



# CARICOOS: Beach Hazards





## CARICOOS

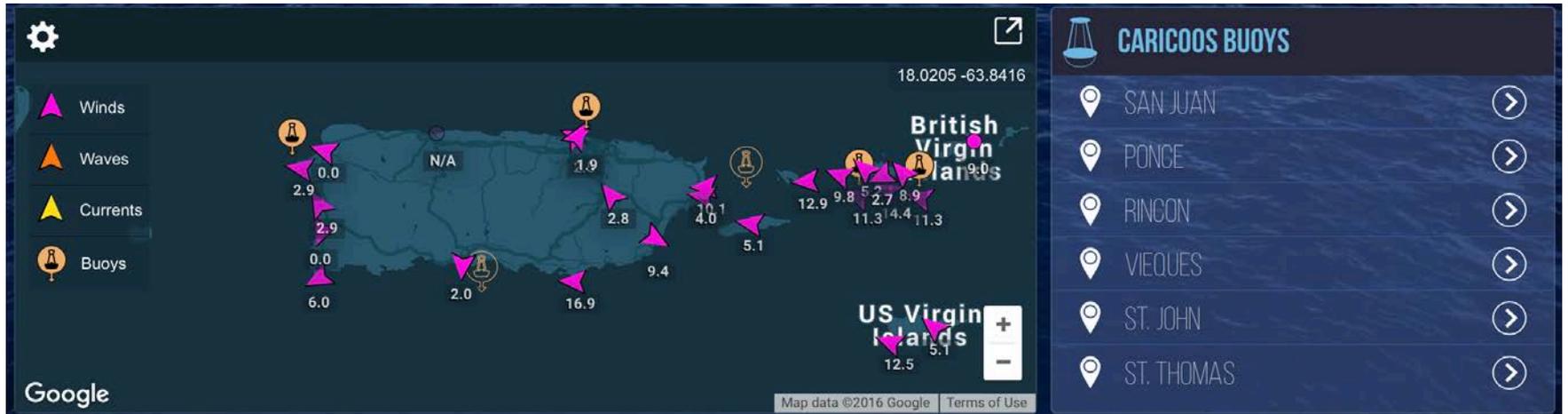
Regional U.S. IOOS: increased observations, distinctive knowledge, and critical technological abilities...development of products to meet regional needs





# CARICOOS

## OUR MISSION: OCEAN OBSERVATIONS AND PREDICTIONS – 24/7 – IN SUPPORT OF YOUR MARINE ACTIVITIES



### OBSERVATION & FORECASTS



WINDS



WAVES



TIDES & CURRENTS



OCEAN COLOR & SST

### DECISIONAL SUPPORT TOOLS



MARINE OPERATIONS



COASTAL HAZARDS



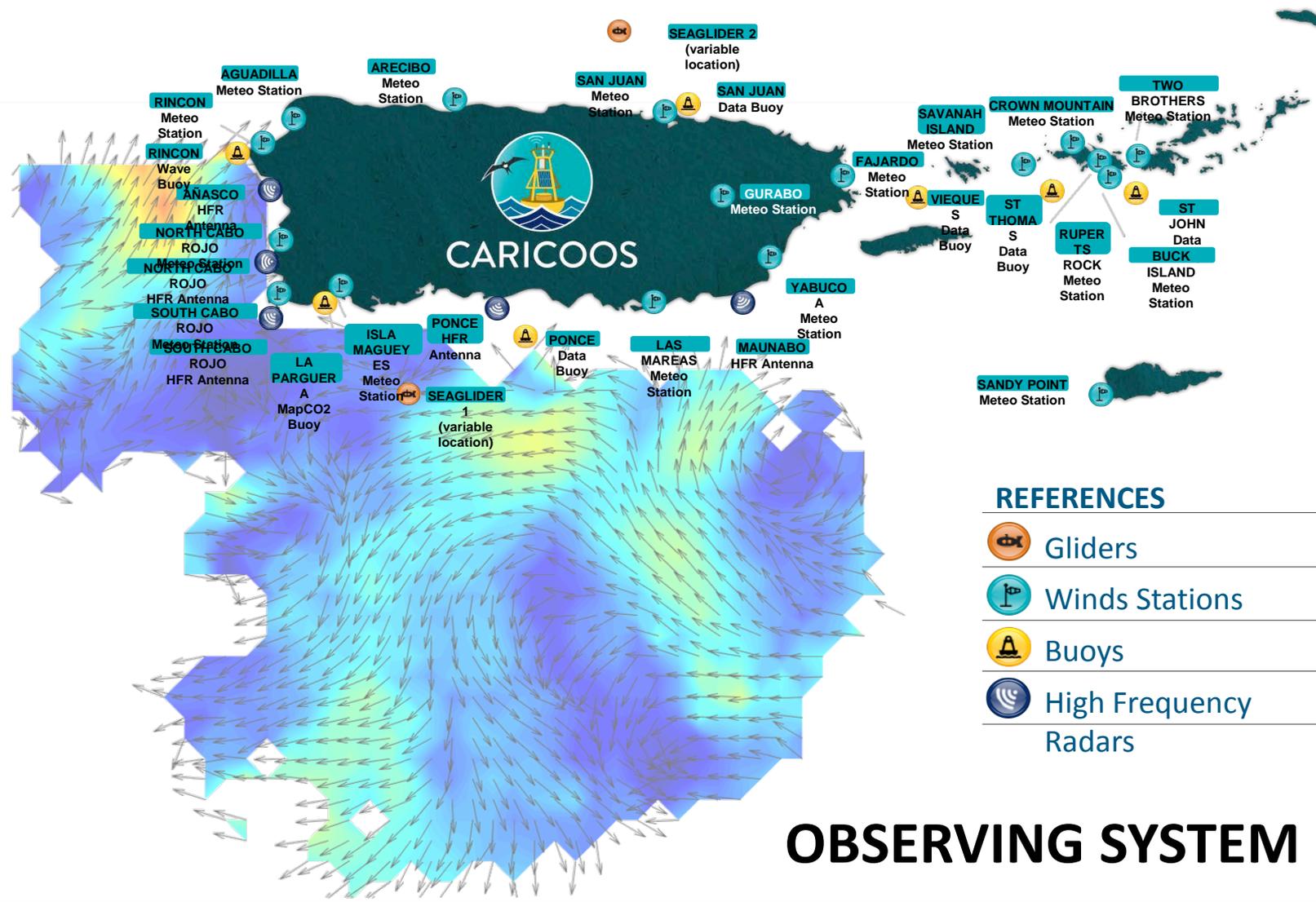
CLIMATE VARIABILITY



ECOSYSTEMS & WATER QUALITY



# CARICOOS



## REFERENCES

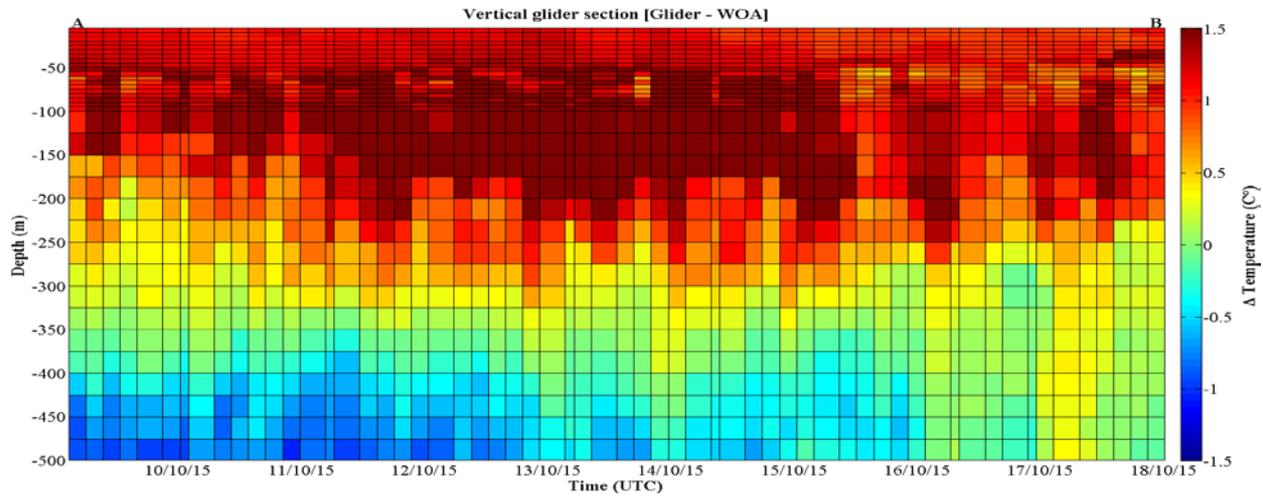
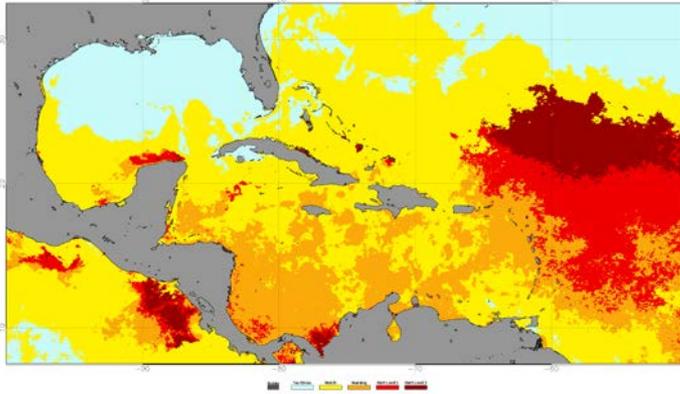
-  Gliders
-  Winds Stations
-  Buoys
-  High Frequency Radars

# OBSERVING SYSTEM



CARICOOS

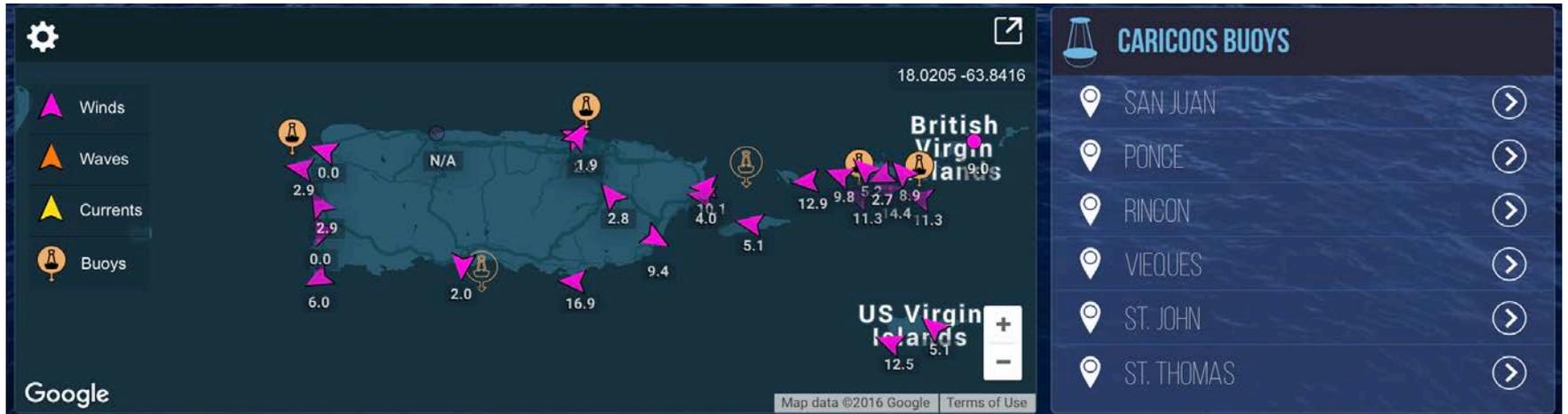
## OPERATIONAL SEAGLIDER DEPLOYMENTS COLLABORATION WITH NOAA-AOML





# CARICOOS

## OUR MISSION: OCEAN OBSERVATIONS AND PREDICTIONS – 24/7 – IN SUPPORT OF YOUR MARINE ACTIVITIES



### OBSERVATION & FORECASTS

	WINDS		WAVES
	TIDES & CURRENTS		OCEAN COLOR & SST

### DECISIONAL SUPPORT TOOLS

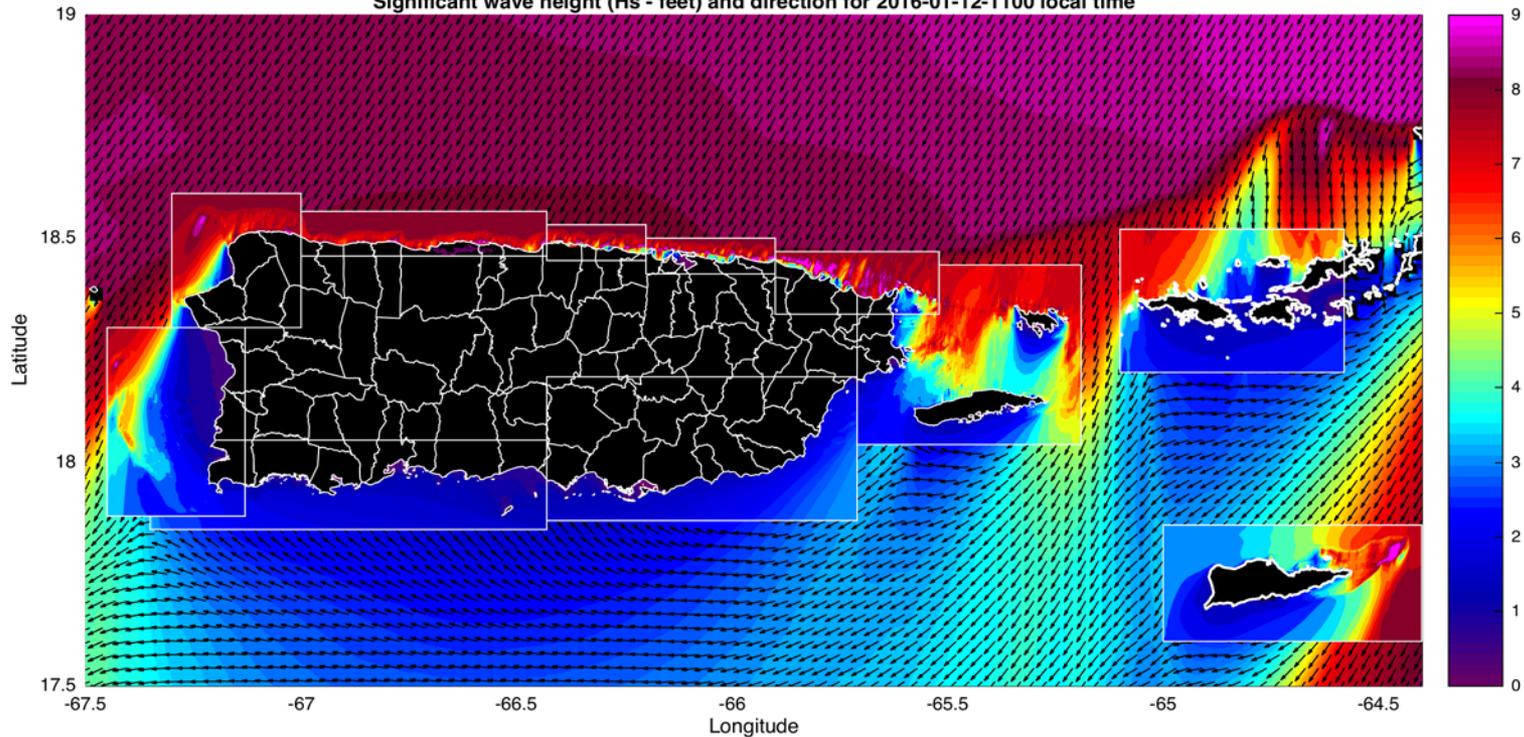
	MARINE OPERATIONS		COASTAL HAZARDS
	CLIMATE VARIABILITY		ECOSYSTEMS & WATER QUALITY



CARICOOS

## MODELING: The CariCOOS Nearshore Wave Model

CariCOOS Nearshore Wave Model v7.0 (run: 20160112.1200 machine:swanwrf)  
Significant wave height (Hs - feet) and direction for 2016-01-12-1100 local time



### HIGHLIGHTS

- 12 nearshore grids at resolution from 240 meters to 10 meters
- Moving to unstructured SWAN in FY16



# CARICOOS



## Playas en las que ocurren corrientes de resaca

- |  |  |  |
|--|--|--|
| <b>A</b> Aguada, Playa Mameyto   | <b>F</b> Humacao, Palmas del Mar                     | <b>J</b> San Juan, Hotel La Concha, Ocean Park, Marriott en el Condado, Hotel Atlantic Beach en el Condado |
| <b>B</b> Aguadilla, Parque Colón   | <b>G</b> Isabela, El Túnel, Guajetaca                | <b>K</b> Vega Baja, Playa Cibuco   |
| <b>C</b> Arecibo, Poza del Obispo y Sector Caza y Pesca en la carretera 881, del barrio Islote | <b>H</b> Loíza, Piñones                              |  |
| <b>D</b> Guánico, Bollena  | <b>I</b> Luquillo, Balneario La Monserrate, La Pared |  |
| <b>E</b> Guayama, Barrio Pozuelo   |  |  |

judel@imnshri.com

La zona norte de Puerto Rico es donde ocurren más ahogamientos

# 44.2%

## ¿Quiénes se ahogan?

**HOMBRES**  
89.3%



**MUJERES**  
10.7%

La mayoría de los ahogados tienen entre 16 y 30 años

La mayoría de las ahogadas tienen entre 31 y 60 años

Fuente: Estadísticas del Programa Sea Grant de la Universidad de Puerto Rico, estadísticas de 1999-2010



CARICOOS

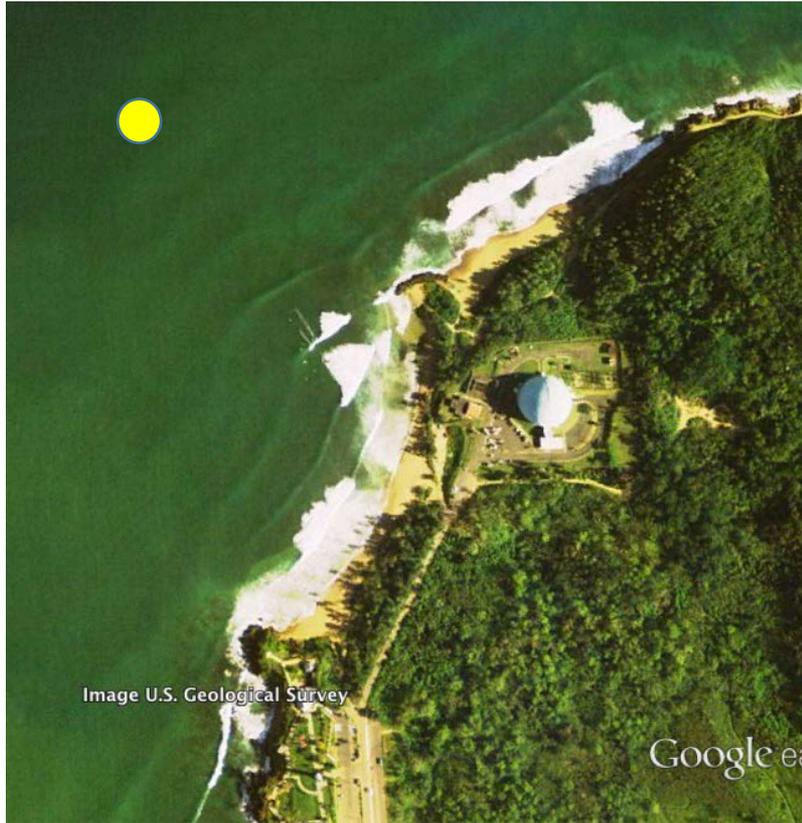


Angelo Cordero:PHOTOGRAPHY.

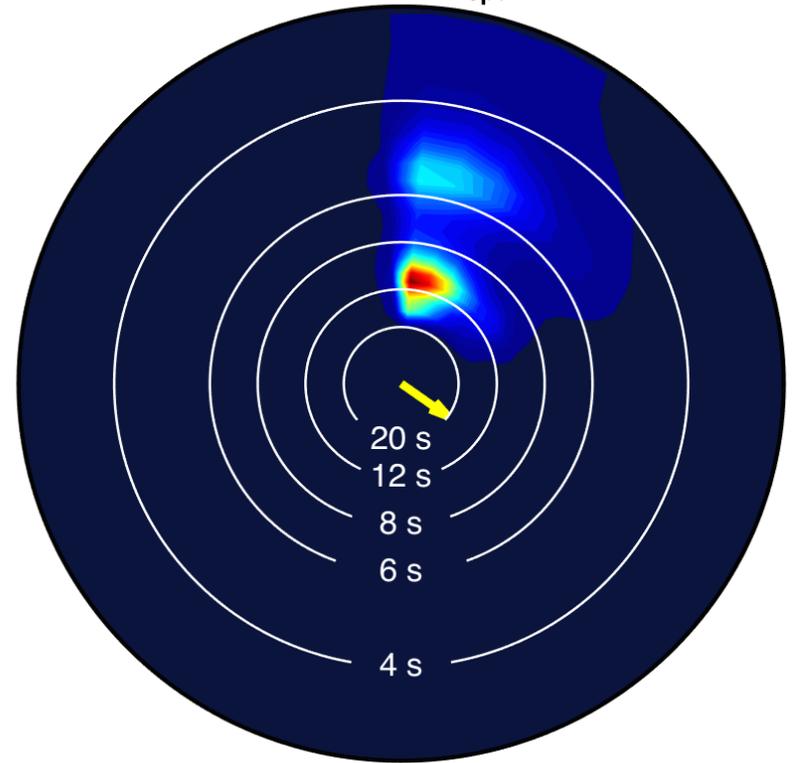
$$H_{b_{min}} < H_b < H_{b_{max}}$$



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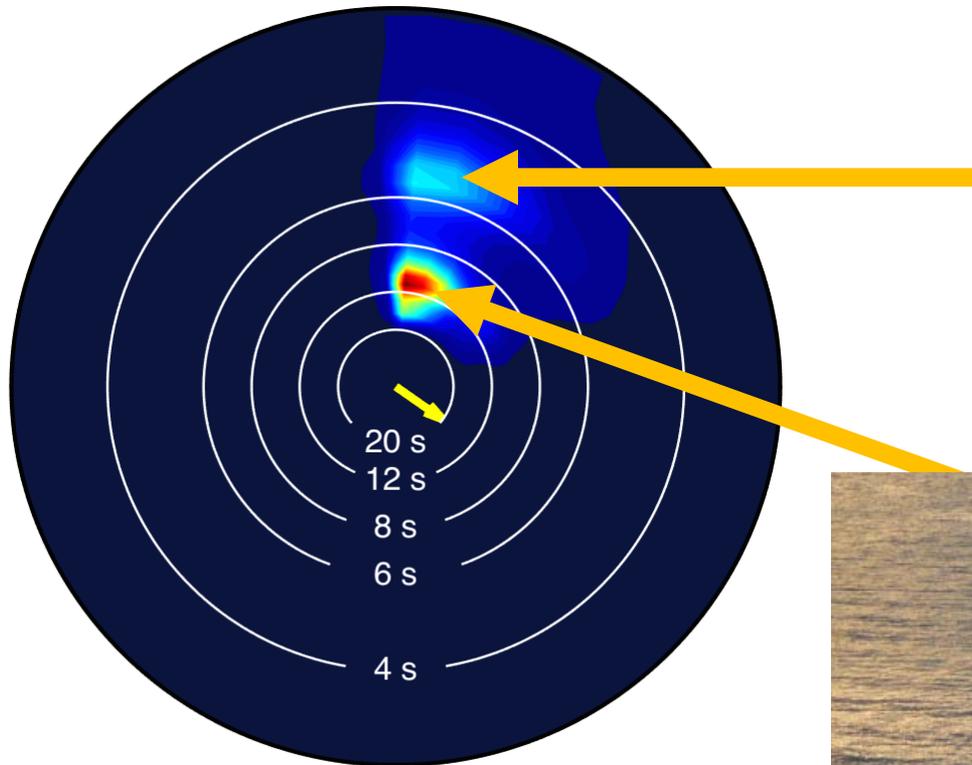


Sun Apr/24/16 3 PM ( $W_{\text{spd}} = 8.6$  knots)





CARICOOS



Wind sea spectral peak  
with partition energy  $e_{sea}$

$$H_{sea} = 4\sqrt{e_{sea}}$$

Swell spectral peak with  
Partition energy  $e_{swell}$

$$H_{swell} = 4\sqrt{e_{swell}}$$



CARICOOS



# COASTAL HAZARDS: BREAKING WAVES



EXPECTED BREAKER HEIGHT

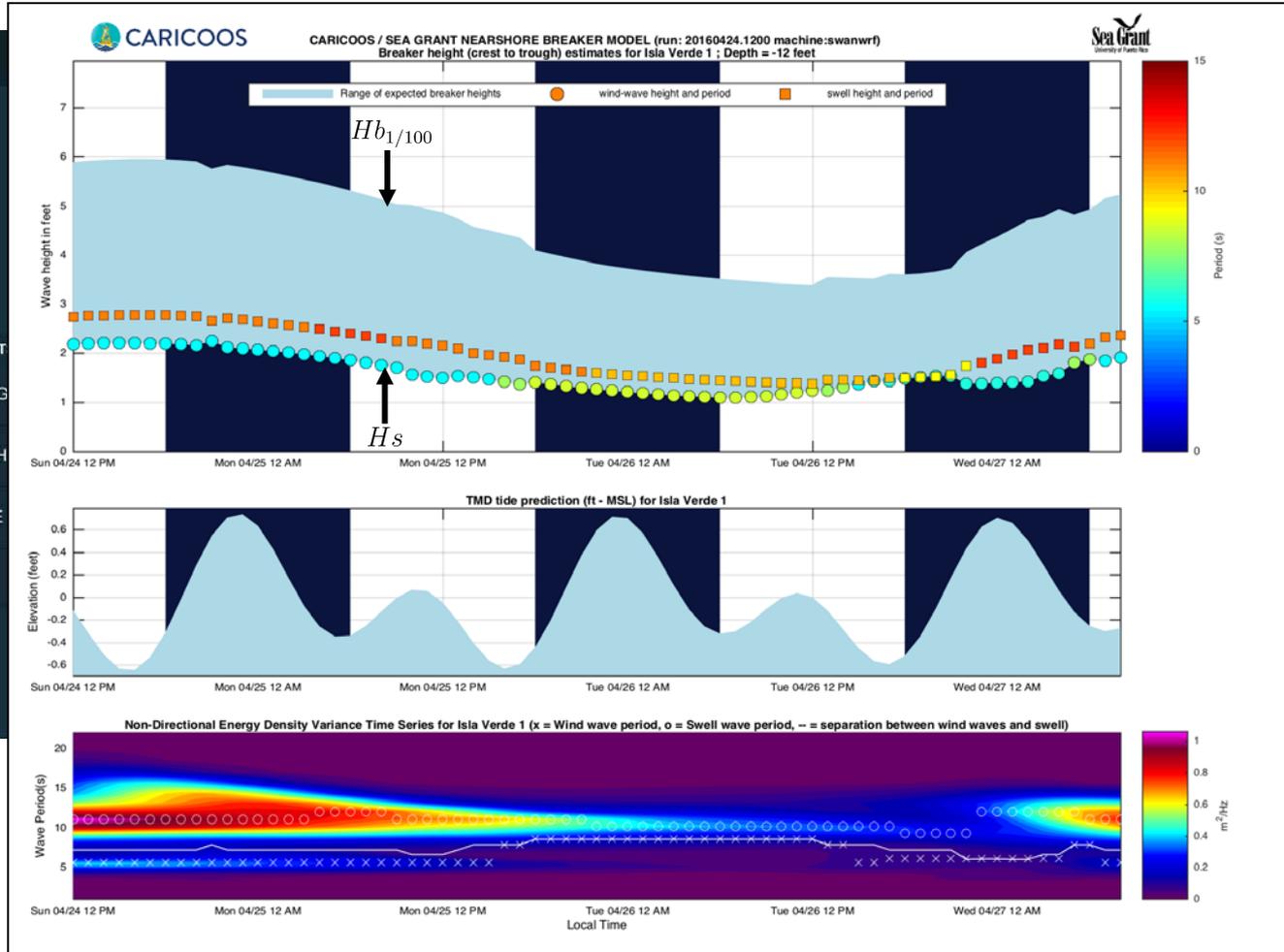
HIGH TO VERY LARGE

MODERATE TO HIGH

LOW TO MODERATE

LOW

Google



18.2476 -67.2281

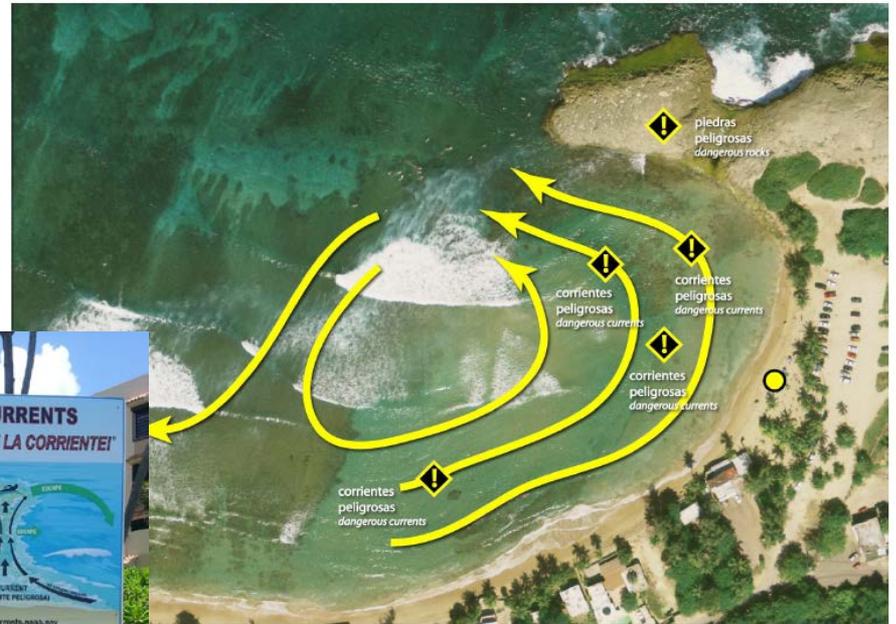
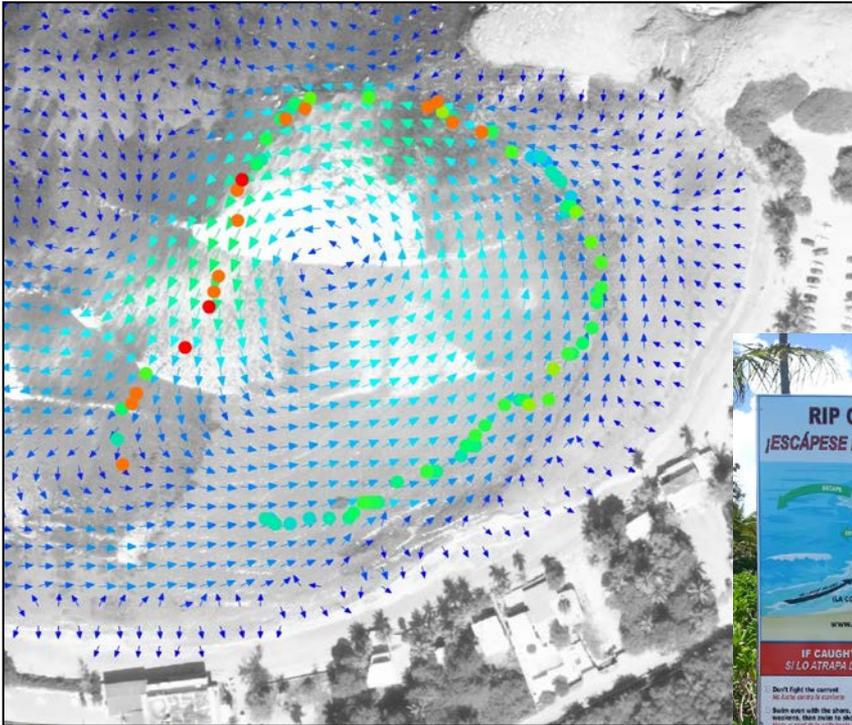


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CARICOOS

# CUSTOM HAZARDOUS CURRENTS WARNING SIGNS



Esta playa presenta corrientes peligrosas que pueden causar la muerte.  
This beach has dangerous wave-induced currents which have caused several drownings at this beach.

En esta playa han muerto bañistas luego de haber sido arrastrados por las corrientes.  
Beachgoers have died here after being dragged out to sea by currents.

⚠️ peligro danger

📍 usted esta aqui you are here



# Beach Forecast & Warning Process

**Ernesto Rodríguez**

Senior Forecaster

Marine Program Leader

NOAA National Weather Service

Weather Forecast Office - San Juan

April 27, 2016

NOAA Collaborators:







# Surf Zone Forecast



## Surf Forecast

Issued by NWS San Juan, PR

Current Version | [Previous Version](#) | [Text Only](#) | [Print](#) | [Product List](#) | [Glossary On](#)  
 Versions: [1](#) [2](#) [3](#) [4](#) [5](#) [6](#) [7](#) [8](#) [9](#) [10](#) [11](#) [12](#) [13](#) [14](#) [15](#) [16](#) [17](#)

892  
 FZCA52 TJSJ 101759  
 SRFSJU

SURF ZONE FORECAST FOR PUERTO RICO  
 NATIONAL WEATHER SERVICE SAN JUAN PR  
 159 PM AST THU MAR 10 2016

### RISK DEFINITIONS

LOW RISK...SURF ZONE CONDITIONS ARE NOT EXPECTED TO SUPPORT THE DEVELOPMENT OF LIFE THREATENING RIP CURRENTS. HOWEVER, LIFE THREATENING RIP CURRENTS OFTEN OCCUR IN THE VICINITY OF REEFS, JETTIES AND PIERS.

MODERATE RISK...SURF ZONE CONDITIONS ARE FAVORABLE FOR THE DEVELOPMENT OF LIFE THREATENING RIP CURRENTS.

HIGH RISK...SURF ZONE CONDITIONS WILL LIKELY SUPPORT THE DEVELOPMENT OF LIFE THREATENING RIP CURRENTS.

PRZ001-111800-  
 SAN JUAN AND VICINITY-  
 INCLUDING THE BEACHES OF...CAROLINA...SAN JUAN AND TOA BAJA  
 159 PM AST THU MAR 10 2016

...HIGH SURF ADVISORY IN EFFECT UNTIL 6 PM AST FRIDAY...  
 ...HIGH RIP CURRENT RISK IN EFFECT THROUGH FRIDAY AFTERNOON...

BEACH	BREAKING WAVE HEIGHT	RIP CURRENT RISK
BALNEARIO CAROLINA	8-10 FEET	HIGH
CONDADO	8-10 FEET	HIGH
ISLA VERDE	8-10 FEET	HIGH
OCEAN PARK	8-10 FEET	HIGH
LEVITTOWN	7-9 FEET	HIGH

.TONIGHT...MOSTLY CLOUDY. SCATTERED SHOWERS. LOWS IN THE UPPER 60S.  
 NORTHEAST WINDS AROUND 10 MPH.

\$\$

PRZ002-111800-  
 NORTHEAST-  
 INCLUDING THE BEACHES OF...RIO GRANDE...LIGUILLIO

U.S. Virgin Islands Beaches

**Playa Jobos**

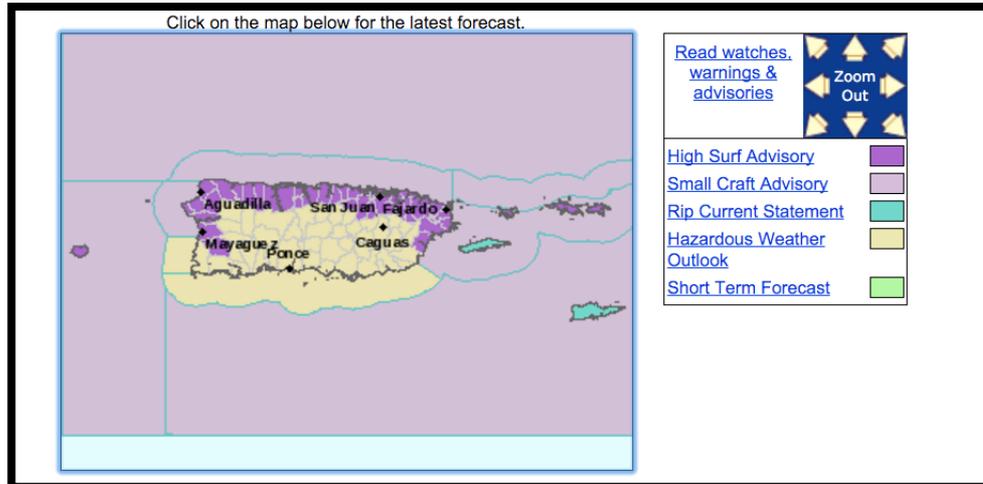
Issued: Mon May 9 2016  
 Breaking Waves: 3-5 feet  
 Rip Current Risk: **MODERATE**

Google Imagery ©2016 TerraMetrics | Terms of Use

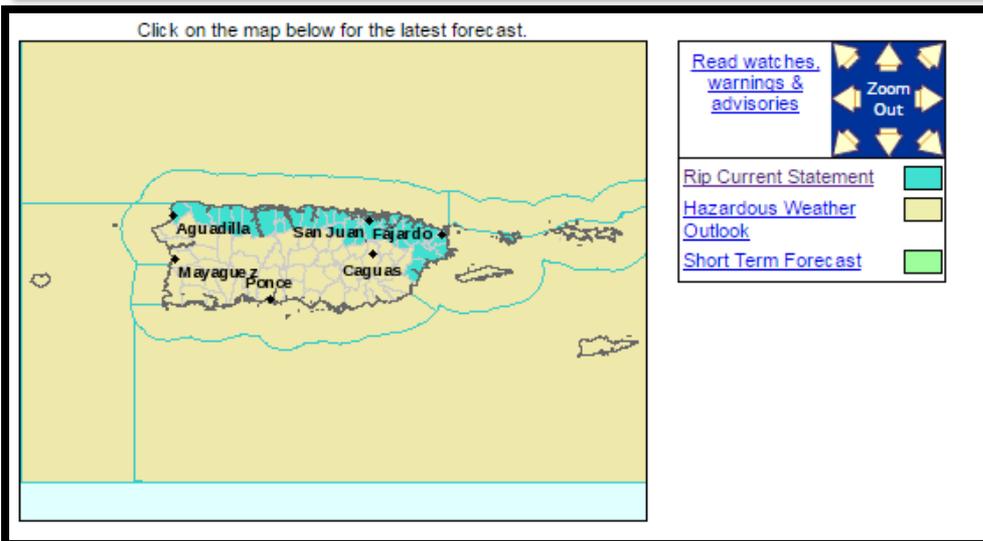
NOTICE TO ALL USERS - The graphical surf zone forecast is experimental and may not be available at all times. For additional information please contact the [webmaster](#).

Risk Level	Description	Click on the icons for more detail
Low	The risk for rip currents is low, however, life threatening rip currents often occur in the vicinity of inlets, groins, jetties, reefs, and piers.	The map above is color-coded to indicate the forecast rip current risk level. <a href="#">Click on the beach area of your choice for more information.</a>
Moderate	Life threatening rip currents are possible in the surf zone.	<b>Rip currents</b> are powerful, channeled currents of water flowing away from shore. They typically extend from the shoreline, through the surf zone, and past the line of breaking waves. Rip currents can occur at any beach with breaking waves.
High	Life threatening rip currents are likely in the surf zone.	If caught in a rip current, swim parallel to the beach and you will eventually swim out of the outgoing current. Remember to heed the advice of the local beach patrol and flag warning systems.
<a href="#">Rip Current Safety Videos</a>		<a href="#">Click here for the Surf Zone Forecast</a>

# Watches, Advisories & Warnings



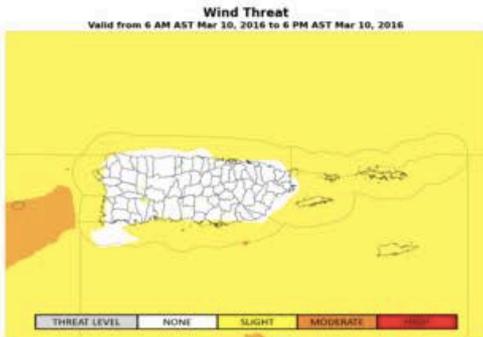
- High Surf Advisory
- High Surf Warning
- Coastal Flood Watch
- Coastal Flood Advisory
- Coastal Flood Warning
- Rip Current Statement



# Decision Support Services

## Hazard Weather Outlook

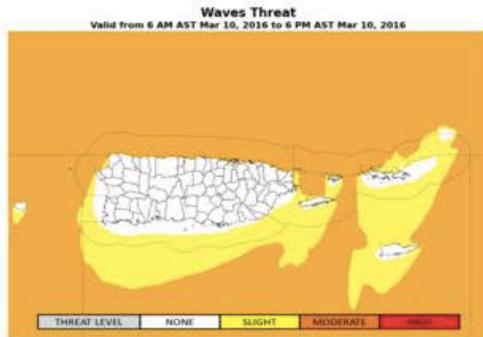
Flood	Thunderstorm	Heat	Wind	Waves	Rip Current
NONE	NONE	NONE	MODERATE	MODERATE	HIGH



National Weather Service  
San Juan, PR  
03/10/2016 03:46 AST

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weather.gov/sju

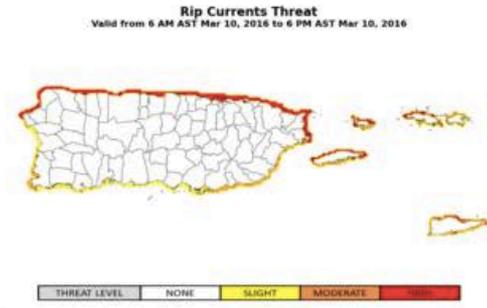
Wind Threat



National Weather Service  
San Juan, PR  
03/10/2016 03:47 AST

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weather.gov/sju

Waves Threat



National Weather Service  
San Juan, PR  
03/10/2016 03:48 AST

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weather.gov/sju

Rip Current Threat

Threat	Winds	Waves	Rip Current
SLIGHT	Wind sustained 20-24 mph possible.	Significant wave height 5-6 feet	The risk for rip currents is low. Rip currents often occur in the vicinity of reefs and piers.
MODERATE	Wind sustained 25-34 mph possible.	Significant wave height 7-9 feet	Life threatening rip currents are possible in the surf zone.
HIGH	Wind sustained 35+ mph possible.	Significant wave height +10 feet	Life threatening rip currents are likely in the surf zone.

# Joint efforts led to a significant reduction of drownings associated with rip currents on beaches in Puerto Rico

Emergency managers, local lifeguard associations, newspapers, radio and TV reporters spread the message about the rip currents and relayed the NWS advisories.



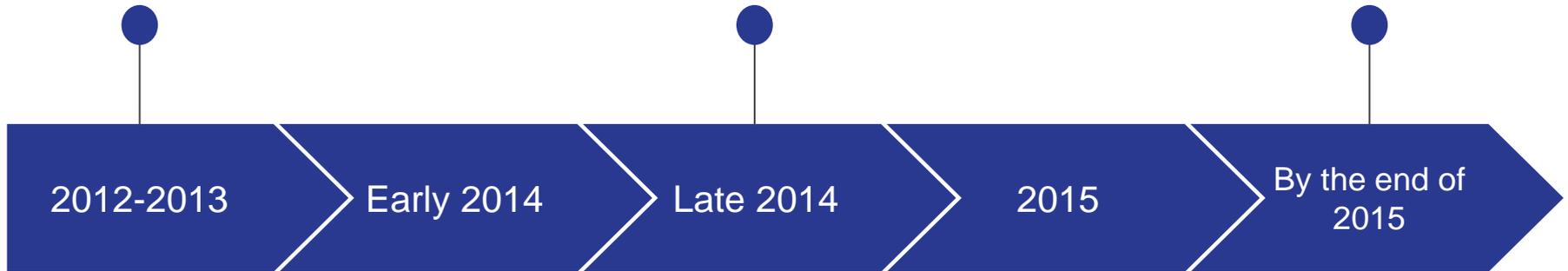
NOAA Sea Grant performed a research about Drownings in Puerto Rico's beaches



National Weather Service San Juan started issuing the Surf Zone Forecast



Drownings associated with rip currents have diminished by 50% compared with the long term average of 30 deaths



CariCOOS developed a breaking wave height model



NWS San Juan increased the awareness issuing High Surf Advisories & Rip Current Statements



# Significant reduction of drownings associated with rip currents in 2015



## NWS San Juan Statements & Advisories

## Outreach Activities

## Media Partners

NWS San Juan @NWSSanJuan · 23 Nov 2015  
 Nov 23: Rough seas and High Risk of Rip Currents expected through tonight.  
[go.usa.gov/3eKHe](http://go.usa.gov/3eKHe) #prwx #usvix

NWS San Juan @NWSSanJuan · 26 Nov 2015  
 Nov 26: HIGH Risk of Rip Currents expected along the north coast of Puerto Rico.  
[go.usa.gov/3eKHe](http://go.usa.gov/3eKHe) #prwx

AEMEAD @AEMEAD1 · Apr 19  
 Boletín AEMEAD :: High Surf Advisory issued April 19 at 5:33PM ADT until April 19 at 7:00PM ADT by NWS  
[1.usa.gov/20V4aas](http://1.usa.gov/20V4aas)

AEMEAD @AEMEAD1 · Apr 19  
 Boletín AEMEAD :: Rip Current Statement issued April 19 at 5:33PM ADT until April 19 at 9:00PM ADT by NWS  
[1.usa.gov/1VhBNUo](http://1.usa.gov/1VhBNUo)



Las advertencias de corrientes marinas hay que tomarlas en serio

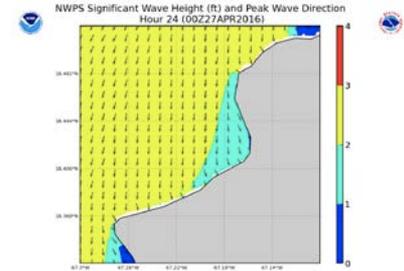
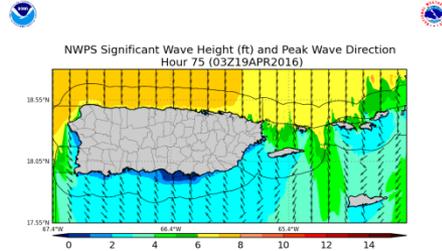
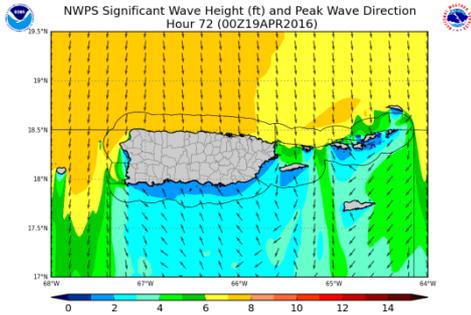
PH Por Rosita Marrero / [marrero@primerahora.com](http://marrero@primerahora.com) PRIMERAHORA

SNM emite advertencia de alto riesgo de corrientes marinas

Conoce los detalles

[f](https://www.facebook.com/ElVocero.com) [in](https://www.linkedin.com/company/elvocero.com) [yt](https://www.youtube.com/channel/UC...) [t](https://www.tumblr.com/ElVocero.com)

**elVocero.com**



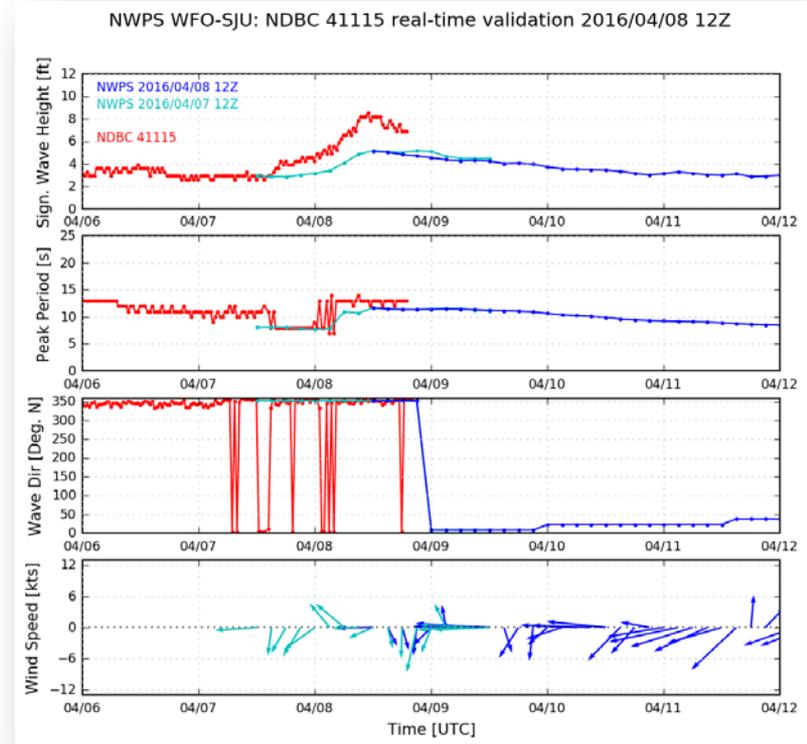
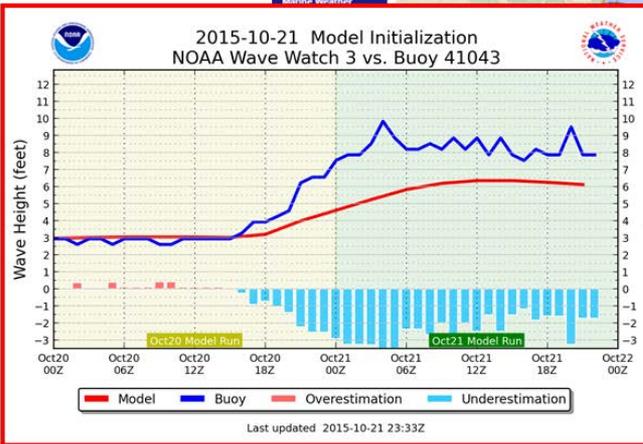
National Weather Service weather Forecast Office  
**San Juan, PR**

Home Site Map News Organization Search for:  NWS All NOAA

Local forecast by "City, ST" or Zip Code  
City, ST  Go

**Real-time Verification**  
Click over each icon in the map, to see the verification plot.  
<http://go.usa.gov/3ShX9>

Local RSS Feeds  
Current Hazards  
Local  
Nationwide  
Outlooks  
Forecasts  
Local  
Forecast Discussion  
Activity Planner  
Graphical  
Tropical Weather  
Fire Weather  
Aviation Weather  
Hydrology  
Marine Weather

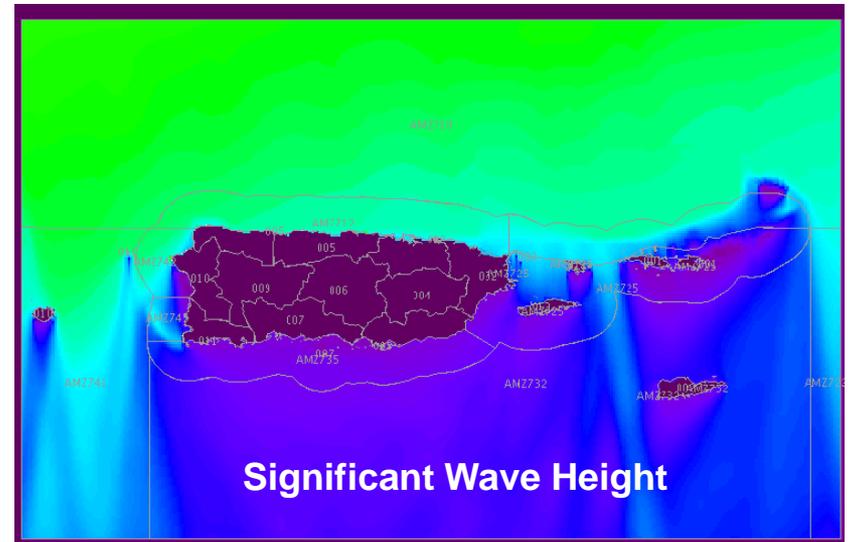


# Research

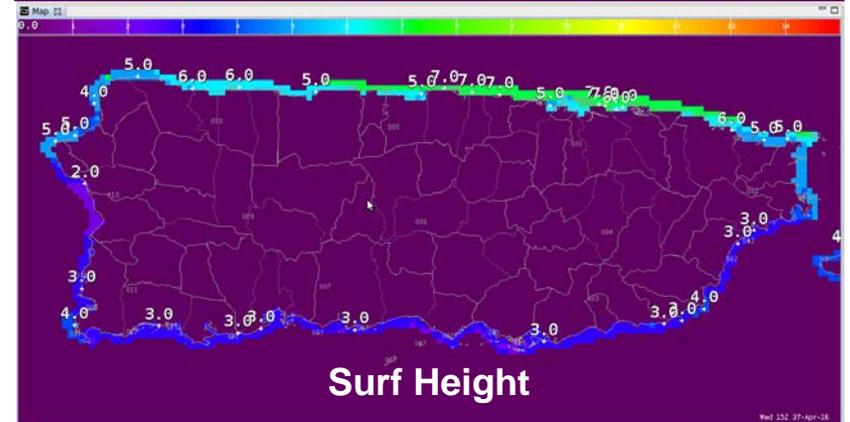


# Operations

```
CreateGrids_SurfHeight
1 #
2 # SVN: $Revision$ - $Date$
3 #
4 #
5 # This software is in the public domain, furnished "as is", without technical
6 # support, and with no warranty, express or implied, as to its usefulness for
7 # any purpose.
8 #
9 # CreateGrids_SurfHeight
10 #
11 # Author: Ernesto Rodriguez
12 # Assisted by: Miguel Canals/CariC005
13 # Calculation Method from: Caldwell/Aucan and Komar/Gaughan
14 #
15
16 ToolType = "numeric"
17 from numpy import *
18 import math as mt
19 HideTool = 0 # Change to 0 to display tool, 1 to hide tool
20
21 WeatherElementEdited = "None"
22
23 ScreenList = ["WaveHeight", "SurfHeight"]
24
25 import SmartScript
26
27 class Tool (SmartScript.SmartScript):
28     def __init__(self, dbss):
29         SmartScript.SmartScript.__init__(self, dbss)
30
31     def calc_surf(self, GridTimeRange):
32
33         gravity = 9.81
34         sqrt_gr = 3.132092 # Square root of gravity
35
36         wavehgt = self.getGrids("Fcst", "WaveHeight", "SFC", GridTimeRange, mode="Max")
37         waveper = self.getGrids("Fcst", "Period", "SFC", GridTimeRange, mode="Max")
38         pi = 3.14
39
40         #wavehgt = where((wavehgt < 4.5), floor(wavehgt), ceil(wavehgt))
41
42         # Empirical Method.. Komar and Gaughan, 1973
43         Breaker = wavehgt**0.8*(1/sqrt_gr)*((gravity*waveper)/(4*pi))**0.4
44
45         # Coefficient of Refraction derived by Caldwell/Aucan (currently use in WFO Hawaii)
46         Refrac_coeff = -0.0013*(Breaker**2) + (0.1262*Breaker) + 0.3025
47
48         # Breaking Wave Height using Calculations of Caldwell/Aucan
49
50         SurfHeight = Breaker + Refrac_coeff
51
52         editArea = self.encodeEditArea("AllSurfZone") #self.encodeEditArea("SJU Water")
53         #SurfHeight = where((SurfHeight > 0) & (SurfHeight < 4.5), SurfHeight, ceil(SurfHeight))
54         SurfHeight = where(editArea, SurfHeight, 0)
55
56 # To take into account steep beaches in Puerto Rico, Surf greater than 7ft add 20%. If surf is greater th
```



### Significant Wave Height



### Surf Height



### Rip Current Risk

## Breaking Wave Height Model



# ESI Mapping

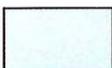
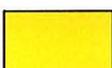
ESI maps were the brainchild of Research Planning Inc. (RPI), a NOAA contractor. In 1979, the Ixtoc 1 exploratory oil well blew out, spilling 140 million gallons of crude oil into the Gulf of Mexico. The first Environmental Sensitivity Index (ESI) maps were created by RPI to prioritize areas along the Texas coast for environmental cleanup.





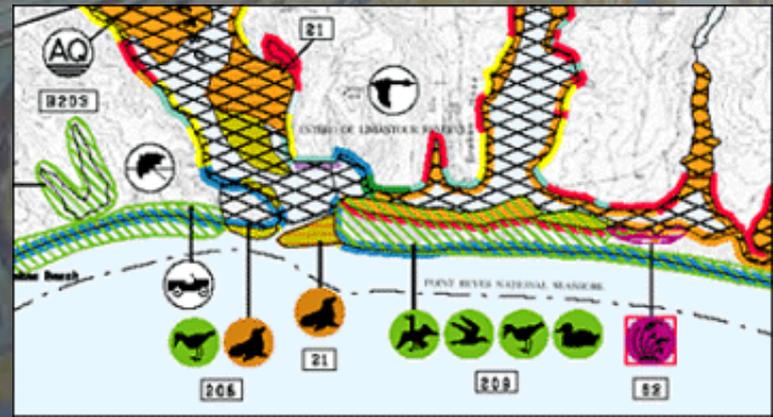
ESI maps were initially hand drawn over U.S. Geological Survey (USGS) maps. Areas along the shore were "ranked" in terms of their vulnerability in the event of a spill. Scientists used marker pens to color code the maps, making it easy to quickly identify high-risk areas. The first ESI maps for Puerto Rico were done in this fashion in 1984.

# Shoreline Index

	1	EXPOSED, VERTICAL ROCKY SHORES & SEAWALLS
	2	EXPOSED ROCKY PLATFORMS
	3	FINE-GRAINED SAND BEACHES
	4	COARSE-GRAINED SAND BEACHES
	5	MIXED SAND & GRAVEL BEACHES & FILL
	6	GRAVEL BEACHES & RIPRAP
	7	EXPOSED TIDAL FLATS
	8	SHELTERED ROCKY SHORES & SEAWALLS
	9	SHELTERED TIDAL FLATS
	10a	EXPOSED MANGROVES
	10b	SHELTERED MANGROVES

Technological advances allowed for greater accuracy and distribution of ESI maps. Cost-effective, large-format color copiers and printers quickly made 11" x 17" the preferred page size. The first ESI atlas developed using GIS was produced in 1989. GIS software enabled a more precise presentation of the color-coded, ranked shoreline sensitivity.

Although the initial intent of using GIS for ESI mapping was to produce a high-quality, less-expensive paper product, it quickly became apparent that the GIS data themselves were in equally high demand.



In 1989, the Exxon Valdez oil spill also had a significant impact on the demand for ESI maps. Public concern over the damage oil caused to the coastal environment was heightened. State and federal funds and legislation were directed to oil spill prevention and response strategies.



It was important to develop a standard ESI format so responders who move from spills on different coasts would have maps with the same look, allowing them to easily extract resources at risk.

Research Planning, Inc. (RPI), put together the first set of ESI guidelines in June of 1993. Based on these guidelines, the Marine Spill Response Corporation created digital versions of nearly all of NOAA's existing ESI maps.

NOAA Technical Memorandum NOS OR&R 11



**Environmental Sensitivity Index Guidelines  
Version 3.0**

Hazardous Materials Response Division  
Office of Response and Restoration  
NOAA Ocean Service  
National Oceanic and Atmospheric Administration



Seattle, Washington

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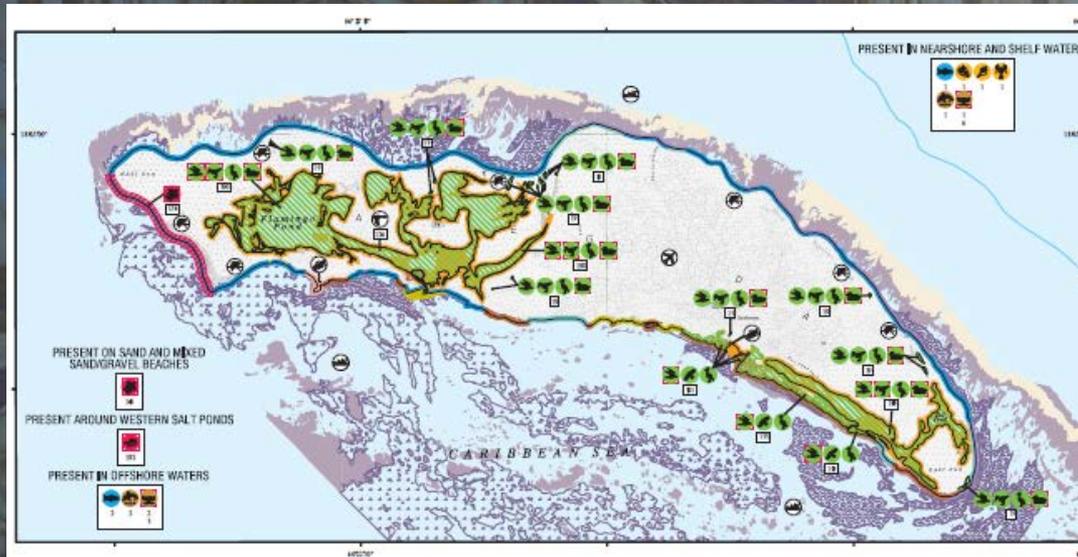
United States  
Department of Commerce  
Donald L. Evans  
Secretary

National Oceanic and  
Atmospheric Administration  
VADM Conrad C. Lautenbacher, Jr., USN (Ret.)  
Under Secretary for Oceans  
and Atmosphere

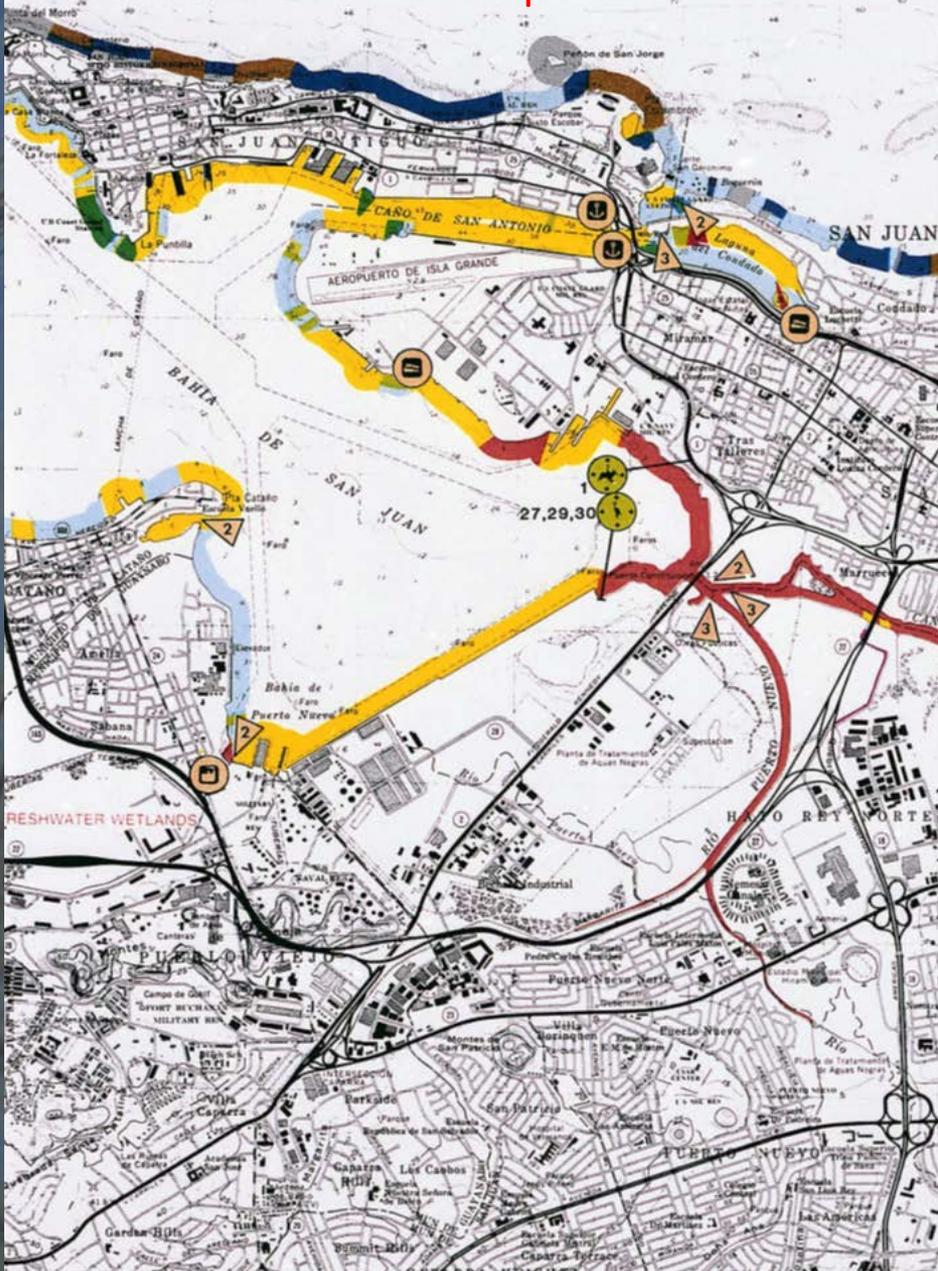
NOAA Ocean Service  
Margaret A. Davidson  
Acting Assistant  
Administrator for  
Ocean Services and  
Coastal Zone Management

ESI maps have proven to have a long-term use and they are excellent tools for planning, development of land use, and project evaluation.

The next ESI effort in the Caribbean started in the late 1990's. The final maps printed in 2000 included Puerto Rico, US Virgin Islands and British Virgin Islands. It also included the Reach Sensitivity Index (RSI) for some PR Rivers. Although dated, these are still some of the most complete ESI maps in the NOAA library.



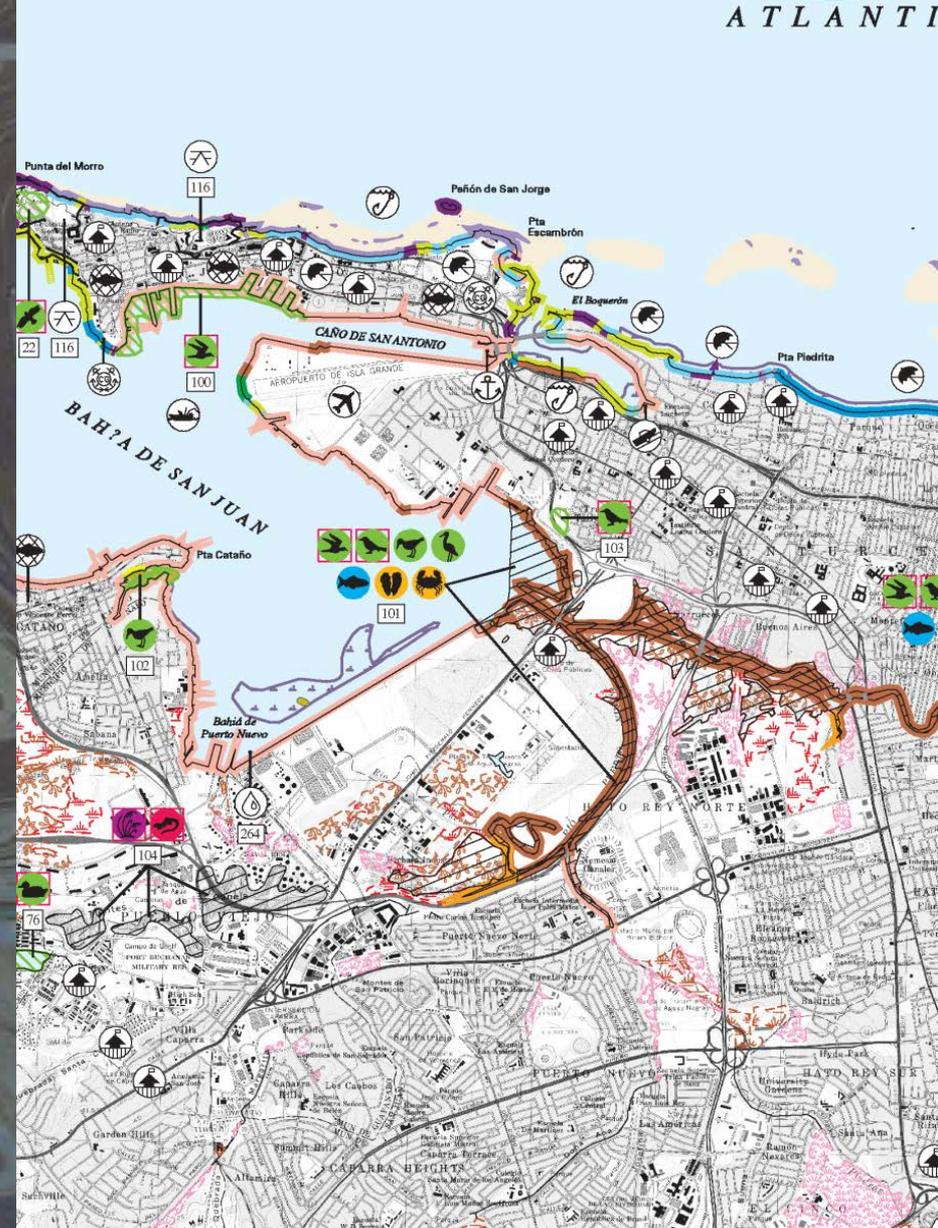
1984 ESI Map



PRESENT IN OFFSHORE WATERS



2000 ESI Map



## SHORELINE HABITATS (ESI)

-  1A EXPOSED ROCKY CLIFFS
-  1B EXPOSED, SOLID MAN-MADE STRUCTURES
-  2A EXPOSED WAVE-CUT PLATFORMS IN BEDROCK
-  2B SCARPS AND STEEP SLOPES IN MUDDY SEDIMENTS
-  3A FINE- TO MEDIUM-GRAINED SAND BEACHES
-  4 COARSE-GRAINED SAND BEACHES
-  5 MIXED SAND AND GRAVEL BEACHES
-  6A GRAVEL BEACHES
-  6B RIPRAP
-  7 EXPOSED TIDAL FLATS
-  8A SHELTERED ROCKY SHORES
-  8B SHELTERED, SOLID MAN-MADE STRUCTURES
-  9A SHELTERED TIDAL FLATS
-  9B SHELTERED VEGETATED LOW BANKS
-   10D MANGROVES
-   SALT- AND BRACKISH-WATER MARSHES
-   FRESHWATER MARSHES
-   FRESHWATER SWAMPS
-   FRESHWATER SCRUB/SHRUB

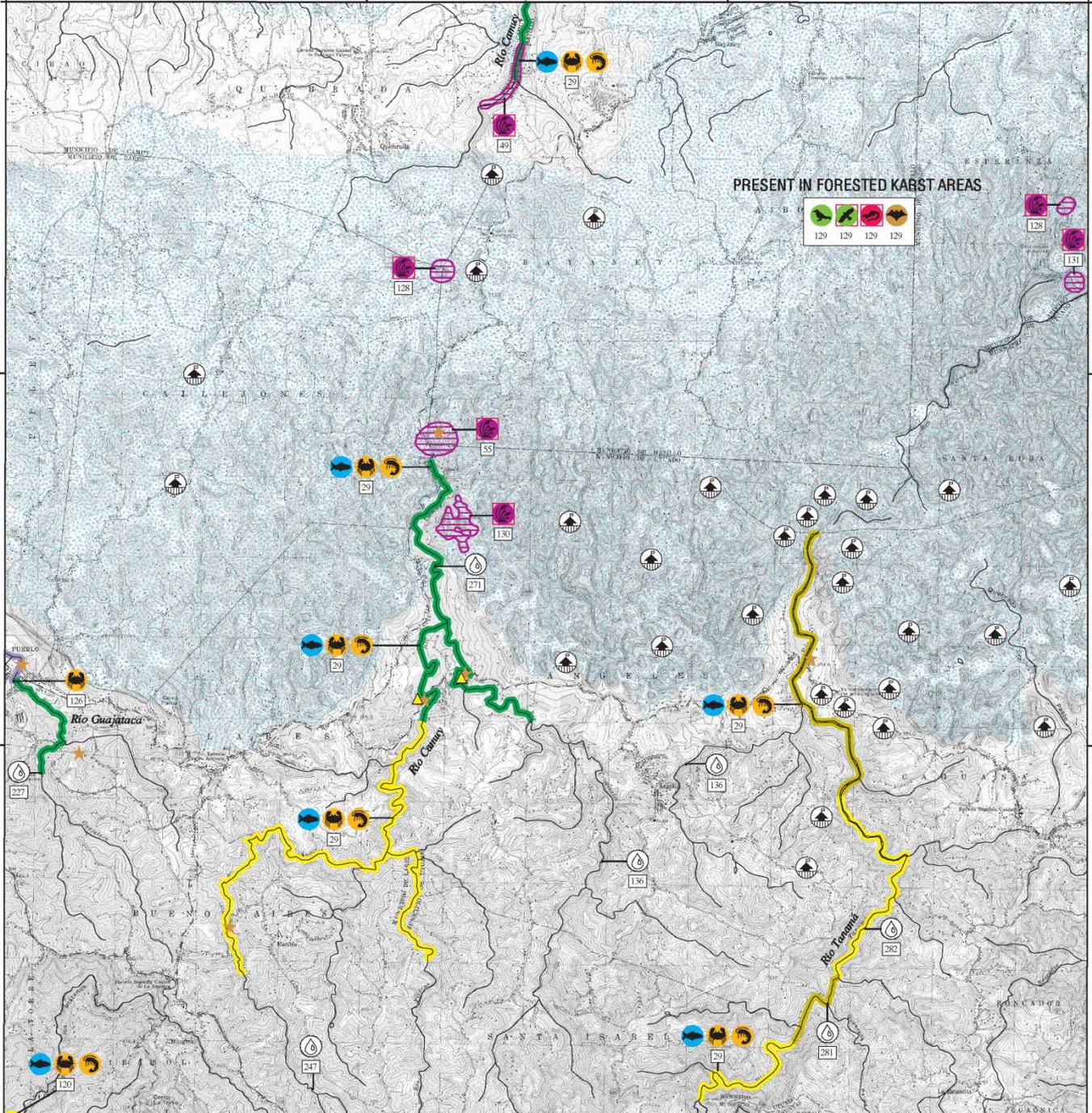
## STREAM REACHES (RSI)

-  1 QUIET POOL; LOW-SENSITIVE BANKS
-  2 STRAIGHT CHANNEL WITH CURRENTS; LOW-SENSITIVE BANKS (MUD DOMINANT)
-  3 MEANDERING CHANNEL; SAND POINT BARS
-  4 MEANDERING CHANNEL; VEGETATED POINT BARS
-  5 RAPIDS OVER BEDROCK
-  6 MEANDERING CHANNEL; SAND AND GRAVEL POINT BARS
-  7 SPLIT CHANNEL WITH COARSE GRAVEL; SOME RAPIDS
-  8 SMALL FALLS; BOULDERS IN CHANNEL
-  9 LARGE FALLS; BOULDERS IN CHANNEL
-  10 CHANNELS WITH ASSOCIATED VULNERABLE WETLANDS
-  KARST



SCALE 1:55000





# New ESI Maps also had species data

## PUERTO RICO - ESIMAP 18

### BIOLOGICAL RESOURCES:

#### BIRD:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Nesting
129	Passerine birds			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	-
	Puerto Rican broad-winged hawk	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X	JAN-JUN
	Scaly-naped pigeon			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	MAR-JUN
	White-crowned pigeon			HIGH	X	X	X	X	X	X	X	X	X	X	X	X	MAR-SEP

#### FISH:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D	Spawning	Eggs	Larvae	Juveniles	Adults
29	Native stream fish				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY AUG-NOV	APR-MAY AUG-NOV	APR-MAY AUG-NOV	JAN-DEC	JAN-DEC
120	Hog-nosed mullet				X	X	X	X	X	X	X	X	X	X	X	X	-	-	-	JAN-DEC	JAN-DEC
	Native stream fish				X	X	X	X	X	X	X	X	X	X	X	X	APR-MAY AUG-NOV	APR-MAY AUG-NOV	APR-MAY AUG-NOV	JAN-DEC	JAN-DEC

#### PLANT:

RAR#	Species	S/F	T/E	Conc.	J	F	M	A	M	J	J	A	S	O	N	D
49	Calyptronoma rivalis	S/F	T/T		X	X	X	X	X	X	X	X	X	X	X	X
55	Thelypteris verecunda	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X
128	Cornutia obovata	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X
130	Cornutia obovata	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X
131	Tectaria estremerana	S/F	E/E		X	X	X	X	X	X	X	X	X	X	X	X

### HUMAN USE RESOURCES:

#### WATER INTAKE:

HUN#	Name	Owner/Manager	Location	Phone
136	ANGELES PARTIAL PLANT	PRASA		
227	LARES FILTER PLANT	PRASA		
247	MIRASOL CHLORINATION PLANT	PRASA	PR 128, KM 38.3 FINAL	787/897-1280
271	QUEBRADA PARTIAL PLANT	PRASA		
281	RONCADOR PACKAGE PLANT, GRAVEDAD	PRASA	PR 603, KM 4.9 INTERIOR	
282	RONCADOR PACKAGE PLANT, TANAMA PUMPS	PRASA	PR 603, KM 4.4 INTERIOR	

Biological information shown on the maps represents known concentration areas or occurrences, but does not necessarily represent the full distribution or range of each species. This is particularly important to recognize when considering potential impacts to protected species.

**Archaeological/Historical Site**—Location of archaeological and historic sites for coastal and inland areas. These resources include known archaeological sites documented in the master site file for Puerto Rico, and most National Register listed and potentially eligible historic sites. The exact location and extent of these sites are not represented on the maps due to their sensitivity to disturbance and vandalism, instead, sites are depicted on the maps with an icon placed in the general vicinity of the site (or group of sites). This information was provided by the Puerto Rico State Historic Preservation Office. For more specific site information and guidance during planning and response operations, please contact the State Historic Preservation Officer at 787/721-3737.

# ESI data is incorporated into new platforms

ERMA | Environmental Response Management Application  
Caribbean



Scale: 1: 54K Zoom Level: 13 Location: 18.08644°, -67.91127°

# Challenges

- Data mining, who has the data, and are they willing to share it.
- Sensitive data such as archeological sites, location of sensitive species.
- Correct data, eg. Water intakes.
- Use existing data.

ESI Maps provide a concise summary of coastal and inland resources that could be at risk in the event of an oil spill.

They are a universally understood format in the spill response community, allowing for a quick understanding of coastal features.

ESI maps will constantly evolve as technology and information get better.