Watersheds, Water Quality, and Coastal Communities in Puerto Rico (Water2Coasts): An interdisciplinary island landscape to coastal ocean assessment with socioeconomic implications

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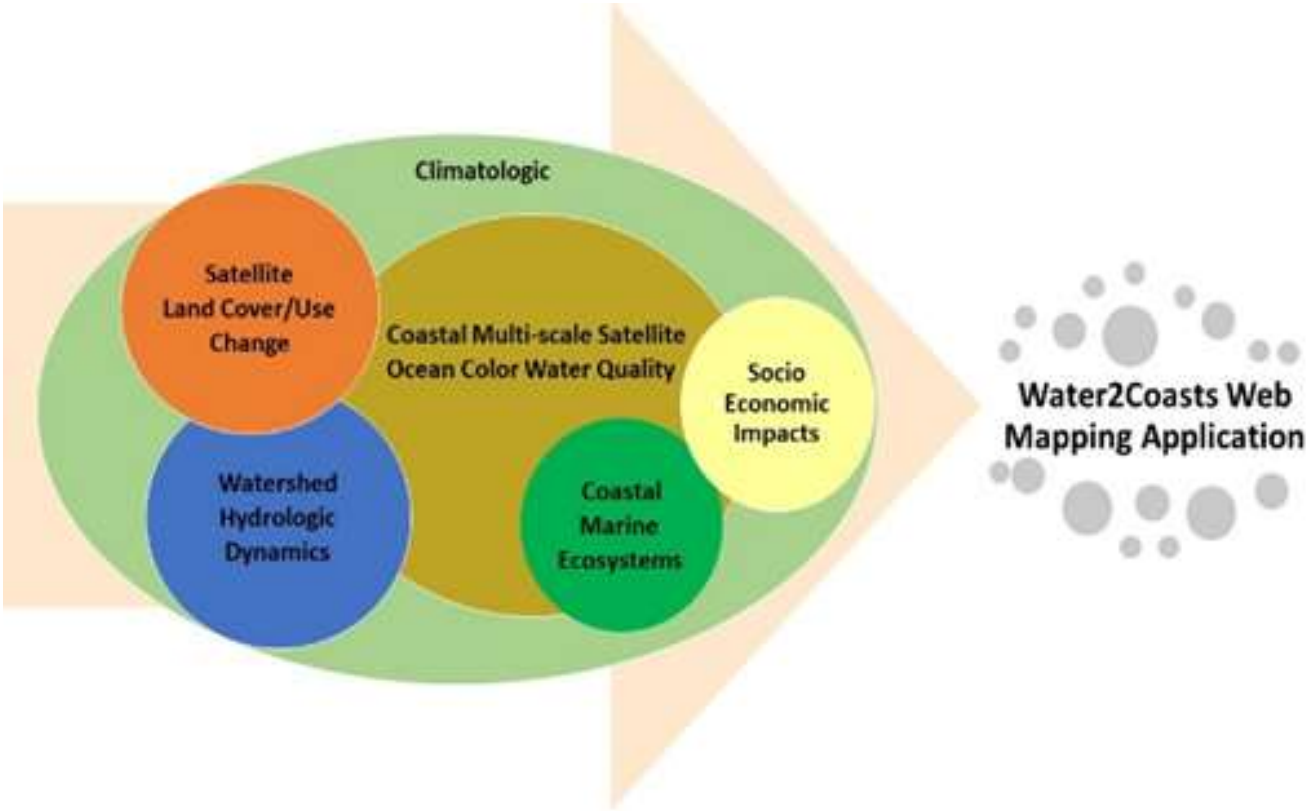
Objectives

Objective 1 – **Hydrologic:** Utilize field data and hydrological modeling

Objective 2 – **Coastal Water Quality**: Utilize current and legacy satellite water quality products in coastal areas with CMEs of ecological importance

Objective 3 – **Socio-economic Impacts:** Assess differential impacts of contrasting coastal communities in southern and eastern Puerto Rico

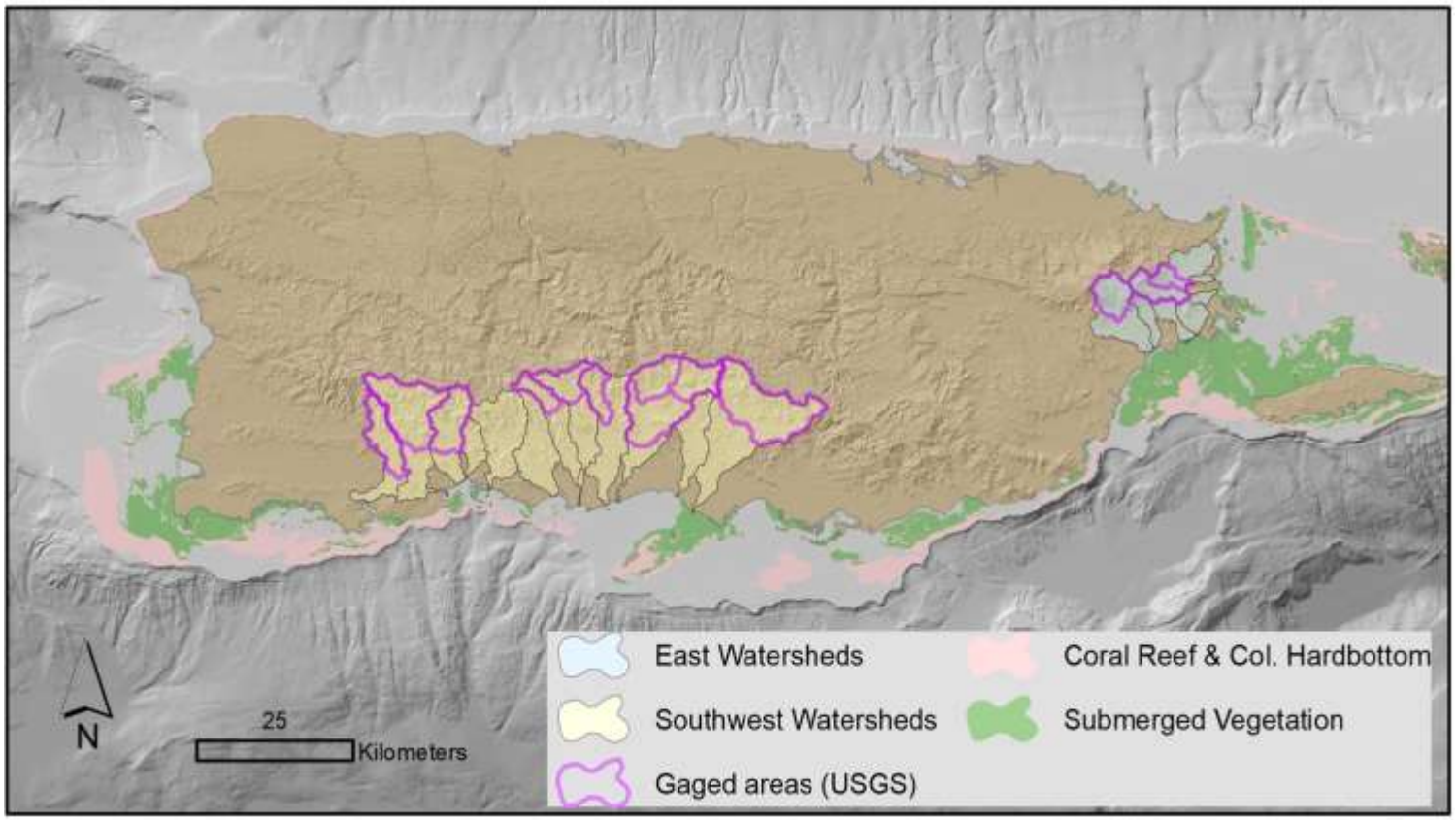


This project will focus on watersheds, their associated coastal water quality, marine ecosystems, and the people of southern and eastern Puerto Rico

Key Hypothesis: Water quality as a function of upstream land cover (e.g., farms and urban areas) and point sources such as water treatment facilities, landfills, and quarries

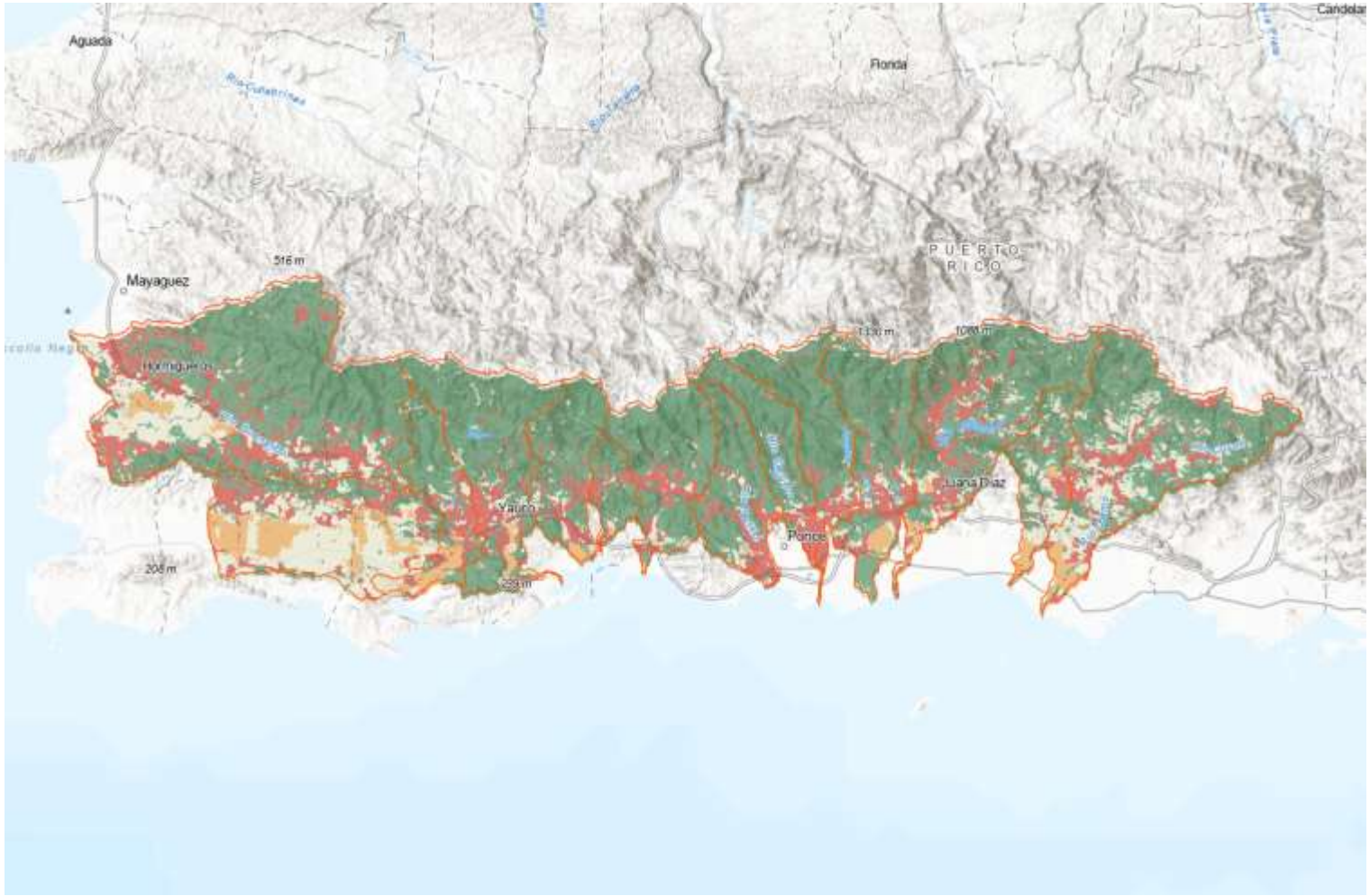
Upstream land cover and point sources (water treatment facilities, landfills, and quarries)

Study Areas



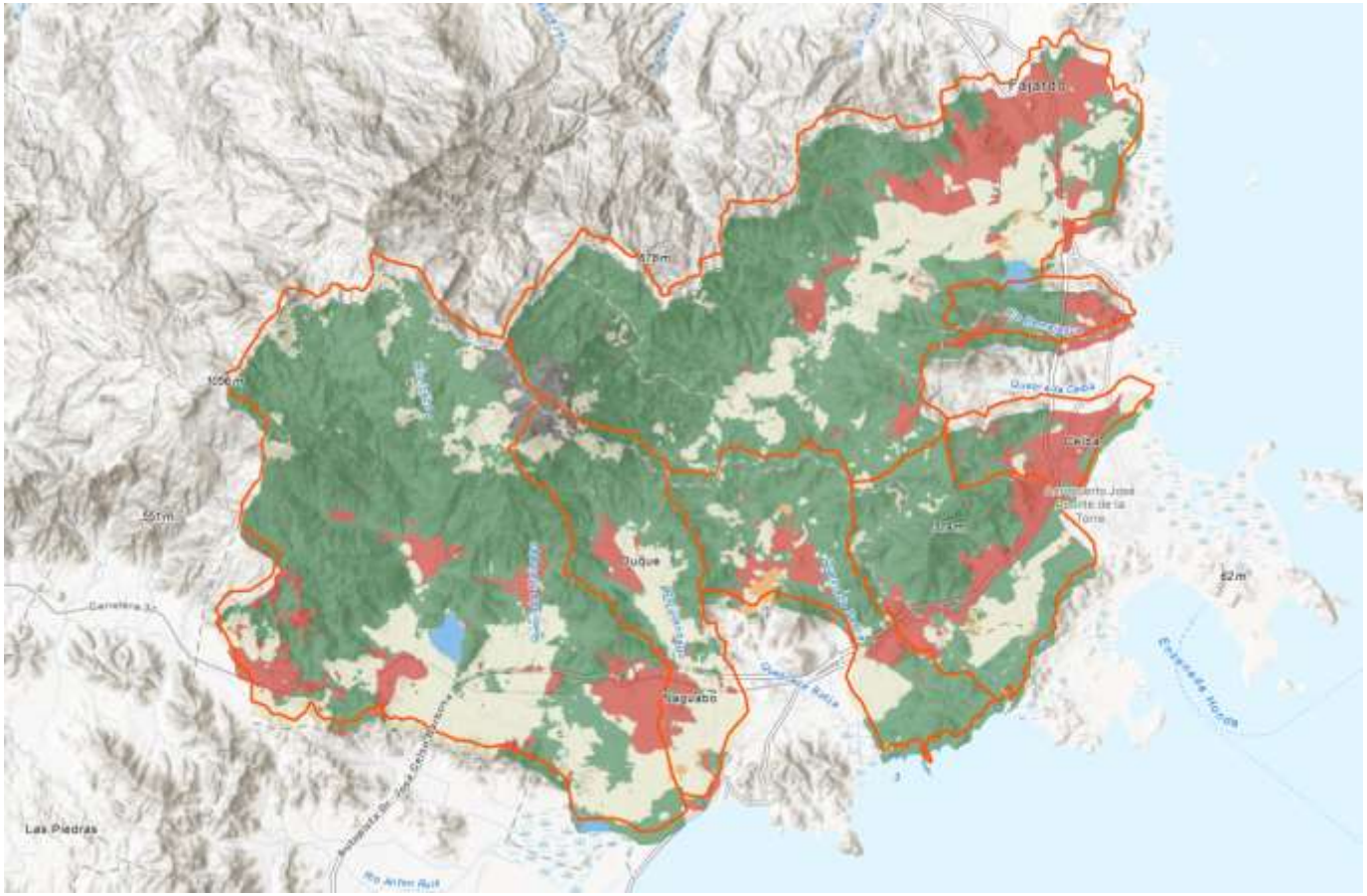
- ~12 Watersheds draining towards the south
- ~7 Watersheds draining towards the east

Sentinel 2 Land Cover Map for SW & S Draining Watersheds - 2017



orange = cropland; ivory = pasture/rangeland or small mountain farms; blue = lakes; red = built-up

Sentinel 2 Land Cover Map for East Draining Watersheds - 2017



orange = cropland; ivory = pasture/rangeland or small mountain farms; blue = lakes; red = built-up

Spatial distribution of sanitary/sewage treatment plants

yellow = primary; purple = secondary; light blue = tertiary

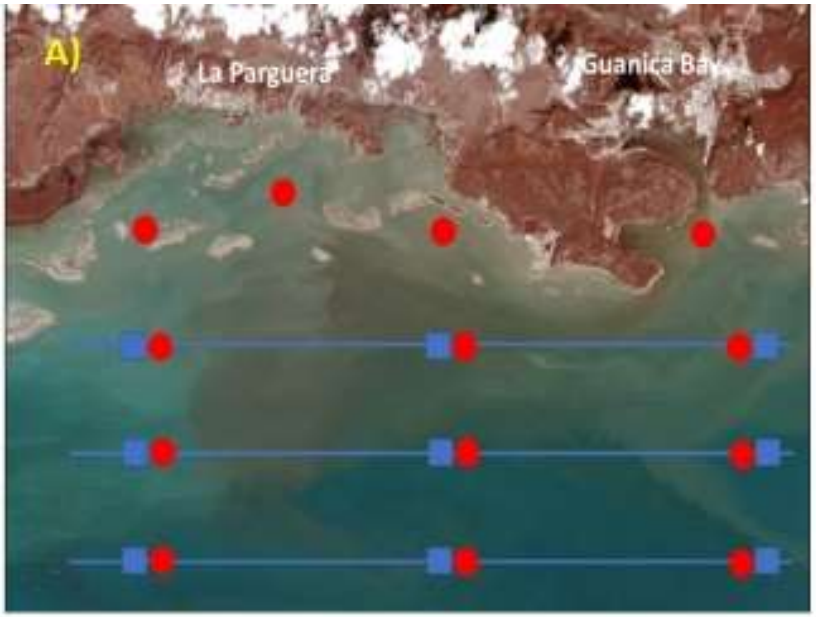
Satellite Data Water Quality Data Products

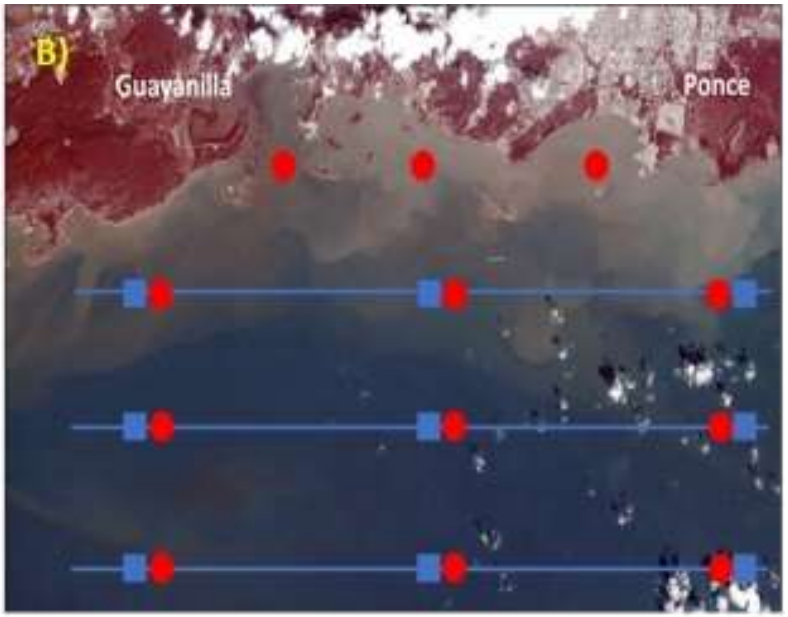
- Will be used to assess the spatial distribution of water quality during the past two decades (2002-2024)
- This period of interest includes a wide variety of climatic conditions relevant to the delivery of LBSP to coastal waters including the 2015-17 drought and two of the highest rainfall and discharge events to have affected PR - Hurricanes Maria in 2017 and Fiona in 2022

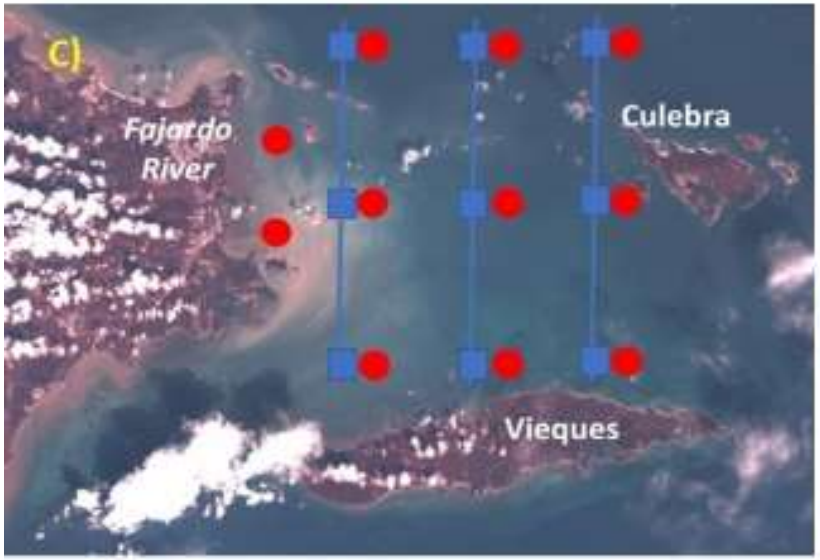
- **Moderate-resolution - (MODIS, VIIRS, Sentinel 3) and PACE (2024)**
- **High-resolution - (Landsat 8-9 OLI, Sentinel 2 MSI)**
- **Very high-resolution - (Planet SuperDove, WorldView)**

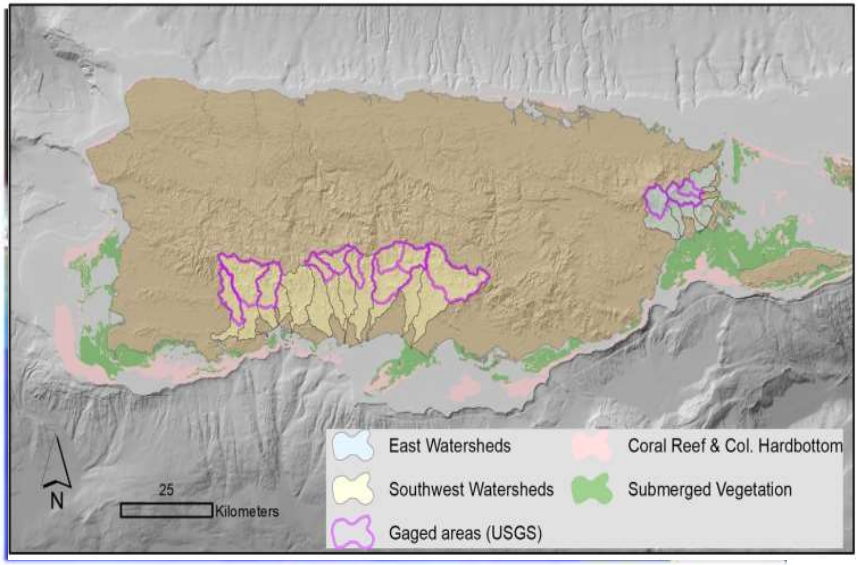
- These satellite sensors will be used to describe the extent of the turbidity plumes in nearshore environments and the exposure of selected CMEs to degraded water quality

Field Sampling Stations and Satellite Virtual Stations at the Puerto Rico Study Sites









Ocean Color Sensors

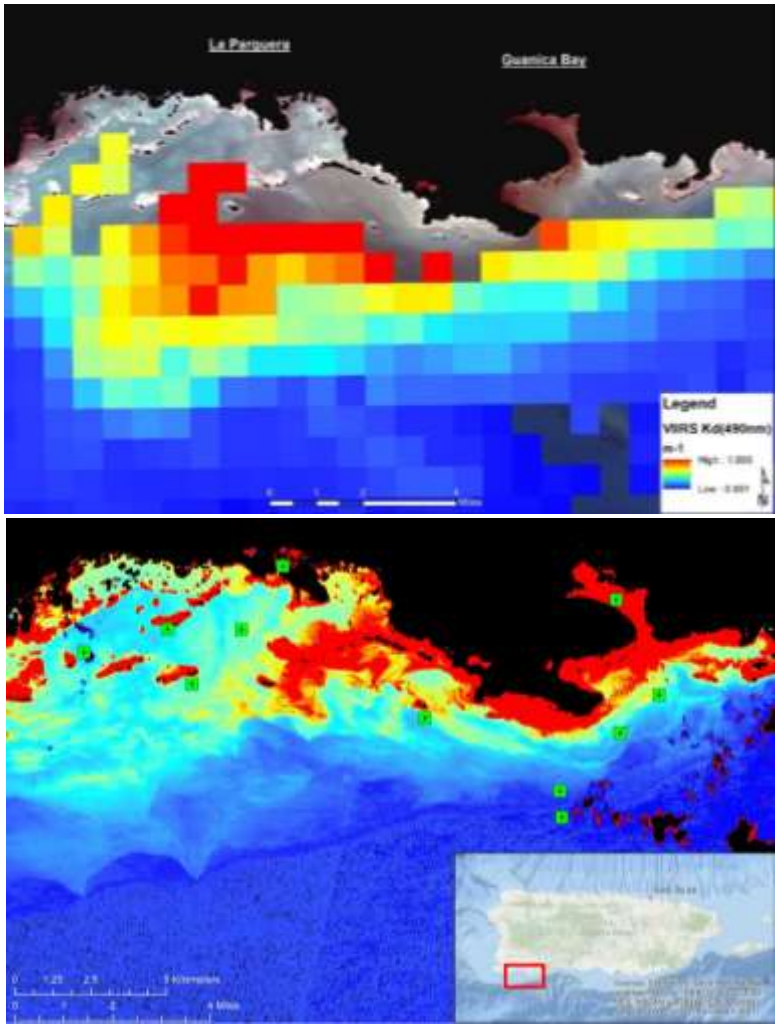
<u>Moderate Resolution</u> – Operational Data
VIIRS, MODIS Aqua, Sentinel 3

- Chlorophyll-*a* (Chl-*a*)
- Kd (490), Kd PAR
- TSS, CDOM
- 2002-present (<u>daily</u>)
- 750-1000m -limited use near-shore

<u>High Resolution</u> – User generated
Landsat 8/9 OLI, Sentinel 2A/2B

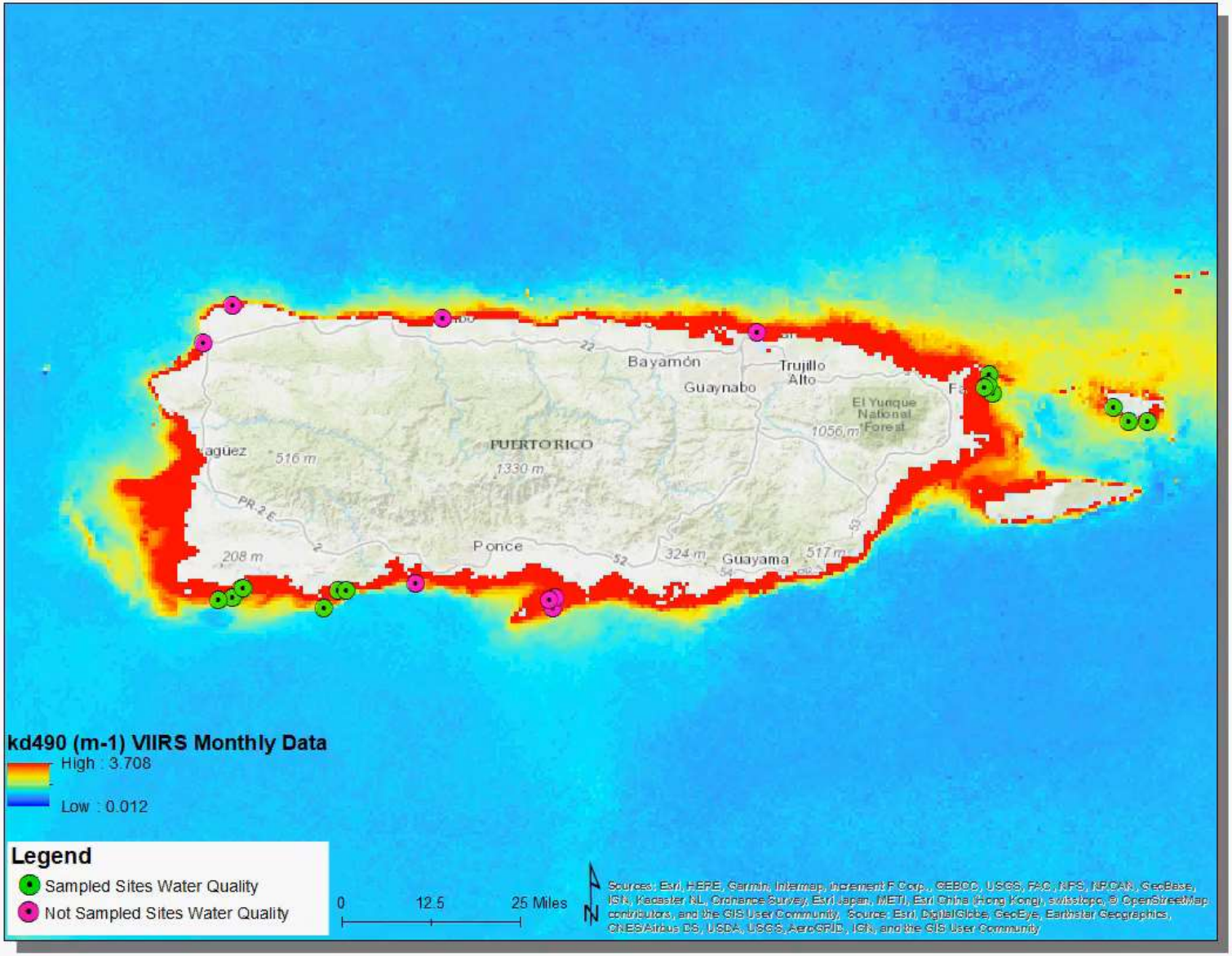
- Chlorophyll-*a* (Chl-*a*)
- Kd(490)
- TSS, CDOM
- 2013-present (8 days, 5 days)
- <u>10-30 m</u> -excellent for near-shore studies

VIIRS



Landsat 8 OLI Kd490 product

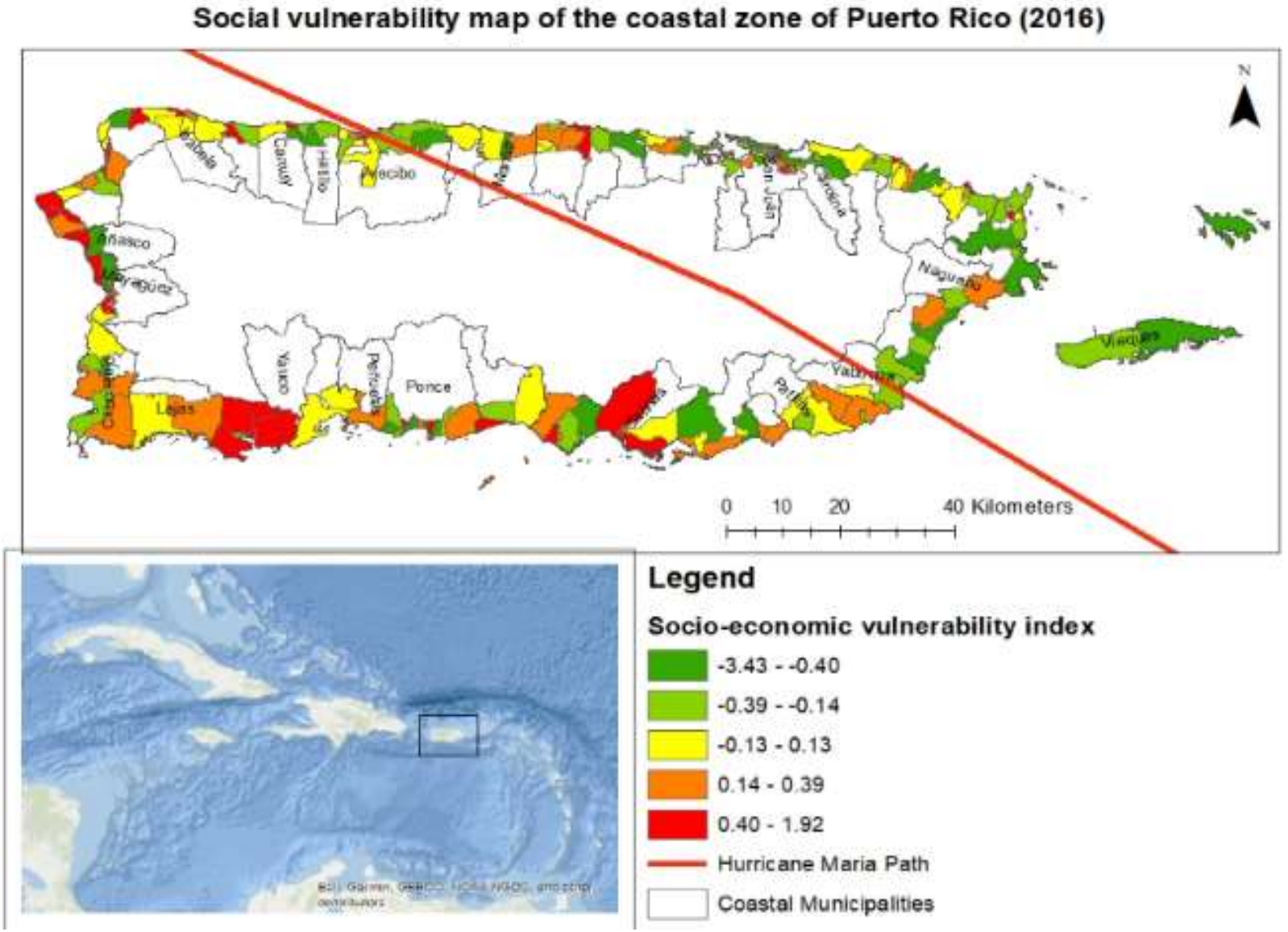
VIIRS (Medium Resolution) Monthly Animation



Water Quality Measurements and Remote Sensing Validation

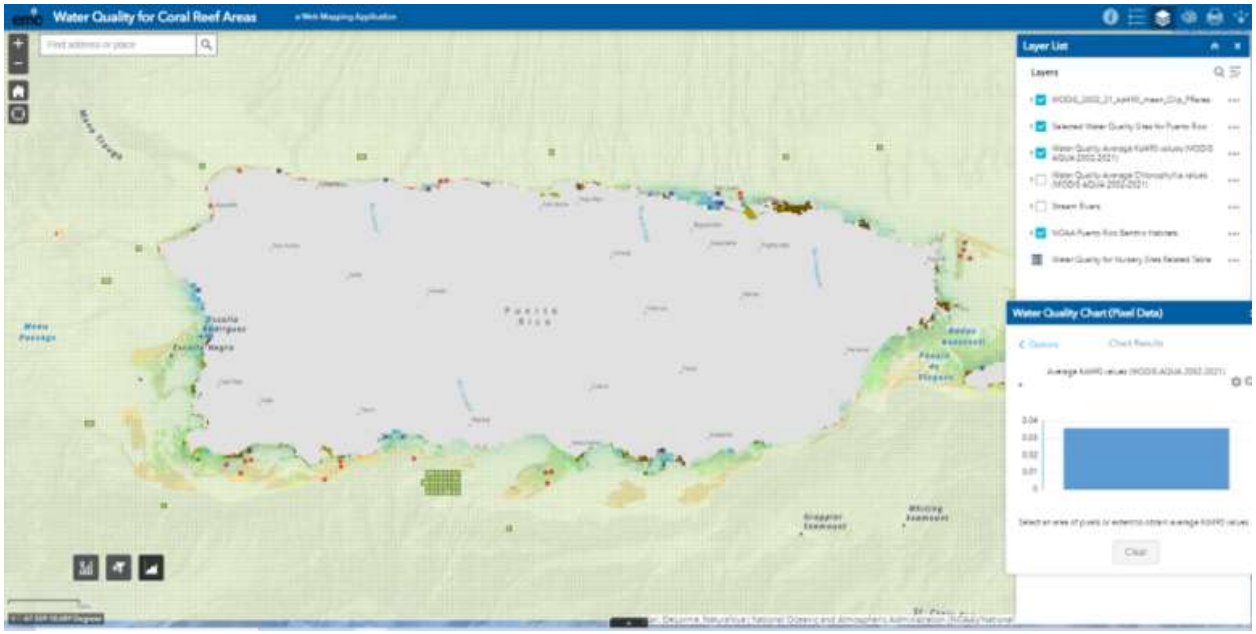
- Eureka Manta 25 multiparameter sonde:
  - Temperature, Chl-a, CDOM, turbidity (NTU), TSS, LiCOR PAR (Quantum) (Kd_{PAR}) sensors.
- SpectraVista HR-512i spectroradiometer (350-900 nm)
- Solar Light submersible PAR radiometer
  - PAR Attenuation (Kd_{PAR})
  - Kd (490 nm)

Social Vulnerability Index by Coastal Census Tract for the Year 2016 in Puerto Rico



Example of Web Mapping Application

- Web Mapping Application – Open access bilingual GIS web mapping application and story map
- Multiscale water quality products
- Watershed and hydrological products
- Socio-economic assessment
- Field water quality surveys
- Bathymetry
- Local administrative boundaries (Marine Protected Areas, natural protected areas)
- Benthic habitats



Sampling Trip October 30, 2024
Testing of Instruments and Sampling Protocols

Acknowledgments

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Questions?