Human Impacts to Coastal Ecosystems in Puerto Rico (HICE-PR)
A remote sensing, hydrologic, ecologic, and socio-economic assessment with management implications

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Project goals:

- To conduct an interdisciplinary study using sound mapping technologies and hydrological modeling to infer how anthropogenic activities related to land cover/land use changes have modified riverine inputs into the coastal and marine ecosystems (CMEs) associated with two priority watersheds in the north and south coasts of PR.
- A secondary goal combines outputs from field measurements within CMEs, ecological modeling and economic valuation methods to assess degradation of CMEs associated with the selected watersheds.
- Additionally, we will demonstrate the use of these remote sensing and modeling tools to stakeholders (local agencies, managers, community) via workshops allowing for technology transfer and future collaboration with the PIs.

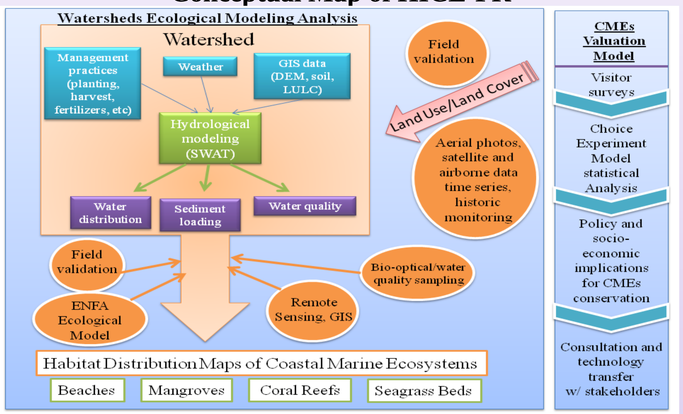
Objectives

- Map the distribution of selected CMEs (e.g. beaches, mangroves and seagrasses) downstream of the watersheds study.
- Develop a time series of land use/land cover changes (LULCC) based on remotely-sensed and published data.
- Conduct a hydrological analysis of the sediment and water loads reaching the coastal ecosystems to model future impacts to CMEs within Puerto Rico's watersheds.
- Assess the net effects of land cover changes and dams on the flux of fluvial sediment to CMEs in Puerto Rico.
- Compute the environmental economic value of selected CMEs (e.g. mangroves, seagrasses, coral reefs and beaches).
- Establish permanent monitoring transects to study current and future benthic cover changes through time in coral reefs located near the mouths of both watersheds.
- Conduct an ecological niche analysis to develop an index of CME cover based on the relative importance of the different environmental parameters (e.g., sediment influx, sediment composition, light attenuation).

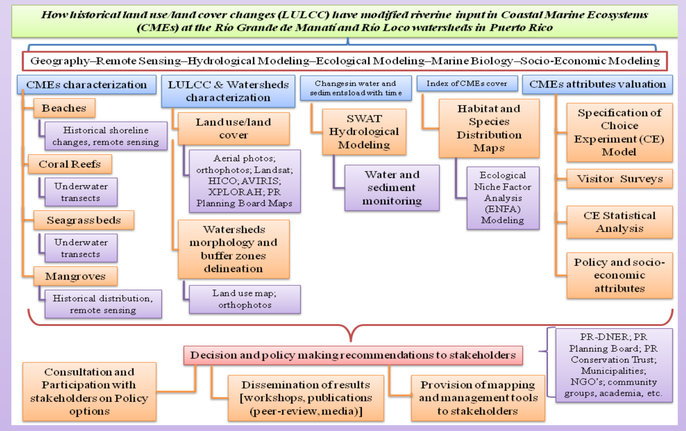
Some Facts:

- Before 1940, land use in PR was mostly dedicated to cropland, particularly sugar cane.
- By the end of the 1940's, Operation Bootstrap and the development of the manufacturing industries promoted the increase and displacements of the population to the urban centers impacting the abundance and quality of the natural resources.
- From 1960-1990 industries were concentrated along the coastal plains encouraging the growth of urban centers resulting in the degradation of groundwater reservoirs and coastal marine ecosystems (CMEs).
- By 2010, 56% of PR's population live in the coastal zone.
- CMEs (mangrove forests, seagrass beds, coral reefs, beaches) have been severely impacted by land-based human activities for decades.
  - Some impacts include: reduced coral cover and coral growth rates, decreased light penetration and quality in the nearshore ecosystems, mangrove and coral diseases, introduction of invasive species, and increase in the amount of waste reaching the beaches from riverine inputs.
  - Coral reefs loss alone in PR has been estimated in 50% with a conservative economic loss of $93 millions/year.

Conceptual Map of HICE-PR

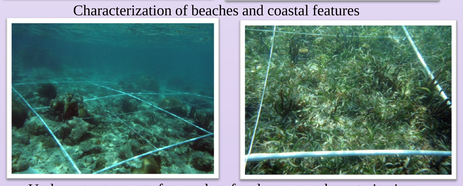


Work Flow for HICE-PR

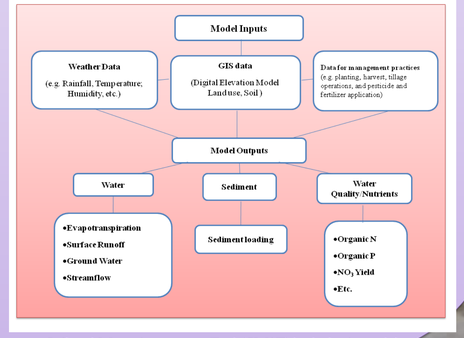


Focal groups with stakeholders

Characterization of beaches and coastal features

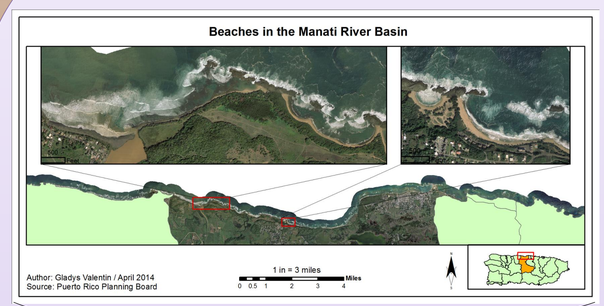


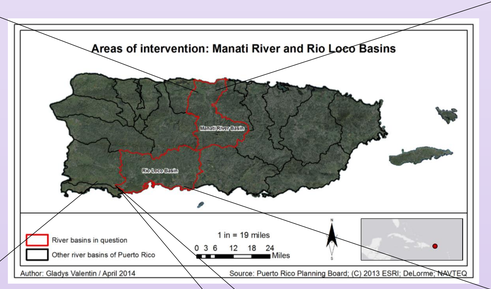
Underwater transects for coral reef and seagrass characterization

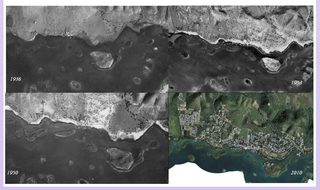


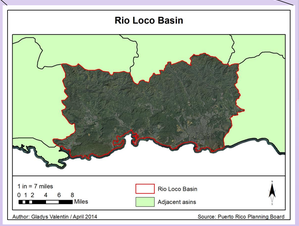
Soil and Water Assessment Tool (SWAT) hydrologic model

Study sites









Upstream activities within the Parguera and Río Loco Watersheds

Typical CMEs in the coastal areas associated with both watersheds in PR