

The state of ocean observing in the Caribbean

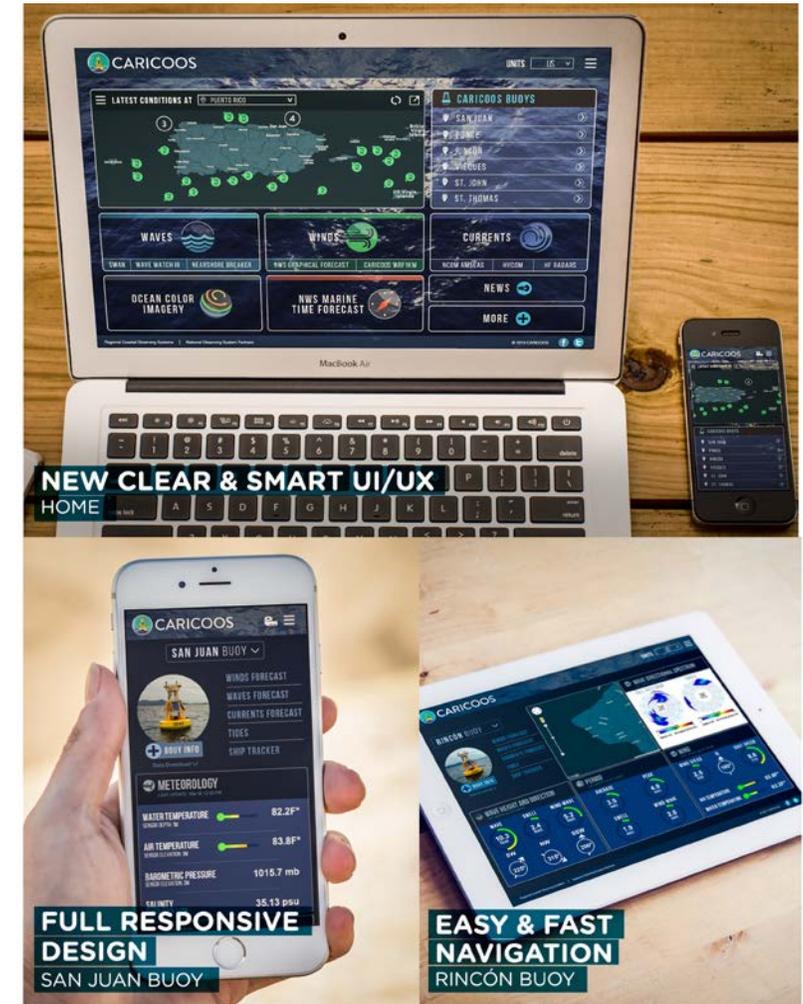
Miguel Canals, Julio Morell, Ruperto Chaparro,
Roy Watlington, Sylvia Rodriguez, Paul Jobsis & CariCOOS Team

Nov 3 2015 – IOOS AC Meeting – St. Thomas, USVI

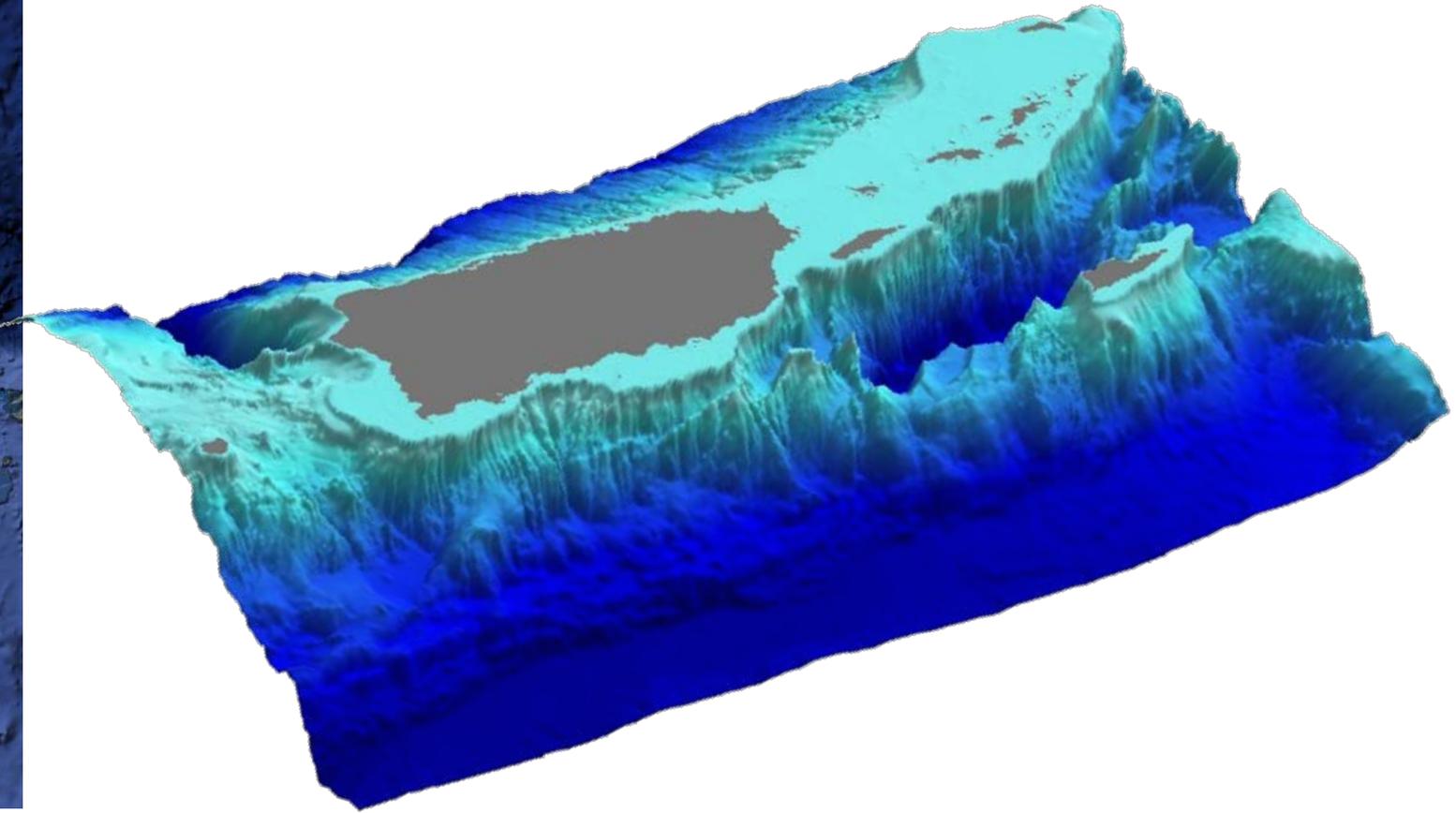
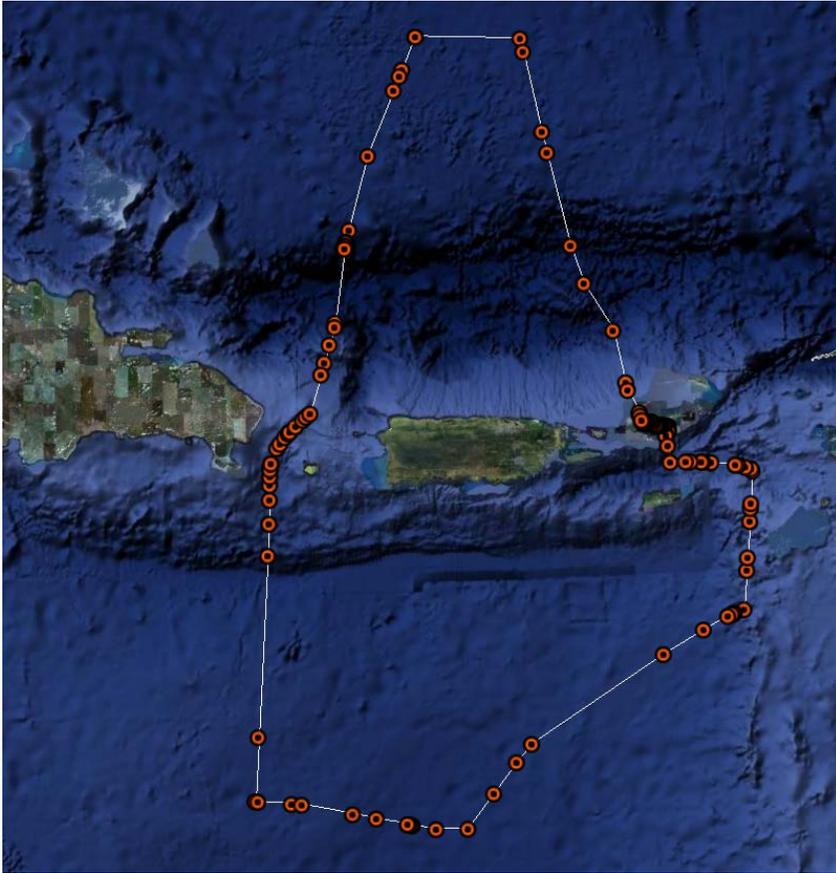


Overview

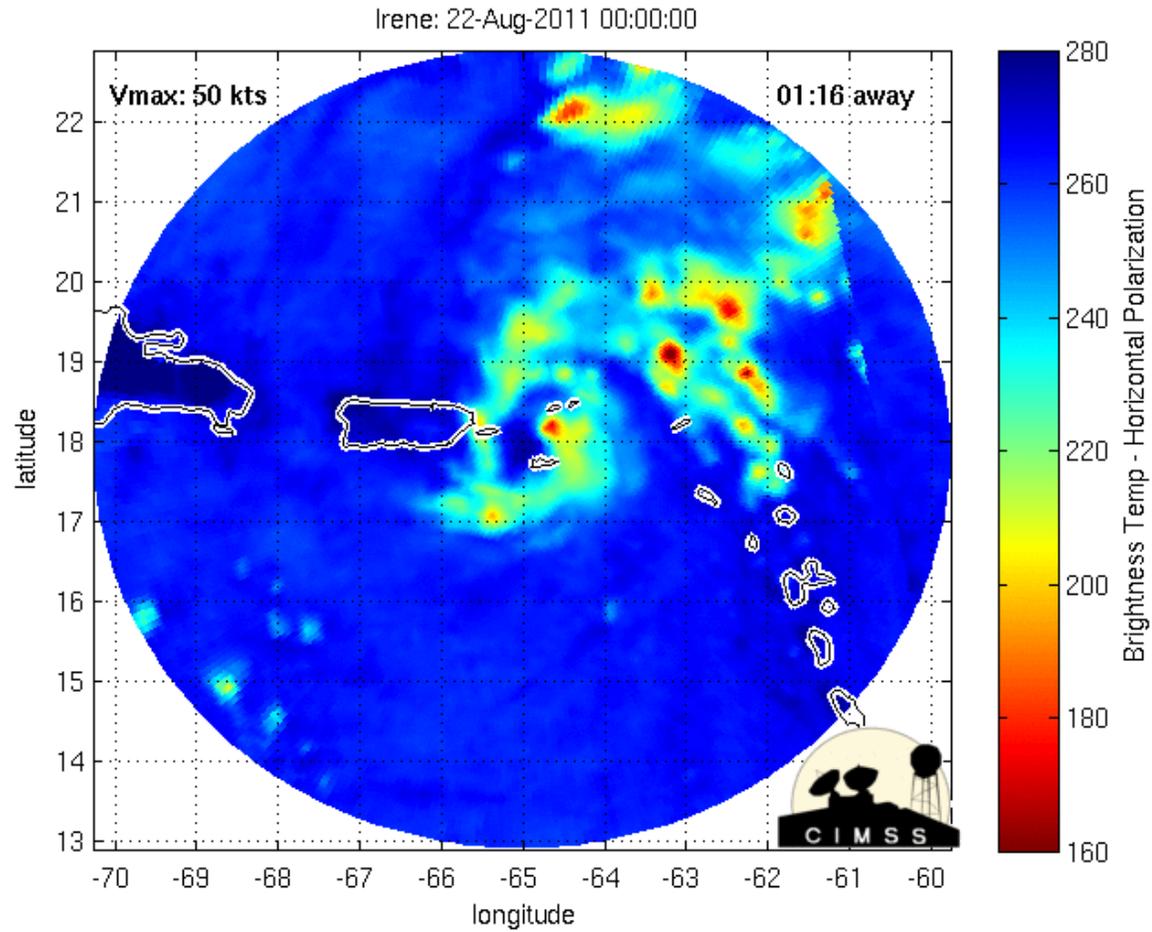
- CariCOOS overview, regional issues
- CariCOOS observing assets & models
- Examples of sector-focused services & regional challenges
 - Maritime safety
 - Coastal hazards & safety
 - Resource monitoring & management
 - Climate variability
- The Future
 - Better data delivery, international collaboration



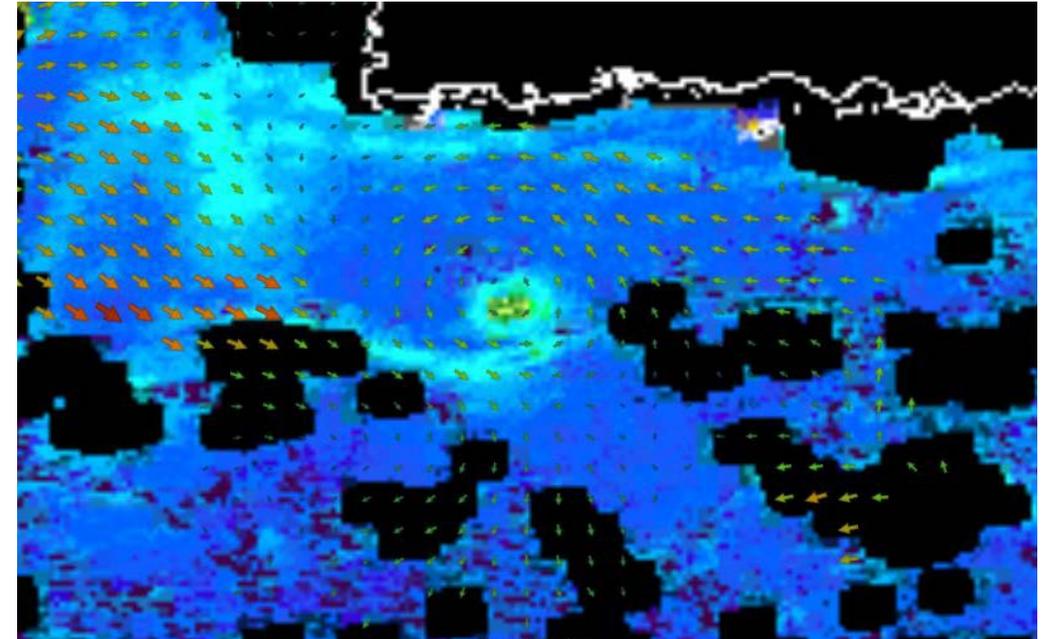
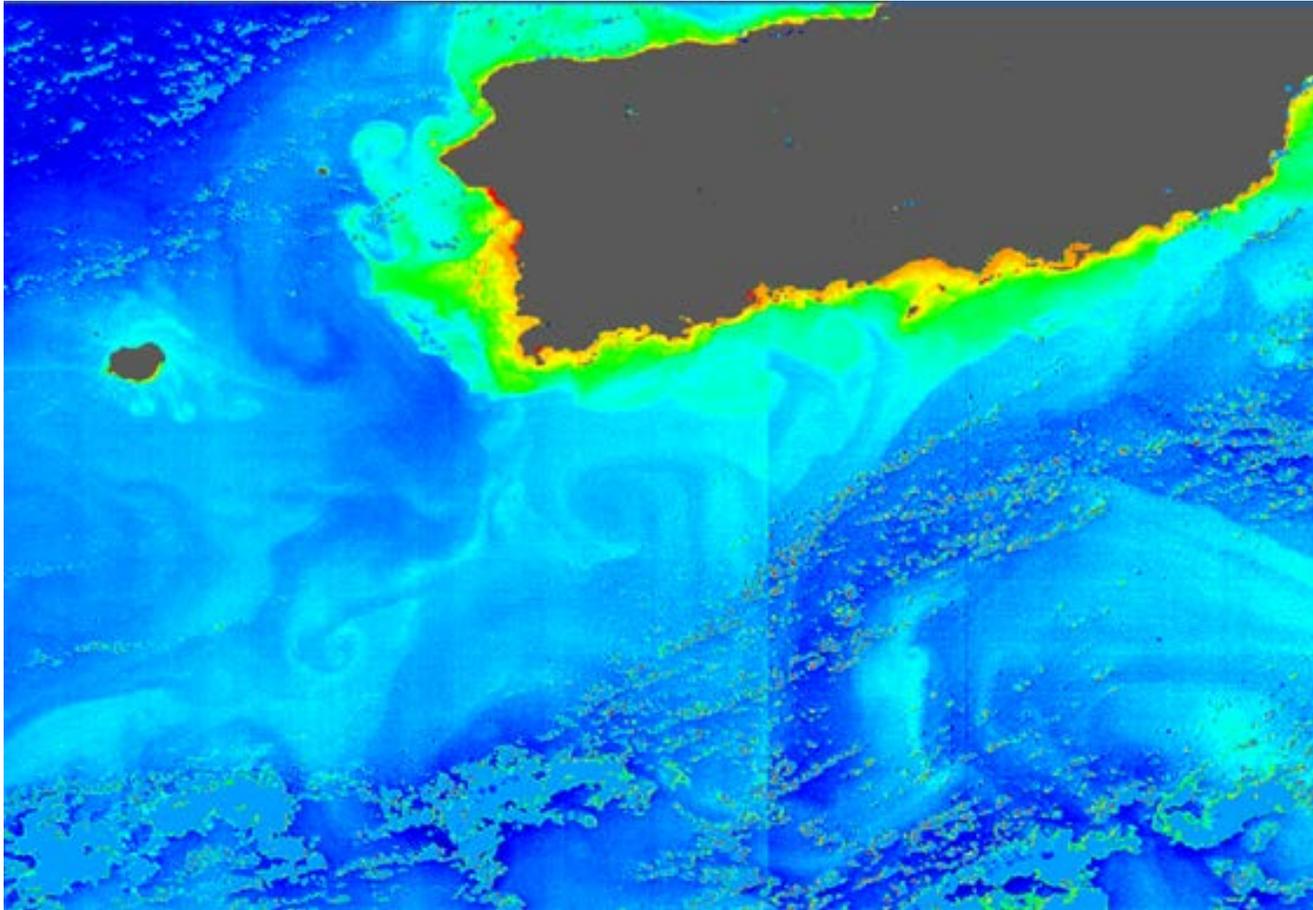
CariCOOS domain is the US Caribbean EEZ



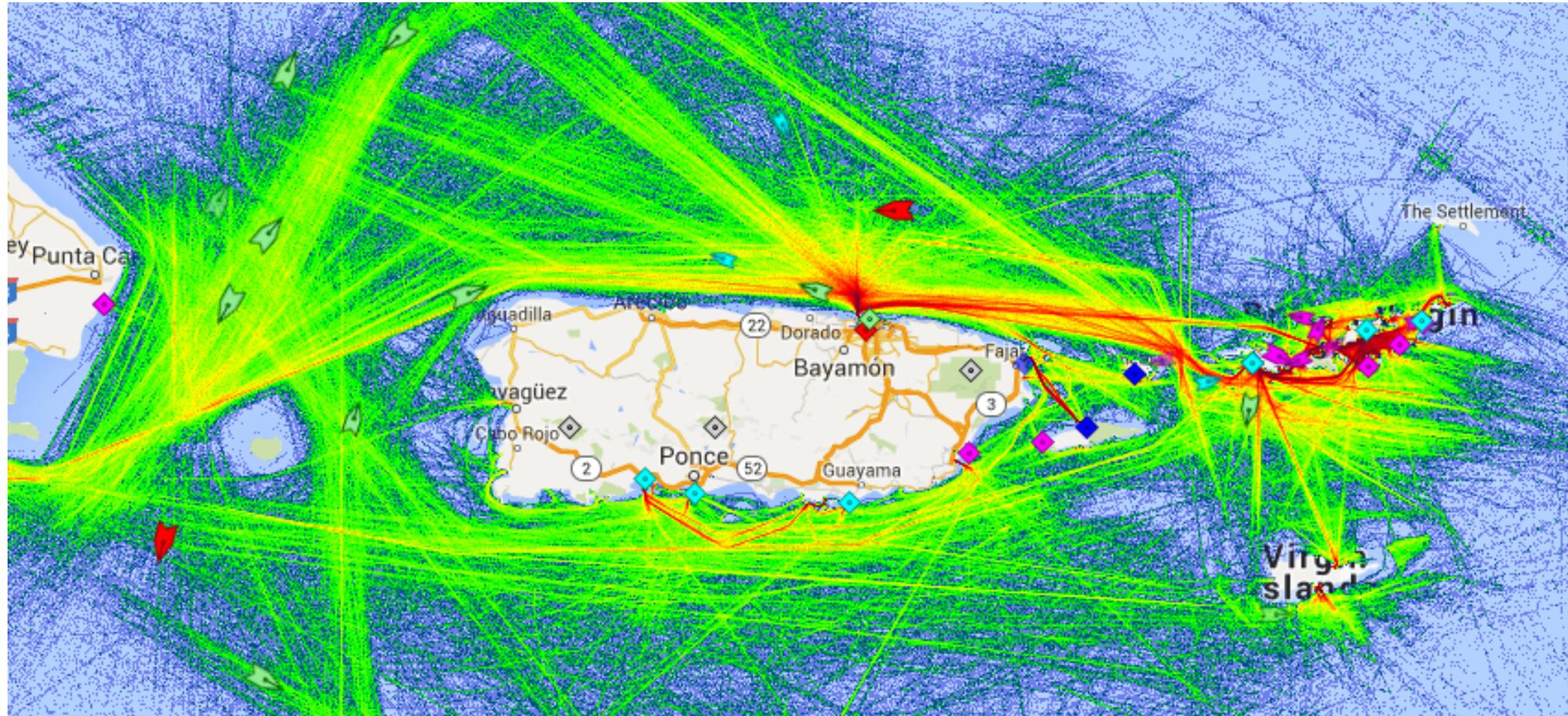
Challenges: extreme events



Challenges: complex flows



Challenges: maritime security



marinetraffic.com

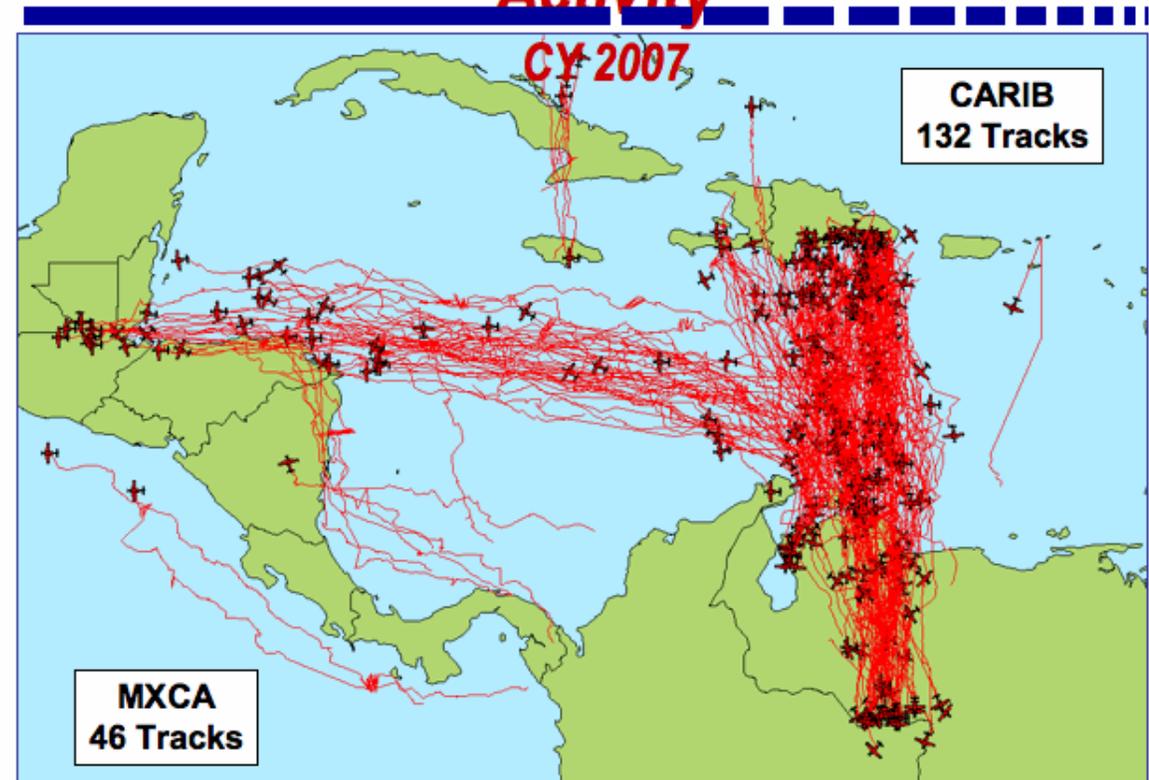




Challenges: maritime security



High Confidence Suspect Air Activity





Ocean observing in the Caribbean – then & now

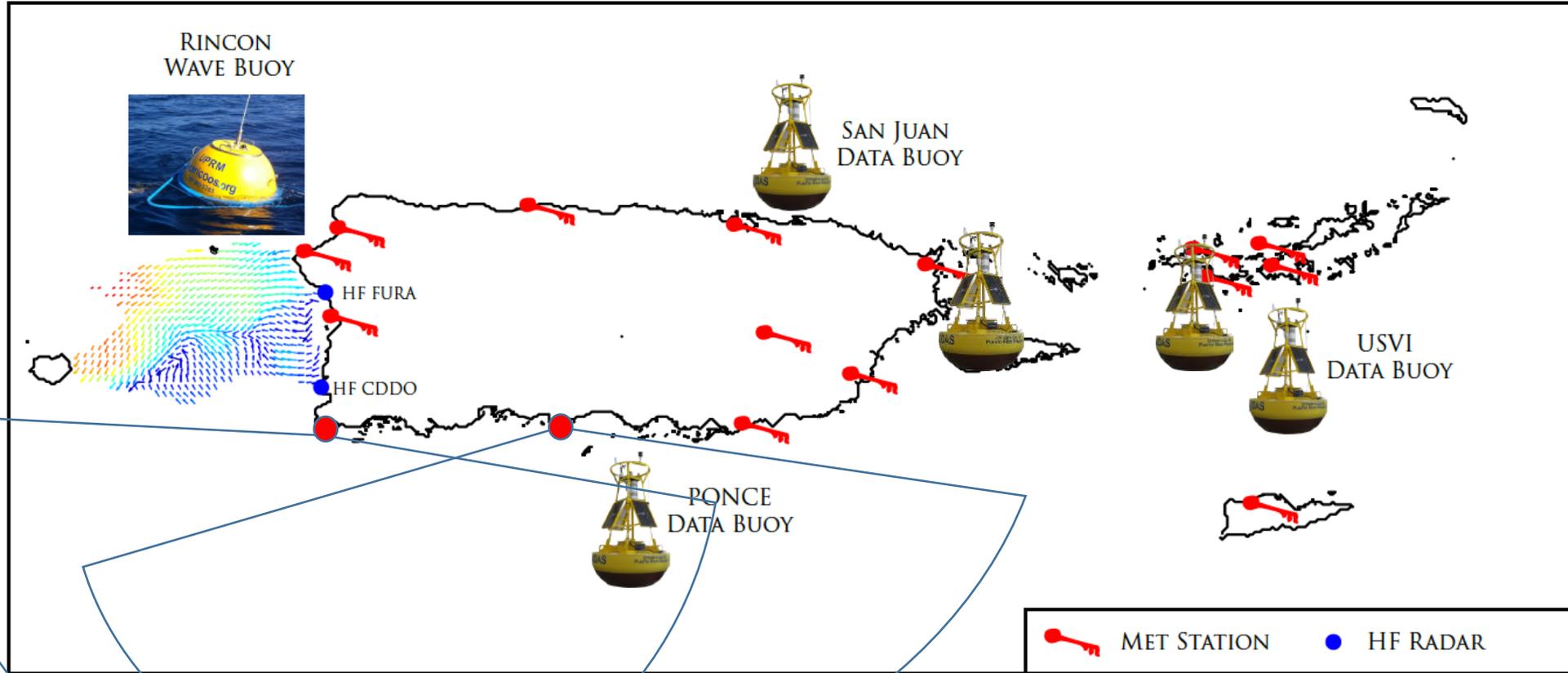


BEFORE 2008:

- No ocean data buoys
- No real-time wave or current data
- Very limited coastal weather stations
- Very few numerical models of waves and currents for the region
- This presented a problem not only for everyday ocean users but also for researchers & engineers
- If you wanted to undertake an ocean engineering project, there were **no boundary conditions, no initial conditions, no background characterization of ocean sites...**



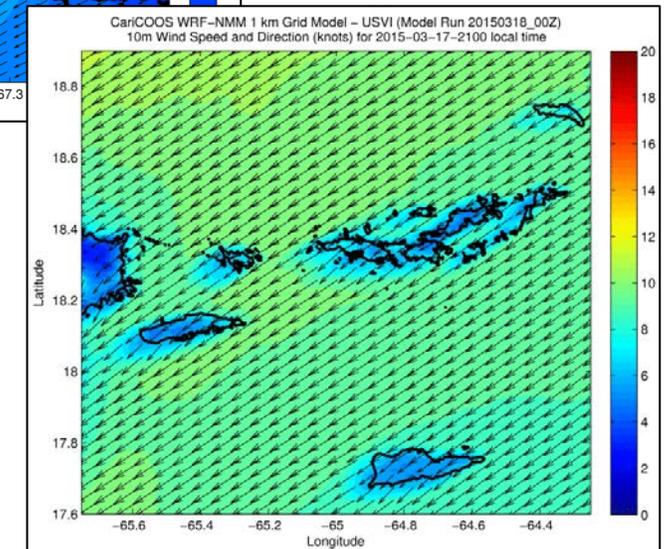
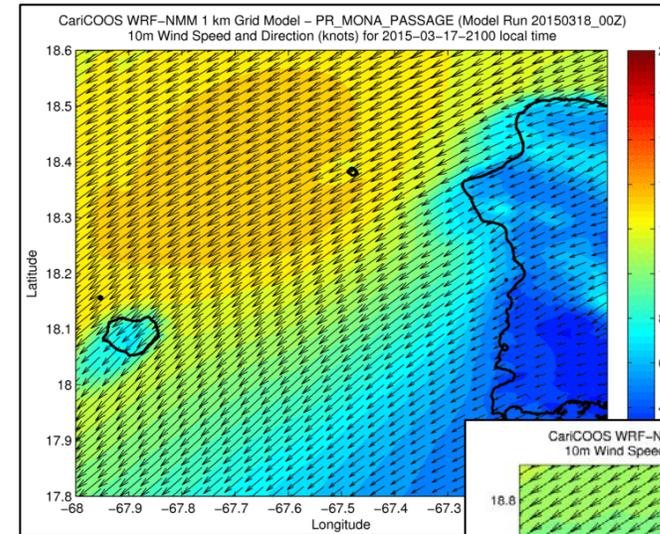
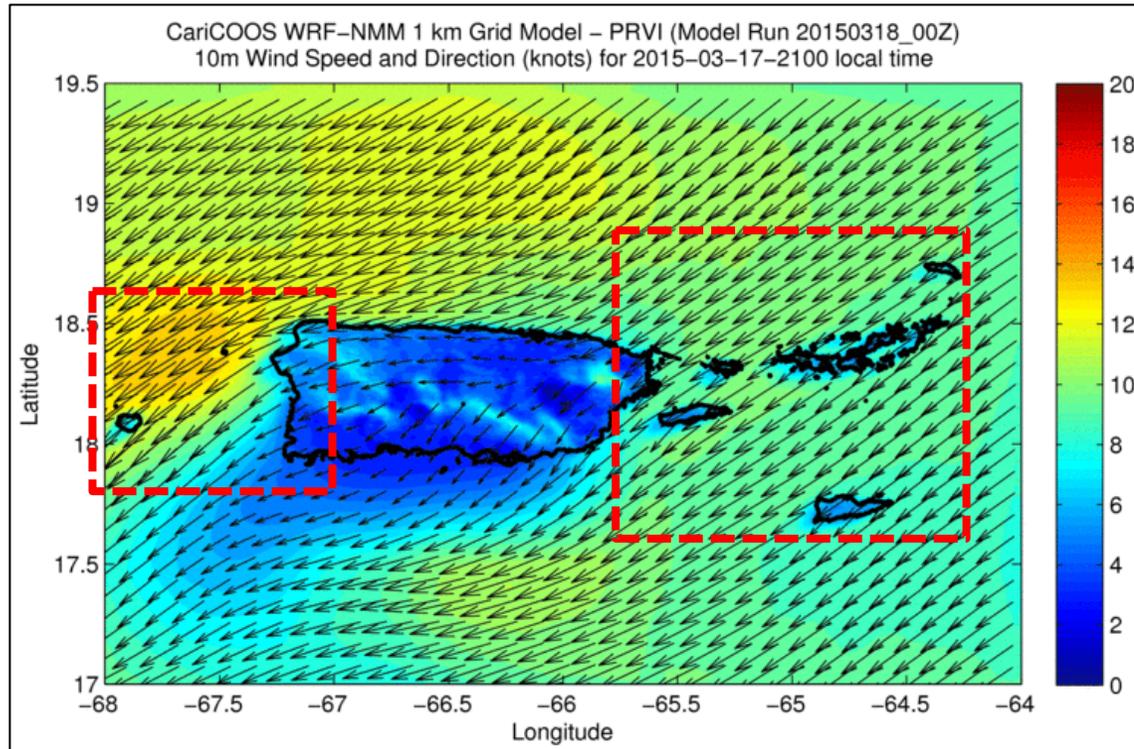
Ocean observing in the Caribbean – then & now



Also, gliders & drifters:



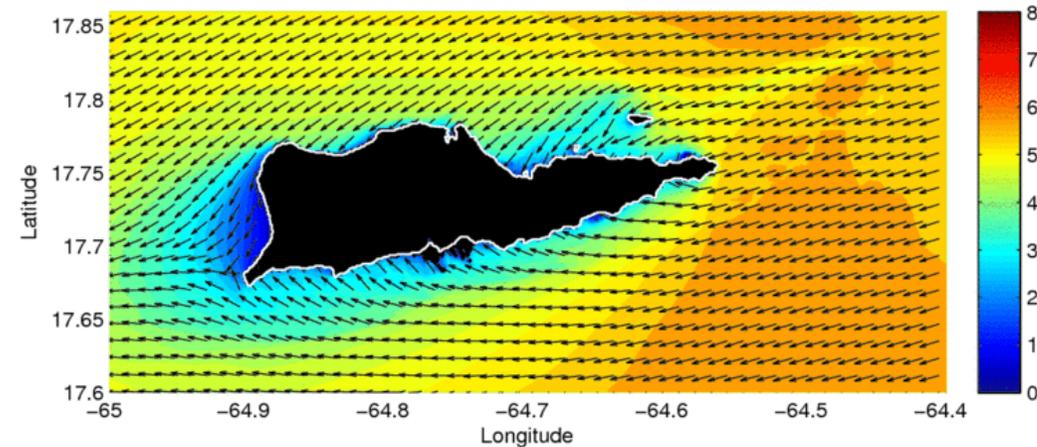
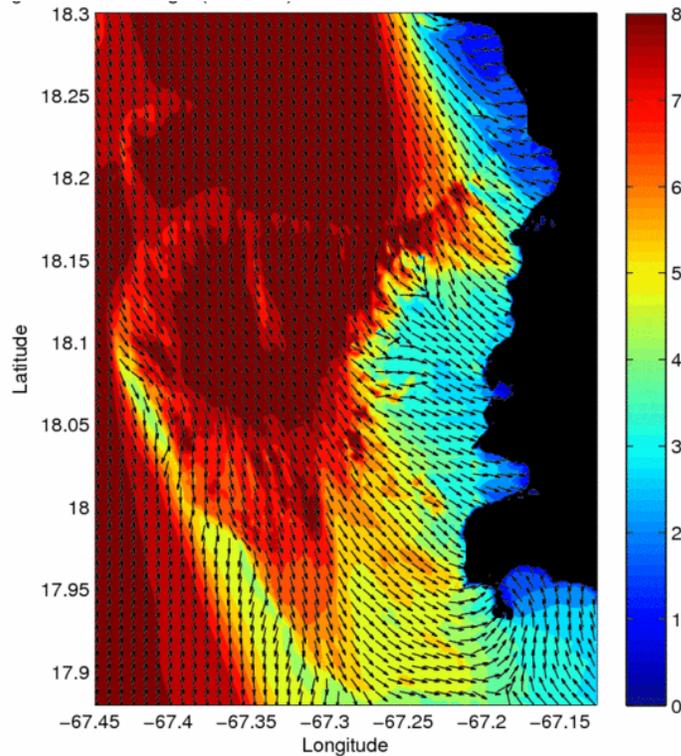
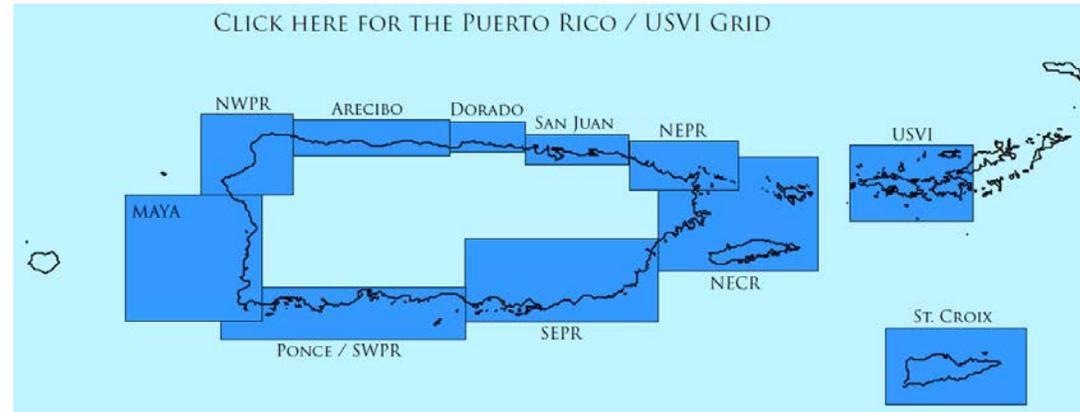
WINDS: The CariCOOS 1km WRF model



WAVES: The CariCOOS Nearshore Wave Model

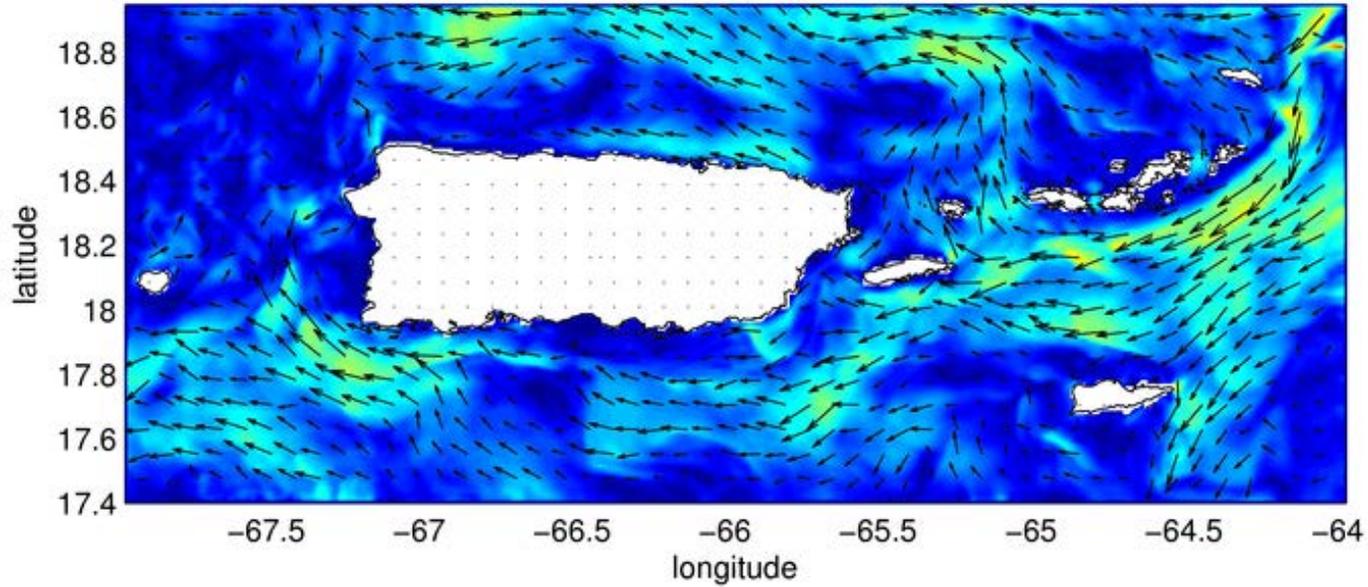


- **Every single meter of inhabited coastline in the US Caribbean is now covered by a very high resolution SWAN grid.**

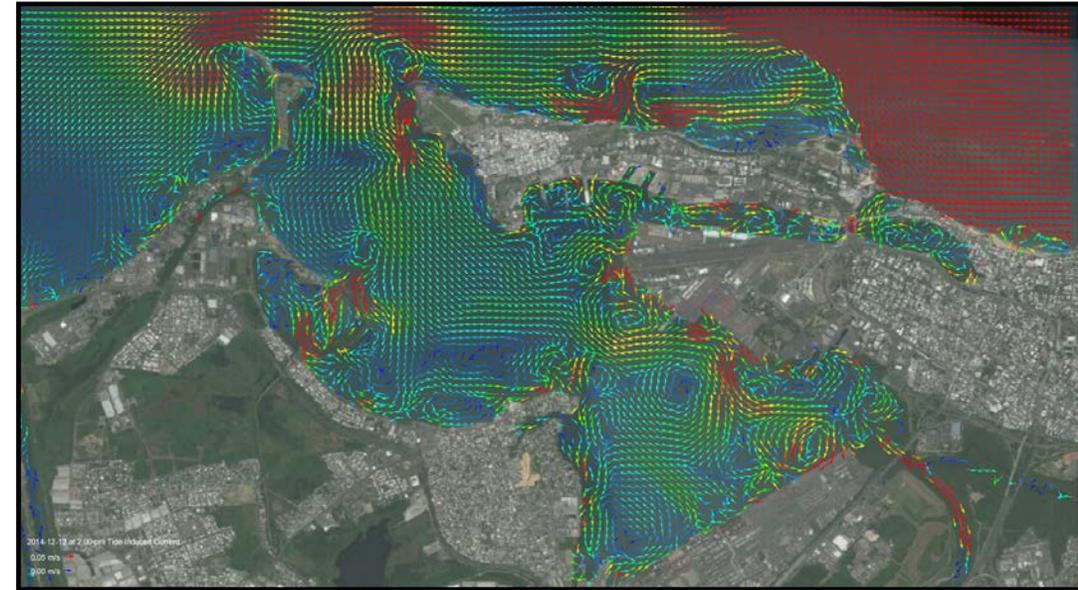


CURRENTS: CariCOOS ROMS & FVCOM

CariCOOS ROMS for open ocean & shelf

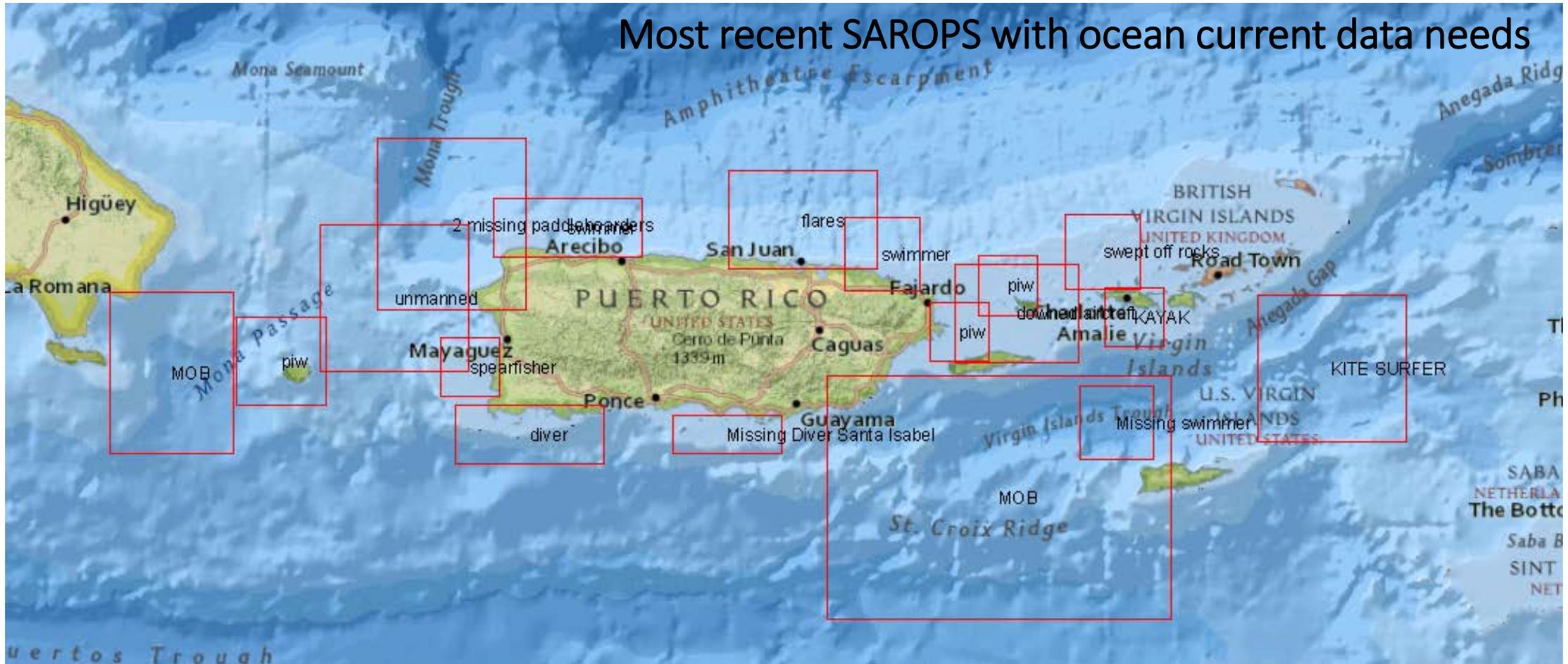


CariCOOS FVCOM for nearshore & coastal



Sector-focused services & challenges

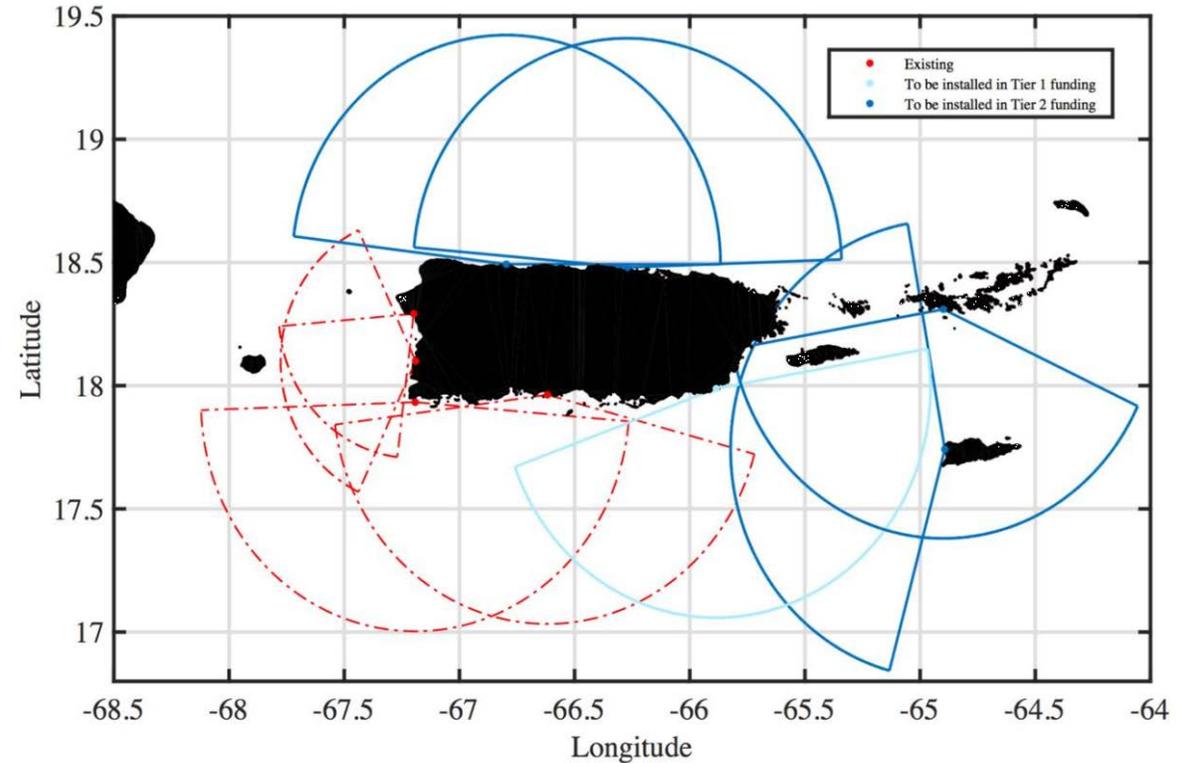
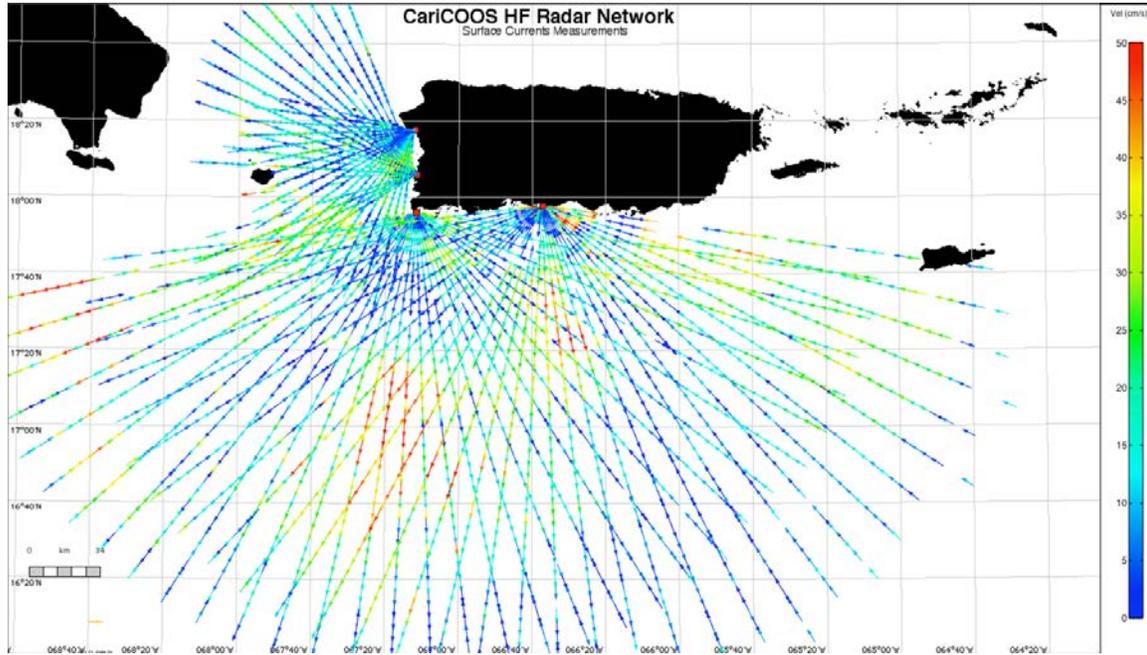
MARITIME SAFETY: Search & rescue in the Caribbean



John Ware, USCG



MARITIME SAFETY: Supporting search & rescue in the Caribbean with HFR data



HFR Network details

- 4 sites operational (red), one to be installed next week (light blue), 4 others planned (blue)
- In summer 2015, CariCOOS HFR finally available to USCG EDS for SAROPS



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MARITIME SAFETY: Coastal intelligence in support of port OPS

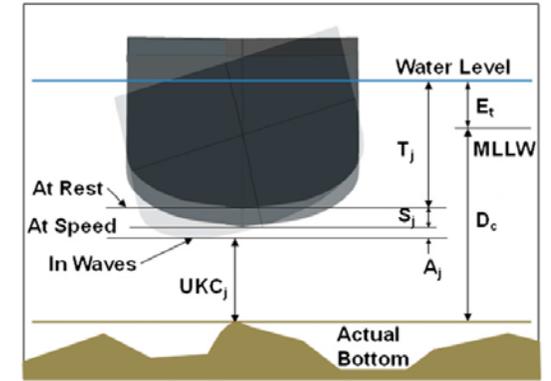
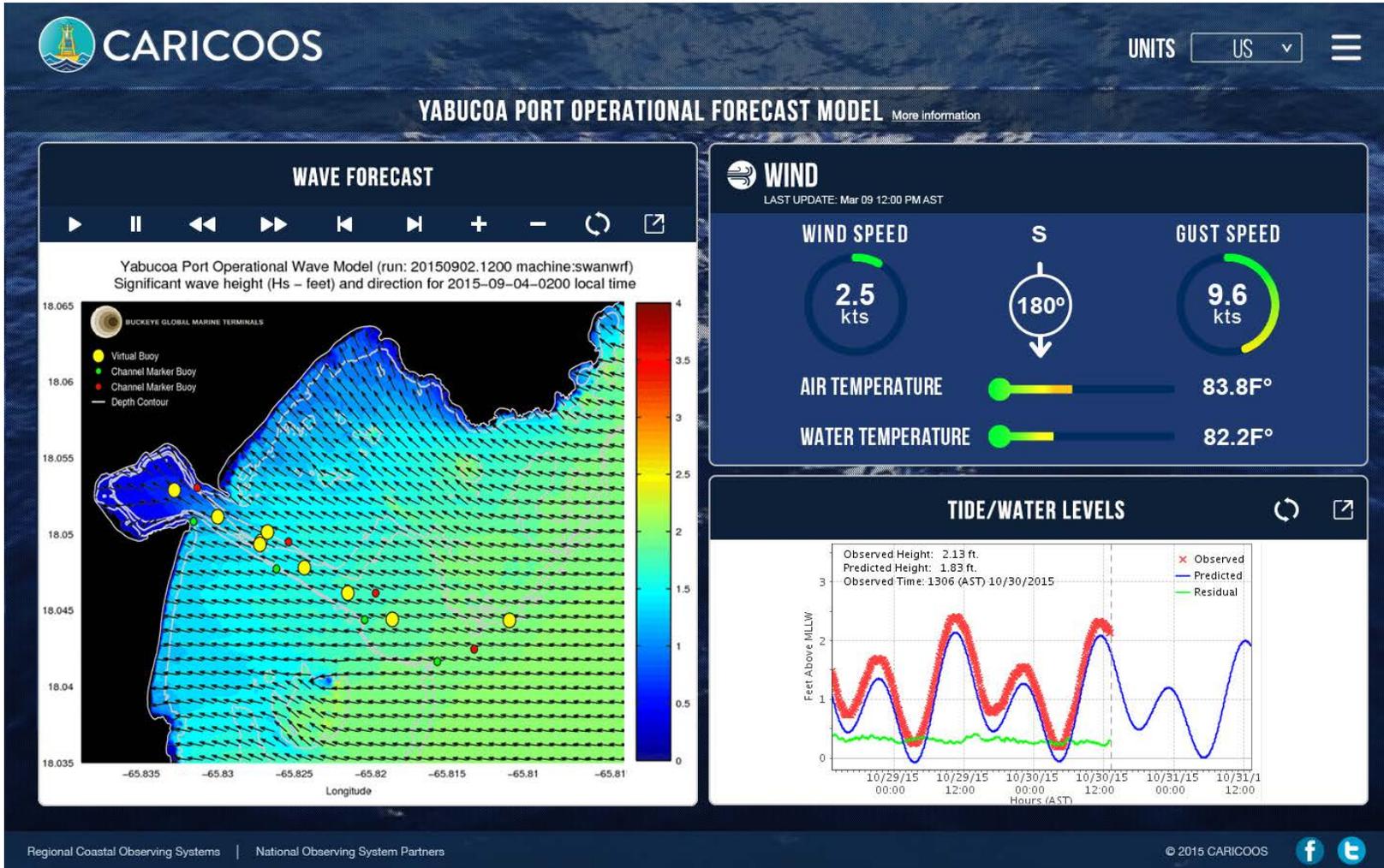


Fig. 1. Parameters defining the vertical position of a ship in a channel



COASTAL HAZARDS: Beach safety & wave-induced drownings



- PR's 15 most dangerous beaches are wave-dominated beaches (Sea Grant UPRM data):



Source: Primera Hora /Sea Grant UPR

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[Minnesota tourist dies while snorkeling in Puerto Rico | Mail Online](#)
www.dailymail.co.uk/.../Minnesota-tourist-dies-snorkeling-Puerto-Rico.htm...
Dec 8, 2013 - Puerto Rico police say a 30-year-old tourist from Minnesota died Sunday while ... Rip currents can be deceiving and aren't always visible to the ...

[New York tourist drowns near Puerto Rico resort - Topix](#)
www.topix.com/forum/world/puerto-rico/T70BPJH1JME8NPARQ
Oct 27, 2007 - 12 posts - 3 authors
I was there also, I witnessed it from when they got in trouble to when they were pulled out of the water...It was terrifying and very sad.

[Tourist Killed](#)
touristkilled.com/
Australia: British man drowns in strong currents while trying to save sons - Australia: ... Costa Rica: Tourist becomes ill with Malaria in Costa Rica, authorities to sea by strong current · Puerto Rico: American tourist drowns while swimming at ...

[Puerto Rico: Canadian man drowns after being swept to sea by ...](#)
touristkilled.com/puerto-rico-canadian-man-drowns-after-being-swept-to-...
Sep 12, 2013 - Puerto Rico: American tourist drowns while swimming at beach in San Canadian man drowns after being swept to sea by strong current ...

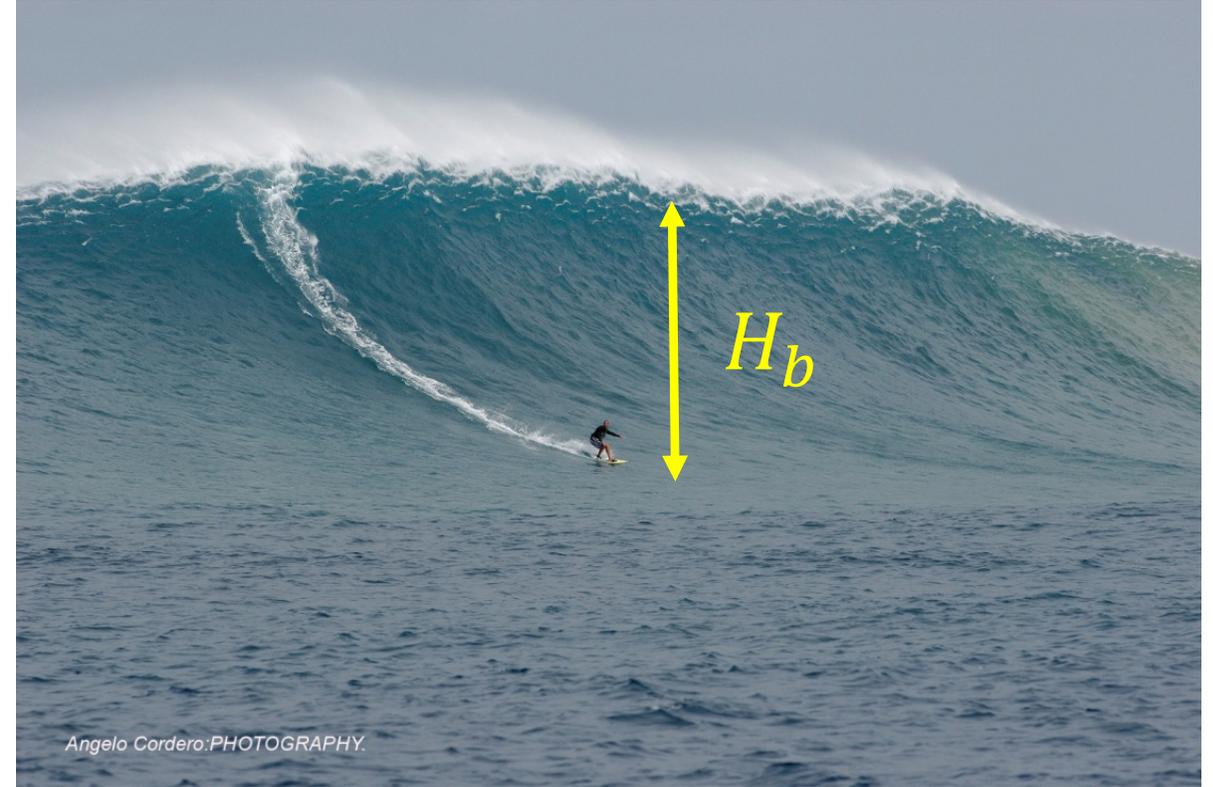
[Tourist from Minnesota dies while snorkeling in Puerto Rico :: Latin ...](#)
latinamericacurrentevents.com/tourist-from...dies...puerto-rico/30234/
Dec 10, 2013 - Puerto Rico police say a 30-year-old tourist from Minnesota has died while snorkeling off the island's north coast. Police identified the victim as ...

[Tourist drowns at Puerto Rico beach :: Latin America Current Even...](#)
latinamericacurrentevents.com/tourist-found-drowns...puerto-rico.../272...
Mar 17, 2013 - Aguadilla (CyberNews) – A tourist drowned at 3:41 Crash Boat Beach in Aguadilla, police said. The tourist has been identified as David A.

COASTAL HAZARDS: Beach safety & wave-induced drownings



- Develop an operational high-resolution wave model capable of accurately predicting the nearshore wave climate
- Using the wave model output, develop a nearshore breaker prediction system, with the following design criteria:
 - Be able to predict the expected range of breaking heights across the PR/USVI archipelago
 - Be modular, with additional beaches added on-the-fly (over 100 beaches)
 - Be a user-friendly tool to increase coastal intelligence in the region
 - Target users: beachgoers, lifeguards, beach safety focus – ***need to err on safe side, but not overly conservative***

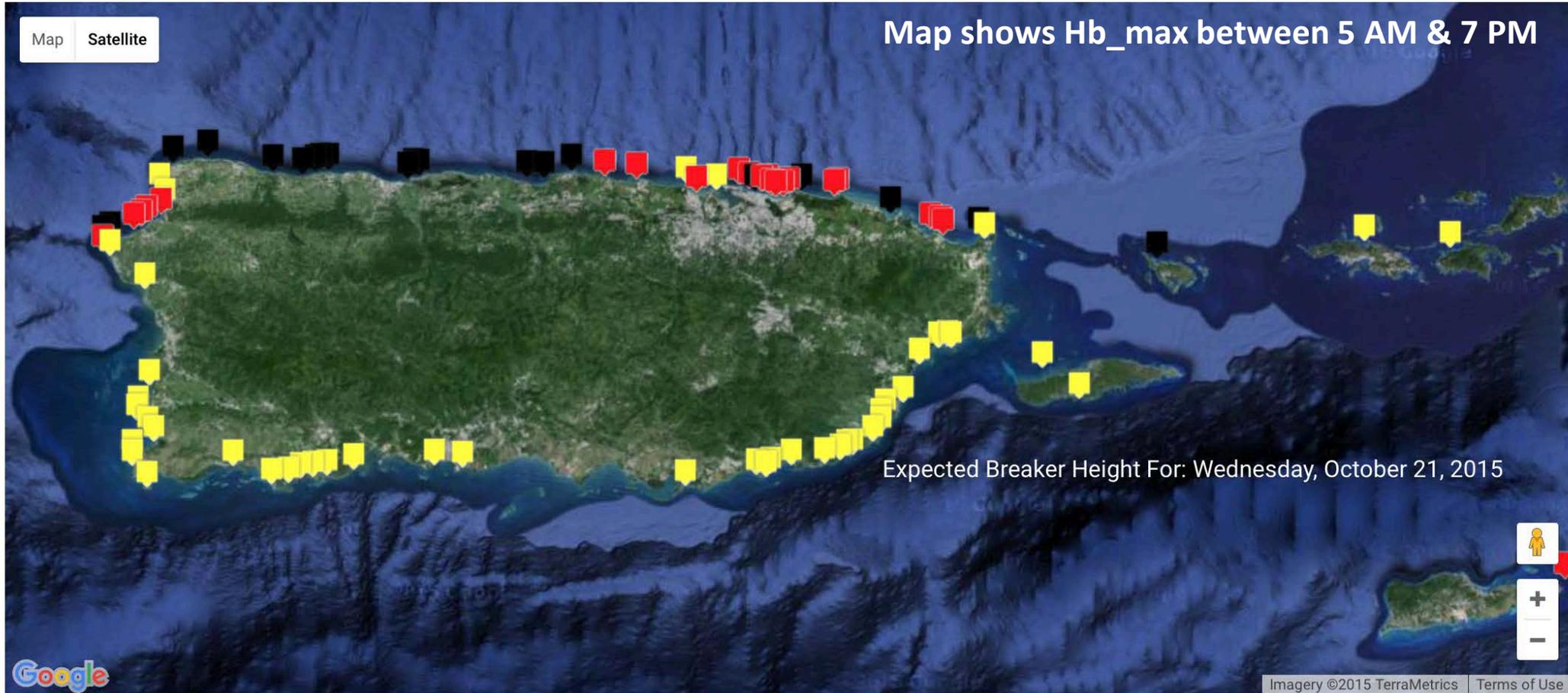


$$H_{b_{min}} < H_b < H_{b_{max}}$$



COASTAL HAZARDS: Beach safety & wave-induced drownings

■ LOW to MODERATE (between 2 and 4 feet) ■ MODERATE to HIGH (between 4 and 6 feet) ■ HIGH to VERY LARGE (> 6 feet)



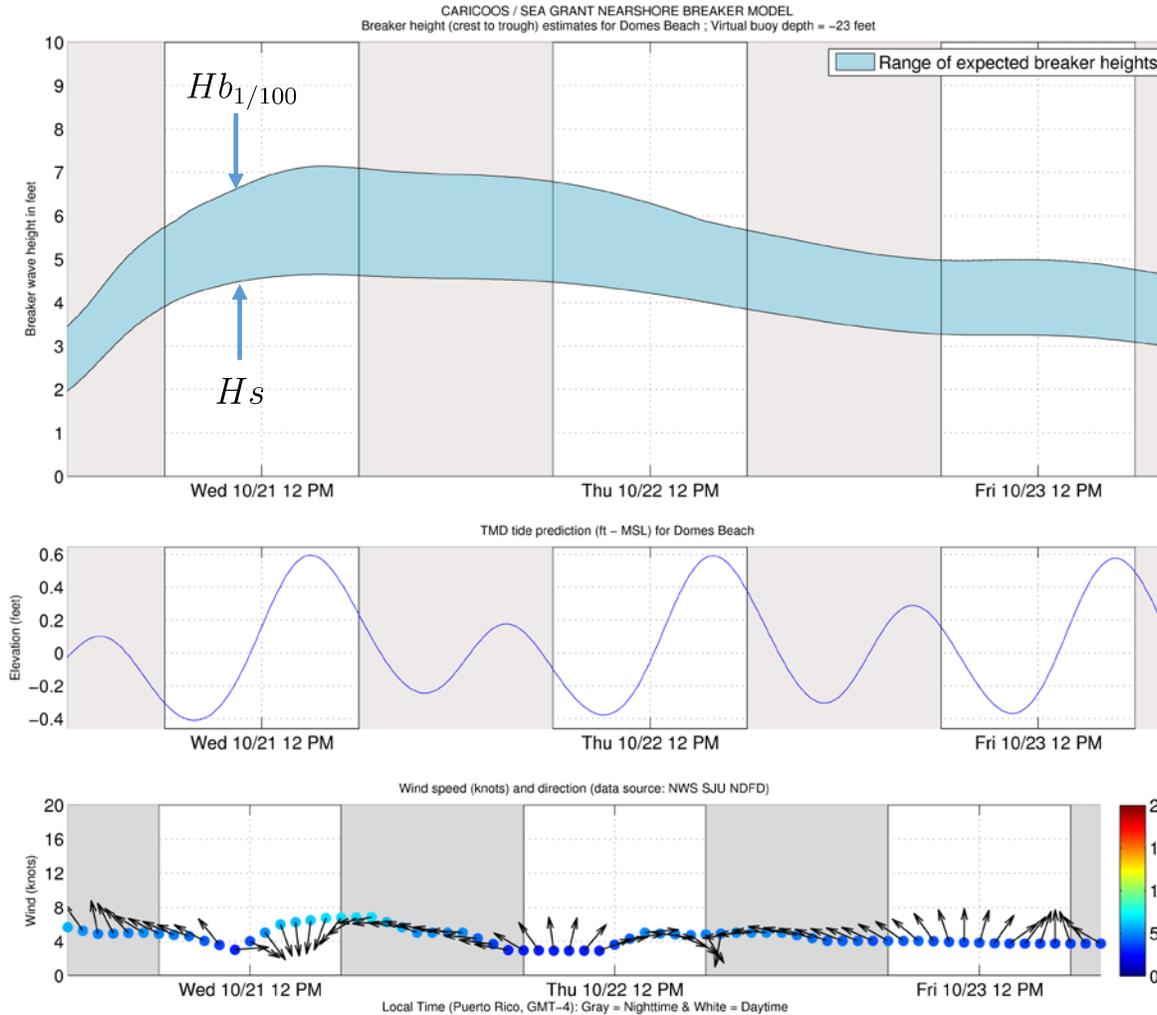
Tuesday, October 20, 2015

Wednesday, October 21, 2015

http://www.caricoos.org/Nearshore_Breaker_Model/



COASTAL HAZARDS: Beach safety & wave-induced drownings



From Rincon Surf Report:
“the surf is still pretty decent with **chest to head high waves with some 2ft overhead sets**. The swell should be building through the day. “

Model checked daily!



COASTAL HAZARDS: Storm surge modeling

Storm surge inundation maps

Potentially storm surge floodable areas were determined for category 1 to 5 hurricanes. Computer simulations used the tightly coupled models **ADCIRC** and **SWAN**. Three headings were chosen: 290°, 270° and 60°

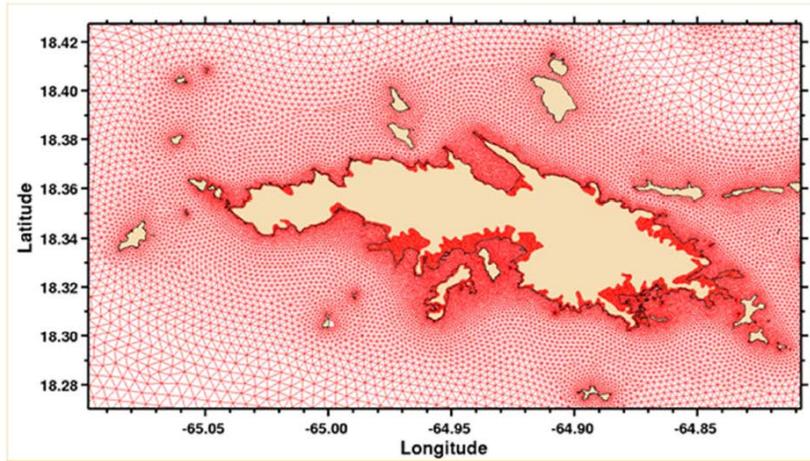
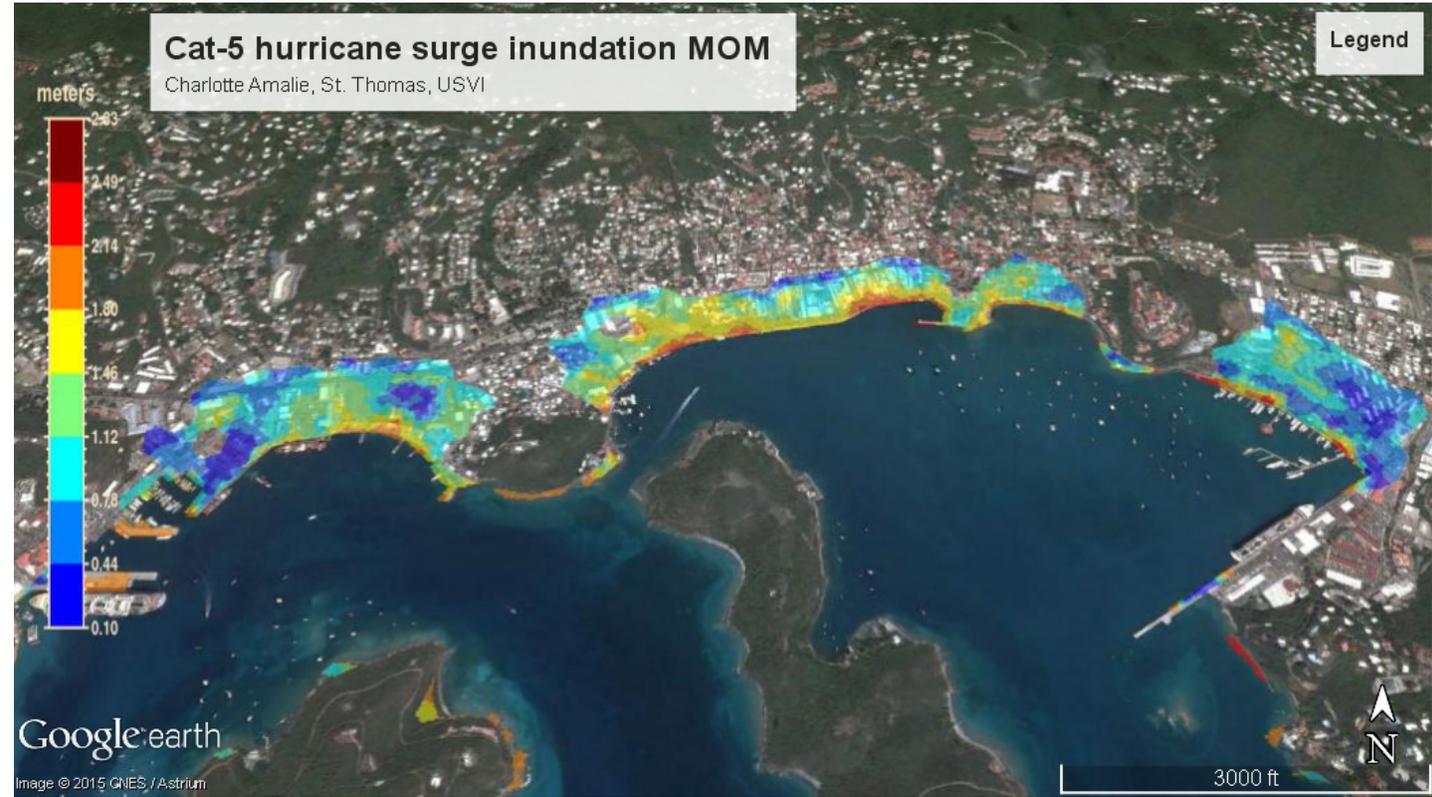
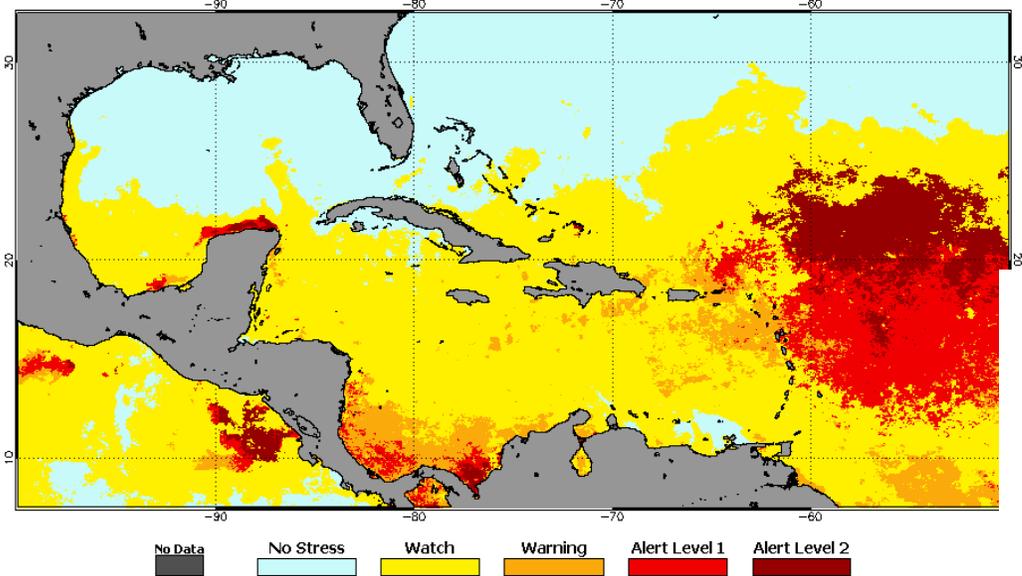


Figure 8 - Computational mesh used for the ADCIRC+SWAN model simulations in the region of St. Thomas Island.



RESOURCE MONITORING & MANAGEMENT: The 2015 warm blob & coral bleaching

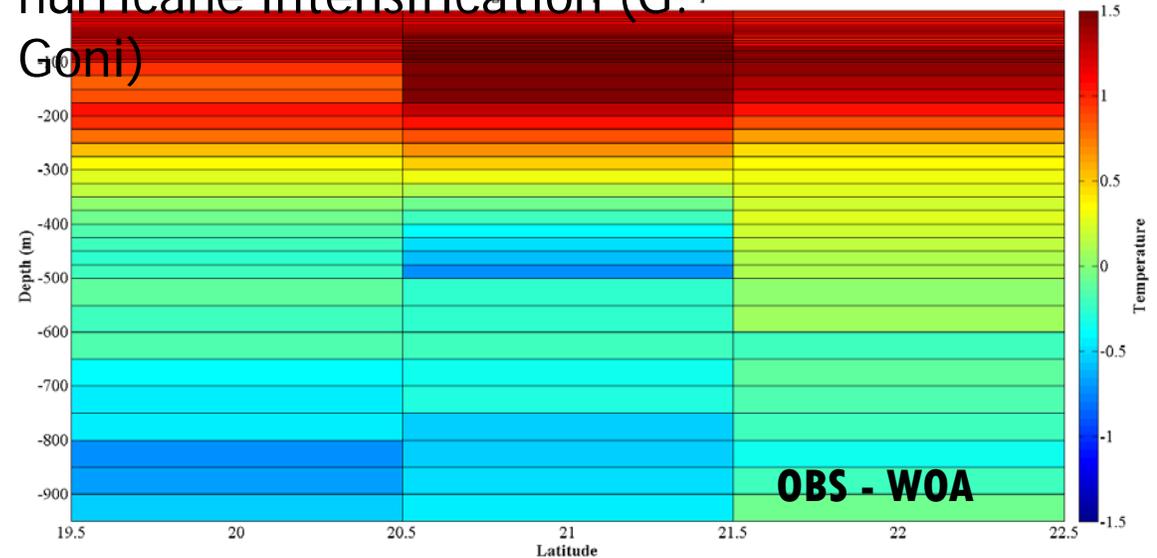
NOAA Coral Reef Watch Daily 5-km Geo-Polar Blended Night-Only Bleaching Alert Area 7d Max 21 Oct 2015



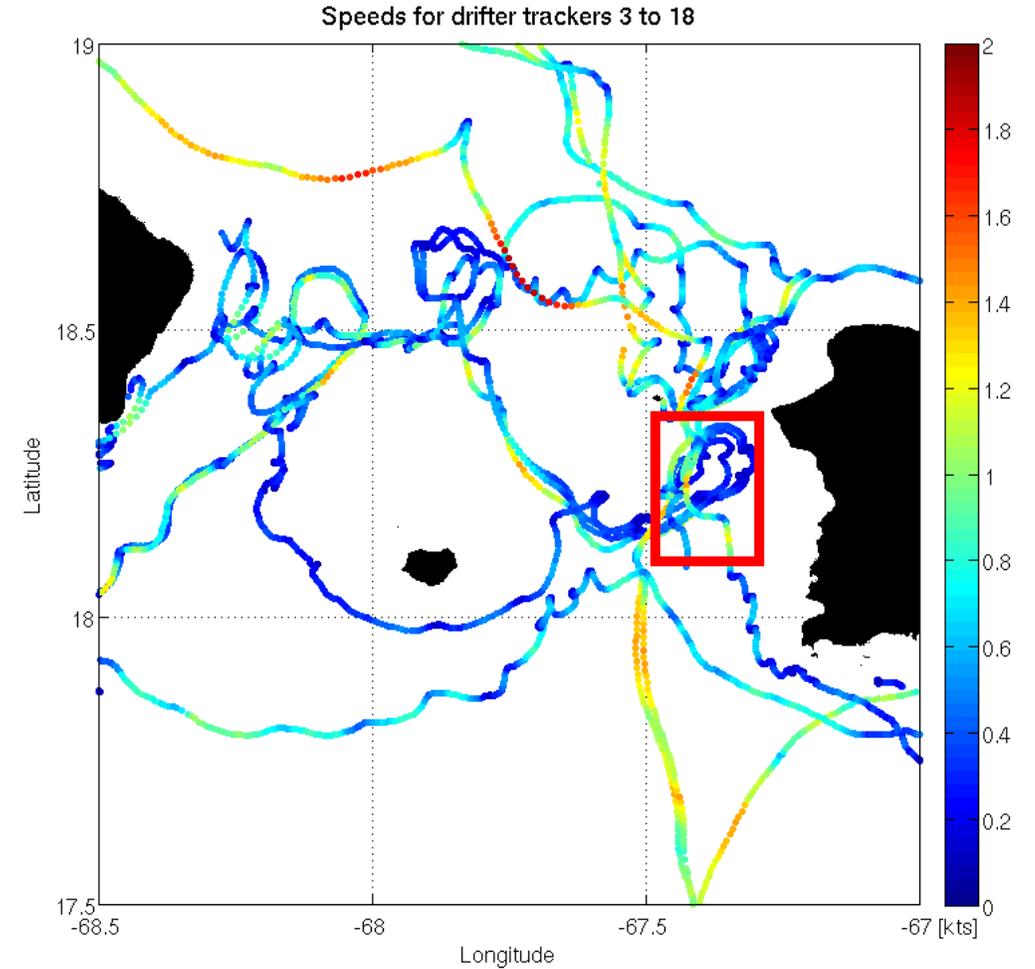
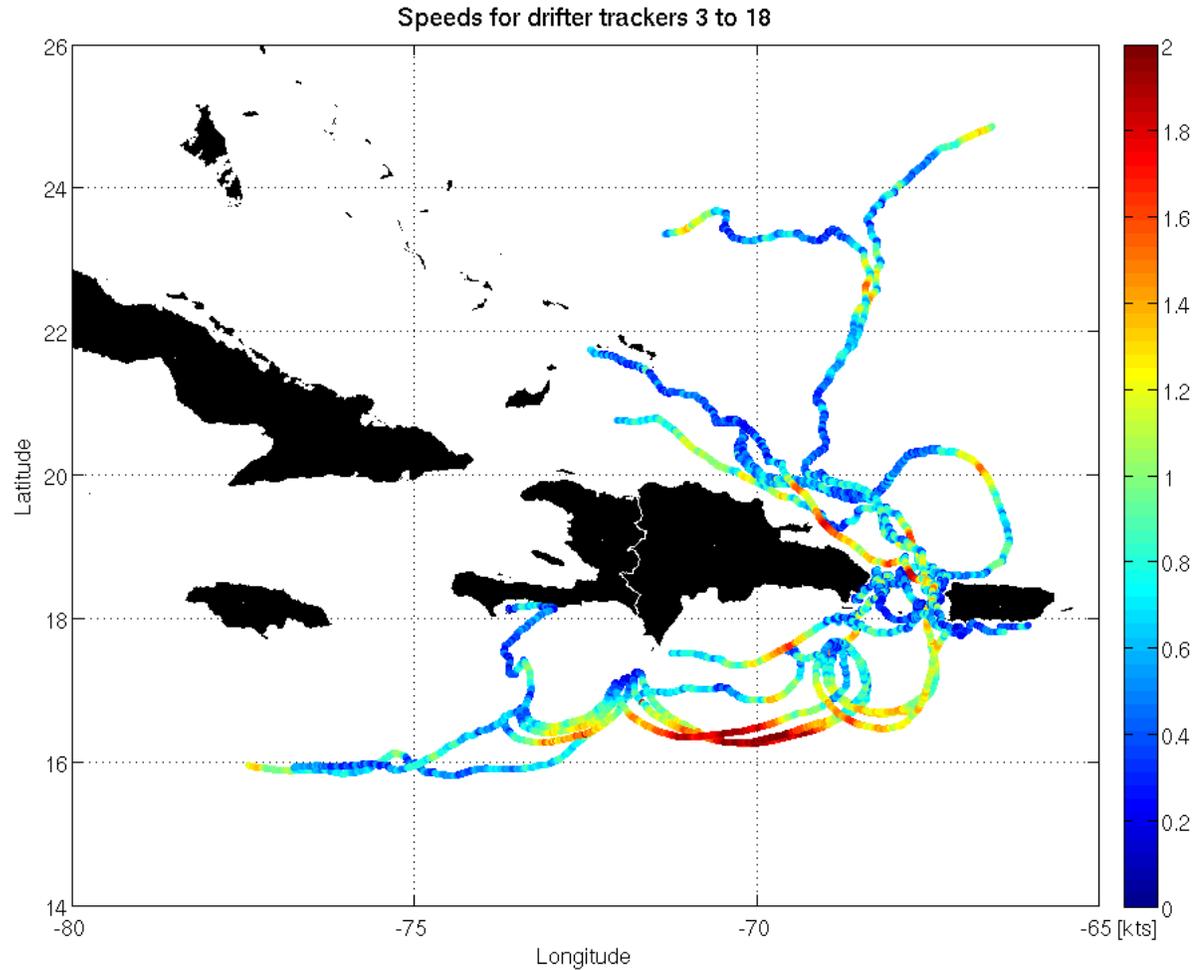
Upper ocean warming

Gliders: operational subsurface observations

- SeaGlider deployments for NOAA-AOML project on hurricane intensification (G. Goni)



RESOURCE MONITORING & MANAGEMENT: Fisheries & MPA effectiveness

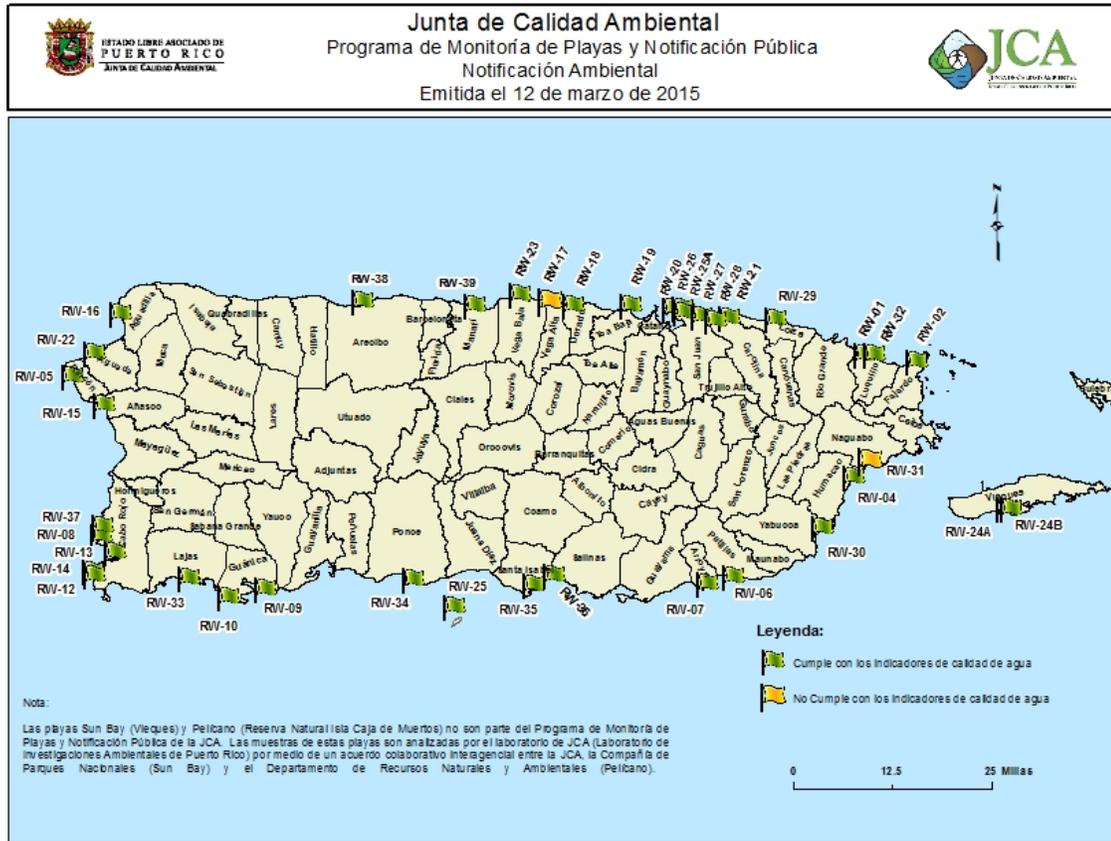


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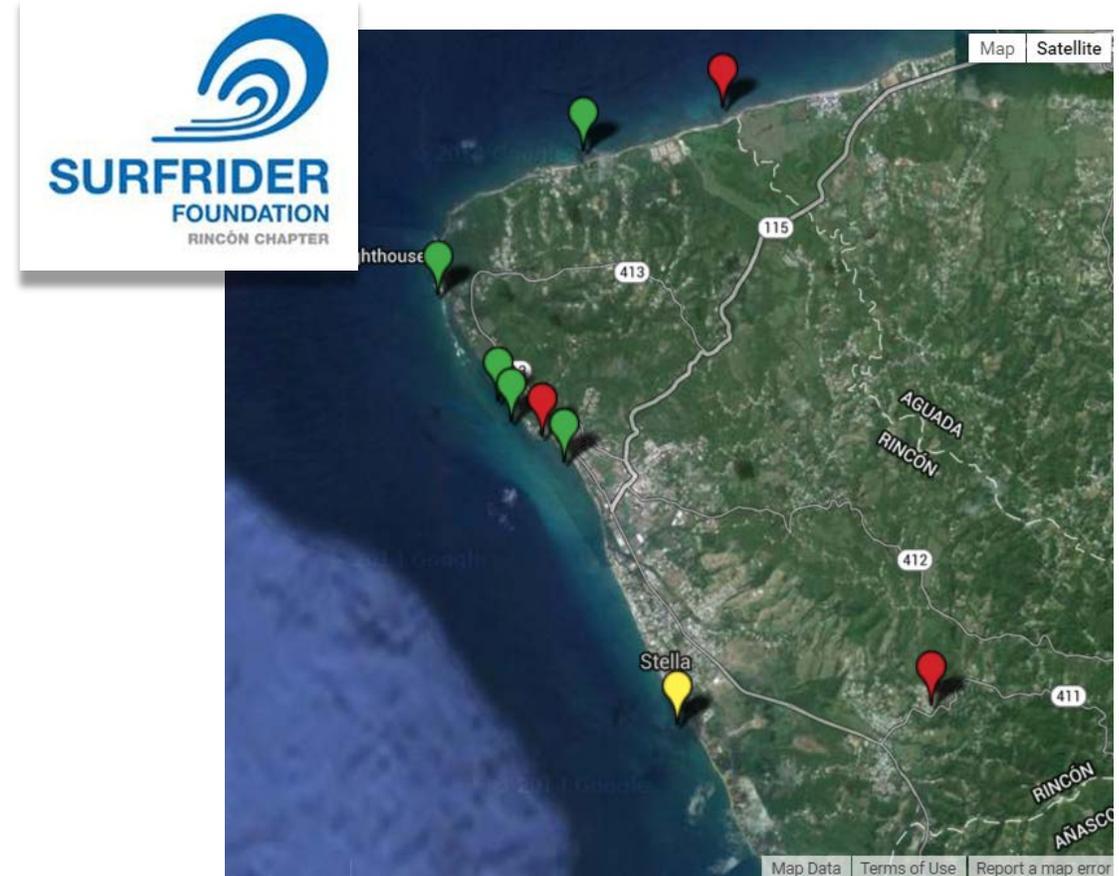
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RESOURCE MONITORING & MANAGEMENT: Pathogens and beach water quality

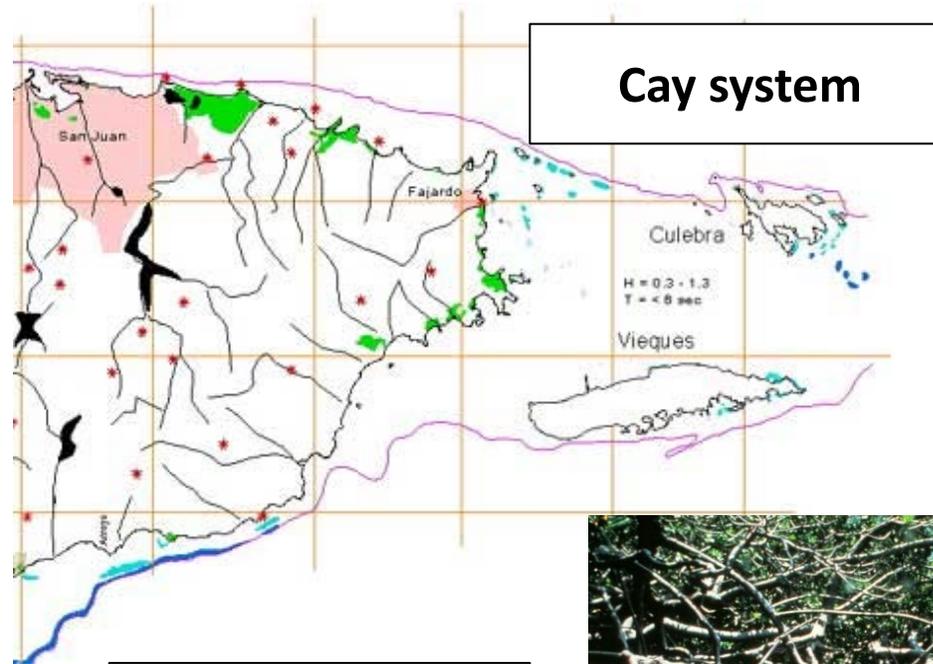
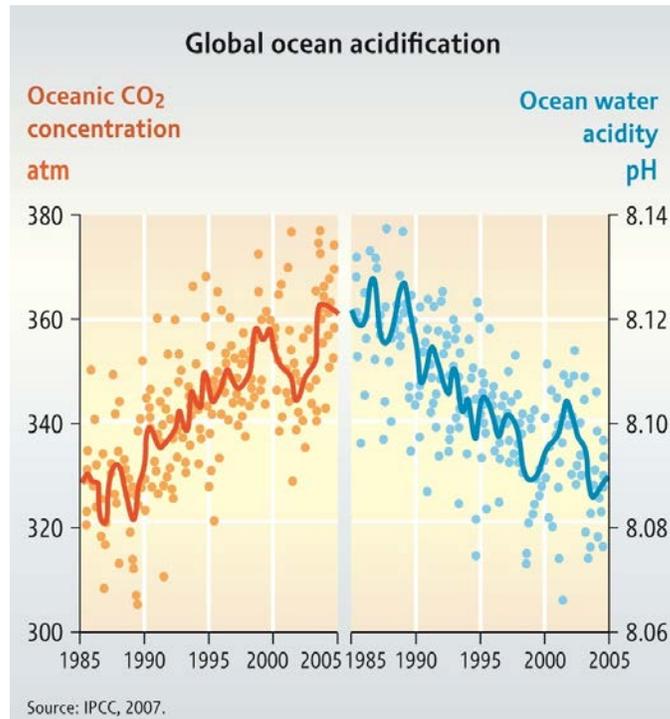


EQB led sampling program

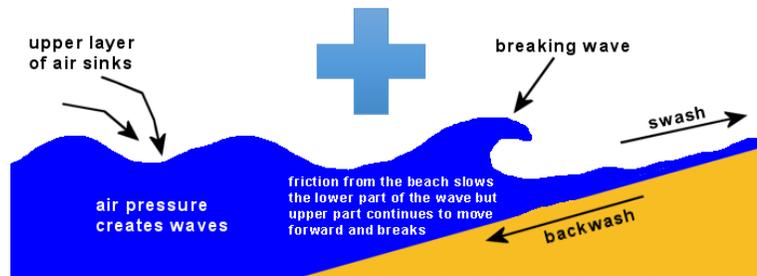


Surfrider's volunteer-driven WQ sampling

CLIMATE VARIABILITY: Ocean acidification



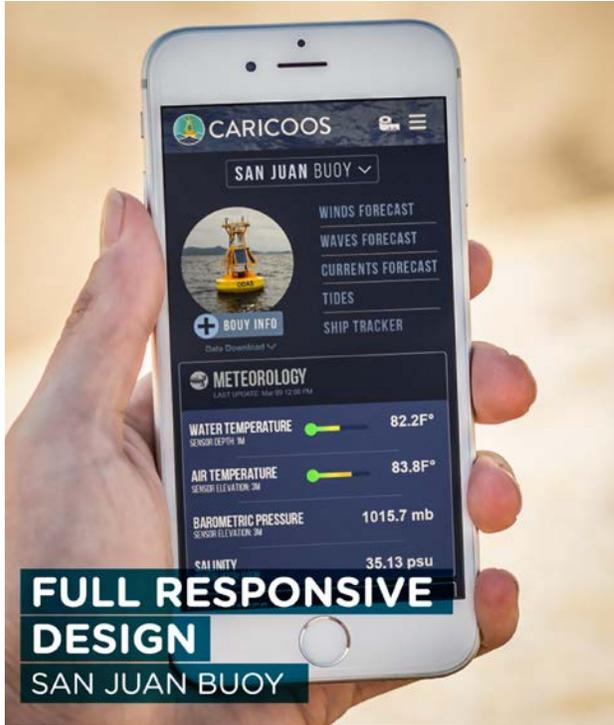
Mangroves



= ?

THE FUTURE

Data Accessibility – new CariCOOS website



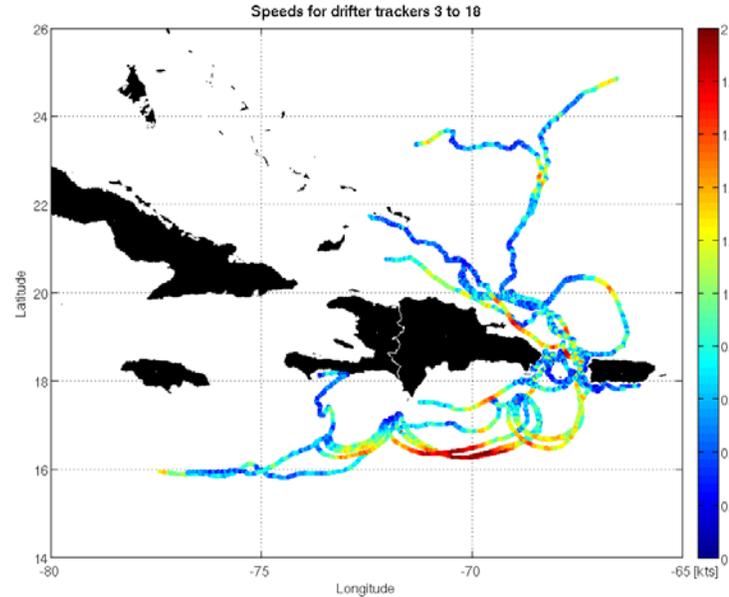
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International collaboration

- Several ongoing CariCOOS led initiatives to collaborate with neighboring island nations on ocean observing
 - Dominican Republic
 - Saba & Netherland Antilles
 - BVI

- Collaborations to take place within the context of IOCARIBE & GOOOS



Cowen &
Sponaugle,
2009

The future: the first generation of Caribbean ocean engineers



CariCOOS led to the development of the UPRM Marine Technology Student Chapter.



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CAOSE

Questions?

Rincon
SurfPhotography.COM



M-DUB



EXTRA



CARICOOS UNITS US

LATEST CONDITIONS AT PUERTO RICO

CARICOOS BUOYS

- SAN JUAN
- PONCE
- RINCON
- VIEQUES
- ST. JOHN
- ST. THOMAS

PORTS

- YABUCOA
- SAN JUAN
- PONCE
- RINCON
- VIEQUES
- ST. JOHN
- ST. THOMAS

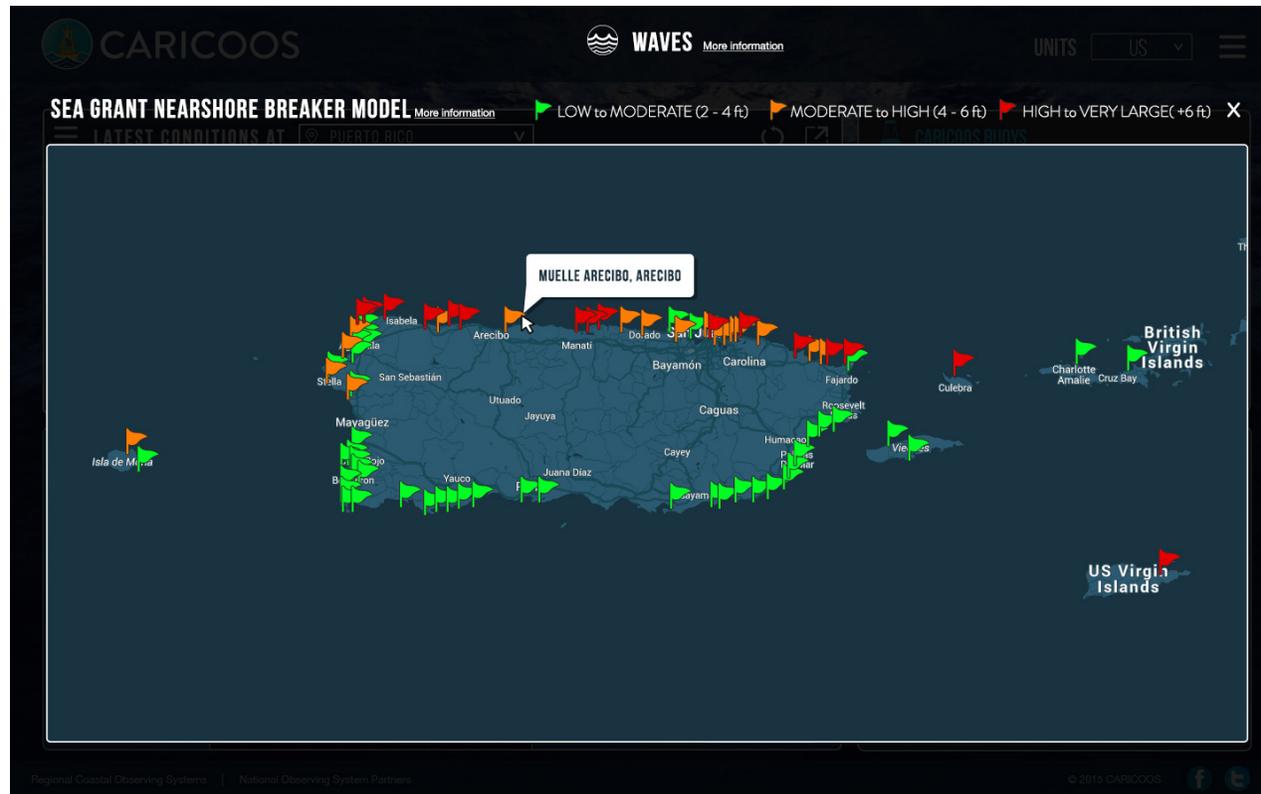
OBSERVATIONS

WAVES REAL TIME BUOY WAVE HEIGHT

FORECAST MODELS

- CARICOOS NEARSHORE WAVE MODEL V 4.0
- CARICOOS/NOAA VIRTUAL WAVE BUOYS
- SEA GRANT NEARSHORE BREAKER MODEL
- WAVEWATCH III

Regional Coastal Observing Systems | National Observing System Partners | © 2015 CARICOOS



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WAVES More information

SEA GRANT NEARSHORE BREAKER MODEL More information

LATEST CONDITIONS AT PUERTO RICO

LOW to MODERATE (2 - 4 ft) MODERATE to HIGH (4 - 6 ft) HIGH to VERY LARGE (+6 ft)

MUELLE ARECIBO, ARECIBO

Regional Coastal Observing Systems | National Observing System Partners | © 2015 CARICOOS



Image U.S. Geological Survey
Image © 2015 DigitalGlobe

Google earth

PONCE BUOY 



 BUOY INFO

Data Download 

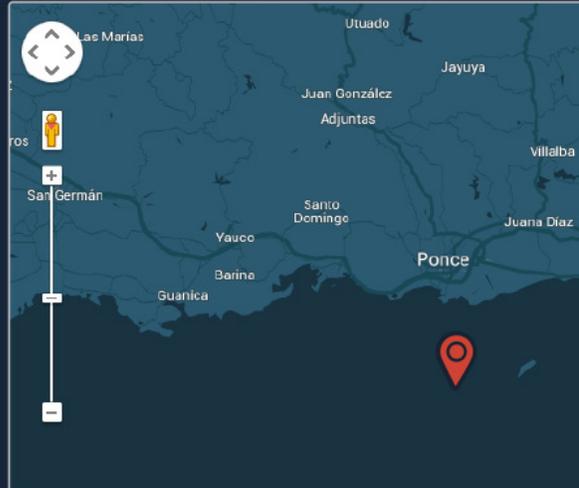
WINDS FORECAST

WAVES FORECAST

CURRENTS FORECAST

TIDES

SHIP TRACKER



 METEOROLOGY

LAST UPDATE: Mar 09 12:00 PM

WATER TEMPERATURE  82.2F°
SENSOR DEPTH: 1m

AIR TEMPERATURE  83.8F°
SENSOR ELEVATION: 3m

BAROMETRIC PRESSURE 1015.7 mb
SENSOR ELEVATION: 3m

SALINITY  35.13 psu
SENSOR DEPTH: 0m

 WAVES

LAST UPDATE: Mar 09 12:00 PM AST

AVERAGE HEIGHT

NE

PERIOD



MAXIMUM HEIGHT  5.2 feet

STEEPNESS  Average

 CURRENTS

LAST UPDATE: Mar 09 12:00 PM AST

DEPTH 7FT 

SPEED

ESE



NORTH VELOCITY  0.6 cm/s

EAST VELOCITY  1.6 cm/s

 WIND

LAST UPDATE: Mar 09 12:00 PM AST

WIND SPEED

NW



GUST SPEED  9.6 kts

MINIMUM SPEED  5.1 kts

Other uses of CariCOOS data

