IOOS COMT:
A Wave, Surge and Inundation Modeling Testbed for Puerto Rico and the US Virgin Islands

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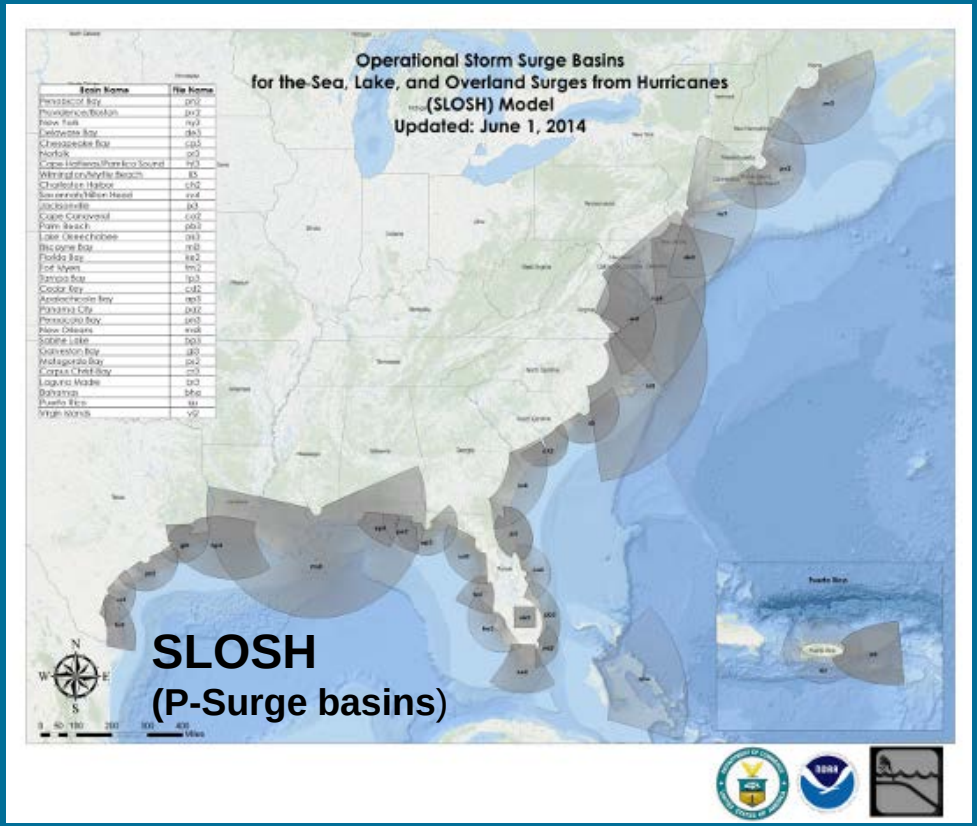
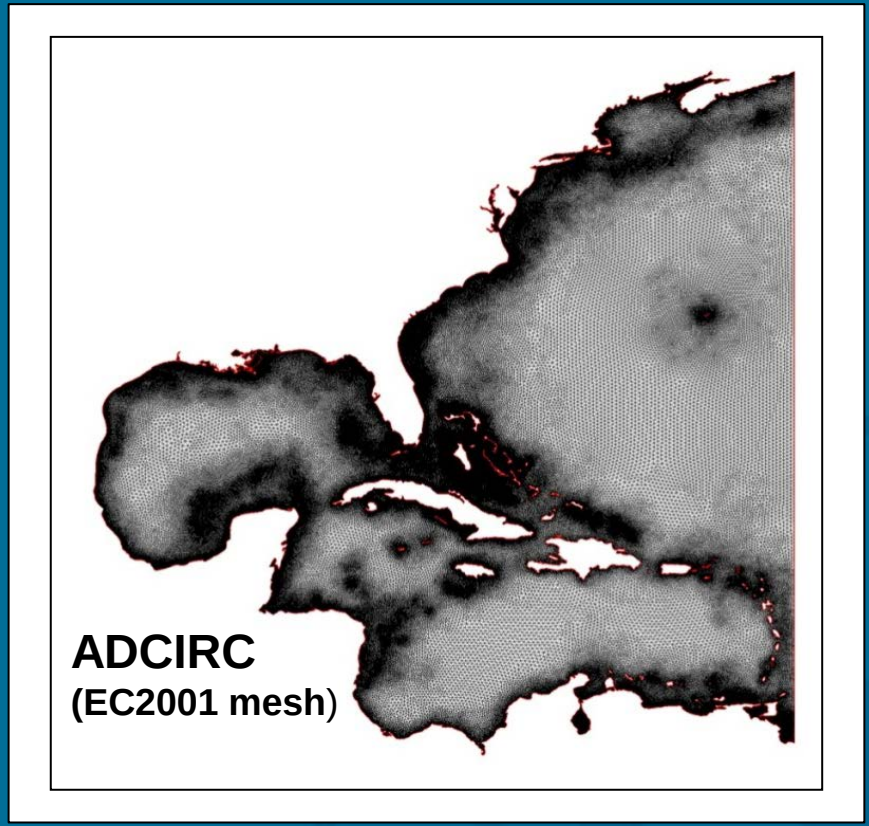
Background

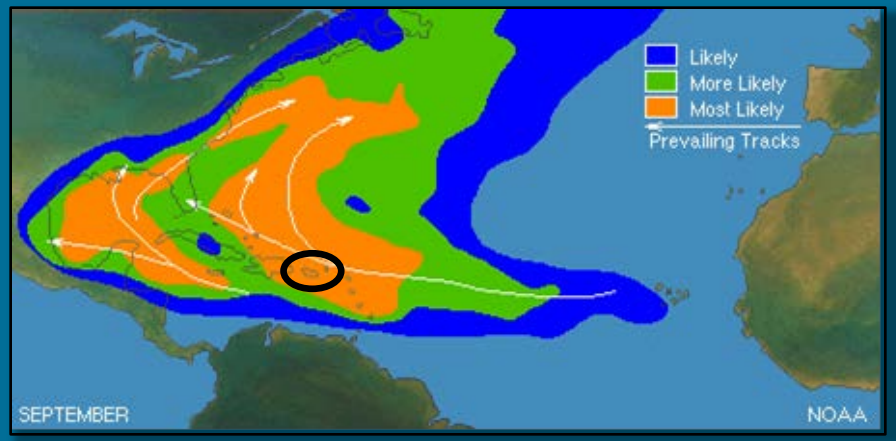
NOAA currently applies both the fast and efficient surge model **SLOSH** (probabilistic guidance) and state-of-the-art **ADCIRC** (deterministic guidance). However, neither of these modeling systems at NOAA has been configured with wave effects or specific focus on island environments.





Objective

To extend the present **operational surge forecasting** capability from mild-sloped coastal areas such as the US East and Gulf of Mexico coasts to **steep-sloped areas** such as Caribbean and Pacific islands, and study the **contribution of waves**. Identify models or techniques to transition to NOAA's **National Hurricane Center** and **local WFOs**.

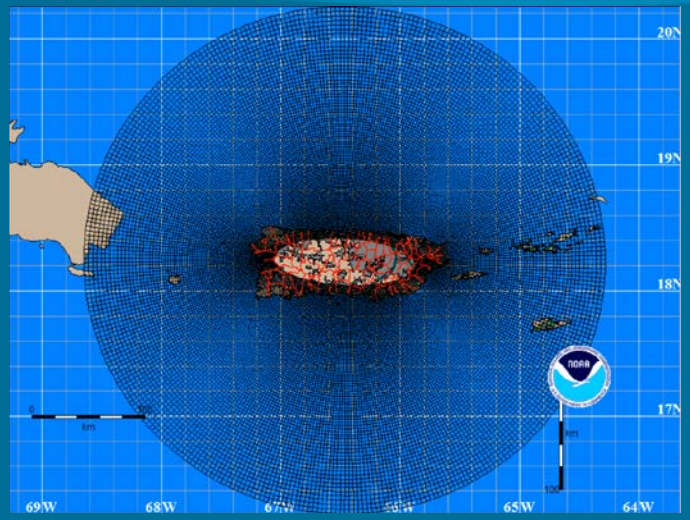


www.nhc.noaa.gov/climo

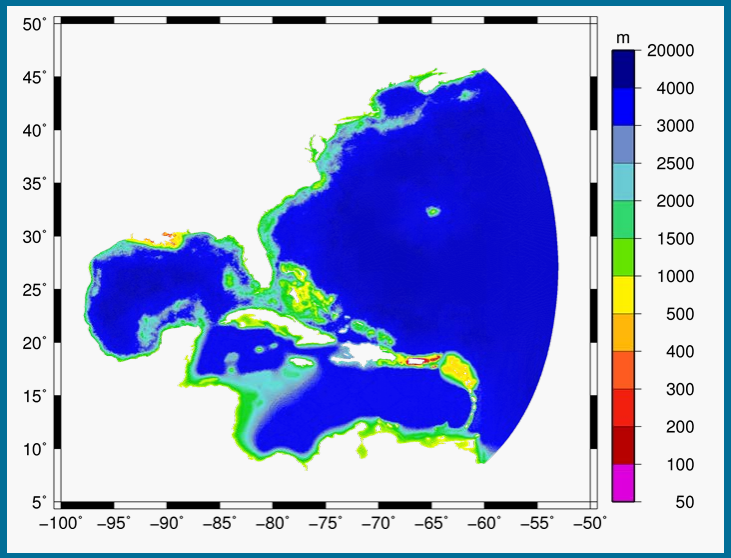
www.caricoos.org

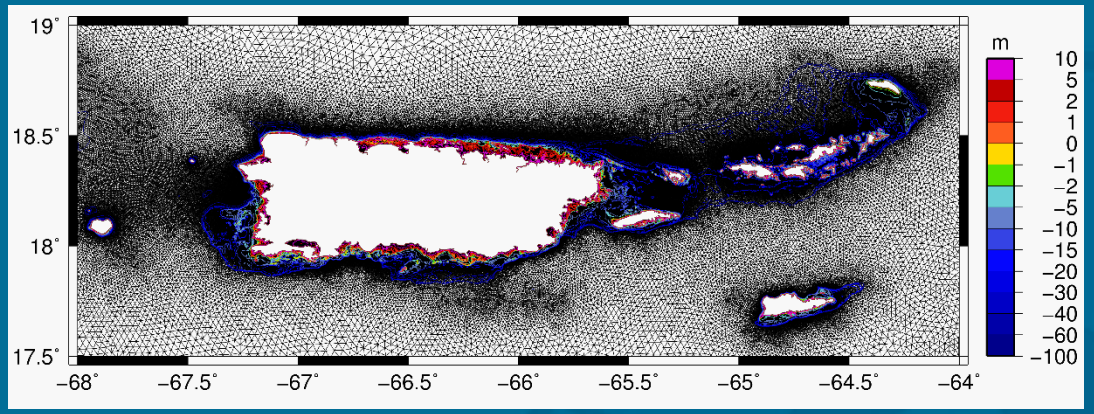
Model selection

- **UND:** ADCIRC+SWAN
- **NCEP:** ADCIRC+WW3
- **NHC:** SLOSH+SWAN
- **UPR:** FUNWAVE/BOSZ/XBeach



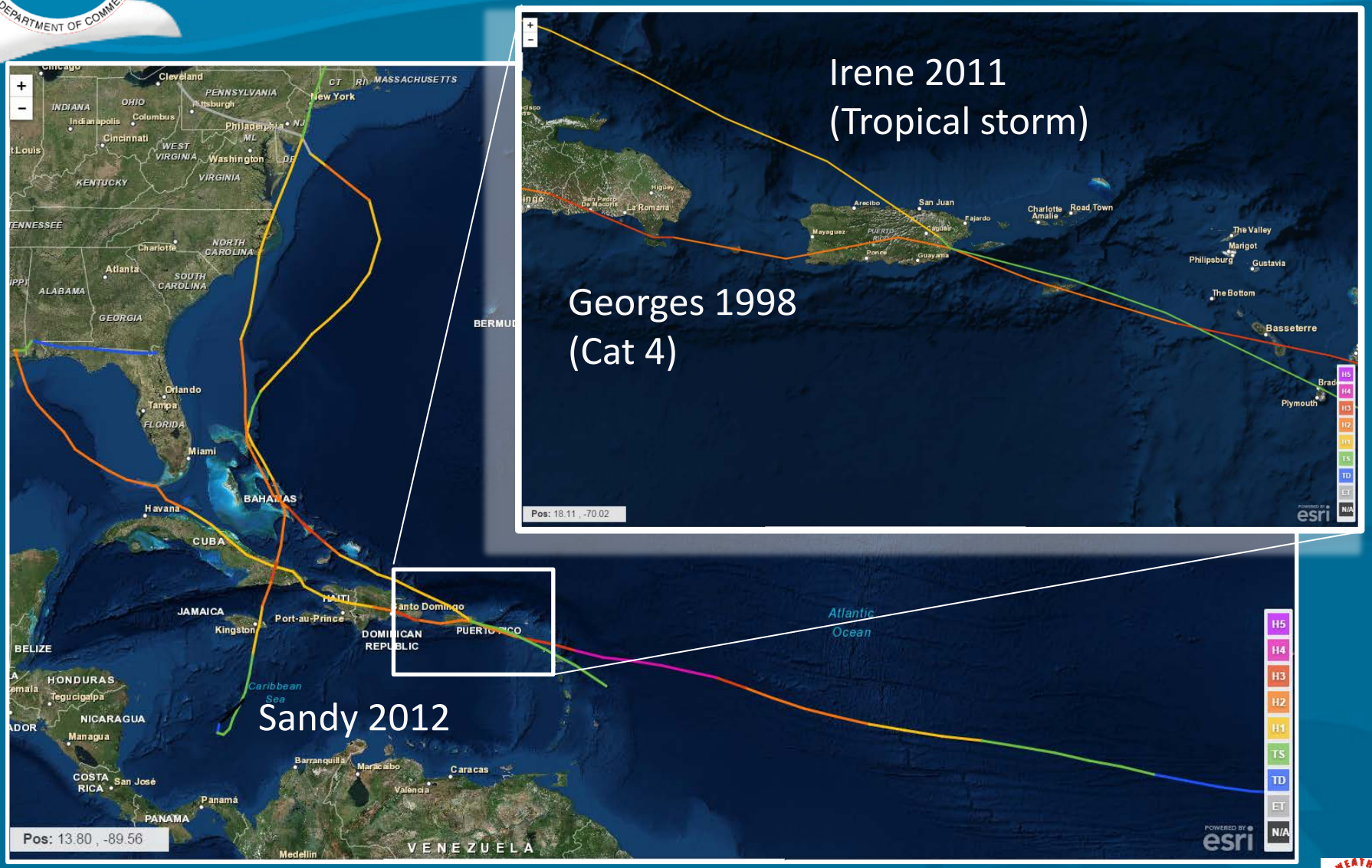
Curvilinear grid (min res: 90 m)



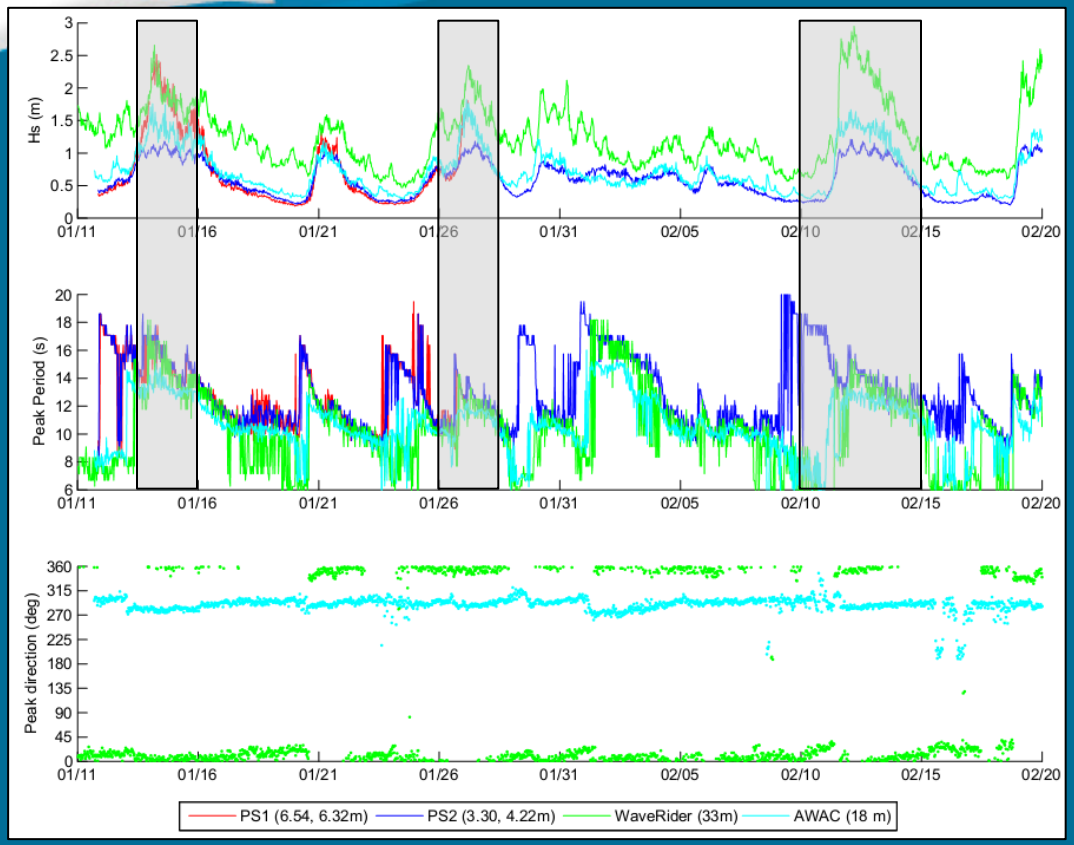


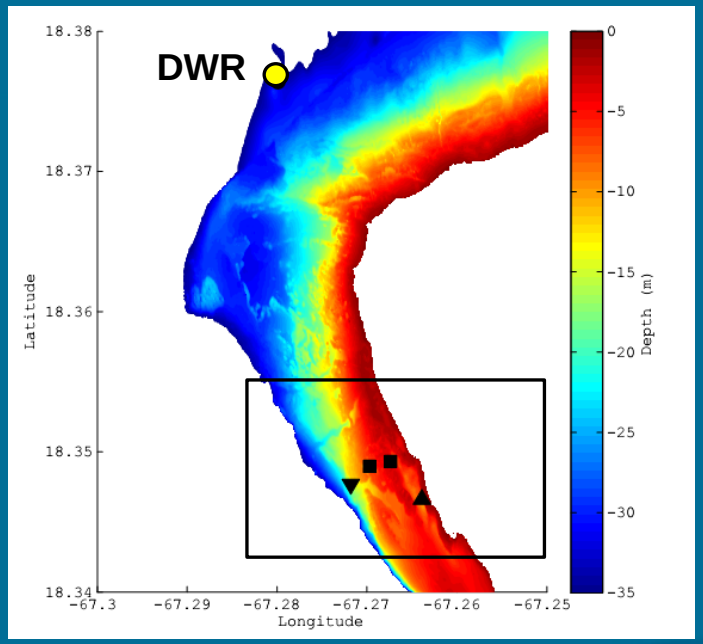
Unstructured, 2,733,258 nodes (min res: 50 m)

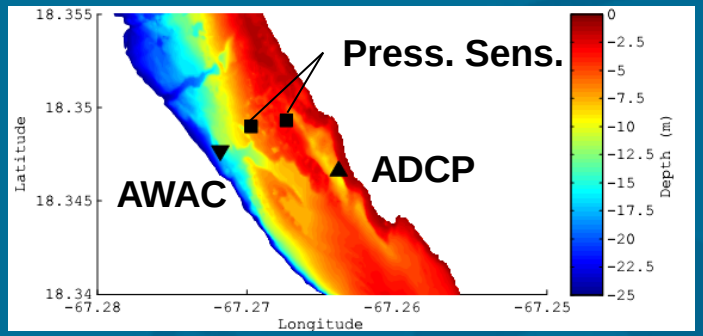
Selection of regional cases



Cross-reef cases (Rincon, PR)







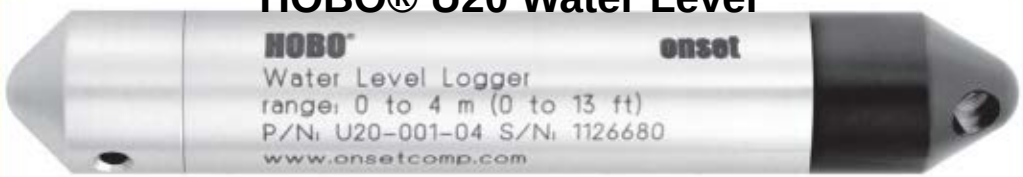
(1) Datawell Waverider (33 m, 2D wave spectrum)
(1) Nortek AWAC (18 m, 2D wave spectrum)
(2) Ocean Sensor Systems Pressure Sensor (6.54 m, 3.33 m)
(1) Teledyne Sentinel ADCP (10 m channel)

USGS “Storm surge chasers”

- **UPR** is partnering with **USGS Puerto Rico** in deploying HOBO water level meters at a number of pre-selected locations around the island (10 available).

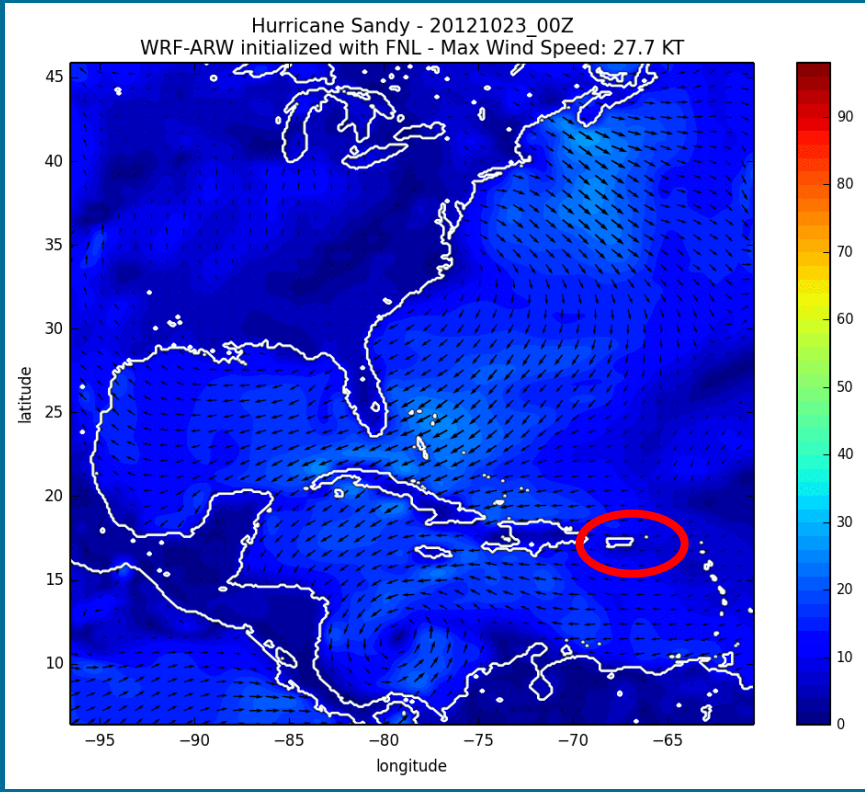
USGS
science for a changing world

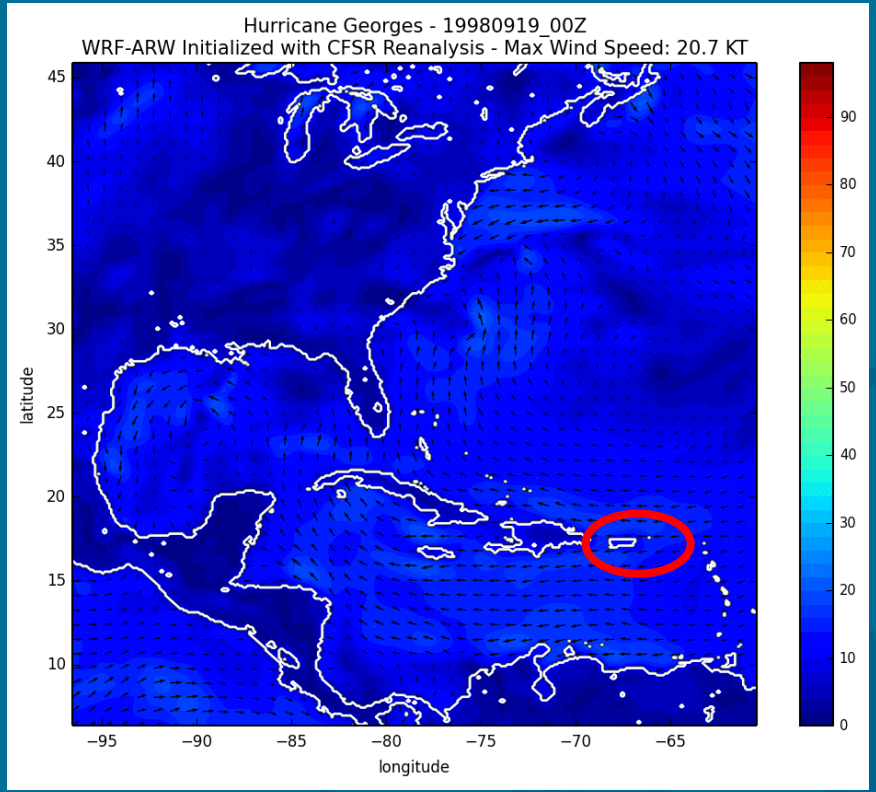
HOBO® U20 Water Level



Input/Validation Data Collection

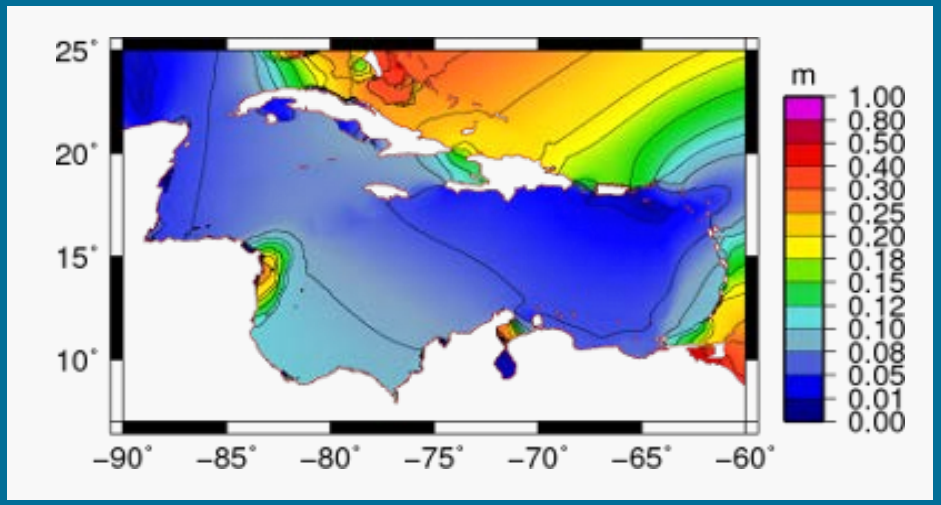
- **Atmospheric input** - ATCF best track, CFSR, WRF model simulations
- **Bathymetry** - 1/3-1 arc-sec NOAA Tsunami Inundation DEMs, NOAA benthic map classifications
- **Observations** - CO-OPS tidal data, NDBC buoys, CariCOOS stations (>2011), WeatherFlow winds



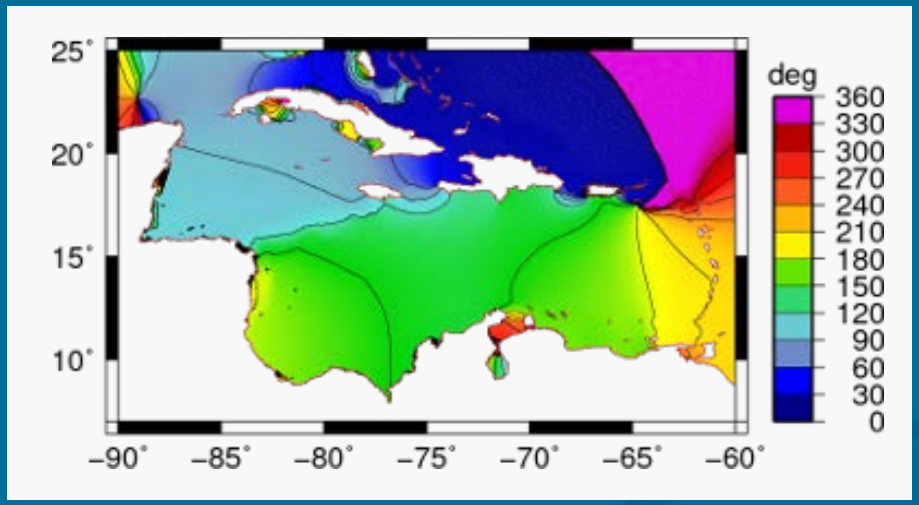


Results: Tidal modeling - ADCIRC

M_2 Constituent (Amplitude)



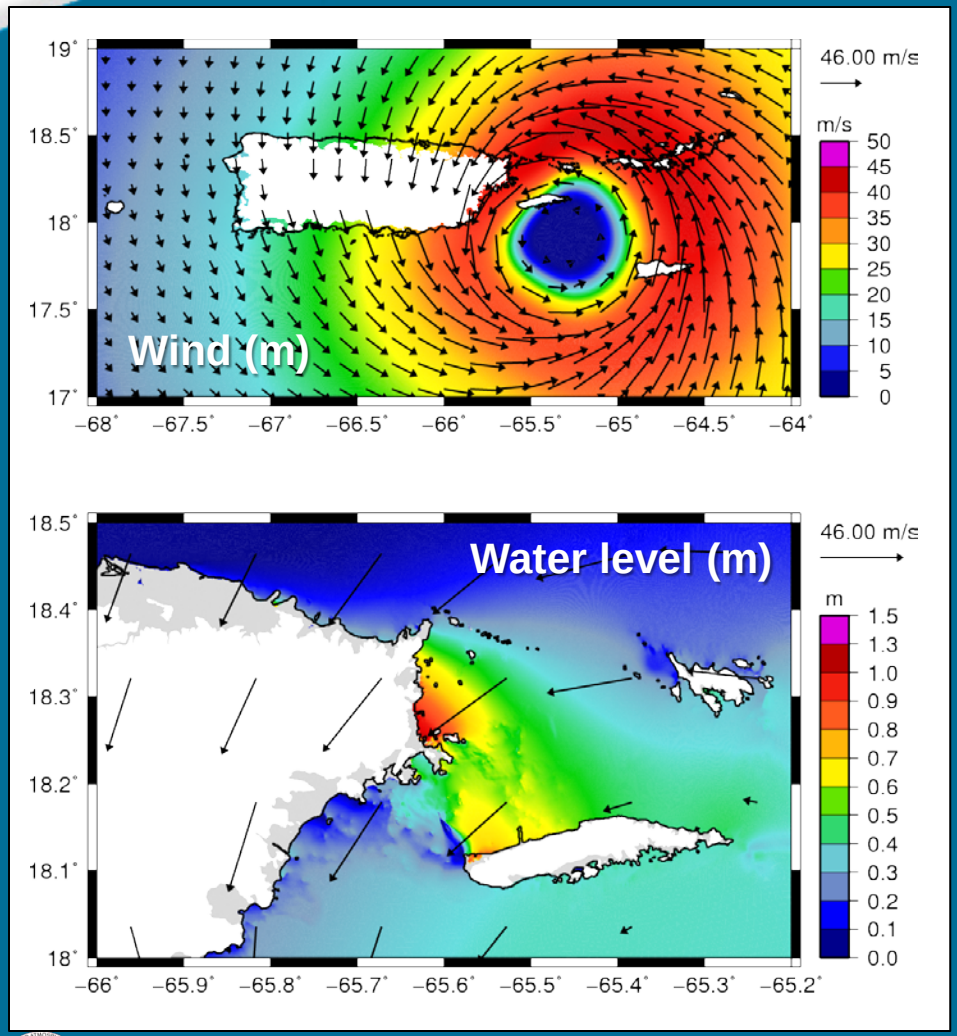
M_2 Constituent (Phase)

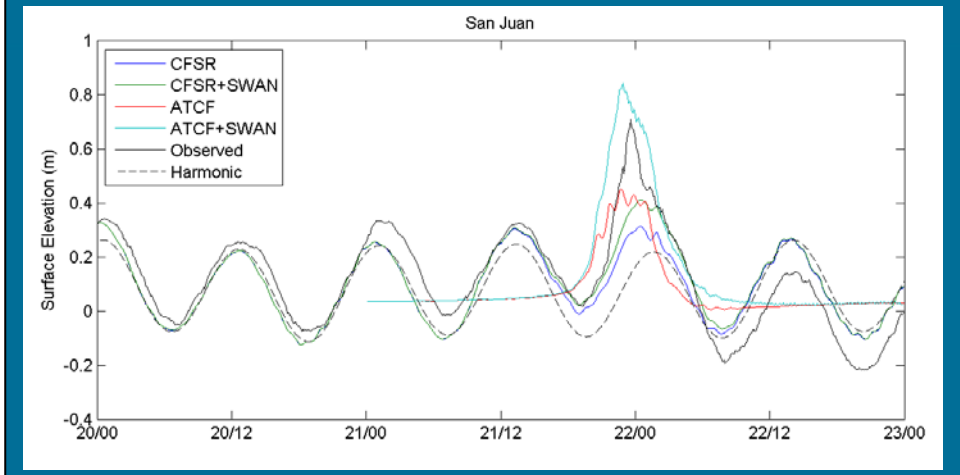


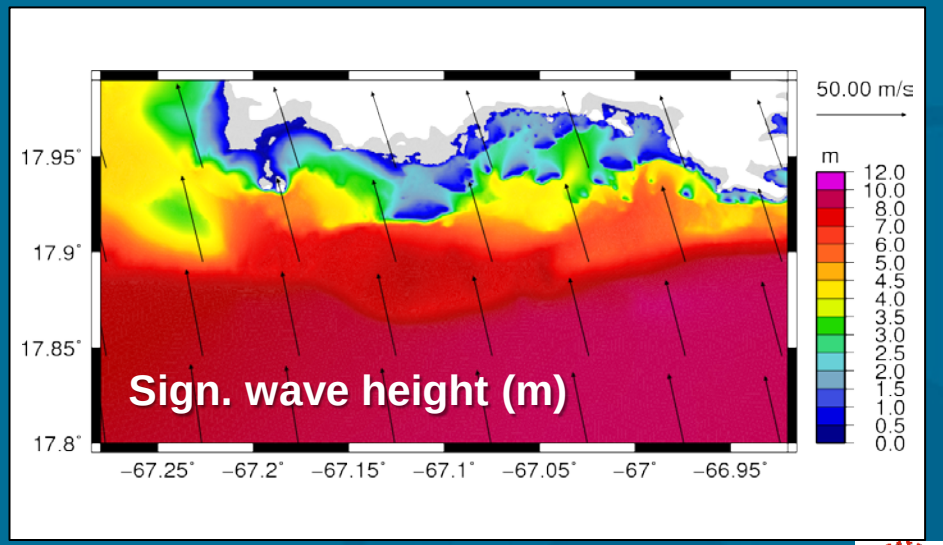
Also: Significant influence on low-period oscillations of including wind forcing over domain

Case 1: Surge and waves - ADCIRC

Hurricane Georges: Category 4 at landfall

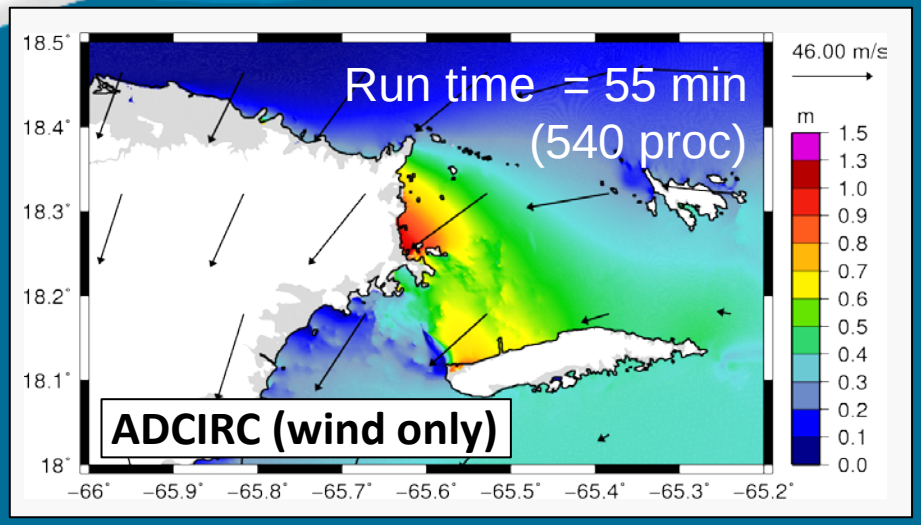


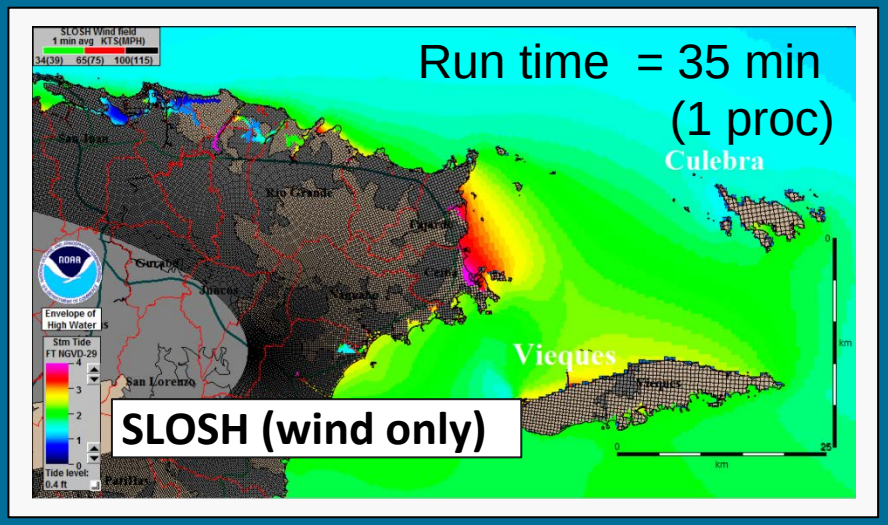


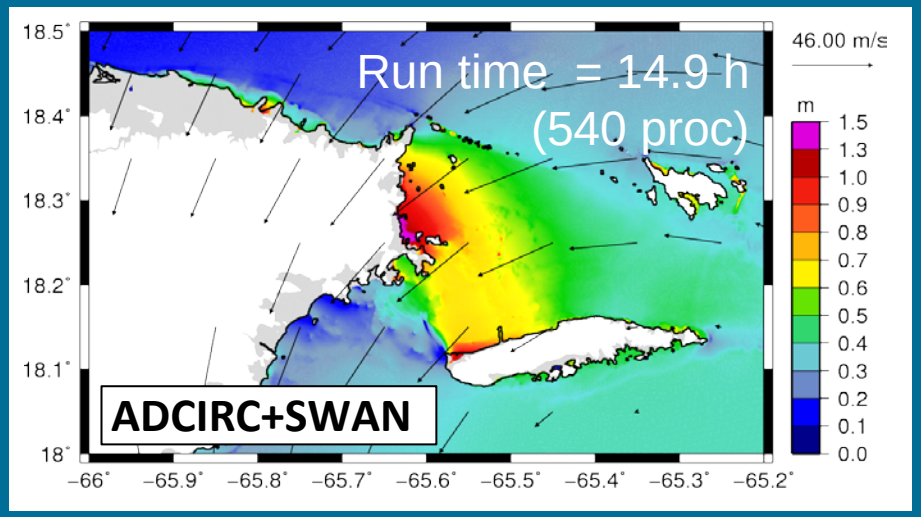


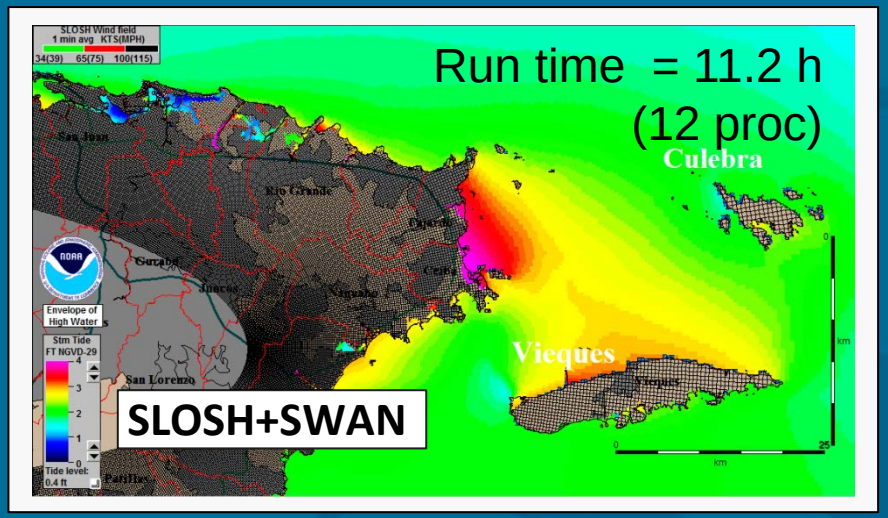
IOOS COMT testbed: ADCIRC vs. SLOSH

H. George (1998), Cat 4, landfall NE Puerto Rico (48 h sim)



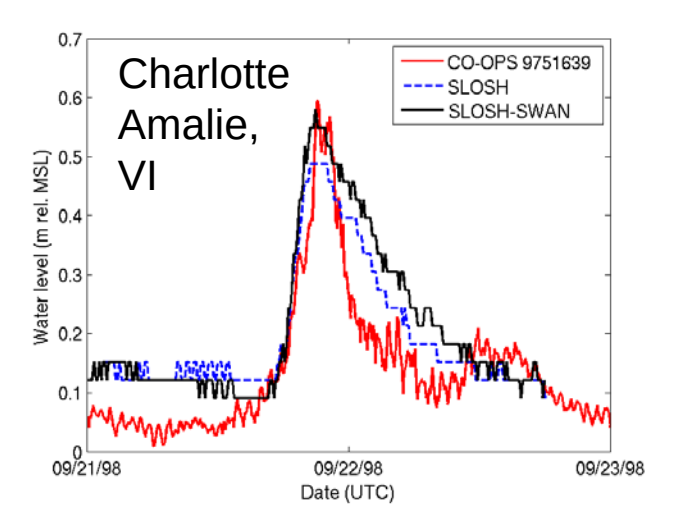


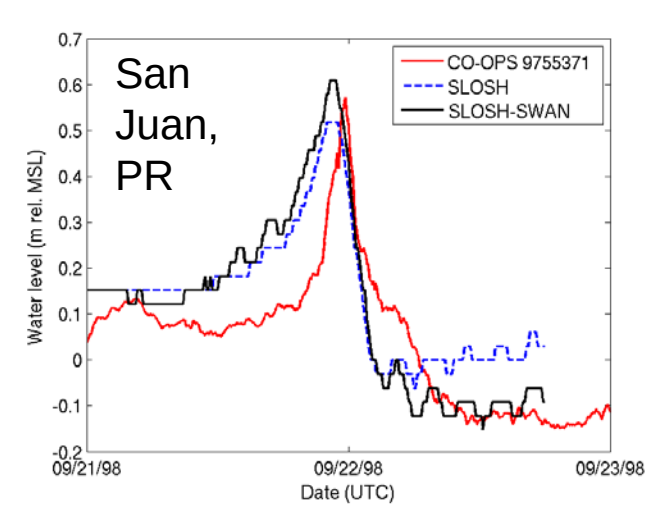


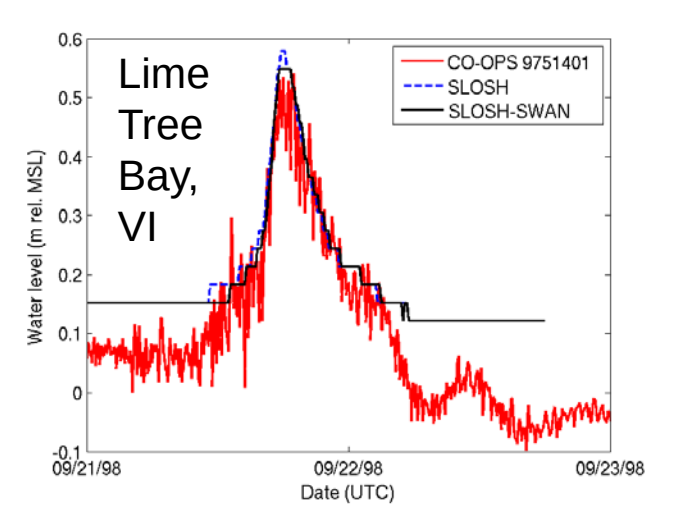


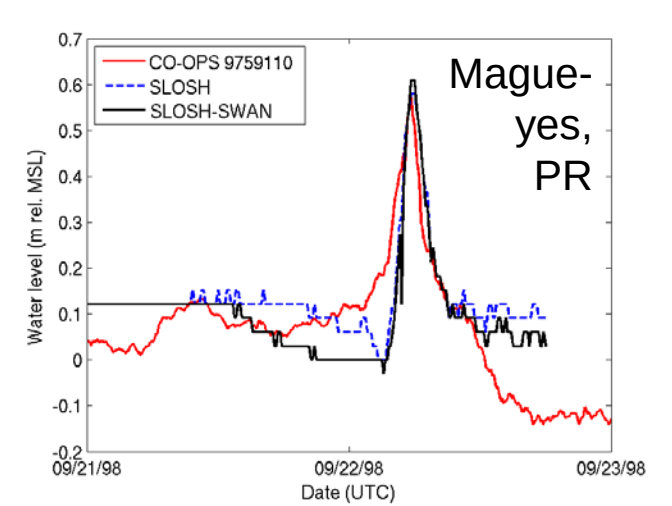
Case 1: Surge – SLOSH, impact of waves

Hurricane George (1998), Asymmetrical vortex model



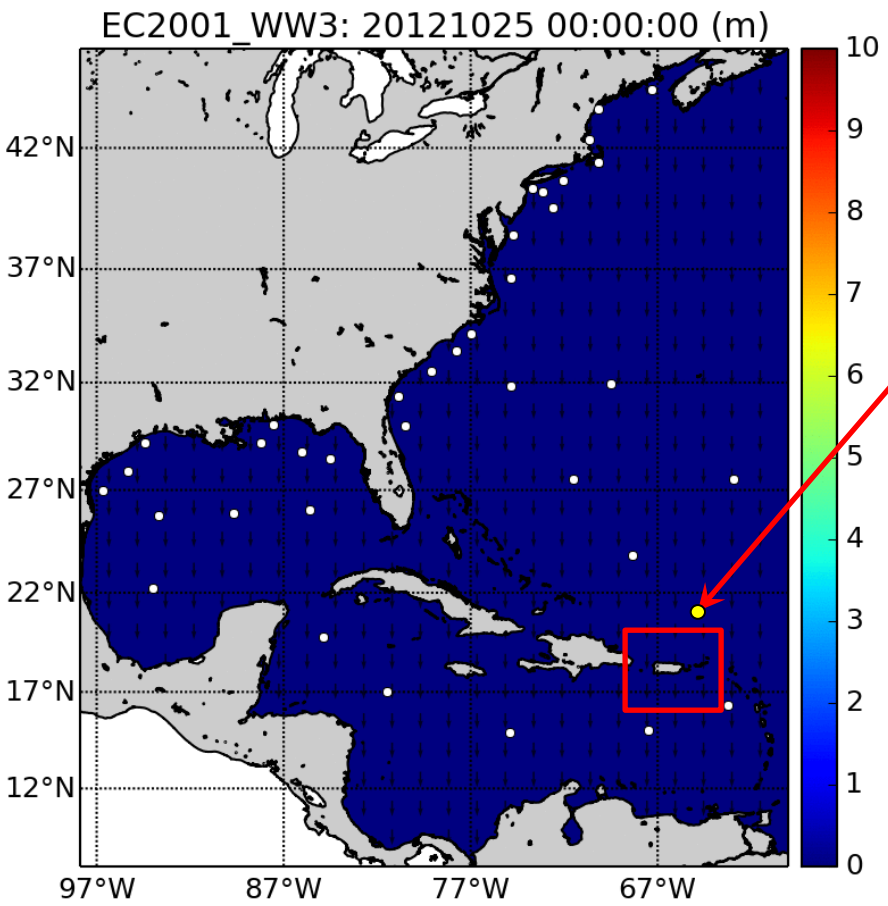


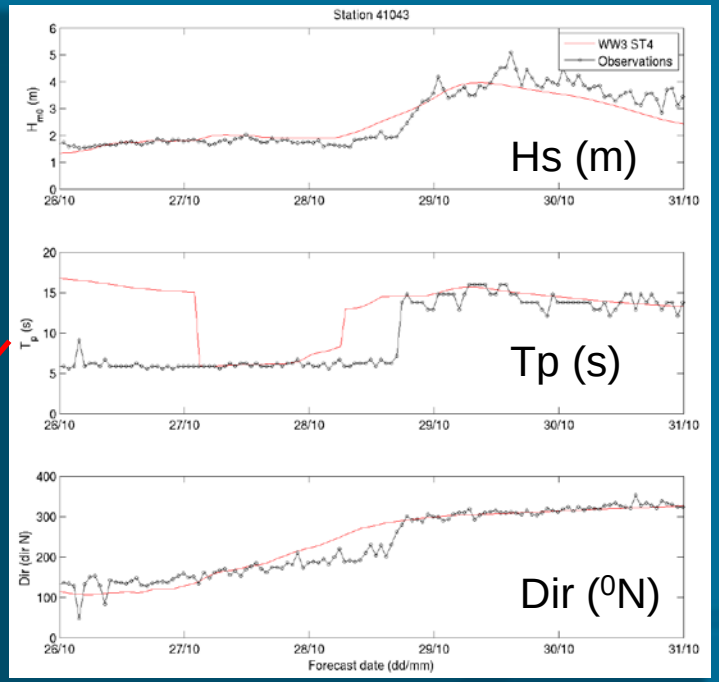




Case 3: Extra-tropical surge

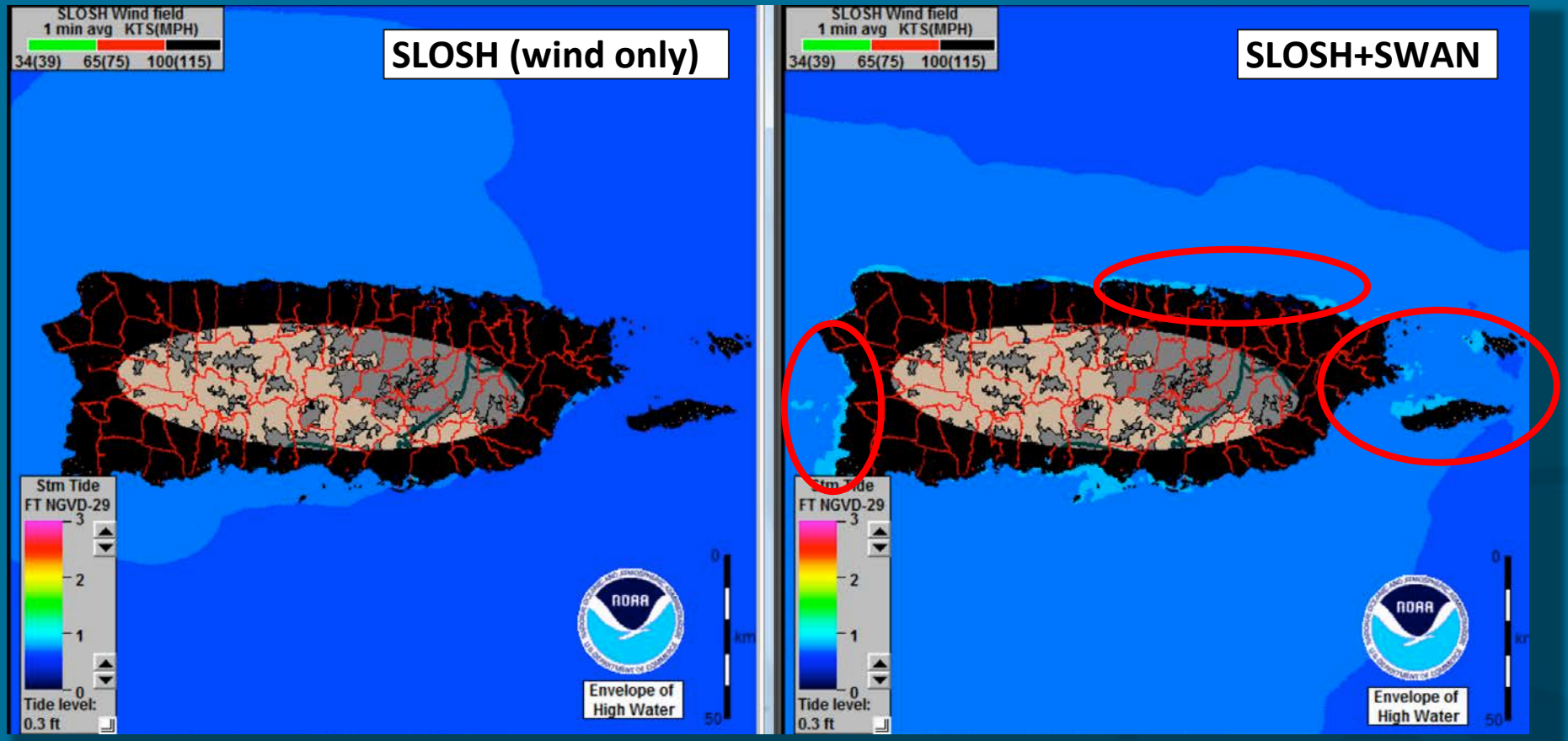
Superstorm Sandy (2012): WW3 waves with CFSR winds





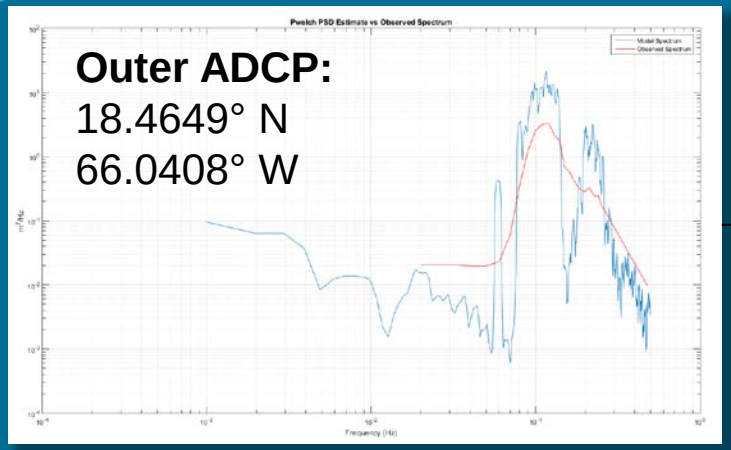
Case 3: SLOSH-SWAN surge

Superstorm Sandy (2012)

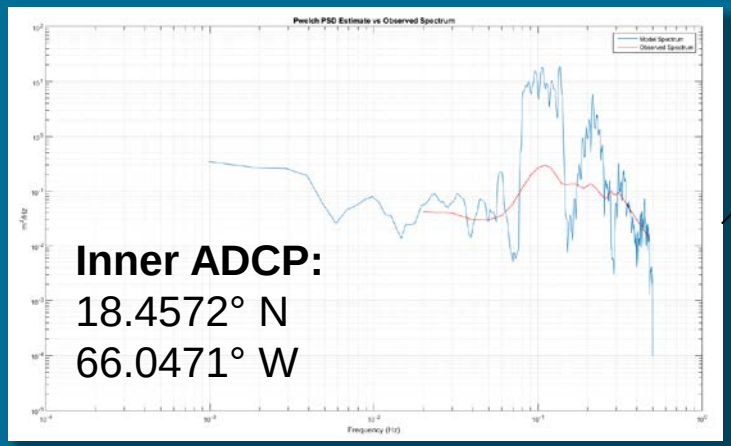


FUNWAVE phase resolving model

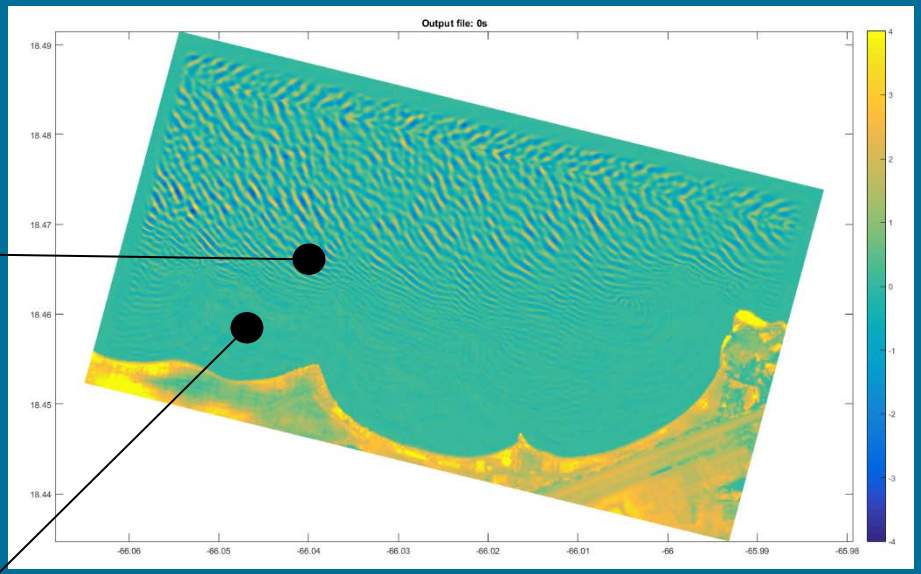
H. Irene Aug 22, 7 am UTC

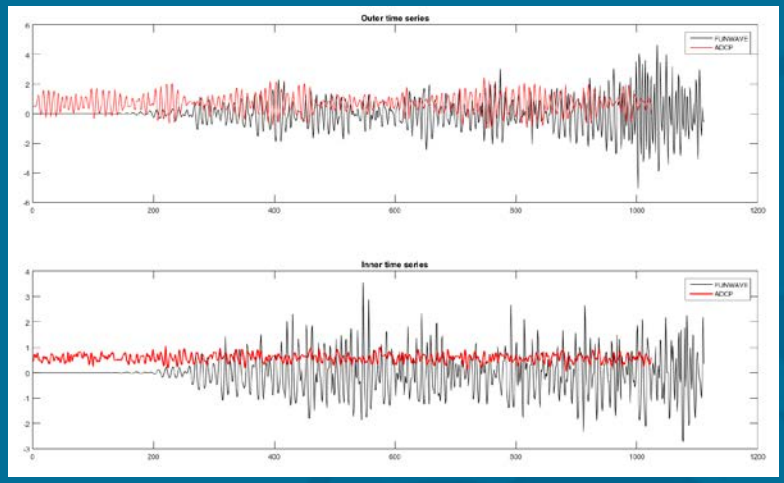


Outer ADCP:
18.4649° N
66.0408° W



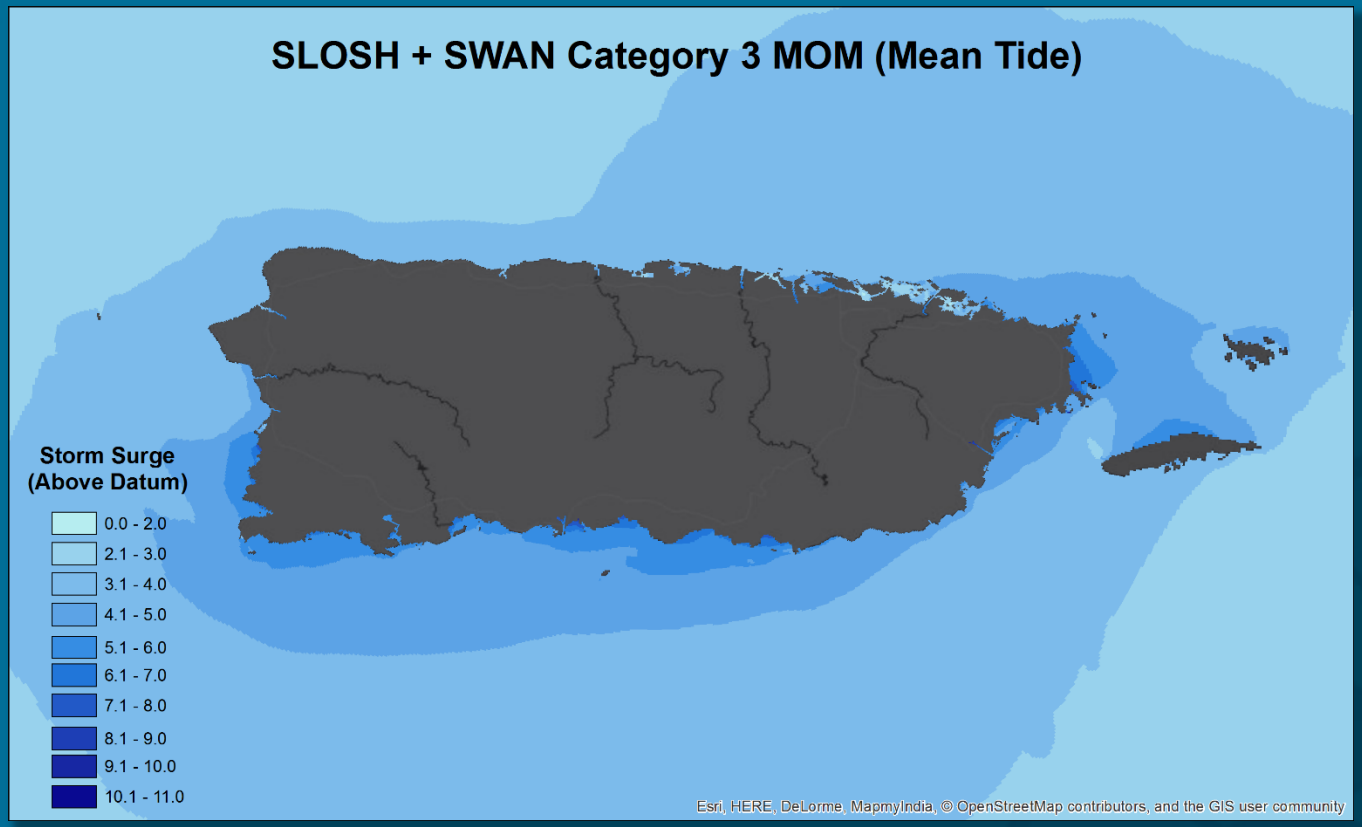
Inner ADCP:
18.4572° N
66.0471° W





Operational application

First-ever Maximum of Maximums (MOM) surge hazard database produced for Puerto Rico, using coupled SLOSH+SWAN. To be used for evacuation planning and response.



Conclusions

1. Island environments have highly-detailed coastline features, best resolved with unstructured meshes.
2. Including wave effects has a clear impact on total surge levels, but magnitude is location-dependent.
3. Able to represent extra-tropical surge in SLOSH via wave coupling.
4. First-ever Maximum of Maximums (MOM) surge hazard database produced for Puerto Rico, using coupled SLOSH+SWAN. To be used for evacuation planning and response.
5. The 3rd-gen wave model is a computationally-expensive component of the forecast system. For real-time operational application more efficient parameterized methods should be pursued.