

# **Recovery & Resilience Puerto Rico**



**Puerto Rico  
02 JUN 2020**

**Ernesto L. Díaz, MS, MEM  
Coordinator PRCCC**



# Overview

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- The Puerto Rico Climate Change Council (PRCCC) and the U.S. Global Change Research Program: Fourth National Climate Assessment (NCA4)
- The State of Puerto Rico's Climate: Effects, Impacts, and Social-Ecological Vulnerabilities
- Puerto Rico's Climate Policy: Mitigation, Adaptation and Resilience (Law 33, 2019)
- Hurricanes Irma and Maria (2017): Response and Damage Assessments, Public Assistance (§428, §06), Hazards Mitigation (§ 404), CDBG-DR
- Recovery: The new generation of Coastal and Islands' infrastructure



# Puerto Rico Climate Change Council

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## Mission

*...assess the state of Puerto Rico's climate, using the best science and knowledge available, understand Puerto Rico's social-ecological vulnerabilities and develop adaptation strategies to build a resilient society.*

**Membership: 150+**



PUERTO RICO



CARICOOS



Geophysical and Chemical Scientific Knowledge

Ecology and Biodiversity



science for a changing world



CCRI



Center for Applied Tropical Ecology and Conservation



PUERTO RICO

Society and Economy

Communicating Climate Change and Coastal Hazards



Protecting nature. Preserving life.™



PROGRAMA DE ARRECIFES DE CORAL DE PUERTO RICO



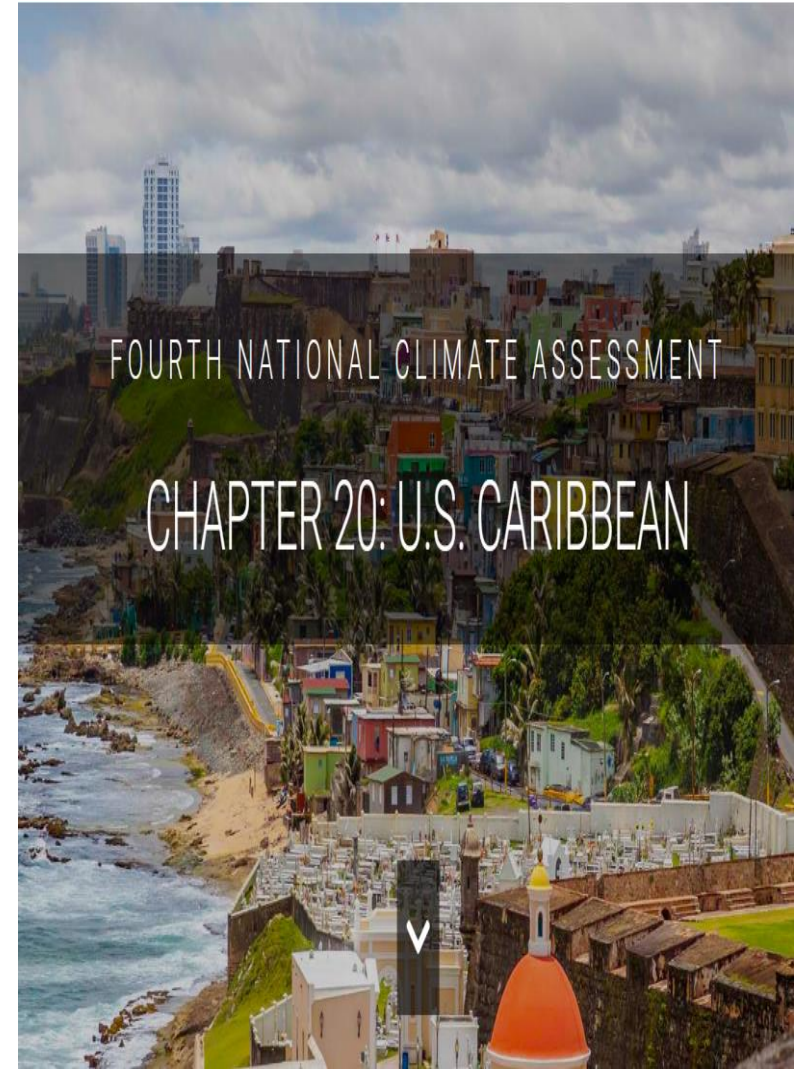
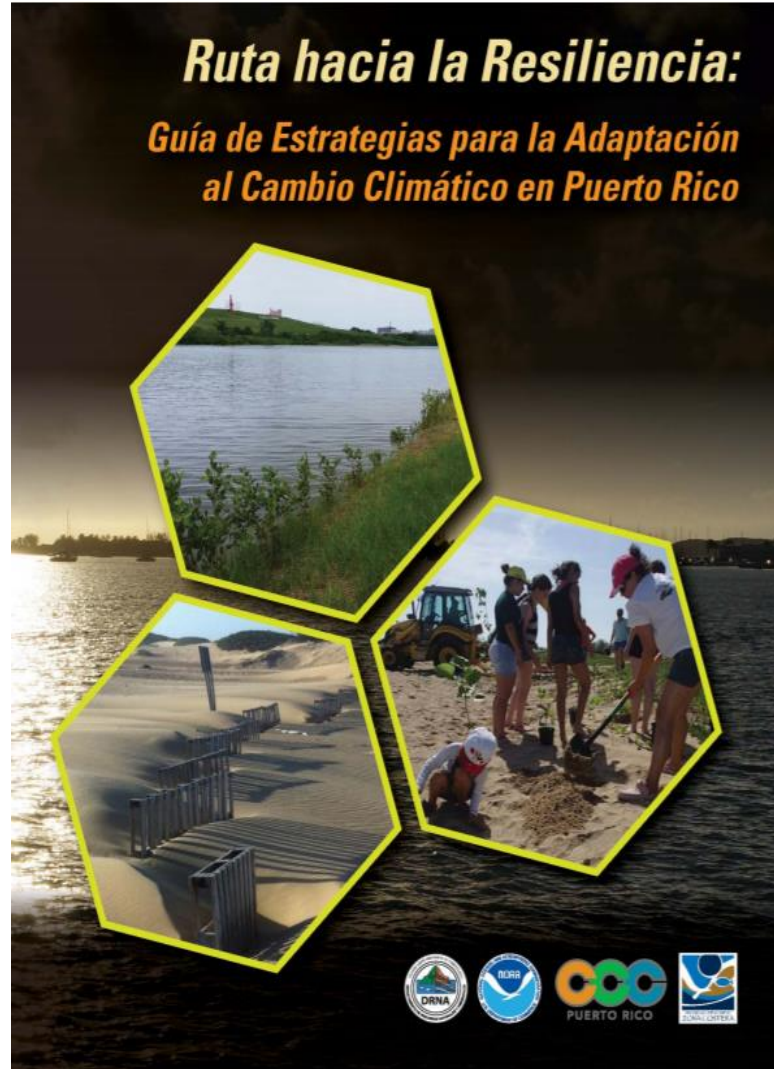
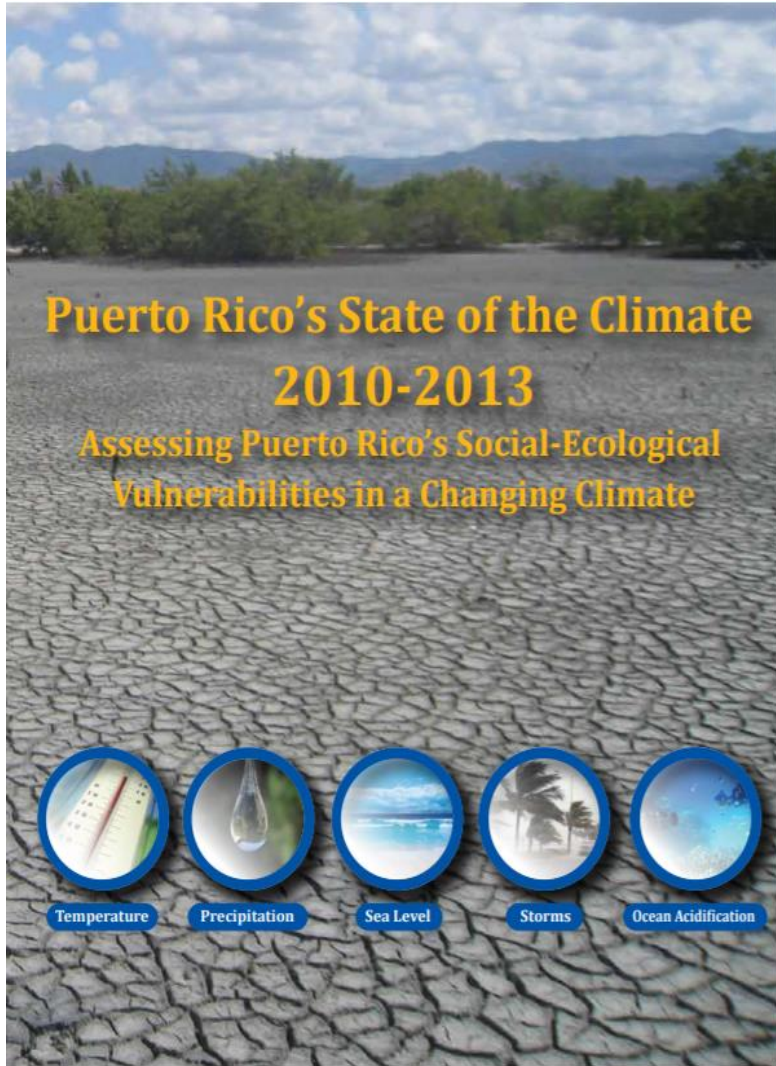
Investigación | Estrategias | Soluciones



Fundado en 1972



PUERTO RICO



<http://www.pr-ccc.org>

# FOURTH NATIONAL CLIMATE ASSESSMENT

The U.S. Caribbean islands face many of the same climate change related challenges as Hawai'i and the U.S.-Affiliated Pacific Islands (Ch. 27: Hawai'i & Pacific Islands), including

- isolation and dependence on imports, making islands more vulnerable to climate-related impacts;
- critical dependence on local sources of freshwater (Ch. 27, KM 1);
- temperature increases that will further reduce supply and increase demand on freshwater (Ch. 27, KM 1);
- vulnerability to drought in ways that differ from mainland regions (Ch. 27, KM 1);
- a projected significant decrease in rainfall in all (Caribbean) or parts (Hawai'i and Pacific Islands) of these regions (Ch. 27, KM 1);
- sea level rise, coastal erosion, and increasing storm impacts that threaten

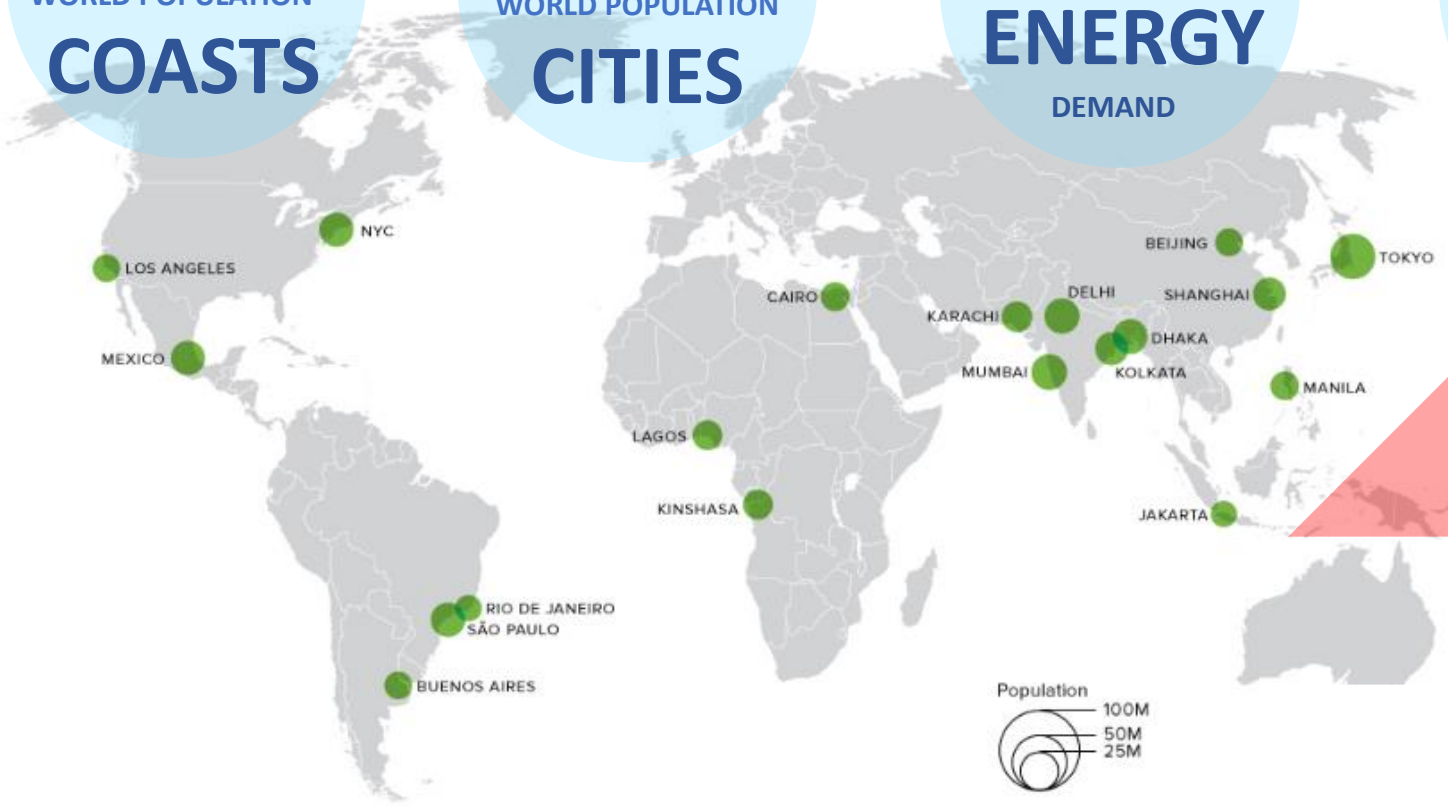
SECTIONS
Executive Summary
<b>Background</b>
KM 1: Freshwater
KM 2: Marine Resources
KM 3: Coastal Systems
KM 4: Rising Temperatures
KM 5: Disaster Risk Response to Extreme Events
KM 6: Adaptive Capacity
Traceable Accounts

**40%**  
WORLD POPULATION  
**COASTS**

**54%**  
WORLD POPULATION  
**CITIES**

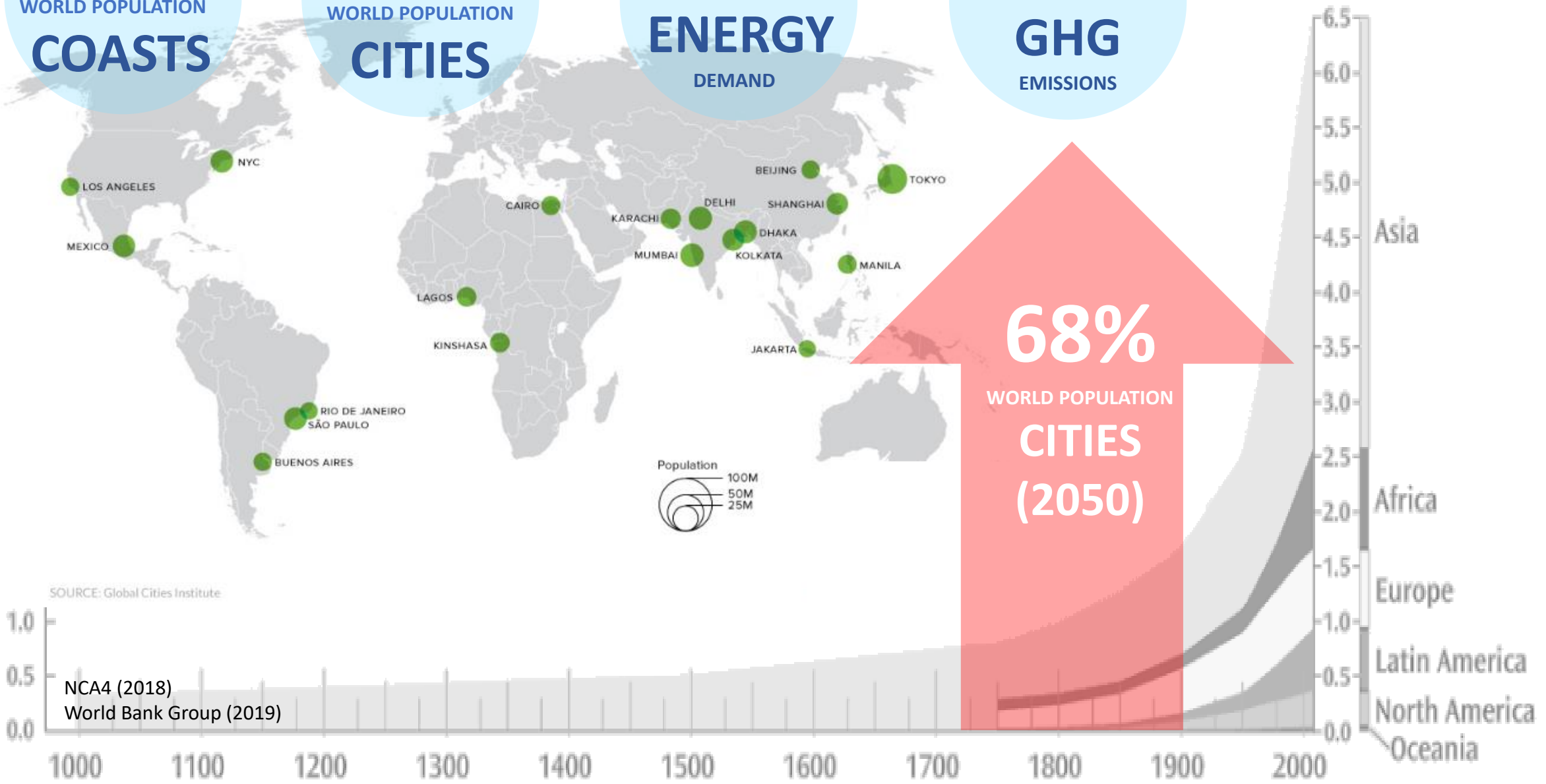
**70%**  
**ENERGY**  
DEMAND

**75%**  
**GHG**  
EMISSIONS



**68%**  
WORLD POPULATION  
**CITIES**  
**(2050)**

7.0 Billion (2011)



SOURCE: Global Cities Institute

NCA4 (2018)  
World Bank Group (2019)

# Puerto Rico's coastal uses and assets at risk



## ECONOMICS

GDP: \$105 billion/year (PRPB2016)  
Tourism \$2.5 Billion/year (7%)  
Built up Areas/Coastline: 24%  
Industrial Parks (81)  
Commercial/Recreational Fisheries



## HOUSING

Public Housing (15)  
Individual Housing (xx)



## TRANSPORTATION

Airports (11)  
Ports (12)  
Bridges, Culverts, Piers  
Miles of Primary Roads (17,387mi/27,982km)



## HEALTH AND SOCIAL SERVICES

Hospitals (3)  
Treatment Centers (xx)



## EDUCATION

Schools (36)

**Coastal population: 2.3 million (61%)  
at 44 coastal municipalities**

**Territorial waters: 9 nm (A=5,078 mi<sup>2</sup>)**

**Coastline: 799 mi/1,225 beaches**

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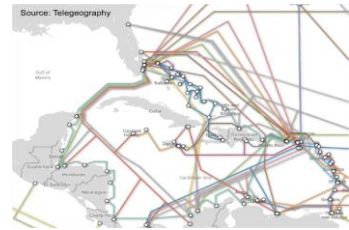


# Puerto Rico's coastal uses and assets at risk



## ENERGY

Power generation systems  
(5 public, 2 private)  
Substations  
Distribution and transmission lines



## COMMUNICATIONS

Fiber Optic Cables (15)  
Internet Infrastructure  
Public comm systems



## WATER

PRASA infrastructure at coastal zone:  
200km potable water  
260km sanitary infrastructure  
6 water systems  
Pump stations  
Wastewater Treatment Plants (28)



## NATURAL AND CULTURAL RESOURCES

Protected Areas (Land) DRNA 8.7% (2015) – PA-CAT 16% (2016)  
Protected Areas (Marine) 27.2%  
Shallow coral reefs and associated communities designated as MPA: 49%  
Historical Properties (20+)



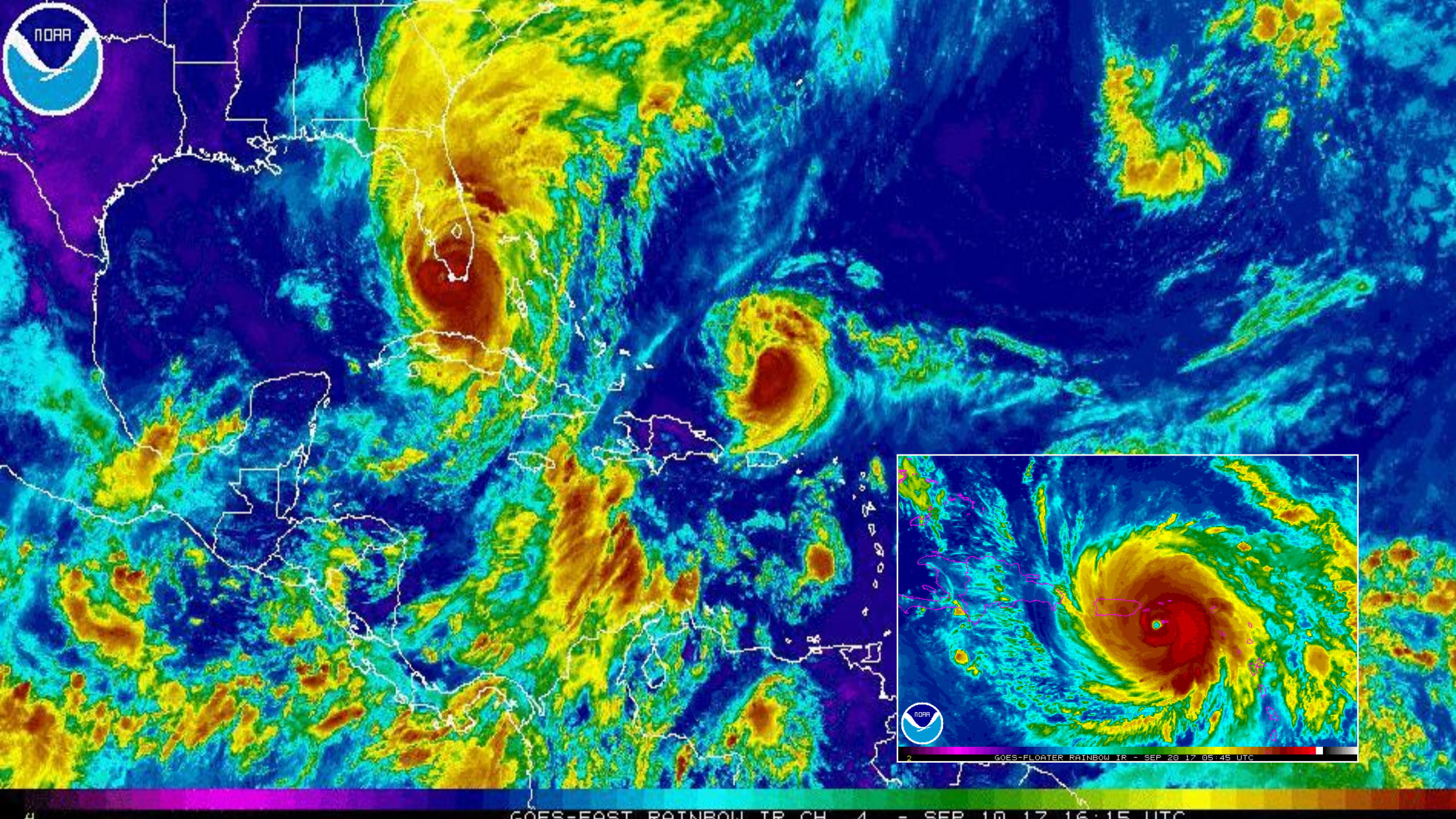
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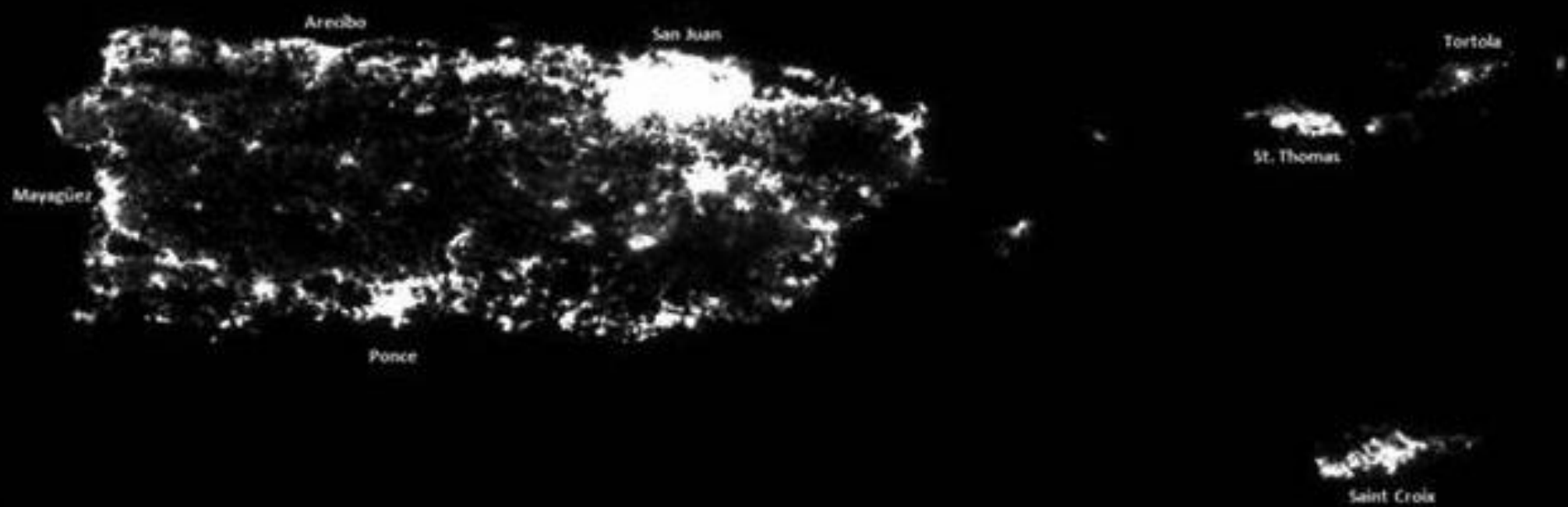


NOAA

NOAA

GOES-FLOATER RAINBOW IR - SEP 20 17 05:45 UTC

GOES-EAST RAINBOW IR CH 1 - SEP 20 17 16:15 UTC



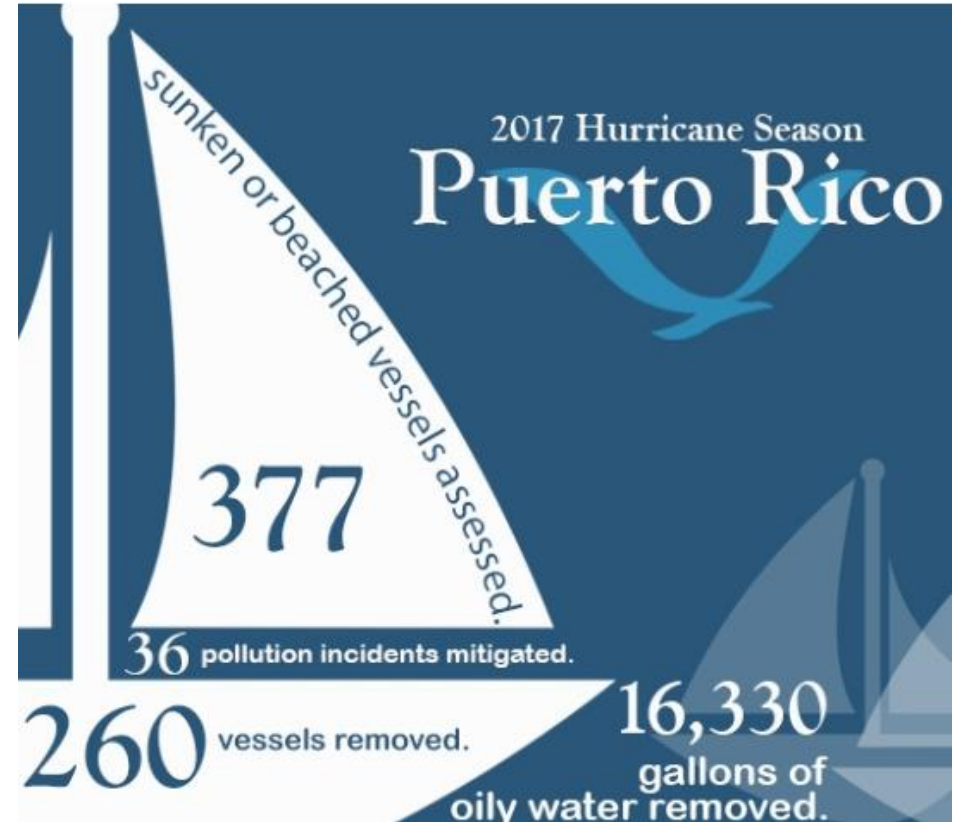


# HURRICANE MARIA RESPONSE

## ESF 10

## SUNKEN VESSELS REMOVAL

FEMA



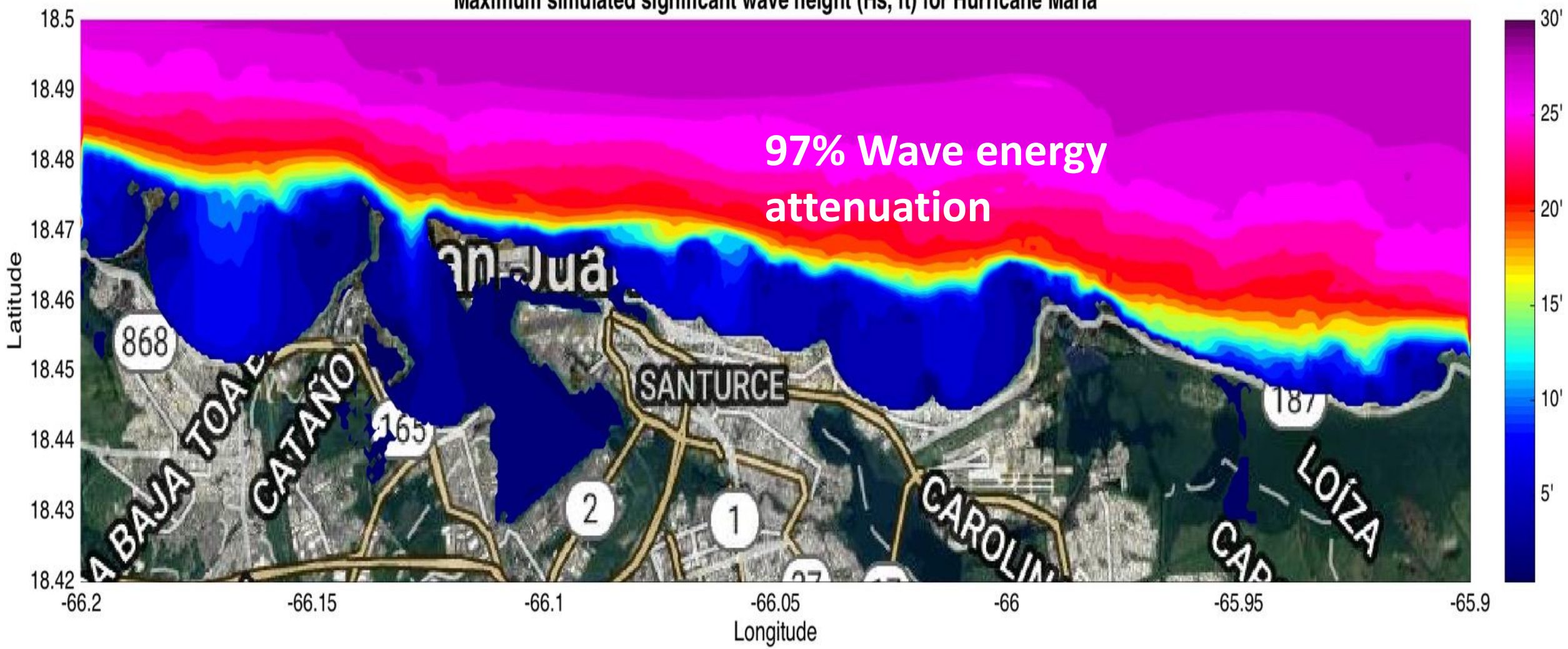
# Status of Puerto Rico's Coral Reefs in the Aftermath of Hurricanes Irma and Maria

*Assessment Report Submitted by NOAA to the FEMA Natural and Cultural Resources Recovery Support Function*

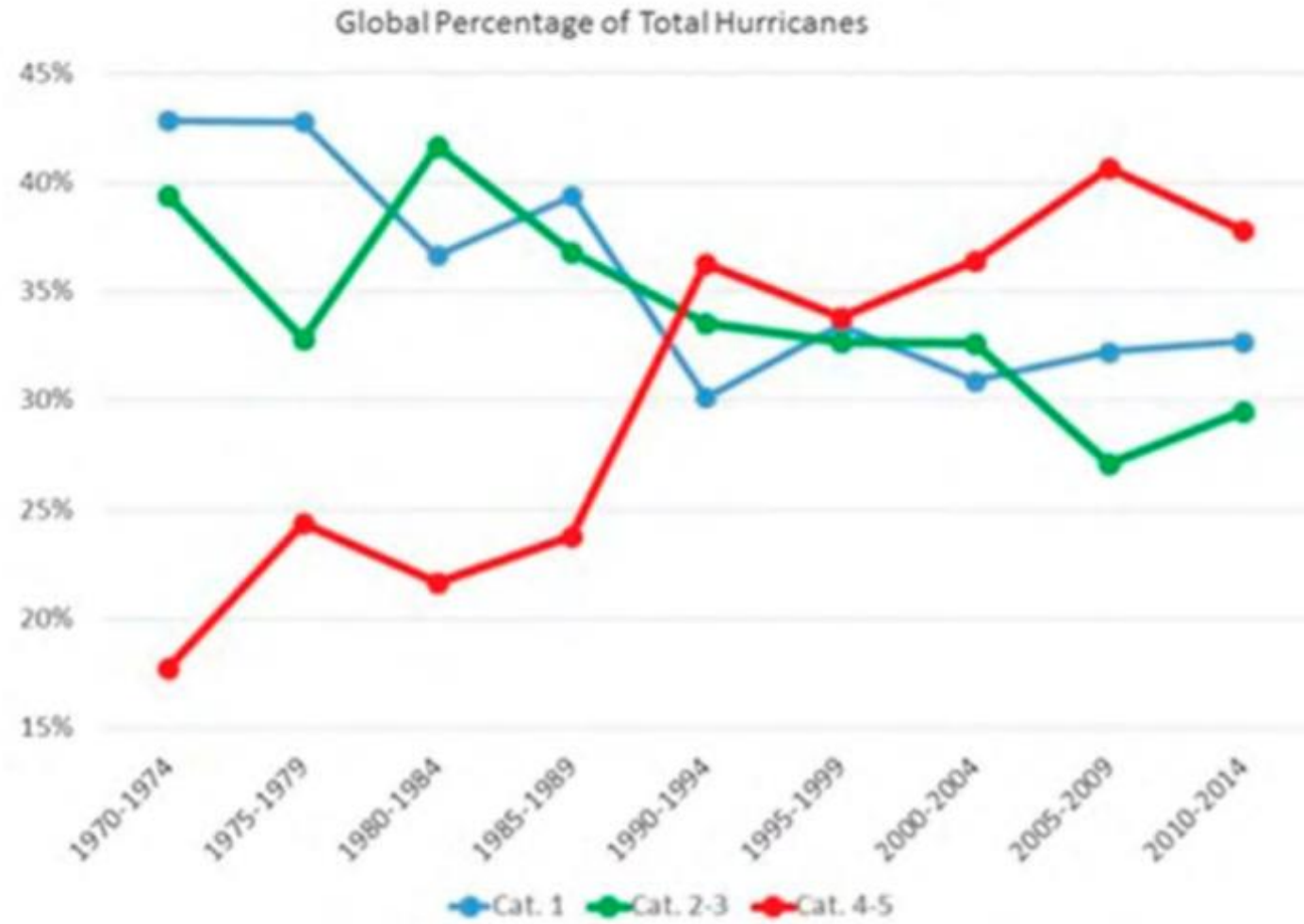


# MAX WAVE HEIGHT @ SJ / CAROLINA- HURRICANE MARÍA (SEP 20.2017)

Maximum simulated significant wave height (Hs, ft) for Hurricane María

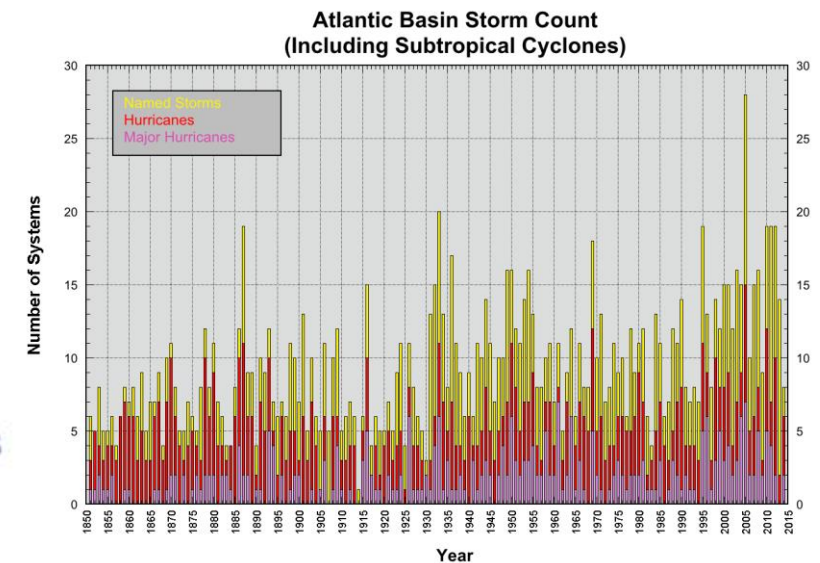




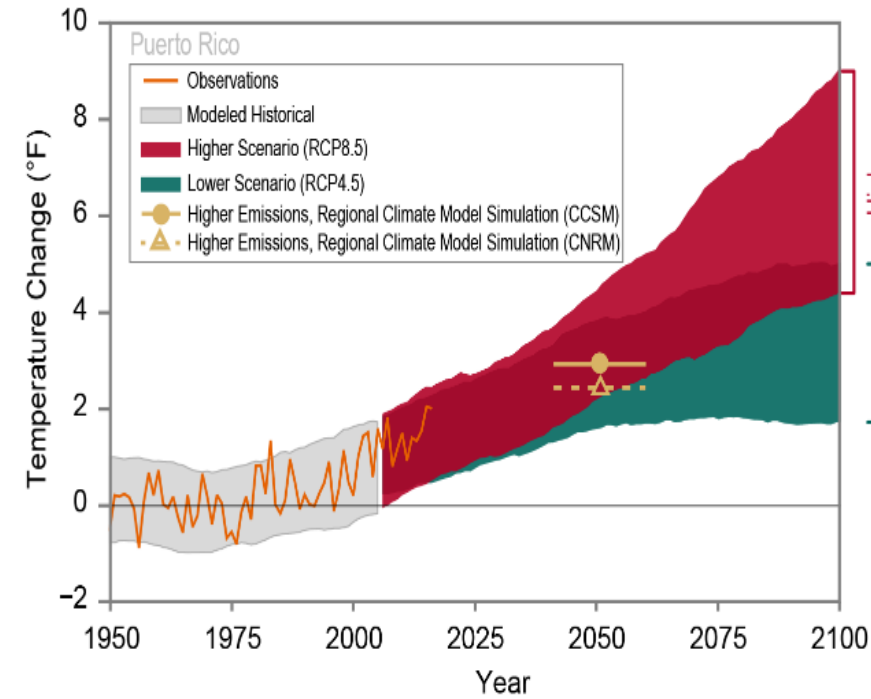


## Hurricanes Cat 4 & 5

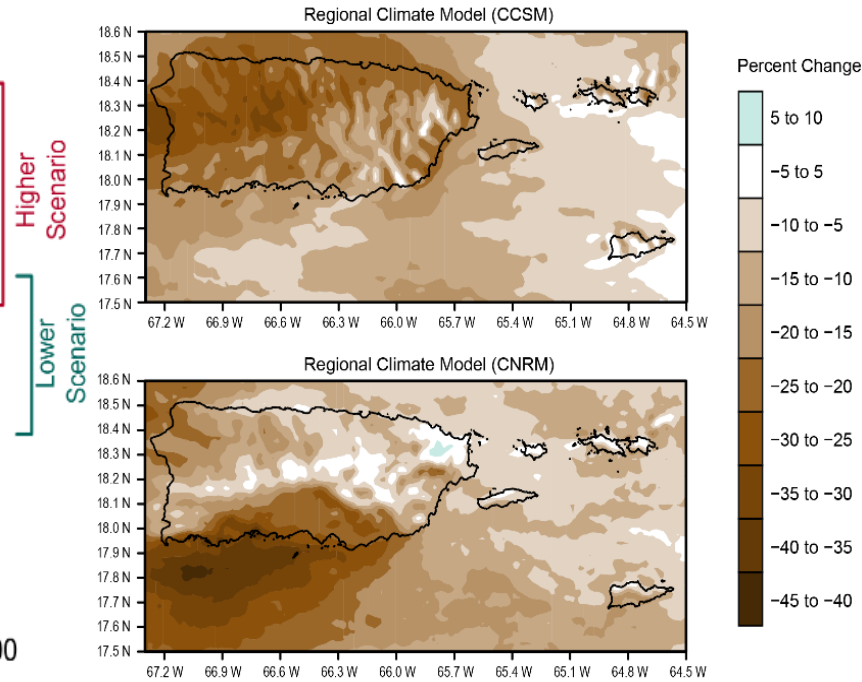
**Figure 3.3.** (a) Pentad total of the number of hurricanes that achieved a maximum intensity of each category grouping as delineated by the Saffir–Simpson scale. (b) As in (a), but for the percentage of total hurricanes achieving each category grouping. Klotzbach and Landsea (2015)



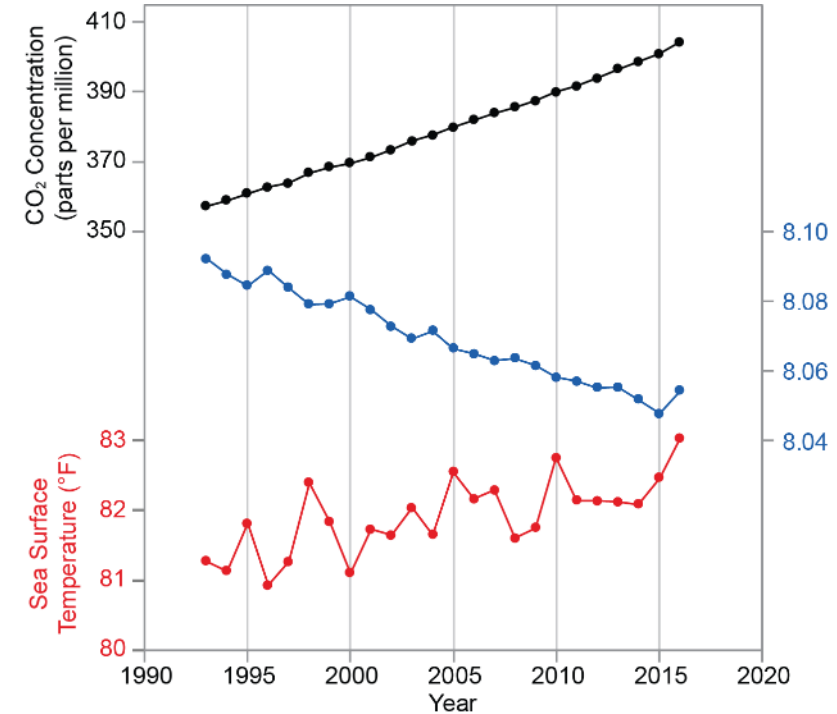
# Puerto Rico Climate and Ocean Trends and projections



**Atmospheric Temperature**  
(2-9 ° F)



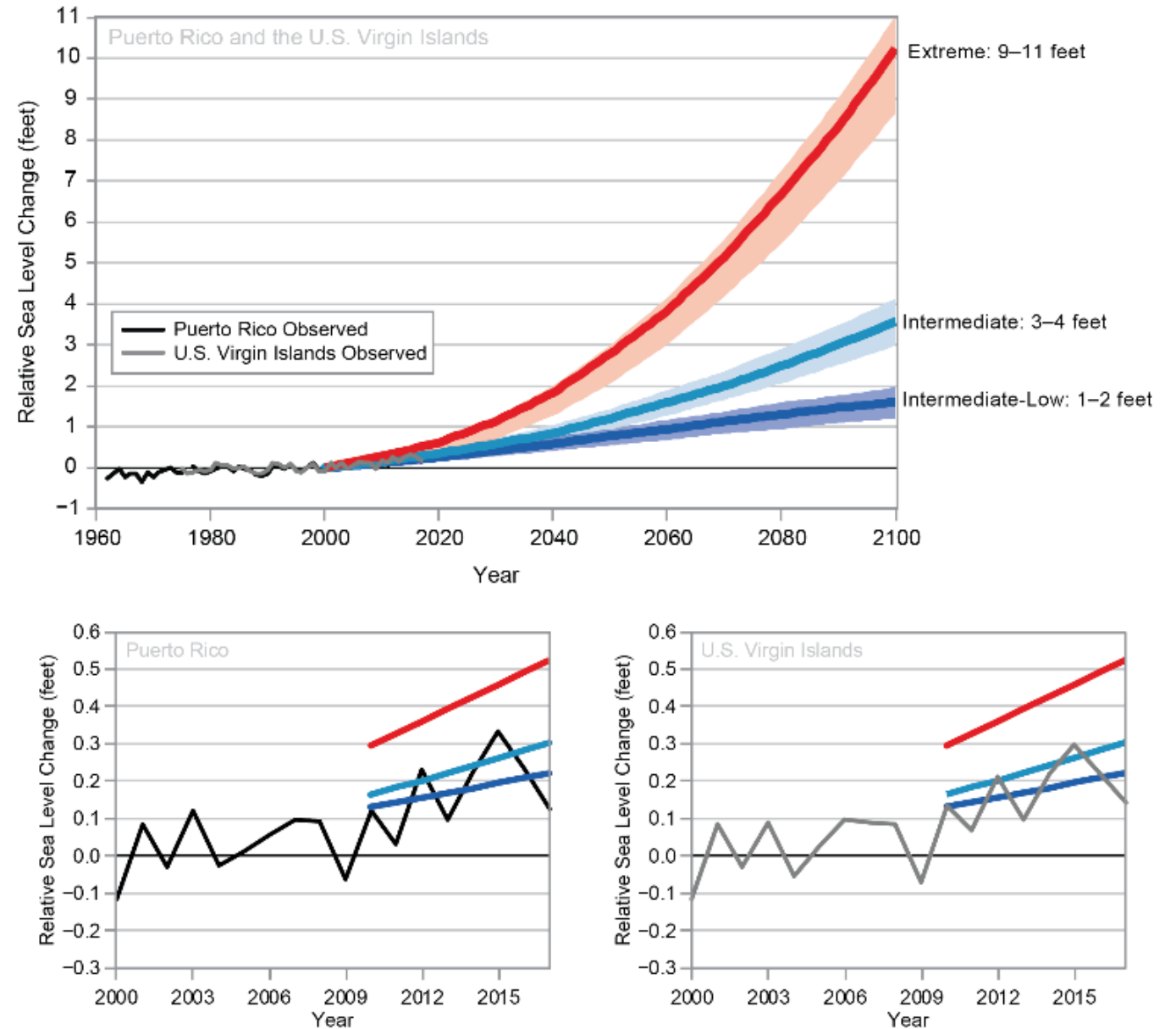
**Precipitation**  
(-10 to -40%)



**CO<sub>2</sub>** 416 ppm  
**Ocean pH** 8.04  
**SST** 80+

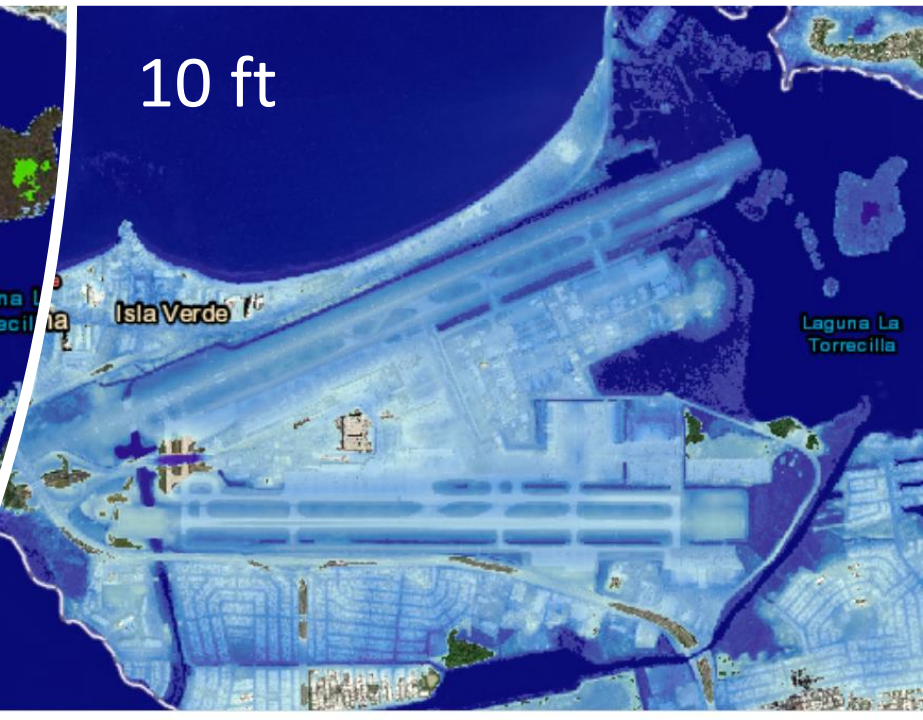
## Fig. 20.6: Observed and Projected Sea Level Rise

Observed sea level rise trends in Puerto Rico and the U.S. Virgin Islands reflect an increase in sea level of about 0.08 inches (2.0 mm) per year for the period 1962–2017 for Puerto Rico and for 1975–2017 for the U.S. Virgin Islands. The bottom panels show a closer look at more recent trends from 2000 to 2017 that measure a rise in sea level of about 0.24 inches (6.0 mm) per year. Projections of sea level rise are shown under three different scenarios of Intermediate-Low (1–2 feet), Intermediate (3–4 feet), and Extreme (9–11 feet) sea level rise. The scenarios depict the range of future sea level rise based on factors such as global greenhouse gas emissions and the loss of glaciers and ice sheets. *Sources: NOAA NCEI and CICS-NC.*



# SEA LEVEL RISE SCENARIOS

## International Airport San Juan, Puerto Rico



# **Puerto Rico Law 33 (2019) Climate Change Mitigation, Adaptation and Resilience**

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## **Art 3.- Public Policy**

- PR Power grid progressively uses less fossil fuels
- Coal phase out
- Promote clean energy
- Improve energy efficiency
- Lower GHG emissions from other land uses and activities
- Promote the use of electric cars
- Reforestation and ecosystem services

## **Art 6.- Expert Advisory Committee**

## **Art 7.- Mitigation, Adaptation and Resilience Plan**

## **Art 10.- GHG Inventory (regularly update)**

## **Artículo 14.- Funding mechanisms**

## **Artículo 15.- Creation of a Joint PR Senate-House of Representatives Commission**

## **Art 20.- Renewable Energy Goals: 100% by 2050 (20% by 2022, 40% by 2025, 60% by 2040)**

# Building Coastal Resilience

## Planning and design:

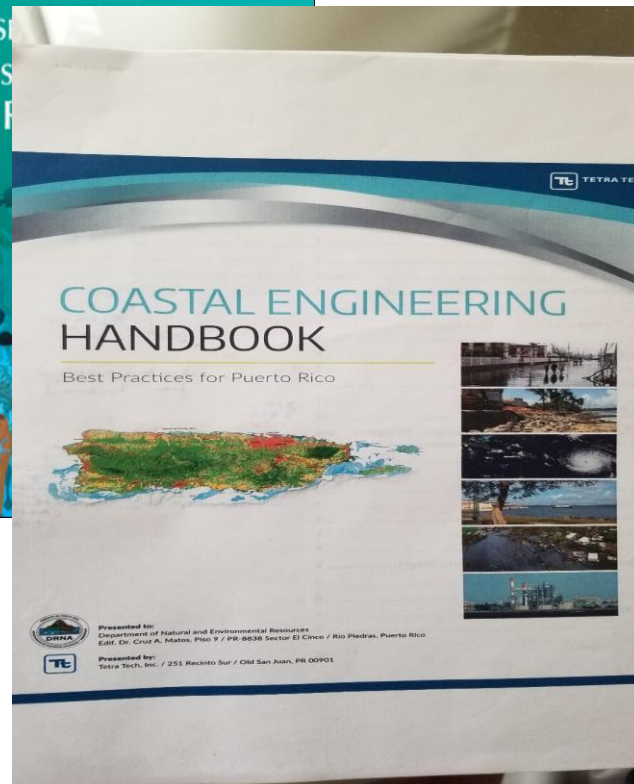
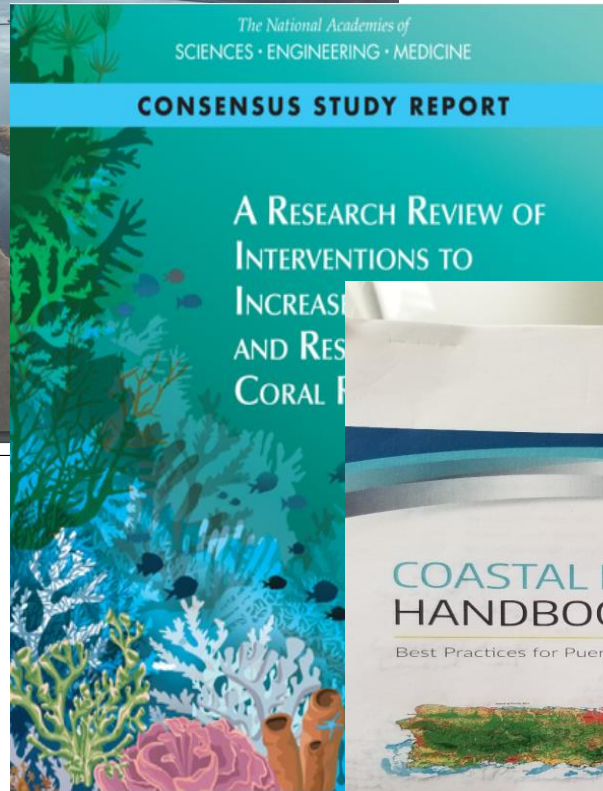
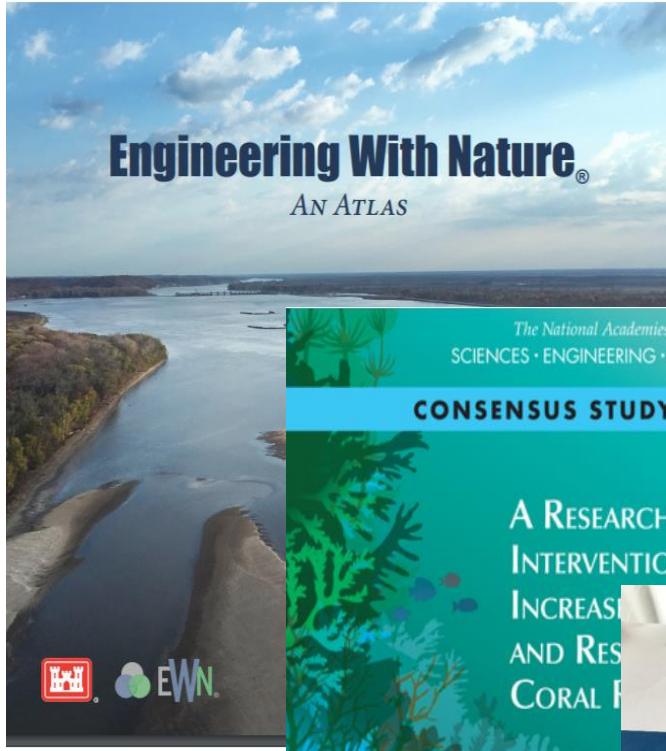
- Land use plans, zoning regs, building codes
- Dynamic Setback/Coastal Construction Line
- Increase freeboard requirements (best BFE)
- Adaptive design
- Information, outreach and education

## New generation of PR infrastructure:

Hybrid and Nature-based alternatives integrating structural and nature-based solutions (Coral reefs, Wetlands, Beach and Dunes, Swales, Horizontal levees, etc.)

## B-C Analysis:

- Lower or similar cost
- Rapid return on investment
- Lower O&M (Operations and Maintenance)
- Longer design life
- Aesthetically attractive, tourism and recreation



# FEMA 428, 406 and 404 projects

BEACHES AND DUNES	5/3/2019 6:25 AM	File folder
CORAL INTERVENTIONS	3/20/2019 1:51 PM	File folder
CORAL REEFS	7/9/2019 10:55 AM	File folder
DUNE TEAM	5/3/2019 6:26 AM	File folder
MPA CREATION	5/3/2019 6:25 AM	File folder
SJ METRO INTERVENTIONS	8/1/2019 6:21 PM	File folder
WETLANDS	5/3/2019 6:26 AM	File folder



## Policy Advisory

**Title:** Coral Reef facility eligibility

**Keywords:** Coral Reef, facility, eligibility, planting, beach,

**Project Description:** Coral Reef Restoration

**Requestor:** Puerto Rico Department of Natural and Environmental Resources (DNER)

**Sector:** NCR

**Subrecipient:** Puerto Rico DNER

**Project Category:** G

**Project Size:** \$31,000,000

**Policy Issue or Question:** Is the restoration of a coral reef by the Puerto Rico DNER eligible for Public Assistance?

# Hurricanes Irma and María (2017) · Earthquakes (2020)

FEMA



COR

CENTRAL OFFICE FOR  
RECOVERY, RECONSTRUCTION AND RESILIENCY



**\$85+ Billion**



# Recovery & Resilience Puerto Rico



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