

Using Geospatial Analysis to assess Post-Hurricane coastal changes at Puerto Rico

El estado de las playas de Puerto Rico post-María FEMA HMGP Subgrantee: 4339-0007-P

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Major Challenges in the PR Coast

- Increase of beach erosion in selected coastal sites at the Island since 2012.
- Hurricane Maria affected the coastline producing diverse and complex geomorphic effects especially over the beach systems.
- Loss of beach width and elevation in the majority of beaches at the Island after Hurricane María (Barreto, M, 2017)
- Approximately, 22% of population (2020) was located in a 10m Low Elevation Coastal Zone (LECZ); 13% of population (2020) was located in the Coastal Zone at the Island (Barreto 2023 in publication process).
- Approximately, 32% of the critical infrastructure was located in a 10m Low Elevation Coastal Zone (LECZ).
- Few updated data was available of coastal erosion at island-wide/municipality level at PR
- Needs of increase of reliable data to use as a baseline for decision-making processes at the Island.



Major Challenges in the PR Coast

"Beach erosion reduce the degree of protection of the coast producing an increase exposition and vulnerability of the coastal communities, critical infrastructure and services at the Island."

La Boca, Barceloneta, PR

March 2018 (Swells produced by Riley)

Video Mastache

The Project

- Develop a baseline data (geodatabase) to assess the post-storm stage of beach systems in Puerto Rico for the 44 coastal municipalities.
- Based on this baseline, listing a coastal erosion ranking for the island (2018) and listing Course of Actions (COAs) to reduce beach erosion in some of the sites (state and municipality level).
- The main objective of this activity is bring to stakeholder formal information about coastal erosion. This will helpful for stakeholders in terms of promote best practice decisions and coastal planning.

The Coastal Geodatabase was develop using data extraction from high spatial resolution images March 2017; September 2017 (NOAA) and July 2018 (USACE); GIS tools; DSAS app (USGS); field work and Previous published geodatasets/feature class (JP;NOAA)

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		Shoreline	PR_March2017_Gro	oups1_2and	3		
		Coast	Municipality	Group_	Year_Photo	Coastal_Type	Wtline_Bio_Natur
		North	Barceloneta	1	Pre-Storm	Rocky	No presence
		North	Barceloneta	1	Pre-Storm	Beach	No presence
		North	Barceloneta	1	Pre-Storm	6each	No presence
240		North	Barceloneta	1	Pre-Storm	Seach	No presence
LT S		North	Barceloneta	1	Pre-Storm	Beach	No presence
2. 1		North	Barceloneta	1	Pre-Storm	Beach	No presence
		North	Barceloneta	1	Pre-Storm	Beach	No presence
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and the second	No. Contraction	North	Barceloneta	1	Pre-Storm	Undefined	No presence
Sol Media	A STREET OF	North	Barceloneta	1	Pre-Storm	Beach	No presence
A1 1	E No Tak	North	Barceloneta	1	Pre-Storm	Beach	No presence
2012 1 (North	Barceloneta	1	Pre-Storm	Beach	No presence
1 C C C C	The second second second	North	Barceloneta	1	Pre-Storm	Beach	No presence
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		North	Barceloneta	1	Pre-Storm	Undefined	No presence
		North	Barceloneta	1.	Pre-Storm	Deach	No presence
		North	Barceloneta	1	Pre-Storm	Recky	Coral reef
	the second second	North	Barceloneta	1	Pre-Storm	Nocky	No presence
	and the second second	North	Darceioneta	1	Pre-Storm	Deach	No presence
		North	Barceioneta	1	Pre-Storm	Seach .	No presence
	Contraction of the local data	North	Darceloneta	1	Pre-pagem	Man-Made Structure	No presence
		North	Barceloneta	1	Pre-Storm	Man-Made Structure	No presence
		Tierth	Barceloneta		Pre-Storm	Mayree Made Photokure	No received
and the second second		North	Barcelonela	-	Pre-Sterm	Allerial	No presence
		North	Barcalonata		Dra Chrom	Use Use Churchurg	No presence
1		North	Barceloneta	1	Pre-Storm	Beach	No presence
		North	Barceloneta	1	Pre-Storm	Venetation	No oresence
01 mar		North	Barceloneta	1	Pre-Strem	Backy	No presence
		North	Barceloneta	1	Dre-Strem	Rectiv	No presence
		North	Barceloneta	1	Dre-Storm	Venetation	No presence
			oran ownofitetia	-		Course -	No presente

Beach width changes (erosion and accretion) at La Boca Barceloneta (Sept 2017-Post Hurricane María; transects each 10 meters) PR coastal geodatabank (Coastal Research and Planning Institute of Puerto Rico-CoRePI)

Field work at Barceloneta (drones; beach measurements)

2017-2018 Puerto Rico Beach WebMap

Positional accuracy shoreline: 2017 (March): uncertainty: 3.44 meters; 2017 (September): uncertainty: 6.29 meters; 2018 (July): uncertainty: 3.53 meters.

Total views 5 story Maps and WebMaps : 32,909 counts (February 19 2023)

21 Data Layers for the entire island

- Coastal types March 2017
- Coastal types September 2017
- Coastal types March 2018
- Shoreline March 2017
- Shoreline September 2017
- Shoreline July 2018
- Backbeach March 2017
- Backbeach September 2017
- Backbeach July 2018
- Beach Width Changes September 2017
- Beach Width Changes July 2018
- Shoreline inland Migration 2018
- Beach inland Migration 2018
- Hard Mitigation Structures March 2017
- Hard Mitigation Structures September 2017
- Hard Mitigation Structures July 2018
- Roads_1Km from the shoreline/floodzone July 2018
- PR mosaic March 2017
- PR mosaic September 2017
- PR mosaic July 2018

Puerto Rico Beach changes (2017-2018) WebMap https://redplayaspr.maps.arcgis.com/apps/webappviewer/index.html?id=339d8926f36a4db1ba3aecc0cd6fac3d

Design: Data extraction/ Attributes & Domain

Shoreline

Coastal Types (Beach;Rocky; Mangrove; alluvial; anthropogenic) Hard Mitigation Structures (type and orientation) Geological Features Biological Features Roads within the coastal zone area (1km) Backbeach Vegetation Dunes Infrastructure Roads **Riverine/Bar** Overwash deposits

Digitalization scale was: 1:500 Imagen: Aguadilla, PR por Alfredo Montañez, CoRePI

Importance of assess Riverine/Bar Geological feature

Flooded site, Guajataca, Quebradillas. Feb 19, 2023

Some results. Coastal Types (2018)

11

36%

28%

19%

Municipalities with major erosion (beach width loss)

- Culebra 2) 3) Isabela
- Loíza 4)
- 5)
- Luquillo
- 6) Patillas
- 7) Humacao
- 8) Dorado
- 9) Ponce
- 10) Yabucoa

Cambio de ancho de playa por magnitud en PR (m), julio 2018

por magnitud (m);	Copressi a como es
≤-80.00	0.01 - 19.99
-79.9960.00	20.00 - 39.99
-59.9940.00	40.00 - 59.99
-39.9920.00	60.00 - 79.99
-19.99 - 0	≥ 80.00

0 5 10 20 Kilómetros Mapa preparado por: COREPI-PR Fuente de Imagen: ArcGis Map Service Incertidumbre: 9 metros

Villa Cristiana, Loíza, PR 2019

with majo								
shoreline inland								
migration(2018)								
Vieques	19 km							
Cabo Rojo	5.3 km							
Arecibo	4.8 km							
Humacao	4.4 km							
Isabela	3.5 km							
Vega Baja	3.5 km							
Fajardo	3.3 km							
Luquillo	2.9 km							
Loíza	2.6 km							
Hatillo	2.6 km							

Shoreline inland migration (PR): 99 kms

Migración de línea de agua "Shoreline" (julio 2018)

0 0.230.45 0.9 Kilómetros

Luquillo

Basemap: World Imagery (2009)* Fuente: ArcGIS Map Service Mapa preparado por: Valeria Bonano-Suazo CoRePI-PR *Última actualización del basemap: Oct 13, 2021

Roads in erosion sites/flood areas within the coastal zone area (1km)

Mapa de Infraestructura de Transportación en la Línea de Costa de Arecibo Julio 2018

Infraestructura de Transportación Identificada Dentro de un Kilómetro de la Costa: 49 Líneas (62% de la Línea de 0.16 Kilometers Costa).

Arecibo Imagen: ArcGis Map Service Mapa por: CoRePI-PR

Arecibo, 2019. Photo by Coastal Research and Planning institute of Puerto Rico (CoRePI)

Barreto. M. and Santos, A. 2023 in publication process

Benefits of the Project

- Estimation of post-Maria and recovery beach response (erosion/accretion) for the entire coastline of Puerto Rico (2017/2018; transects: each 10 meters).
- Estimation and analysis of selected shoreline and backbeach attributes.
- A baseline information of post-storm stage of beaches at the Island will be available to guide stakeholders in the decision-making processes.
- Assessment of beach response will help to understand coastal risk and vulnerability, especially in highly populated areas.
- This project define permanent data collection sites that can serve as a baseline for future assessment and interventions.

Needs

- Acquire and publish an update High resolution aerial photos for the entire PR coastline (2022-2024).
- 2. Continuous acquisition of high resolution aerial photos for the entire island (Plan each 5 years/occurrence of extreme events).
- 3. Update LIDAR data (shoreline extraction)
- 4. Publish an update Puerto Rico DEM products (coastline).
- 5. Publish an update local sea-level rise projections.
- Possible MOU with UPR Rio Piedras Campus (Coastal Research and Planning Institute; Graduate School of Planning)

Published Products

El estado de las playas

2.5

5 Kilómetros

Leyenda

Categorías — Acreción

Estable Erosión

Patillas

Mapa preparado por: COREPI-PR Fuente de Imagen: ESRI

Post Maria Beach Assessment Story Map (all municipalities)

Post Maria Beach Assessment WebMap (PR)

Group 1 (Mayaguez, Rincón, Aguada, Rincón, Aguadilla; Arecibo; Barceloneta; San Juan; Loíza; Humacao

Group 4 (Ceiba, Naguabo, Vieques, Santa Isabel, Juana Díaz, Ponce, Peñuelas, Yauco, Lajas; Cabo Rojo

Instituto de Investigación y Planificación Costera de Puerto Rico CoRePI-PR

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