Human Impacts to Coastal Ecosystems in Puerto Rico (HICE-PR):
The Guánica and Manatí Watersheds
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For several decades Puerto Rico’s coastal and marine ecosystems (CMEs) have suffered the effects of anthropogenic stresses associated to population growth and varying land use. Here we present an overview of the first year of findings of a NASA-funded project that studies human impacts in two priority watersheds (Manatí and Guánica). The project includes remote sensing analysis and hydrological, ecological and socio-economic modeling to provide a multi-decadal assessment of change of CMEs. The project’s main goal is to evaluate the impacts of land use/land cover changes on the quality and extent of CMEs in priority watersheds in the north and south coasts of Puerto Rico. This project will include imagery from Landsat 8 to assess coastal ecosystems extent. Habitat and species distribution maps will be created by incorporating field and remotely-sensed data into an Ecological Niche Factor Analysis. The social component will allow us to study the valuation of specific CMEs attributes from the stakeholder’s point of view. A preliminary assessment shows a range in coral cover from 0.2-30% depending on the site (Guánica) whereas reef health improves with distance from the river mouth in the north coast (Manatí). Historic and current imagery is being collected for land cover/land use change analysis, and a database of inputs for hydrological modeling is underway. Preliminary results show dynamic historical shoreline changes in beaches located west of the Manatí river mouth, and a degradation of water quality in Guánica possibly being one of the main factors affecting the actual condition of CMEs.

Río Loco (Guánica) watershed (south coast PR)

**Image Analysis (LU/LC changes)**
- Acquired historical and actual (aerial and satellite) imagery.
- Developed LU/LC maps for 1977 and 2010 (Yr 1).
- Major changes are related to agriculture and forest areas within the watershed boundaries.
- Delineation and analysis of changes in CMEs cover (Yr 2).
- Maps will be used for a SWAT watershed modeling (Yr 3).

**Watershed Hydrology**
- Rainfall simulations were conducted within coffee farms in the upper watershed (Yr 1).
- Established sediment monitoring stations and started collection of samples for suspended sediments analysis (Yr 1).
- Will obtain continuous water flow and turbidity data (Yr 2).
- Runoff and sediment monitoring at ephemeral streams (Yr 2).
- Calibrate SWAT and conduct a watershed modeling workshop (Yr 3).

**Coastal and Marine Ecosystems (CMEs)**
- Conducted field work for reef benthic characterization (Yr 1).
- Analysis of benthic components with CPCe (Yr 1).
- Live coral cover ranged from 0.2 to 30% depending on the site.
- Dead coral rubble (mostly from branching corals) dominates most back-reef zones.
- Bio-optical water quality sampling (Yr 2).
- Video transects for Ecological Niche Factor Analysis (ENFA) (Yr 2).
- ENFA modeling and development of Habitat Suitability Maps for dominant species (Yr 3).

**Socio-Economic Analysis**
- Conducted informal interviews with residents and visitors (Yr 1).
- Found large differences in human interactions b/n watersheds.
- Water is mostly used for agriculture and power generation.
- Identified ecosystem services (Yr 1).
- Conduct Benefit Transfer Methods for value of ecosystem services (Yr 2).

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Río Grande de Manatí watershed (north coast PR)

**Image Analysis (LU/LC changes)**
- Acquired historical and actual (aerial and satellite) imagery.
- Developed LU/LC maps for 1977 and 2010 (Yr 1).
- Identified a major reduction (from 58 to 6%) in agricultural land use mostly converted to forest and rangeland.
- The map will be used for the Soil Water Analysis Tool (SWAT) watershed modeling (Yr 2).

**Watershed Hydrology**
- Collection of sediment load and discharge data started (Yr 1).
- Analysis of beach sediment data for assessing the influx of terrigenous sediments in the coastal zone (Yr 1).
- Location of additional monitoring stations (Yr 2).
- Using SWAT (July-15) we will model the effects of historic LU/LC changes on the water and sediment flux to the CMEs.

**Coastal and Marine Ecosystems (CMEs)**
- Shoreline and wetline changes analysis (Yr 1).
- First-ever shore reef characterization (Yr 1-2).
- Bio-optical water quality analysis (Yr 2).

**Socio-Economic Analysis**
- Informal interviews were conducted with residents and visitors (Yr 1).
- Delineation of Choice Experiments (Yr 1).
- Permits from the Institutional Review Board for conducting the surveys were obtained (Yr 1).
- Surveys will be conducted on Yr 2 and the integration of stakeholders to assess their perspective on ecosystem services.