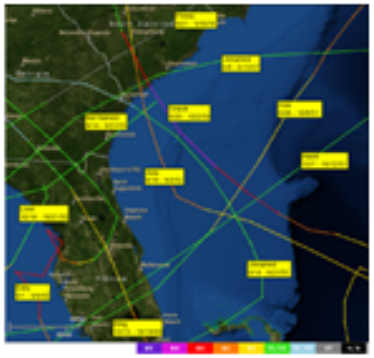
Introduction

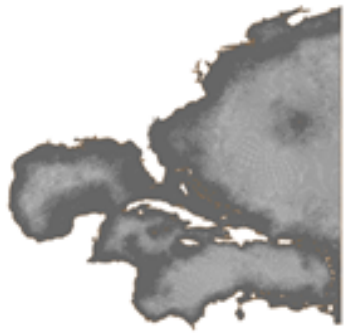
- FEMA risk studies outline
- Overview East Coast Central Florida (ECCFL) and South Florida (SFL) surge studies
- Work completed and project status
  - Model development
  - Comparison of ECCFL measured and modeled wave parameters
  - Review of recent SFL results
- Questions

ECCFL and SFL Coastal Surge Study Extents



Approach – Storm Surge SWEL





Storm Forcing
Hurricane Tracks

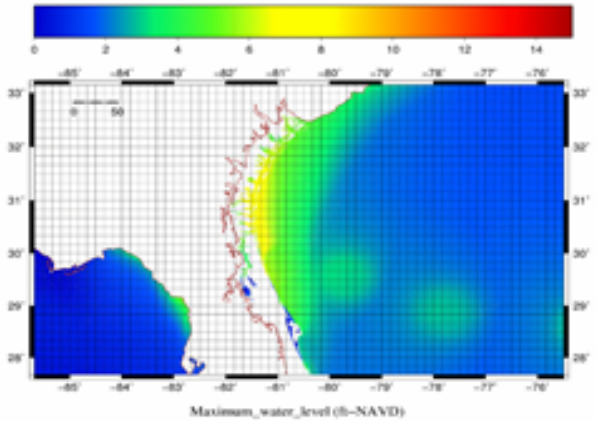
Storm Surge Modeling

Winds

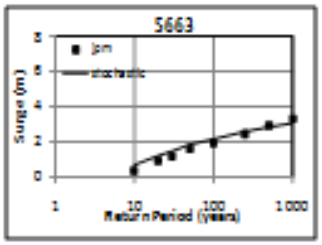
Waves ⟷ **Water Levels**

Return Period Analysis
JPM-OS 2%, 1%, 0.2% Annual Chance
Tide Gage Analysis 50%, 20%, 10% A.C.

SWEL

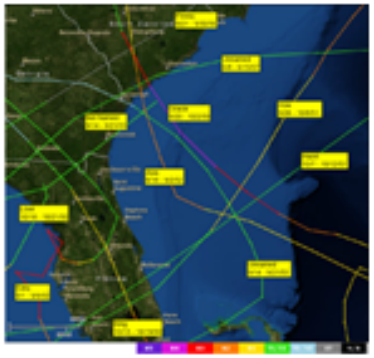


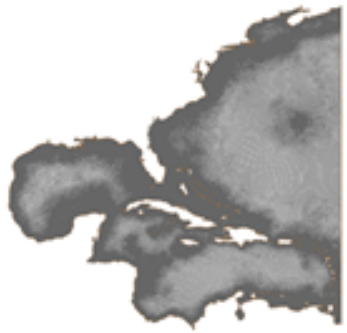
High-Resolution Bathymetry / Topography Mesh



JPM-OS: Joint Probability Method - Optimum Sampling

Approach – Storm Surge SWEL and Waves





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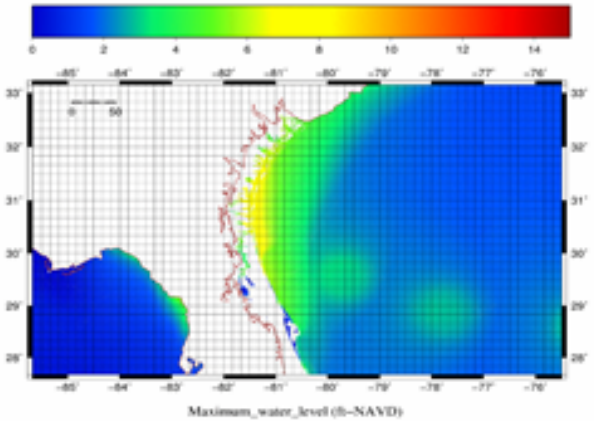

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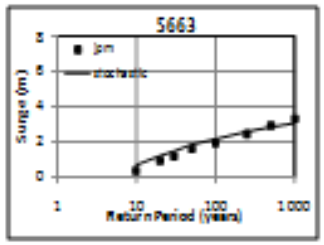


SWEL

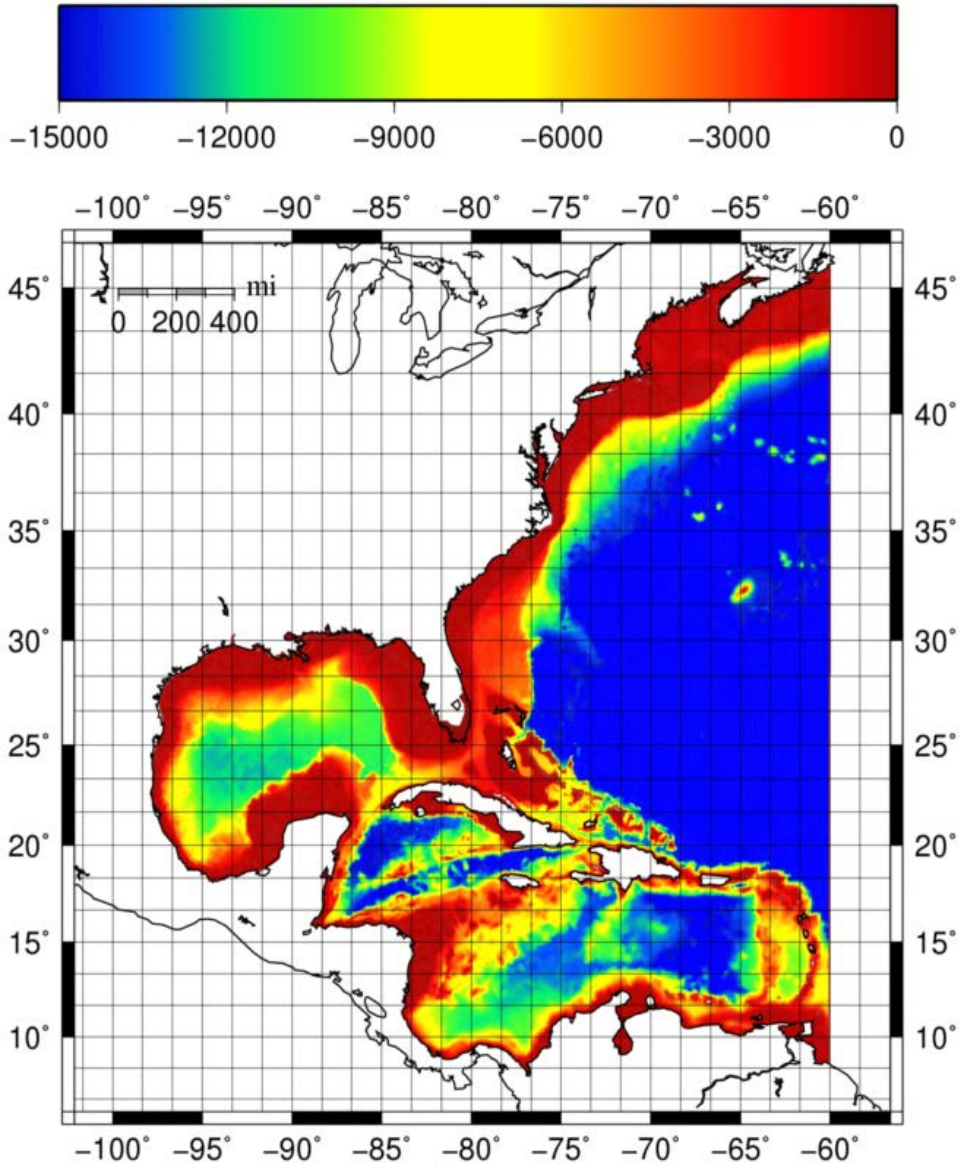
JPM-OS: Joint Probability Method - Optimum Sampling

Model Development and Results

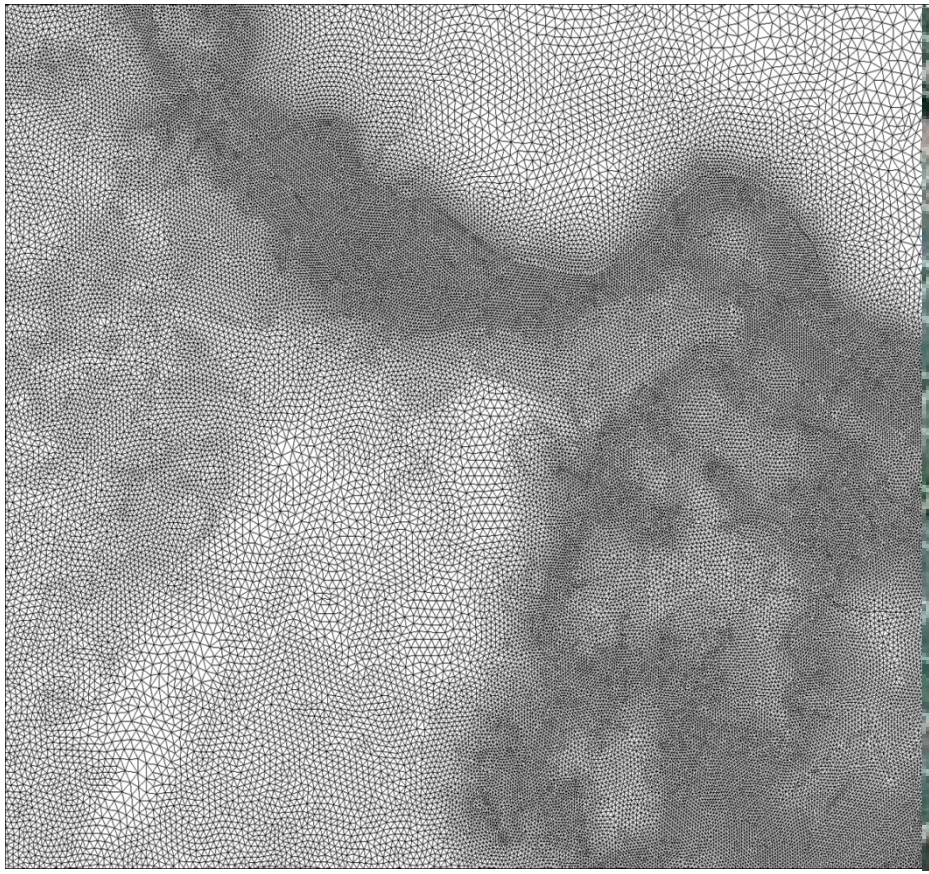
- Model development
  - Developed seamless topographic and bathymetric data surface (Digital Elevation Model [DEM])
  - Developed SWAN+ADCIRC mesh and model
  - Completed tasks in parallel
- Comparison of ECCFL measured and modeled wave parameters
- Review of recent South Florida results

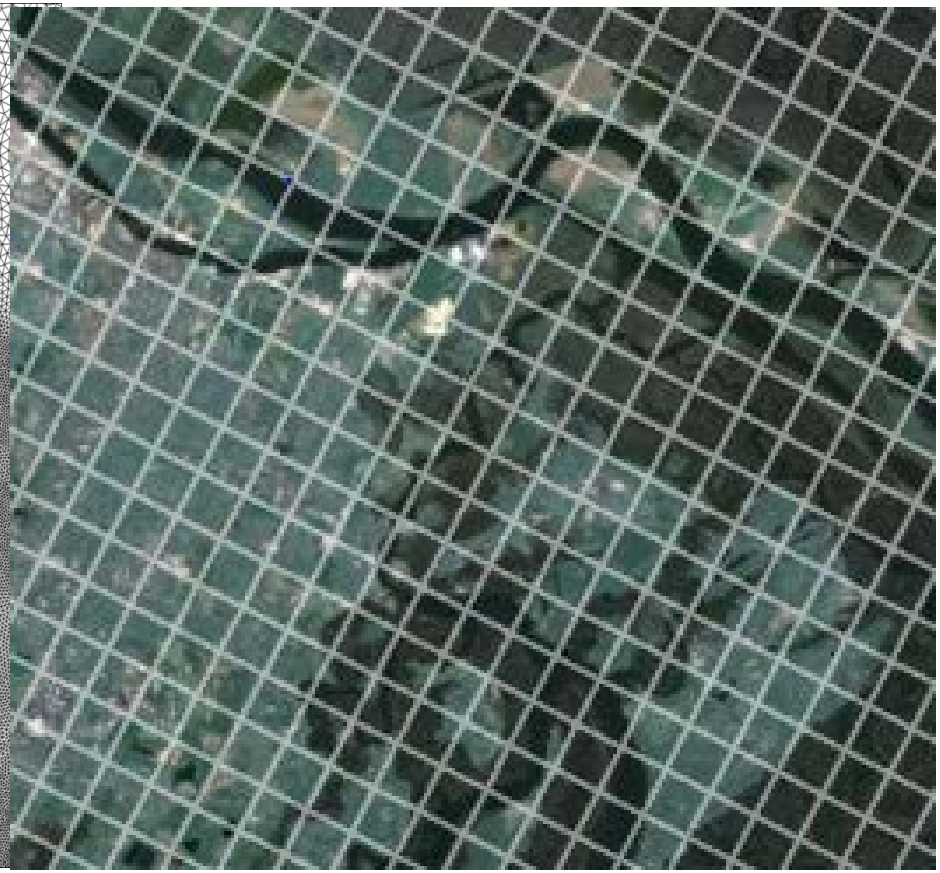
SWAN+ADCIRC Model Mesh Development

- SWAN+ADCIRC model
- Finite element model
- Uses unstructured, triangulated mesh
- Node spacing set to accurately represent topography/bathymetry
- Applies “feature arcs” to represent elevated or depressed features (e.g., roads or channels)

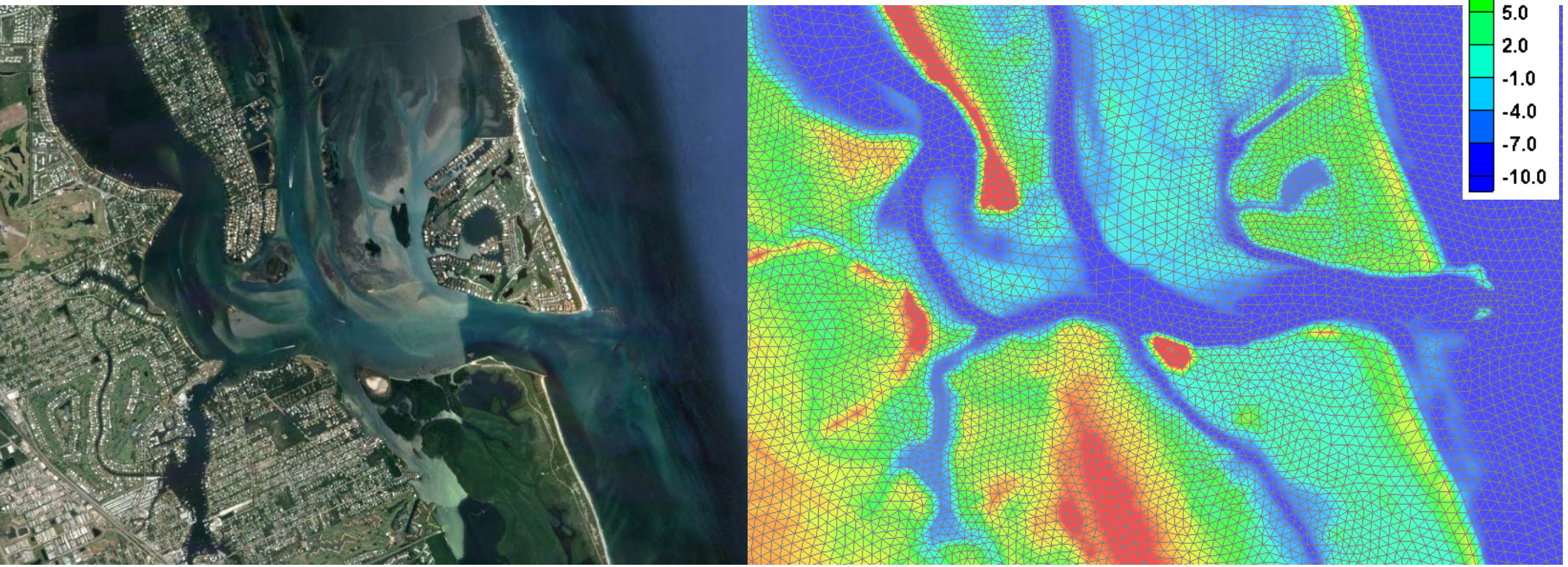


SWAN+ ADCIRC Model Mesh Development





SWAN+ ADCIRC Model Mesh



Martin County, Florida; St. Lucie Inlet

Model Development and Results

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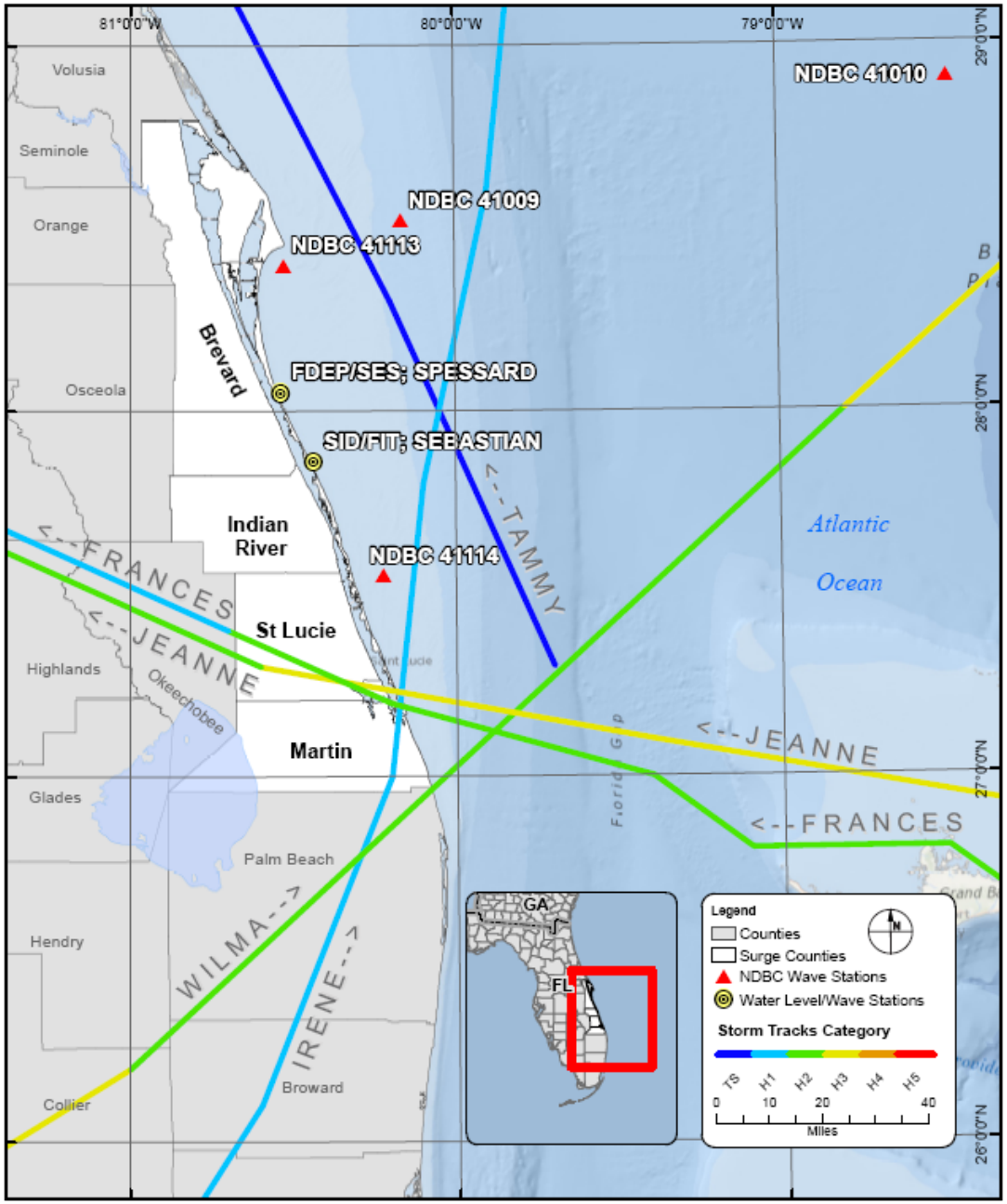
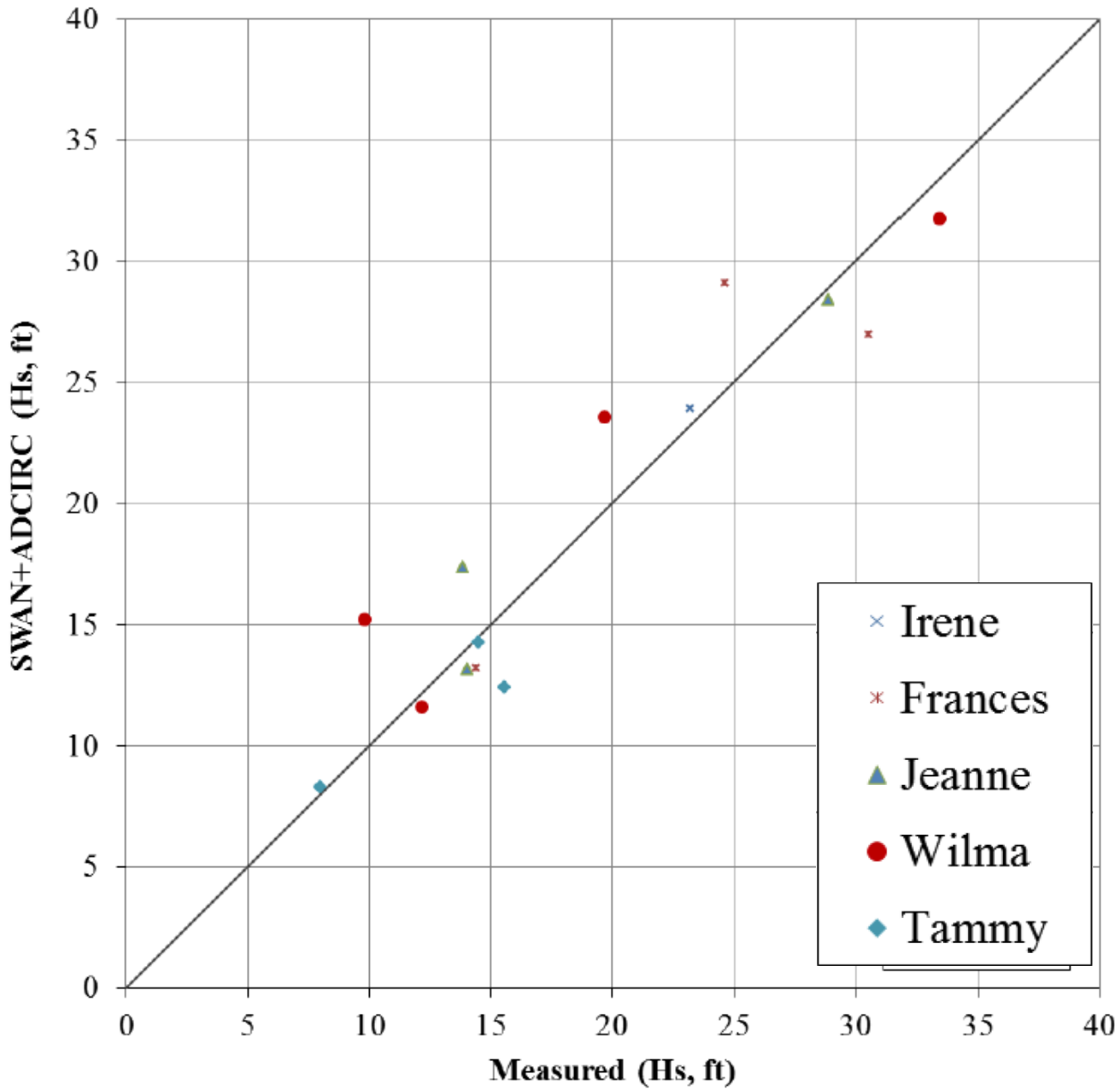
ECCFL Study – Wave Data Stations and Storm Tracks

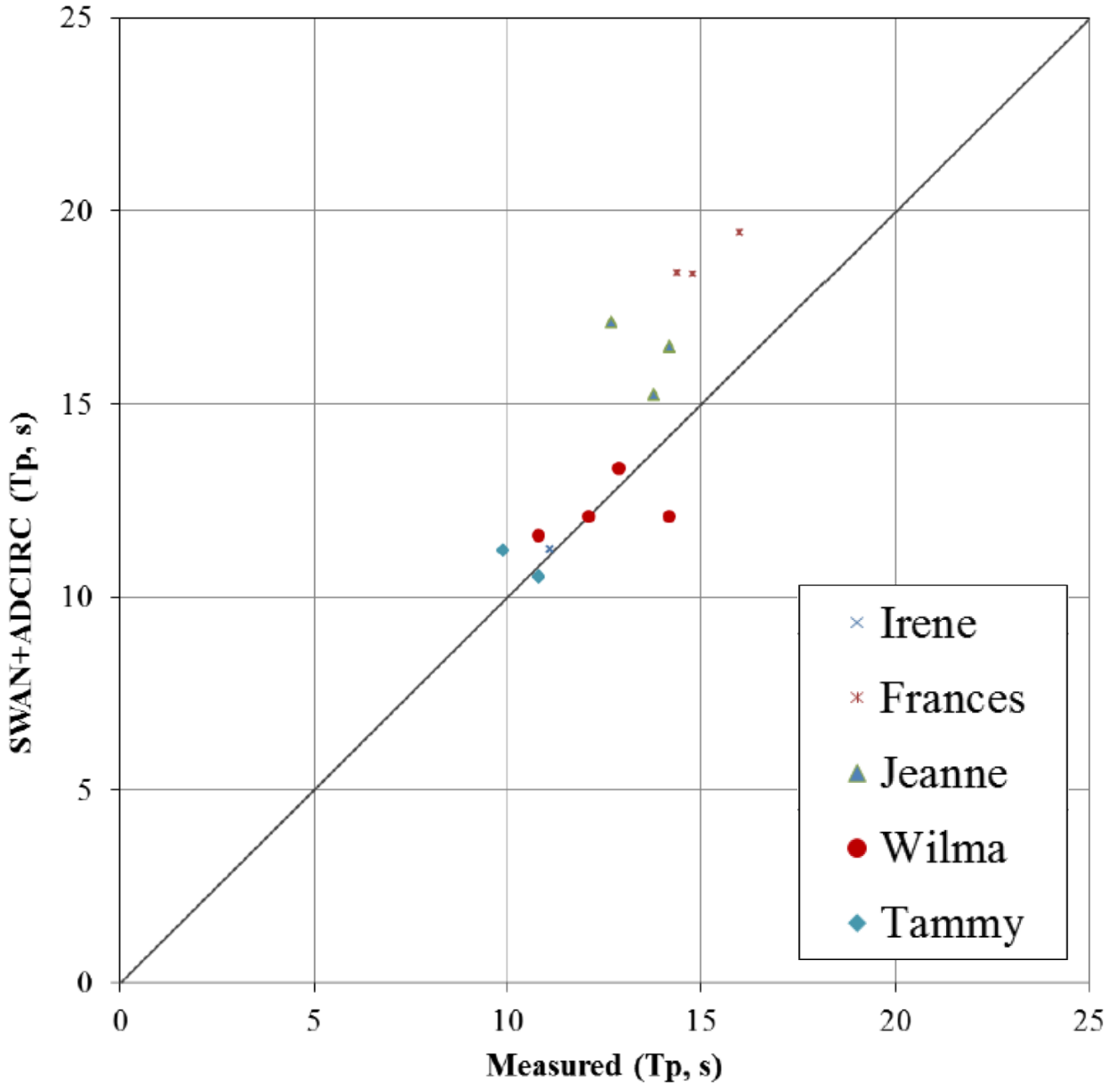
Station ID	Station Description	Water Depth (ft)
NBDC 41009	20 Nautical Miles East of Cape Canaveral	145
NDBC 41010	120 Nautical Miles East of Cape Canaveral	2,863
NDBC 41113	Cape Canaveral Nearshore, Scripps Institution of Oceanography	33
NDBC 41114	Ft. Pierce, Florida, Scripps Institution of Oceanography	53
SID/ FIT	Sebastian Inlet District/Florida Institute of Technology; Sebastian Inlet, Florida	30
FDEP/ SES	FDEP/SES; Spessard Holland Park, Florida	30



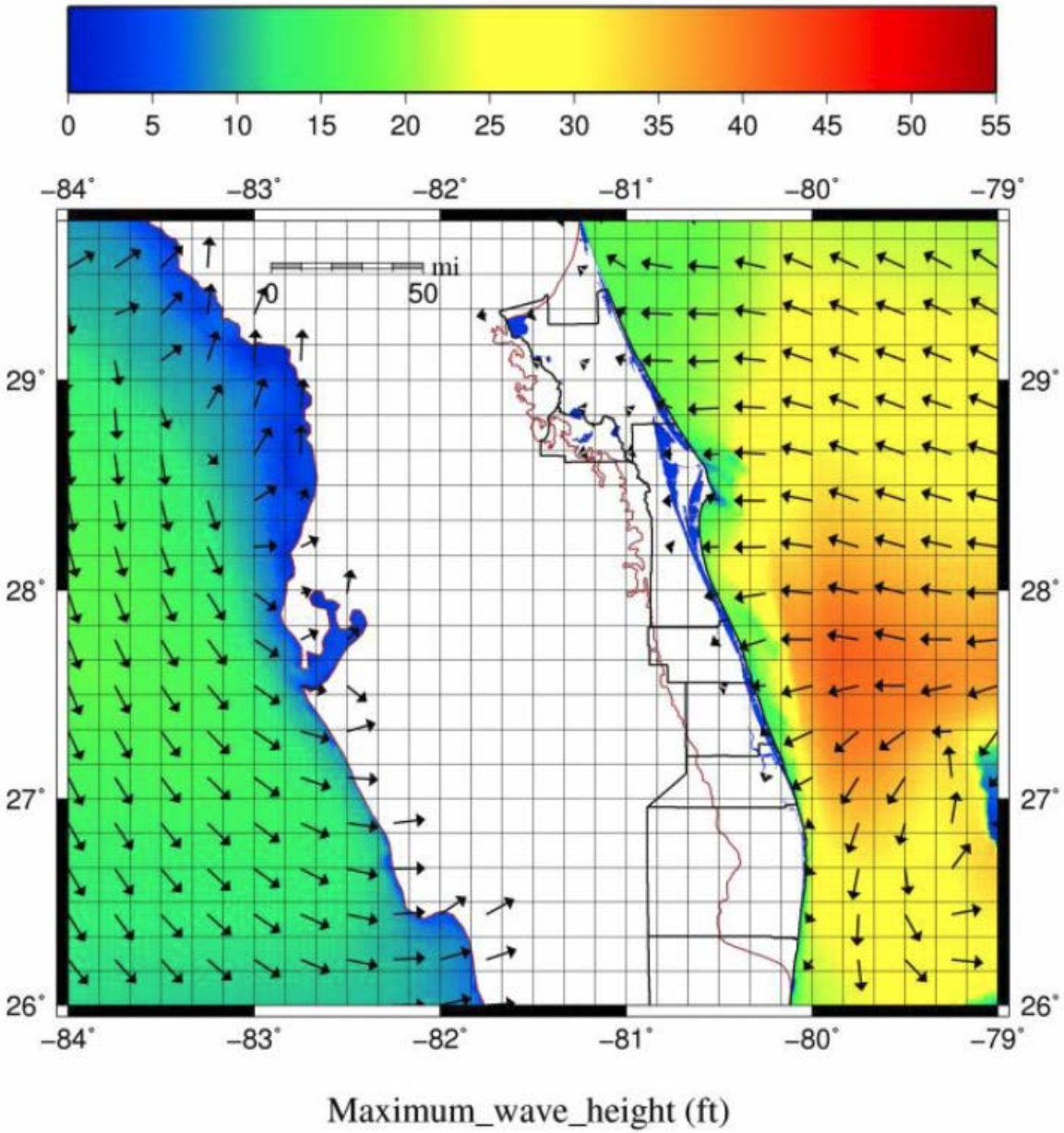
Summary of Measured vs SWAN+ADCIRC Wave Heights



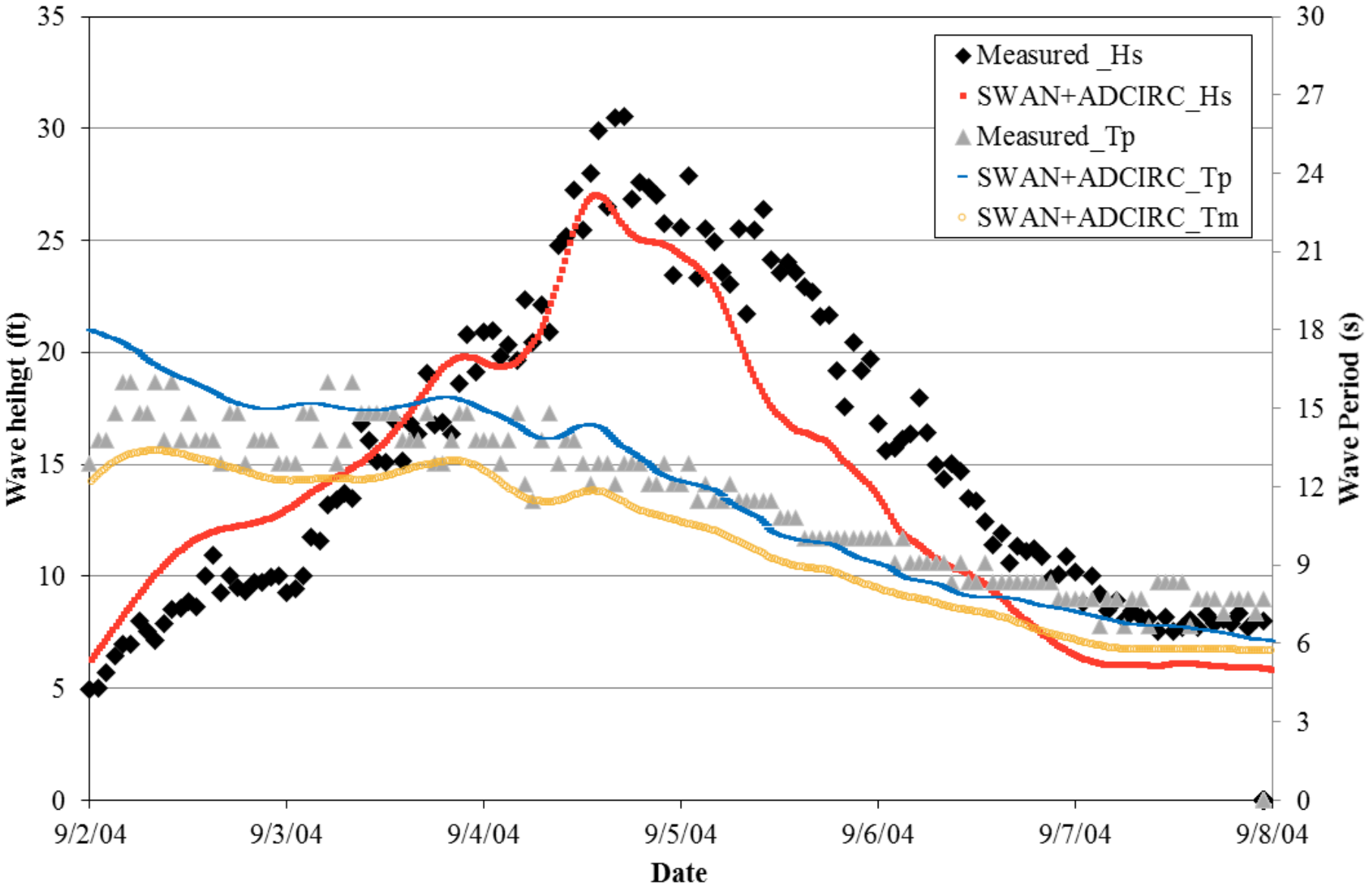
Summary of Measured vs SWAN+ADCIRC Peak Periods



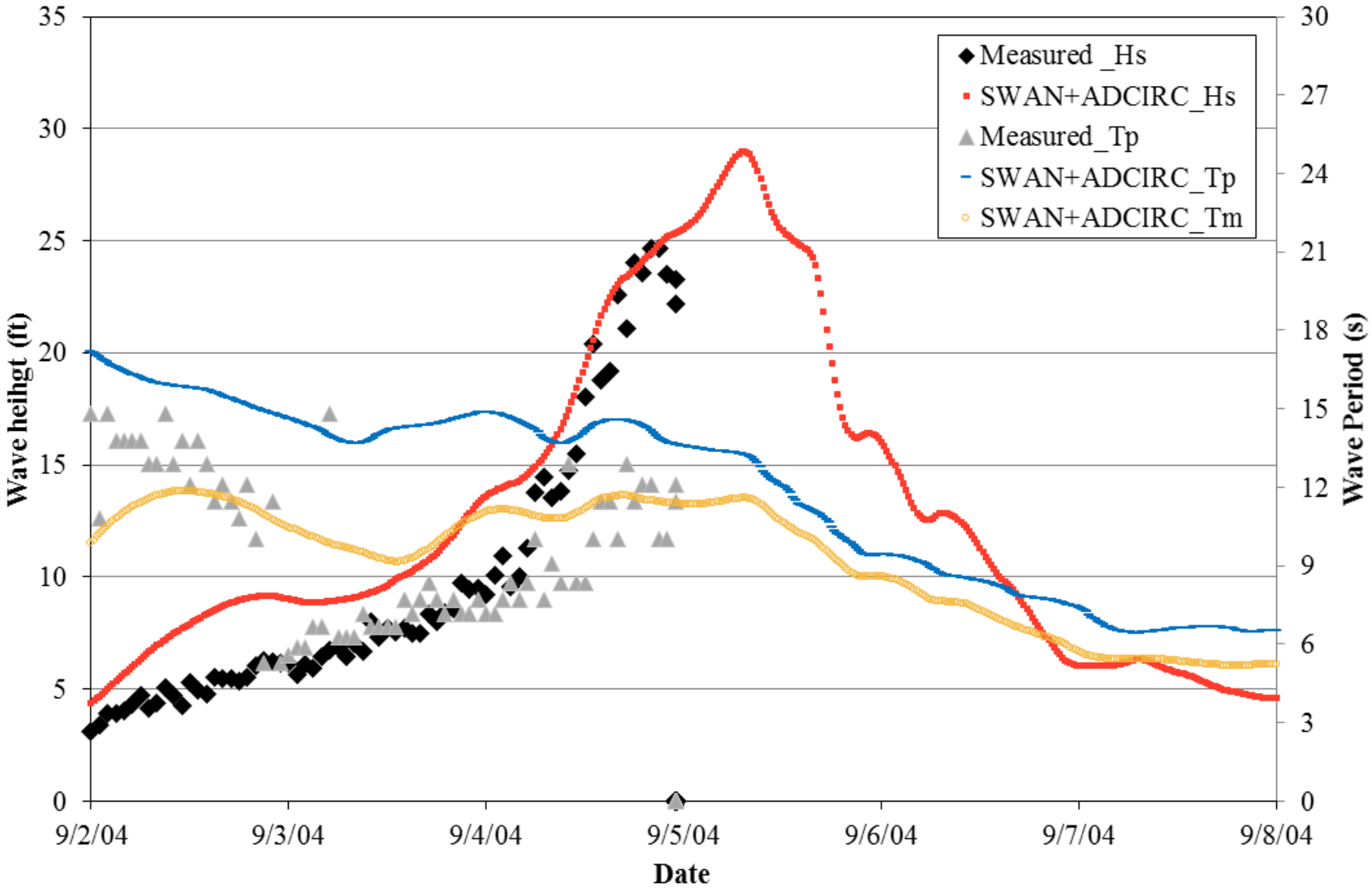
SWAN+ADCIRC Maximum Wave Height Frances



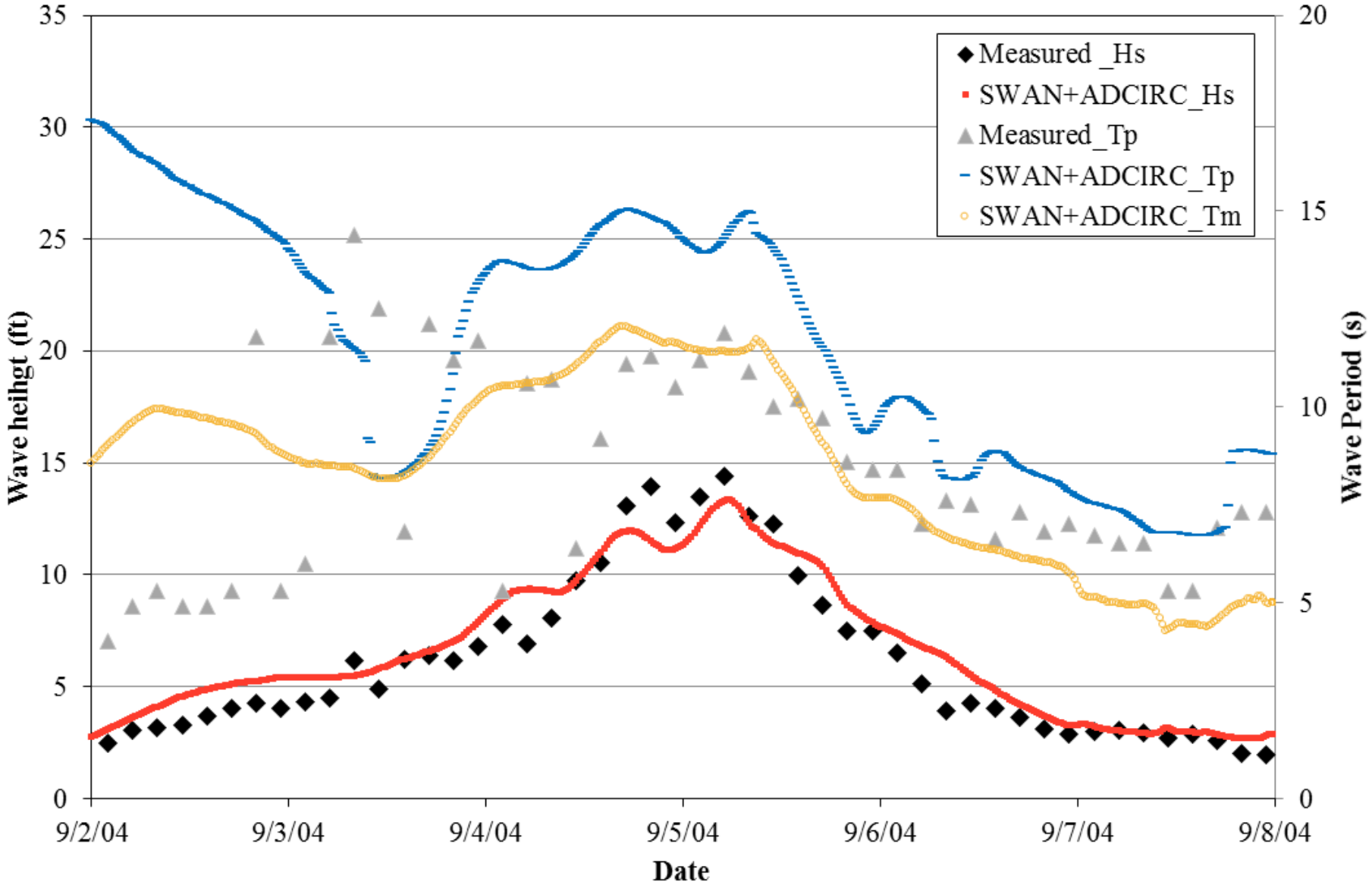
SWAN+ADCIRC Wave Parameter Time Series: Frances; Station 41010



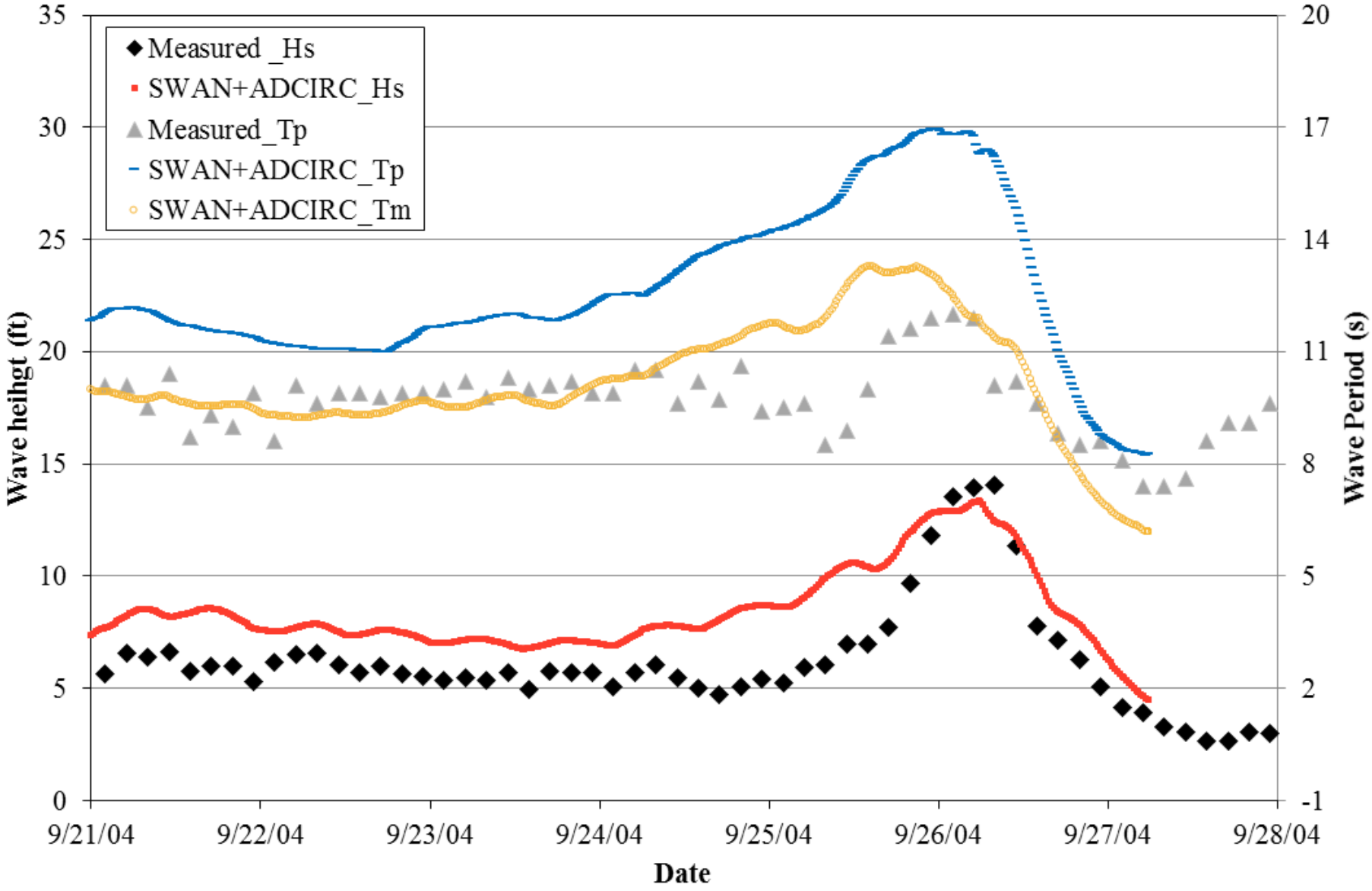
SWAN+ADCIRC Wave Parameter Time Series: Frances; Station 41009



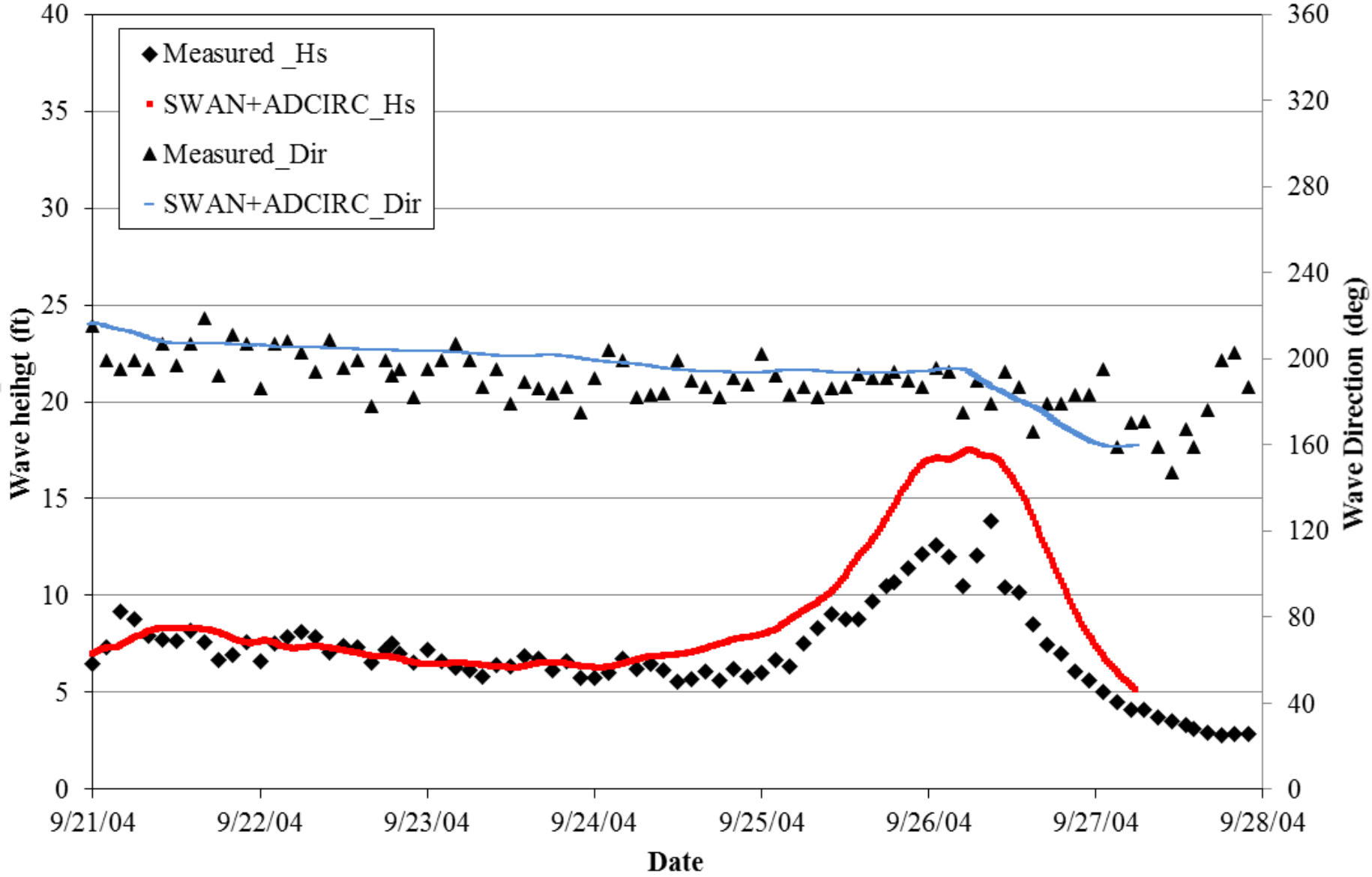
SWAN+ADCIRC Wave Parameter Time Series: Frances; Station FIT



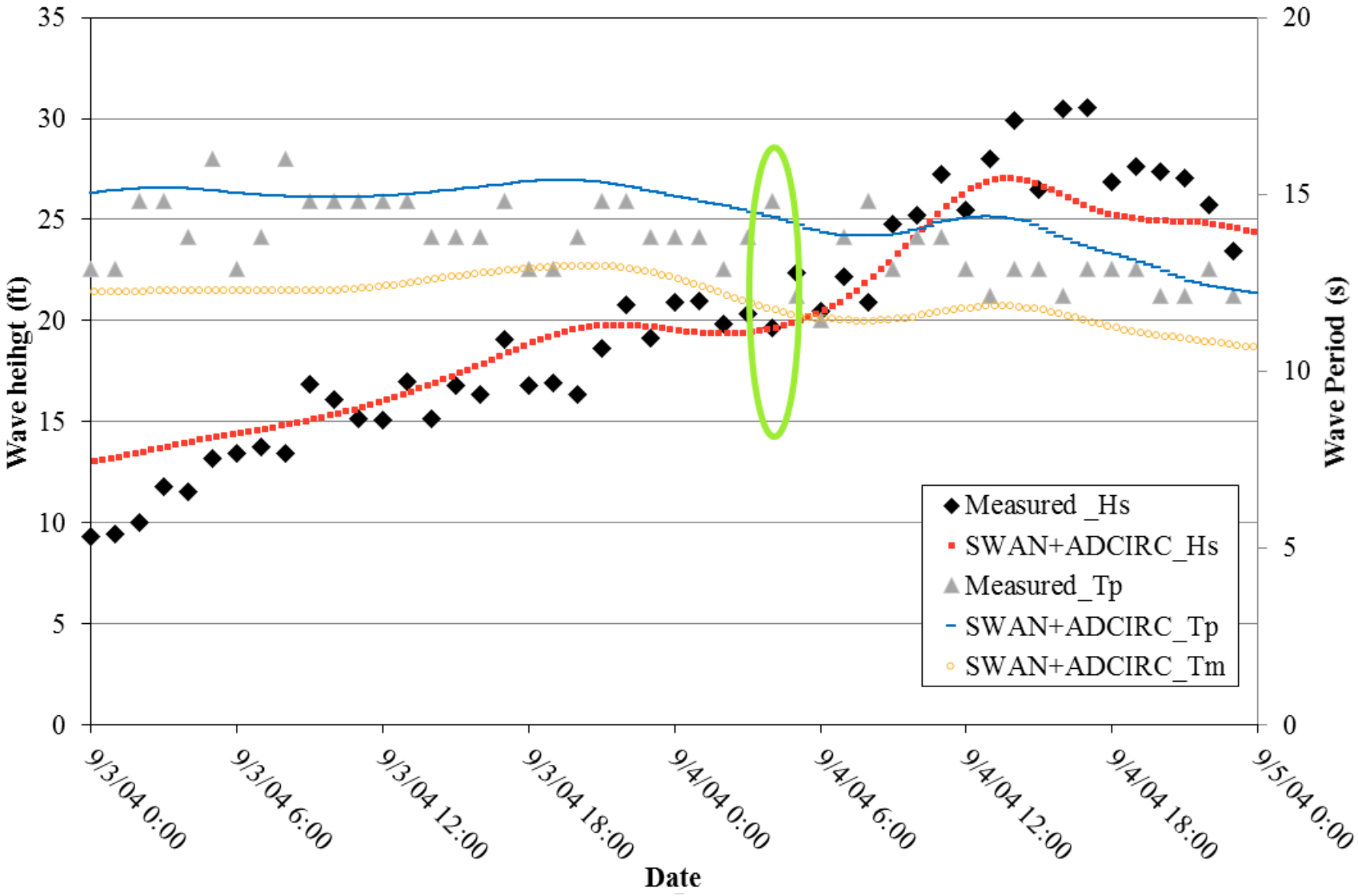
SWAN+ADCIRC Wave Parameter Time Series: Jeanne; Station FIT



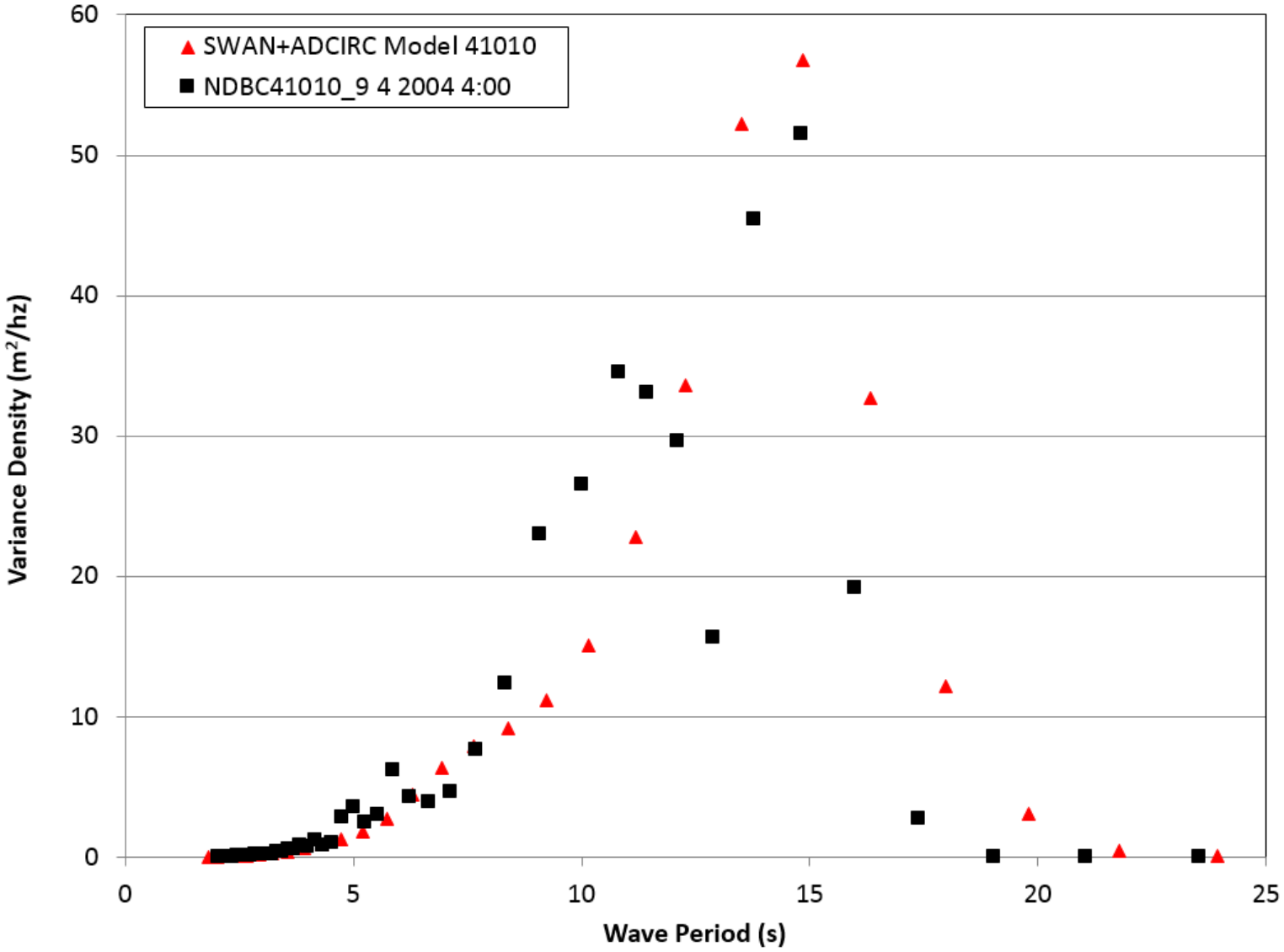
SWAN+ADCIRC Wave Parameter Time Series: Jeanne; Station FDEP/SES



SWAN+ADCIRC Wave Parameter Time Series: Frances; 41010; Spectra



SWAN+ADCIRC Wave Parameter Time Series: Frances; 41010; Spectra



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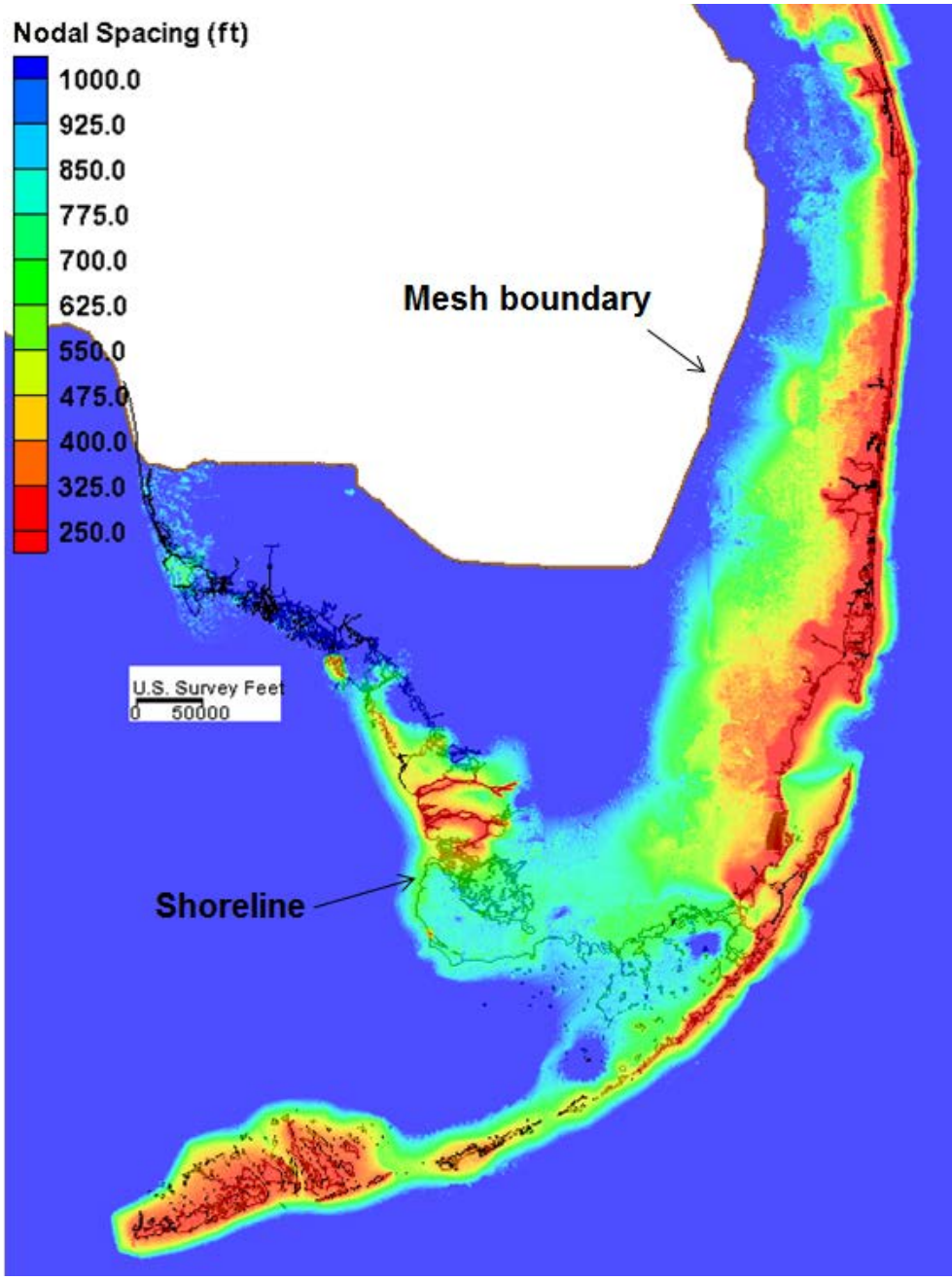
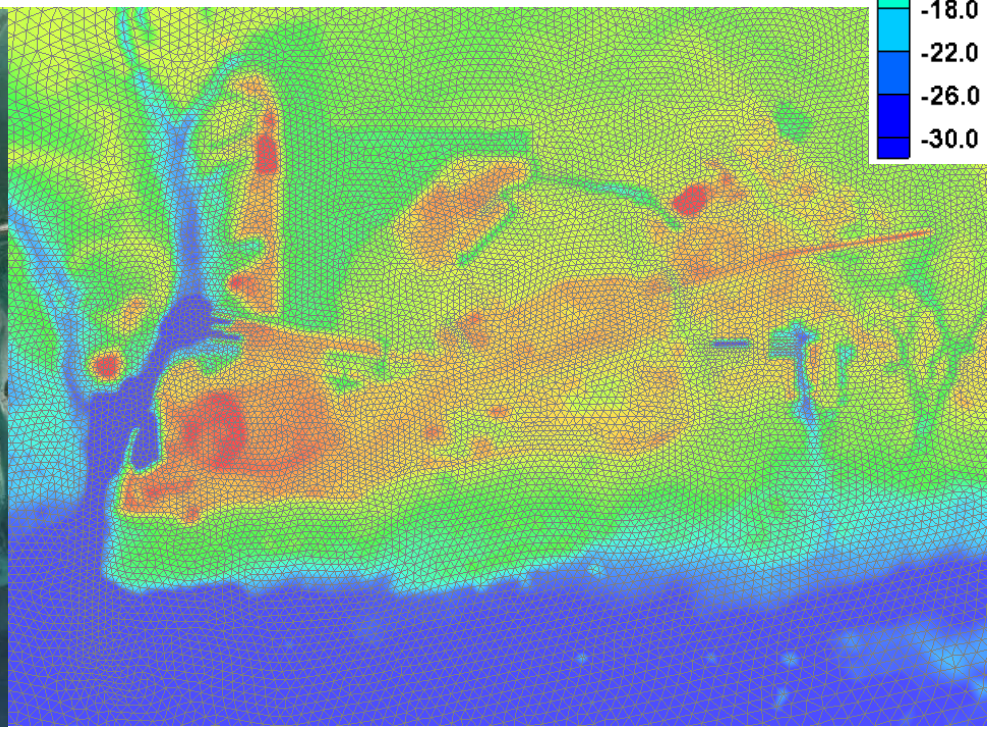
- SFL model mesh development
  - Focus of current efforts
  - Large study area with challenging bathymetry and topography features
  - Nodal spacing down to 30-50 ft resolution to capture important channels
  - No wave data located during data discovery process



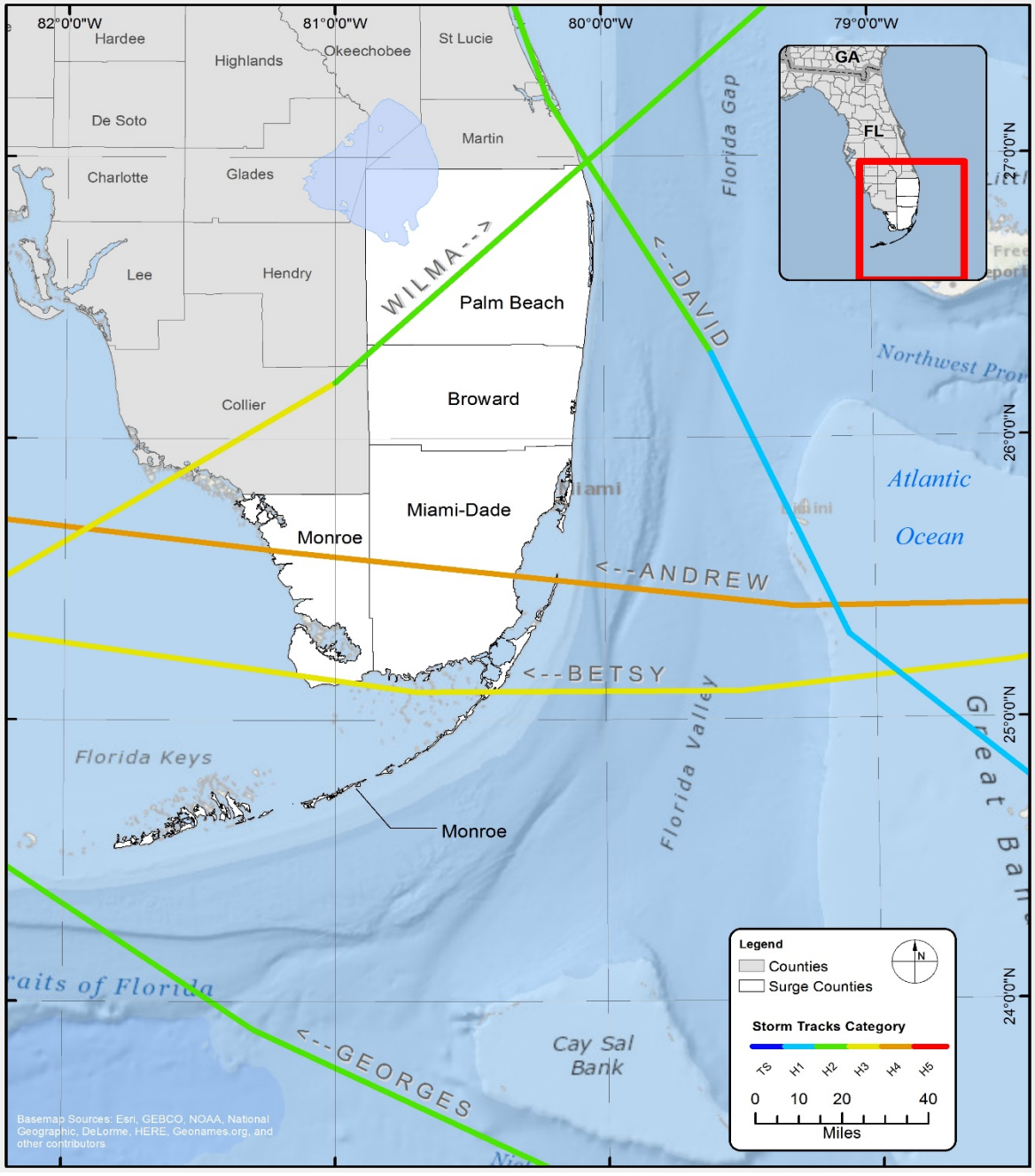
SWAN+ADCIRC Mesh



SFL Study; Key West

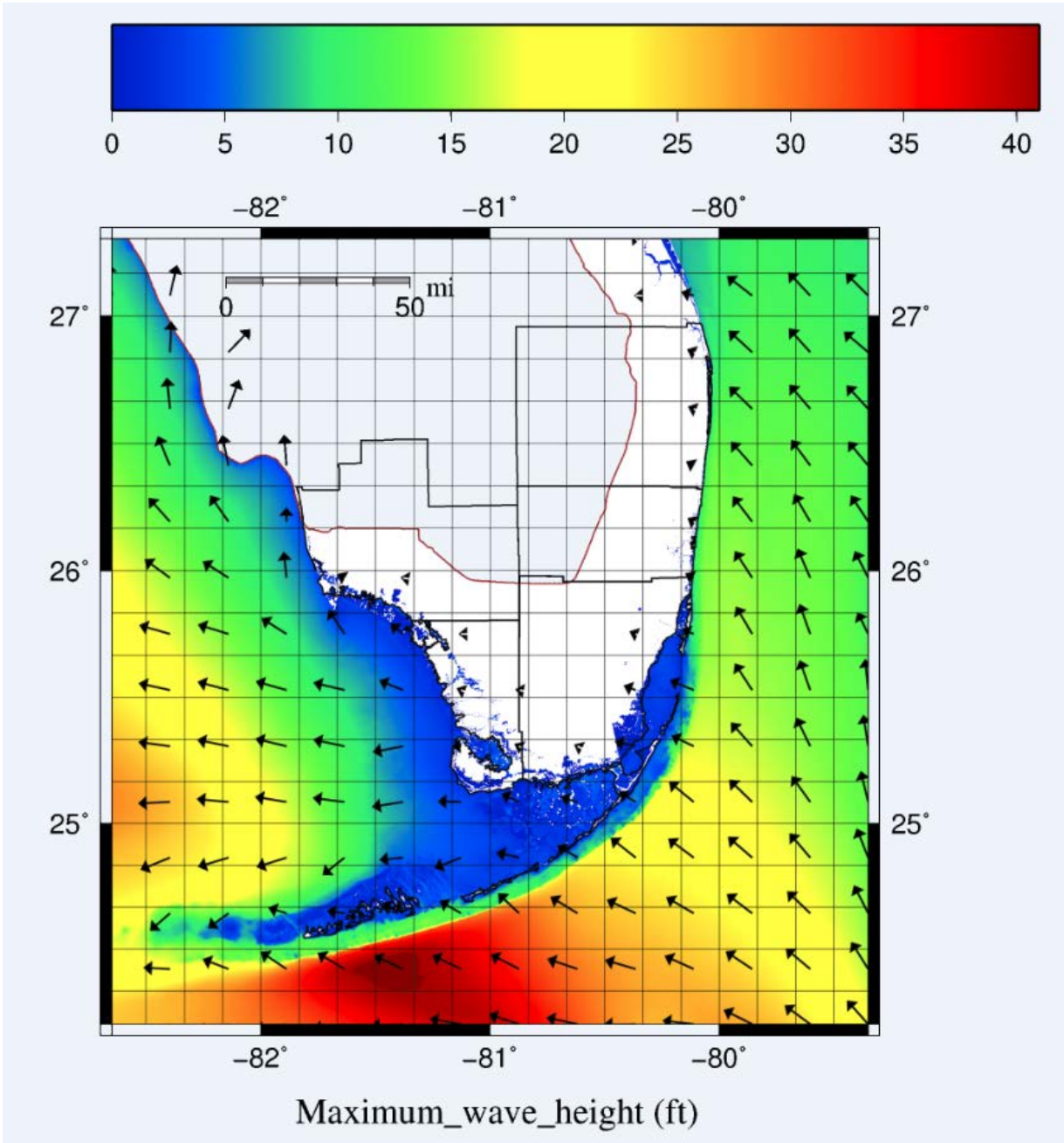
South Florida Surge Study Validation Storms

- Hurricane Betsy (1965)
- Hurricane David (1979)
- Hurricane Andrew (1992)
- Hurricane Georges (1998)
- Hurricane Wilma (2005)

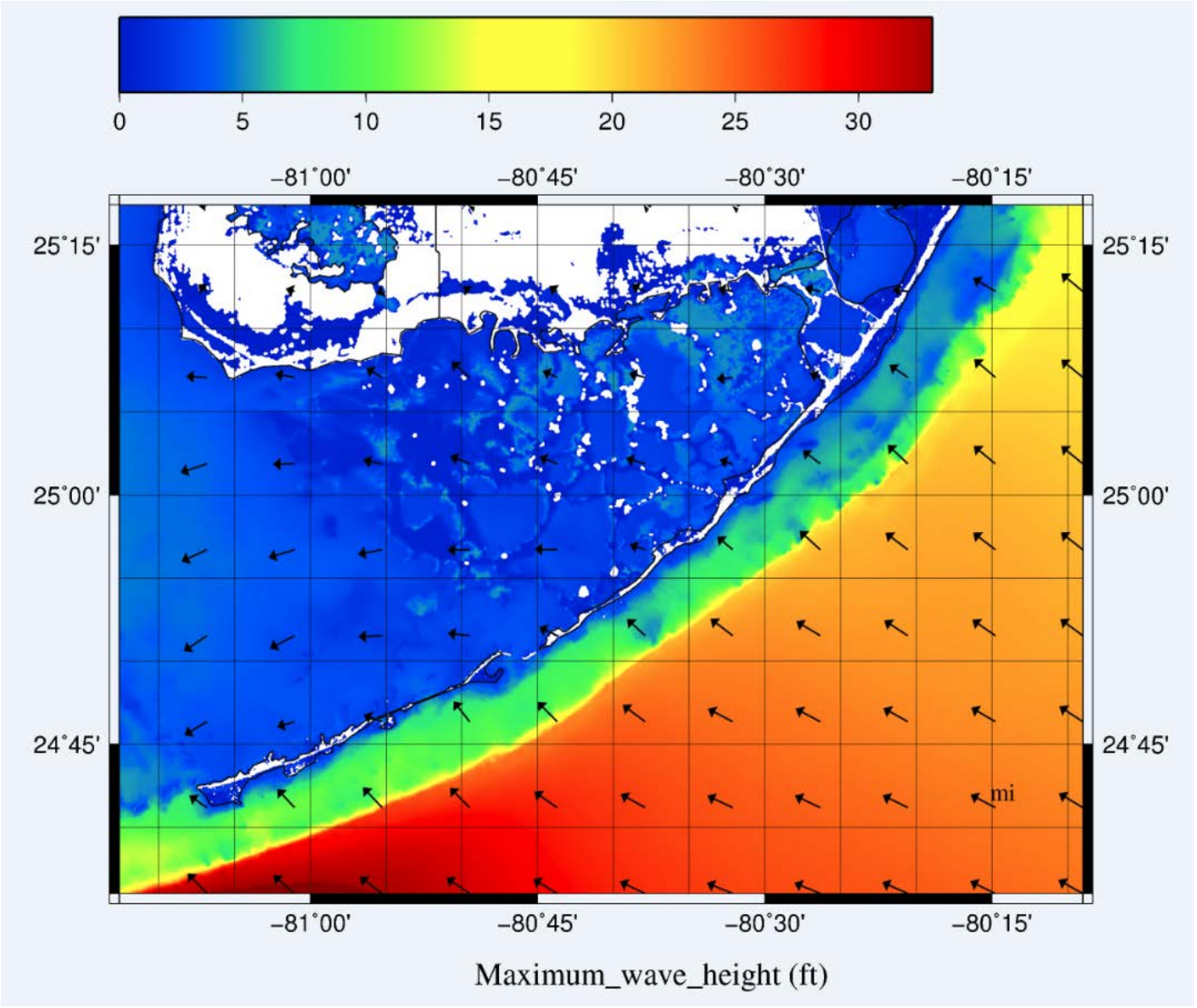


Hurricane Georges Maximum Wave Height

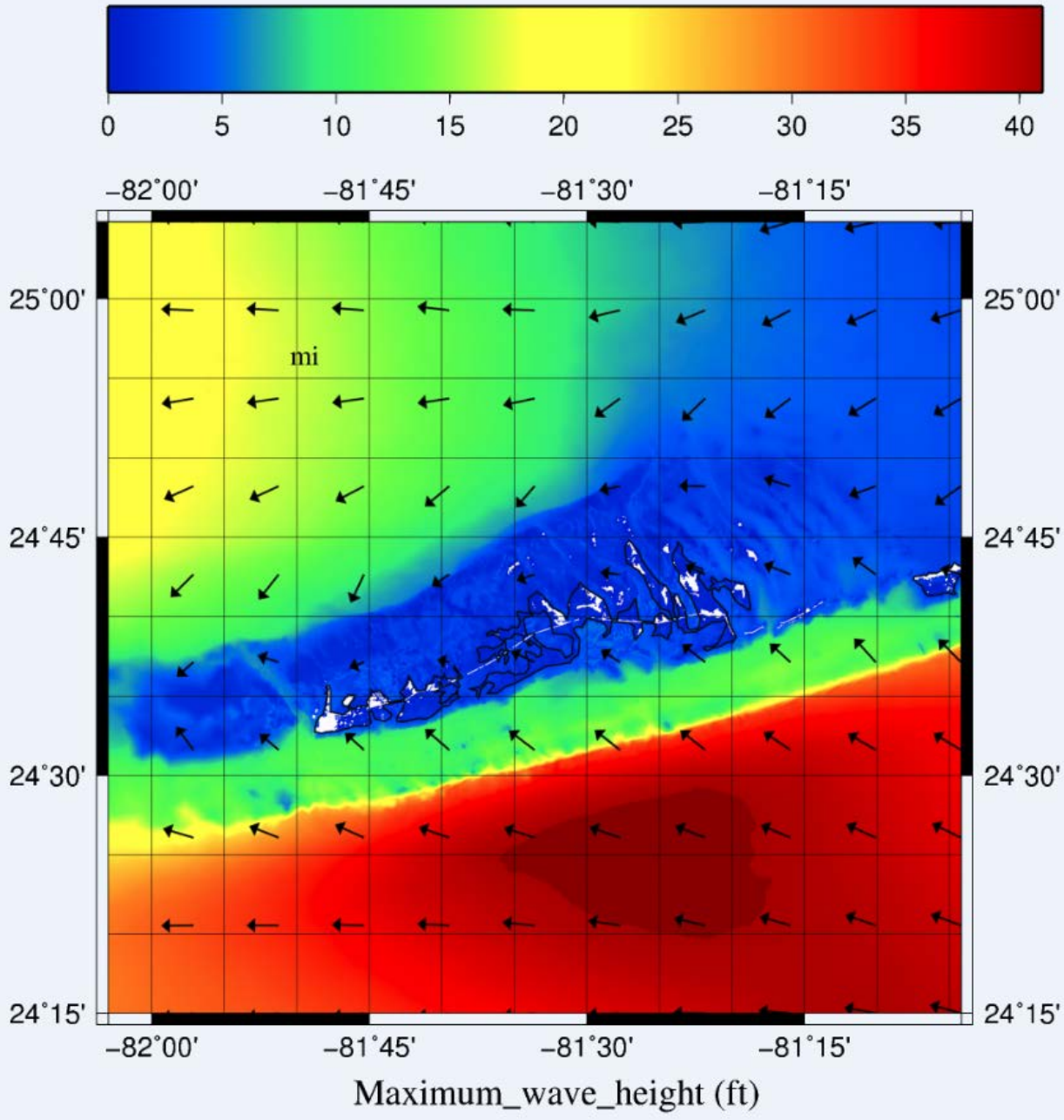
- Values exceed 40 ft offshore
- Significant breaking over nearshore reefs



Hurricane Georges Maximum Wave Height Florida Keys



Hurricane Georges Maximum Wave Height Florida Keys; Key West



Conclusions

- SWAN+ADCIRC model applied for recent FEMA coastal surge studies
- Comparison of SWAN+ADCIRC model wave parameters shows good agreement to available data
- Current efforts are applying SWAN+ADCIRC model for South Florida project
  - Search for measured South Florida wave data during tropical storms continues…
  - cbender@taylorengineering.com

Questions? Data?