Puerto Rico
Coastal Zone Management Program

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Director
Puerto Rico Coastal Zone Management Program

Mission:

The Puerto Rico Coastal Management Program (PRCZMP) is a partnership led by the Department of Natural and Environmental Resources (DNER) to promote the protection, conservation, and sustainable development of Puerto Rico’s coastal zone and natural resources.
Goals and Objectives:

- Develop guides for public and private development on the coastal zone;
- Active management of coastal resources;
- Foster scientific research, education, stakeholders and resource users participation as means of promoting sustainable development of our coastal resources.
PRCZMP jurisdiction
Puerto Rico

RELEVANT STATISTICS

Emerged land area: 9,497 km² (3,508 mi²)
Territorial waters: 9 nm (10.35 stat. mi)
Population: 3.9 million (26th U.S. largest)
Coastal Zone Population: 2.73 million (70%)
40% urban land area
GDP: ~$ 95.7 billion/yr

Composition by sector (2009):

- Manufacturing: 45.5%
- Finance, insurance and real estate: 19%
- Services: 12.8% (Tourism: 7%)
- Government: 9.7%
- Trade: 7.8%
- Transportation and other public utilities: 3.2%
- Construction: 1.9%
- Agriculture: 0.7%

Source: PRPB and BGF 2010
INFRASTRUCTURE WITHIN 1 KM OF THE COAST

- Eight ports
- Eight airports
- Six power plants
- 1,080 miles of sanitary infrastructure
- 81 Industrial lots
- 114 miles of primary roads
Key Priorities:

• Increase knowledge about trends of resource abundance and distribution.

• Increase understanding of interspecies and species-habitat relationships.

• Contribute to increase knowledge about climate change, sea level rise and their impact on terrestrial, coastal, marine, natural and socioeconomic systems.

• Effectively address human use patterns that may affect resource sustainability and biodiversity.

• Protect coastal wetlands and coral reef systems from key stressors.

• Conduct coastal communities vulnerability assessments to current hazards and climate change.
MODELING ASSETS

• CaRA and UPRM have jointly established the Alliance for Numerical Modeling and Coastal Forecast. The PRCMP of DNER has contracted the Alliance to perform Coastal Zone inundation modeling using ADCIRC, SWAN and COULWAVE.

• Coastal winds, WRF J. Gonzales-CaRA/UPRM, S. Strippling NWS-SJ)

• Coastal waves, SWAN (C. Anselmi, CaRA-UPRM, J. C. Ortiz –UniNorte)
MODELING ASSETS (cont.)

• Storm surge-inundation ADCIRC: J. Capella and J. Gonzalez, CaRA-UPRM, A. Mercado-UPRM, B. Blanton-Renaissance Institute, and Ernesto Díaz, DNER Coastal Management Office.

• Coastal currents, ADCIRC (J. Capella-CaRA, Dave Hill, Penn State)

• Offshore currents (HYCOM/ROMS) L. Cherubin-RSMAS, N. Idrissi-UVI), IAS/NCOM (D. Ko-NRL)
Past and future CO₂ atmospheric concentrations

Scenarios:
- A1B
- A1T
- A1FI
- A2
- B1
- B2
- IS92a

Ice core data vs. Direct measurements vs. Projections

Y-axis: ppm (parts per million)
X-axis: AD 1000 to AD 2100

SYR - FIGURE 9-1a

IPCC
INTERGOVERNMENTAL PANEL ON CLIMATE CHANGE
Projected changes in global temperature:
global average 1856-1999 and projection estimates to 2100

Global average temperature in °C

Figure 2: Surface Temperatures over the last 1,100 Years

- Borehole temperatures (Huang et al. 2000)
- Multiproxy (Mann and Jones 2003)
- Multiproxy (Hegerl et al. 2006)
- Instrumental record (Jones et al. 2001)
- Glacier lengths (Oerlemans 2005)
- Multiproxy (Moberg et al. 2005)
- Tree rings (Esper et al. 2002)
Major Coral Reef Stressors

- Climate Change
- Land-based Sources of Pollution
- Fisheries Impact
- Disease
- Recreational Overuse
- Lack of Awareness
Climate Change impacts on coral reefs

Climate change impacts are identified as the greatest global threats to coral reef ecosystems:

- Bleaching
- Disease and Mortality
- Ocean acidification
San Juan Monthly Mean Sea Level 1962-2010

\[ y = 0.0017x - 3.1565 \]

MSL (m)

Date


0.414m 2100
Magueyes - Monthly Mean Sea Level 1955-2008

\[ y = 0.0014x - 2.7066 \]

Date

0.256m 2100
Figure 1. *Comparison of recent estimates of sea level rise in 2100, relative to 1990 levels.*
Climate Change Project:

Puerto Rico Coastal Zone Vulnerability Assessment and Adaptation Strategies
Vision for Puerto Rico

Source: Based on Hawaii’s Island Center for Adaptation and Policy Framework
Four Working Groups for the Puerto Rico Climate Change Caucus (PRCCC)

- Geophysical and Chemical Scientific Knowledge: Scenario Building
- Ecology and Biodiversity
- Society and Economy
- Communicating Climate Change and Coastal Hazards
Recruit critical partners and develop the process

- Recruit project partners and advisors
- Create working groups
- Agree on the sectors to be assessed for the Project and the process
- Agree on a vision for Puerto Rico – safe, productive, healthy, resilient

Explore the relevant issues affecting the coasts

- Preliminary/Qualitative Assessment with expert input
- Develop coastal scenarios for the future based on historic trends (e.g. CariCOOS, NOAA) and already published reports (e.g. IPCC 2007, US Climate Report 2008, UNEP 2008; Simpson et al. 2009)
- Data inventory and collection
- Qualitative/Quantitative risk assessments via stakeholder workshops

Spatial Analyses/Mapping and a Coastal Vulnerability Index (CVI)

- Identify socio-economic and ecological indicators of vulnerability and resilience in Puerto Rico
- Create a Coastal Vulnerability Index (CVI) to identify at-risk communities and ecosystems
- Critical Infrastructure Vulnerability Assessment – WPI
- Complete Draft Vulnerability Assessment Report

Create Adaptation Strategy and Recommendations

- Identify, evaluate, and prioritize adaptation strategies and policies through stakeholder workshops and expert advice
- Finalize report and create executive summaries
- Outreach and education of the key vulnerabilities and adaptation options for Puerto Rico

April 2011
August 2011
June 2012
Geophysical and Chemical Scientific Knowledge: Scenario Building

Israel Matos
Dr. Martiza Barreto
Dr. Jorge Capella
Dr. Miguel Canals
Dr. Jorge Corredor
Melissa Melendez
Dr. Rafael Mendez Tejeda

Dr. Fernando Gilbes-Santaella
Dr. Julio Morell
Plan. Lyzaida Rodriguez
Juan González
Prof. Aurelio Mercado
Ecology and Biodiversity

Dr. Jorge Ortiz Zayas
Plan. Evelio Valeiras
Dr. Ernesto Weil
Dr. Richard Appeldoorn
Plan. Wanda Crespo
Dr. Miguel García
Susan Silander
Dr. Elvira Cuevas
Dr. Nilda Jiménez
Dr. Edwin Hernández
Dr. William Gould

Dr. Clark Sherman
Dr. Vance Vicente
Dr. Lisamarie Carrubba
Carlos Diez
Carmen González
Marelisa Rivera
Dr. Rafael Joglar
Angel Dieppa
Nina Garfield
Dr. Craig Lilyestrom
Society and Economy

Plan. Felix Aponte
Lcdo. Graham Castillo
Ruperto Chaparro
Plan. Maria Juncos
Damaris Lopez
Rafael Mojica
Dr. Eddie Laboy Nieves
Willie Ortiz
Dr. Carlos Padin
Aida Rosario

Arq. José Terrasa
Lcdo. David W. Roman
Deborah Velázquez
Dr. Roy Armstrong
Dr. Joseph Vogel
Graciela García Moliner
Dr. Luis Santiago
Dr. Walter Diaz
WPI Student Team
Communicating Climate Change and Coastal Hazards

Maria Falcón
Susan Soltero
Astrid Green
Yazmin Detrés
Benito Pinto
Tito Quintana
Ernesto Torres
Raimundo Espinoza

Sara Justicia
WPI Student Team
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<th>Planning Area</th>
<th>Feature</th>
<th>Average Likelihood</th>
<th>Average Magnitude</th>
<th>Most Often Risk Category Answer</th>
<th>Average Risk Score</th>
<th>Climate Driver</th>
<th>Most Often Given Time Answer</th>
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• Steering Committee of the “Geophysical and Chemical Scientific Knowledge: Scenario Building” Working Meet in January to discuss historic trends and climate projections for Puerto Rico and the Caribbean Basin. Work has already been done for the basin but at a coarse resolution. For a first-pass assessment this data is useful.

• Started drafting a table of projections to be used for Puerto Rico’s Vulnerability Assessment (See Figure 1 – NOT FOR DISTRIBUTION). The scenarios developed will be finalized by the entire Puerto Rico Climate Change Caucus at a meeting in late March or early April (date TBD).

• New CariCOOS storm surge + sea level rise mapping will be completed for the Coastal Adaptation Project. Modeling a 1 meter sea level rise with a category 2 hurricane.

• Partnering with Dr. Jaime Collazo of North Carolina State University and Dr. Katherine Hayhoe of Texas Tech University. They are half way through statistical downscaling of AOGCMs for the Caribbean Basin. Will have results specifically for Puerto Rico and the USVI. This information will be used for Dr. Collazo’s already funded work for the SW portion of Puerto Rico, the Coastal Adaptation Project and a potential new Caribbean Landscape Conservation Cooperative.
• Received 185 Comments on the Vulnerability Assessment process and draft documents. Process has been revised. A qualitative/descriptive vulnerability assessment will be completed for all the agreed upon sectors by May. Stakeholder risk assessment workshops will be conducted in Spring/Summer 2011. Facilitation techniques for this process are still being researched and selected. PRCC meeting in March or April (Date TBD; Location – DNER; half day).

• A Coastal Vulnerability Index (CVI) for Puerto Rico will be developed by the PRCCC with DNER taking the lead in conjunction with Sea Grant Puerto Rico, University of Delaware, ITTF. The index will use social, ecological and socio-economic indicators to assess vulnerability of the 44 coastal municipalities. A social vulnerability index has already been completed for the West Coast of Puerto Rico by Sea Grant, Walter Diaz, and the University of Delaware.
• A robust research library is continuously updated for the purpose of the project. It contains peer-reviewed literature, technical reports, government publications, in-press articles, lists of websites, and raw data. This “Dropbox” file folder will be shared to all project participants at the next PRCCC meeting. Those who share the folder will be able to add their own documents to this library.

• A survey will be sent out via email in the next 2 weeks to Commonwealth and federal agencies, universities, NGOs, and others to make sure we have an up-to-date database of all climate initiatives, research, events, etc. (Suggestions are much appreciated).

• WPI Student Team is assessing critical infrastructure vulnerability for Puerto Rico. Will be in PR from March to May completing the project.
NEXT STEPS... QUESTIONS?