

High-resolution bottom albedo images and benthic habitat classification to develop baseline management tools in Natural Reserves

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Outline

- ▶ Introduction
 - ▶ Remote Sensing
 - ▶ Study Area
 - ▶ Challenges
 - ▶ Sensors (Active/Passive)
- 1. High Resolution Bottom Albedo and Water Optical Characterization of La Parguera Reserve from Active and Passive
- 2. Benthic Habitat Map of La Parguera Reserve using Passive and Active Remote Sensing
- ▶ Conclusions

Introduction

Coastal areas

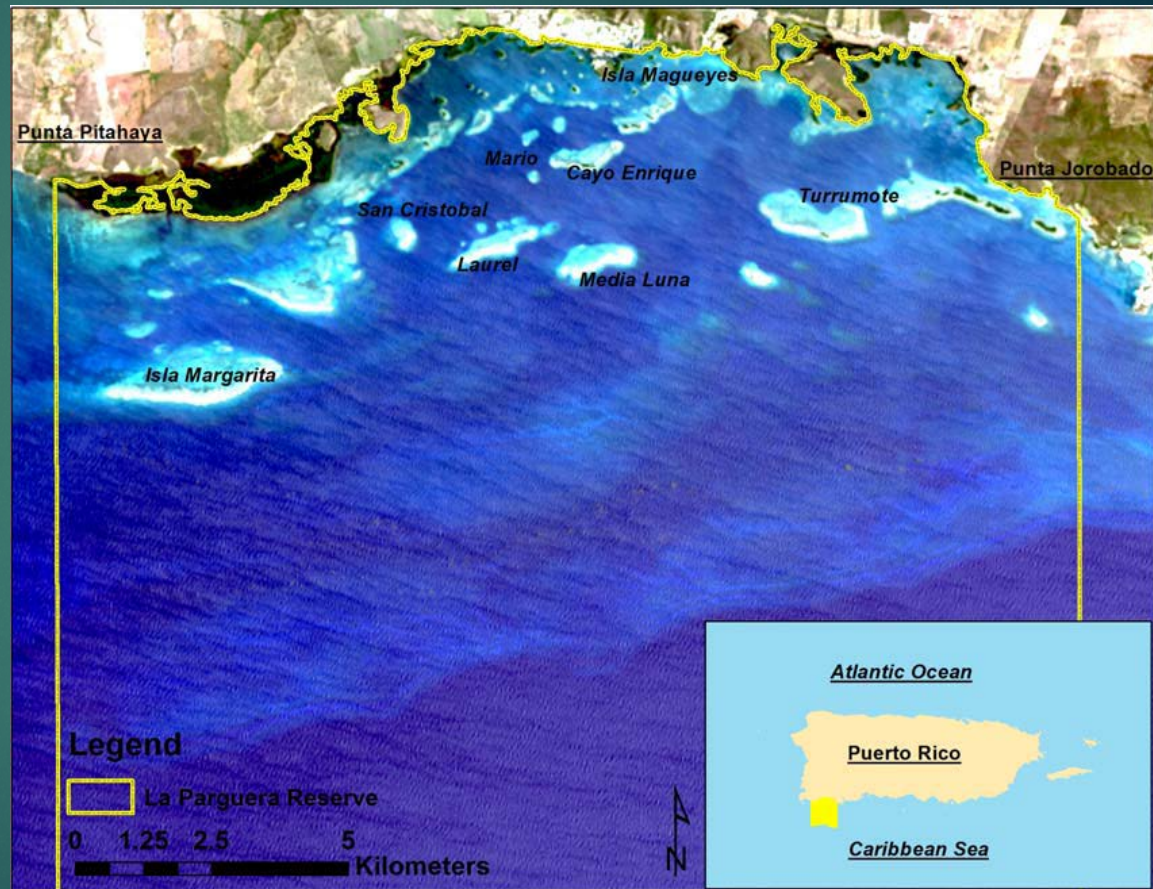
- ▶ Important resources
- ▶ Ecosystems affected by human-based and natural factors.
- ▶ However, little is known about benthic habitats and water properties.



<http://gers.uprm.edu/images/bahia.jpg>

Study Area

- ▶ La Parguera
 - ▶ DNR Natural Reserve
 - ▶ Aprox. 12,500 acres
 - ▶ Unique habitats
 - ▶ ~ Depth 18 meters
 - ▶ Variable substrate
- ▶ Use of Remote Sensing Techniques



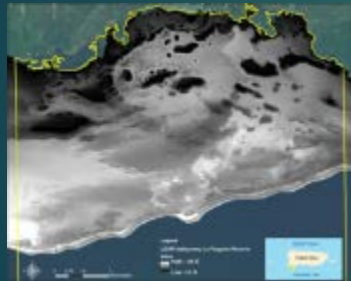
METHODS



AVIRIS image



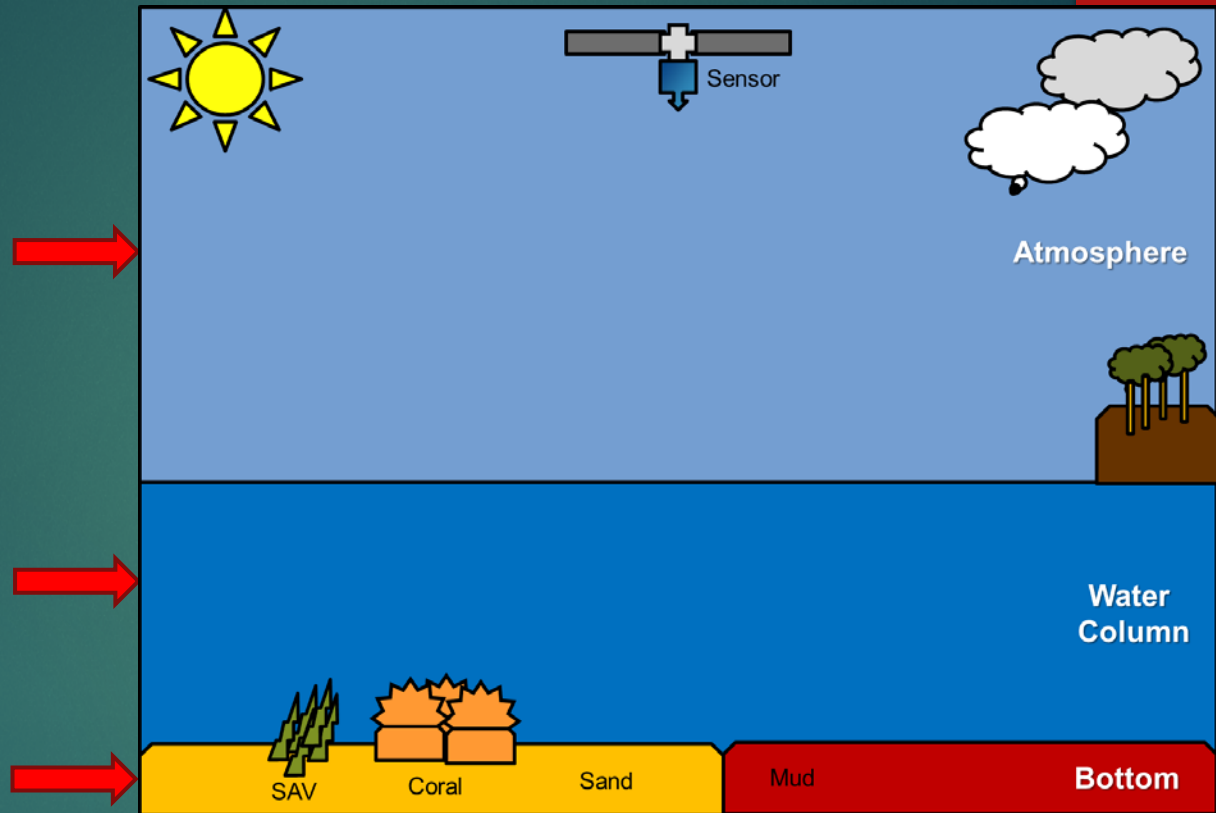
WV2 image



LiDAR SHOALS

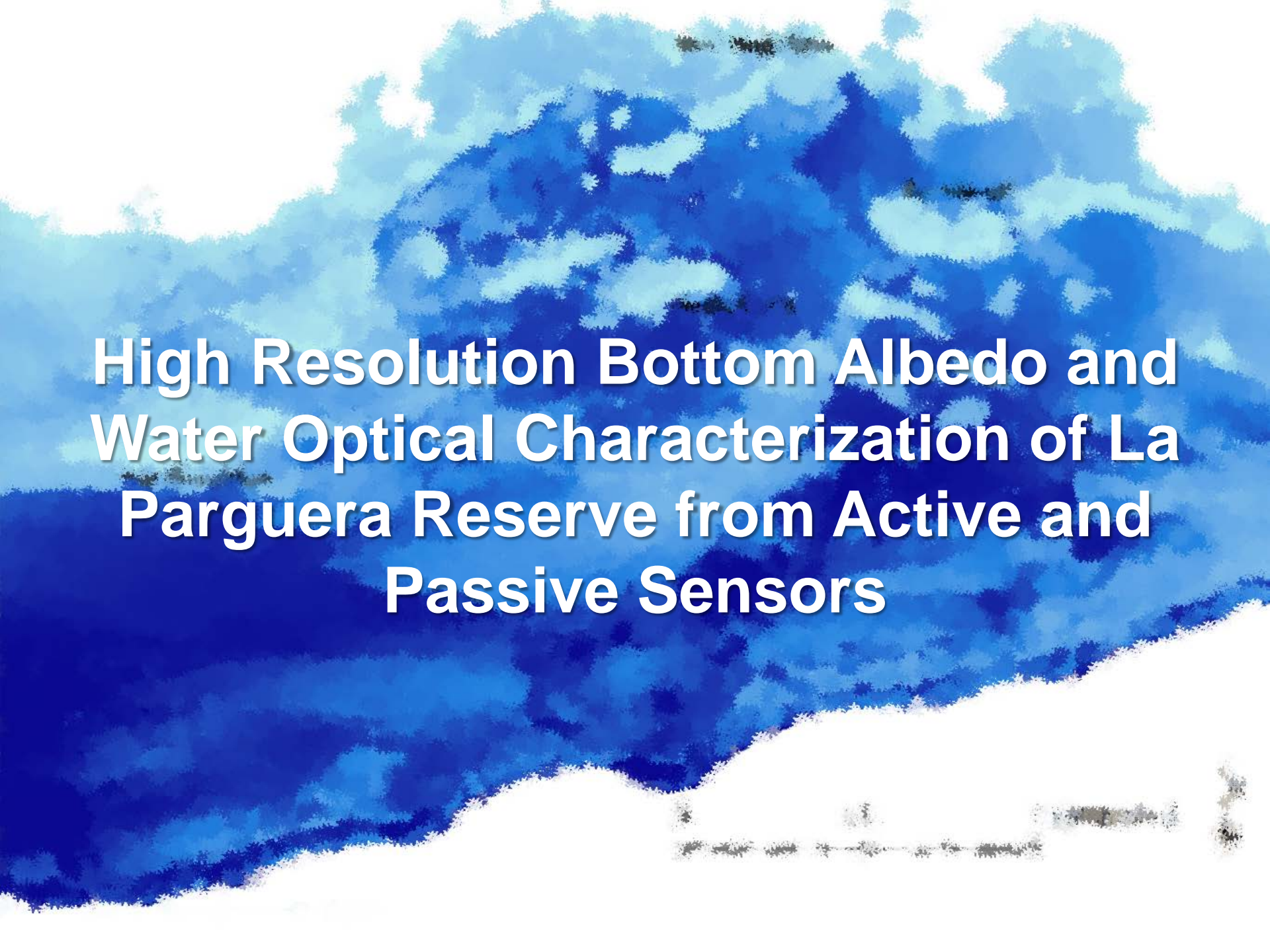


Bio-optical sampling



Pre-processing Steps (co-registration, landmask)

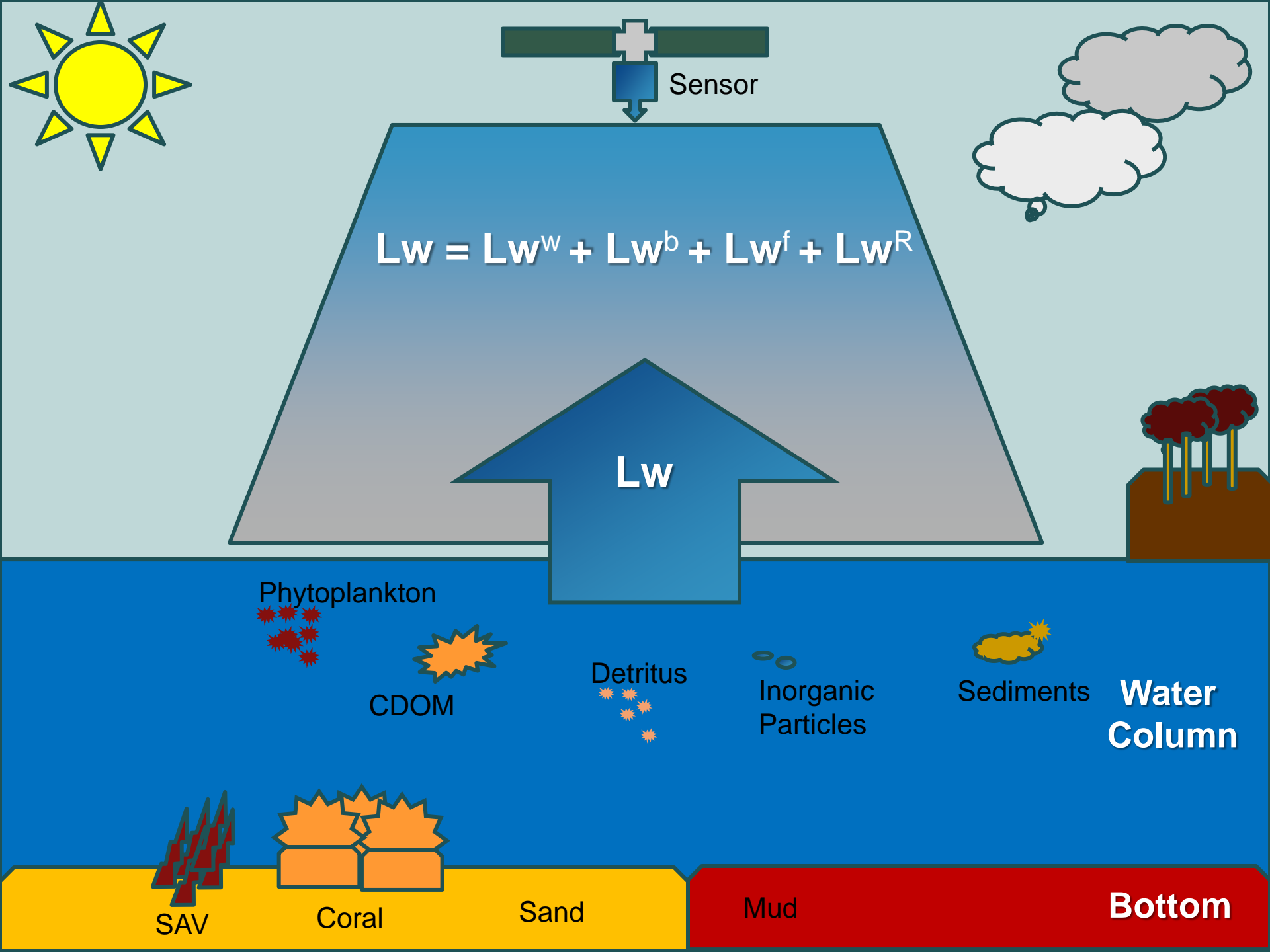
- High Resolution Bottom Albedo and Water Optical Characterization of La Parguera Reserve from Active and Passive Sensors
- Benthic Habitat Map of La Parguera Reserve using Passive and Active Remote Sensing



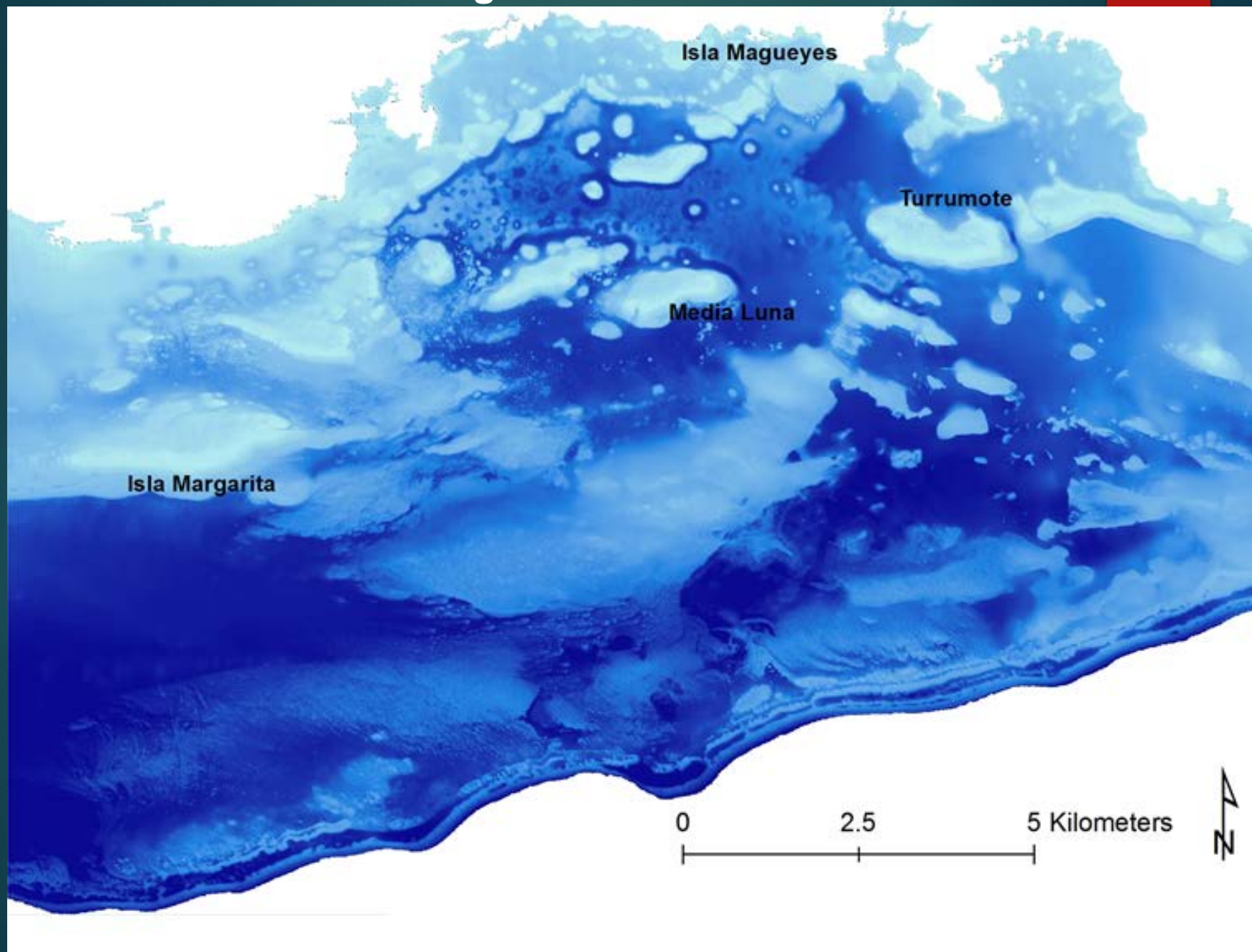
High Resolution Bottom Albedo and Water Optical Characterization of La Parguera Reserve from Active and Passive Sensors

Objectives

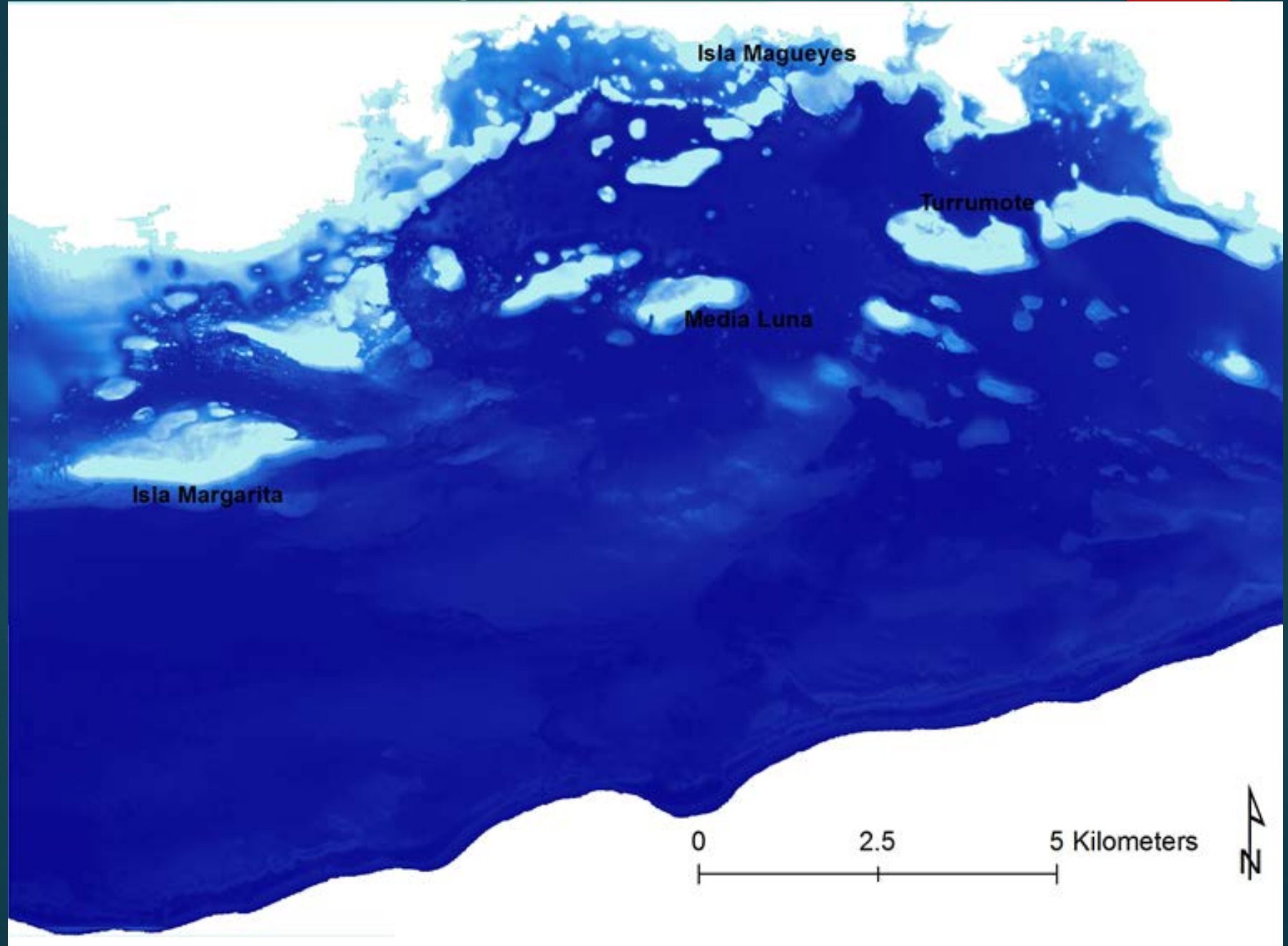
- Characterization of optical properties of La Parguera Reserve.
 - Inherent Optical Properties (IOP)
 - Apparent Optical Properties (AOP)
- Image derived IOP's/AOP's from both multispectral (WV2) and hyperspectral (AVIRIS) sensors.
 - Validate image derived with *in situ* values.
- Water column correction of imagery from IOP/AOP .
 - Lee's inversion model- QAA (Lee et al., 1999, 2001).
- Bottom albedo images from AVIRIS and WV2.



AVIRIS Bottom Albedo Image



WV2 Bottom Albedo Image

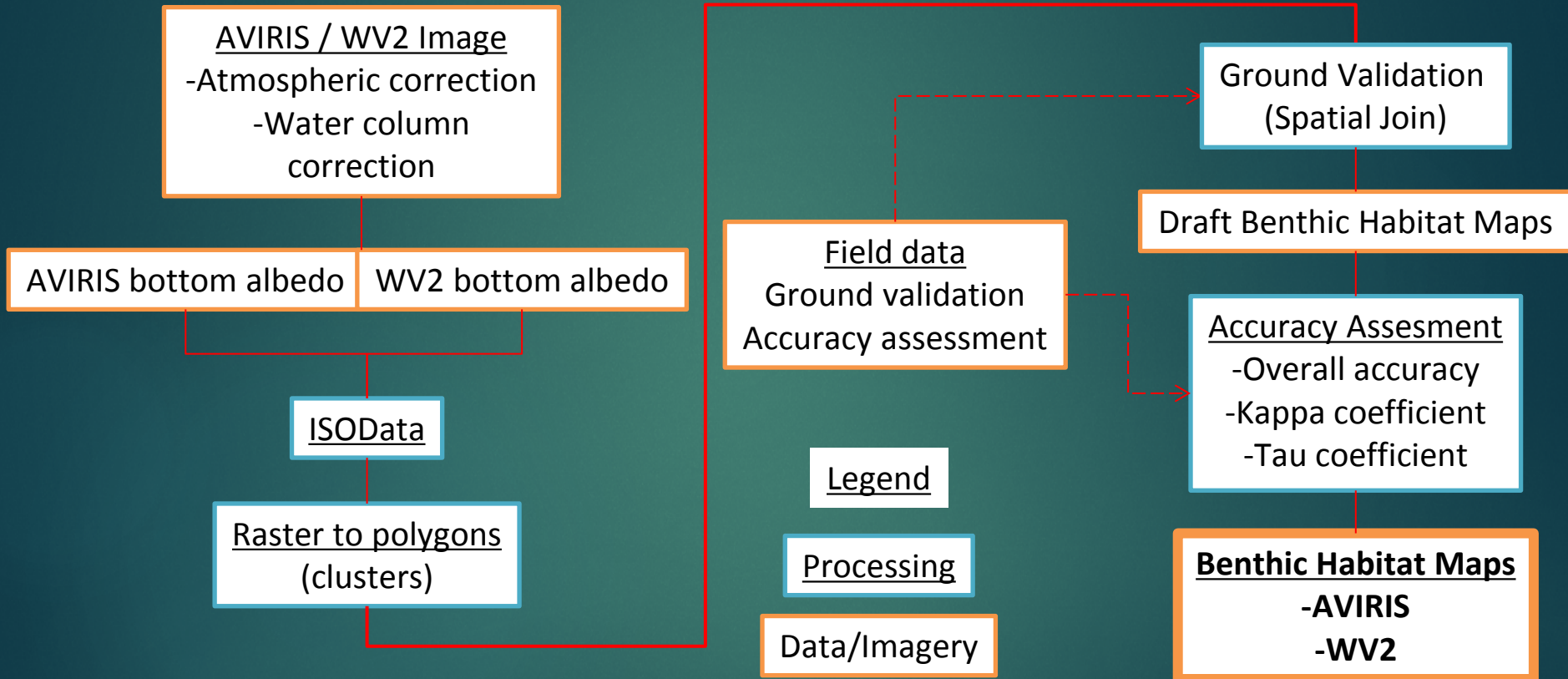


Benthic Habitat Mapping

► Goals

- Develop a high-resolution benthic habitat map
 - AVIRIS and WV2 modeled bottom albedo
- Identify ecologically important habitats in La Parguera for scientific and management purposes.
- Improve the methods for developing objective-based classifications from high-resolution satellite imagery.

Methods



Benthic habitat classification scheme

(1) Coral Reefs



(2) Seagrass



(3) Hardbottom



(4) Mix: Sand/
Hardbottom/Coral



(5) Mud



(6) Sand



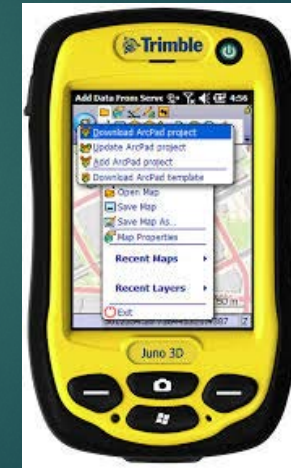
(7) Sand with
Benthic Algae

Sampling Sites

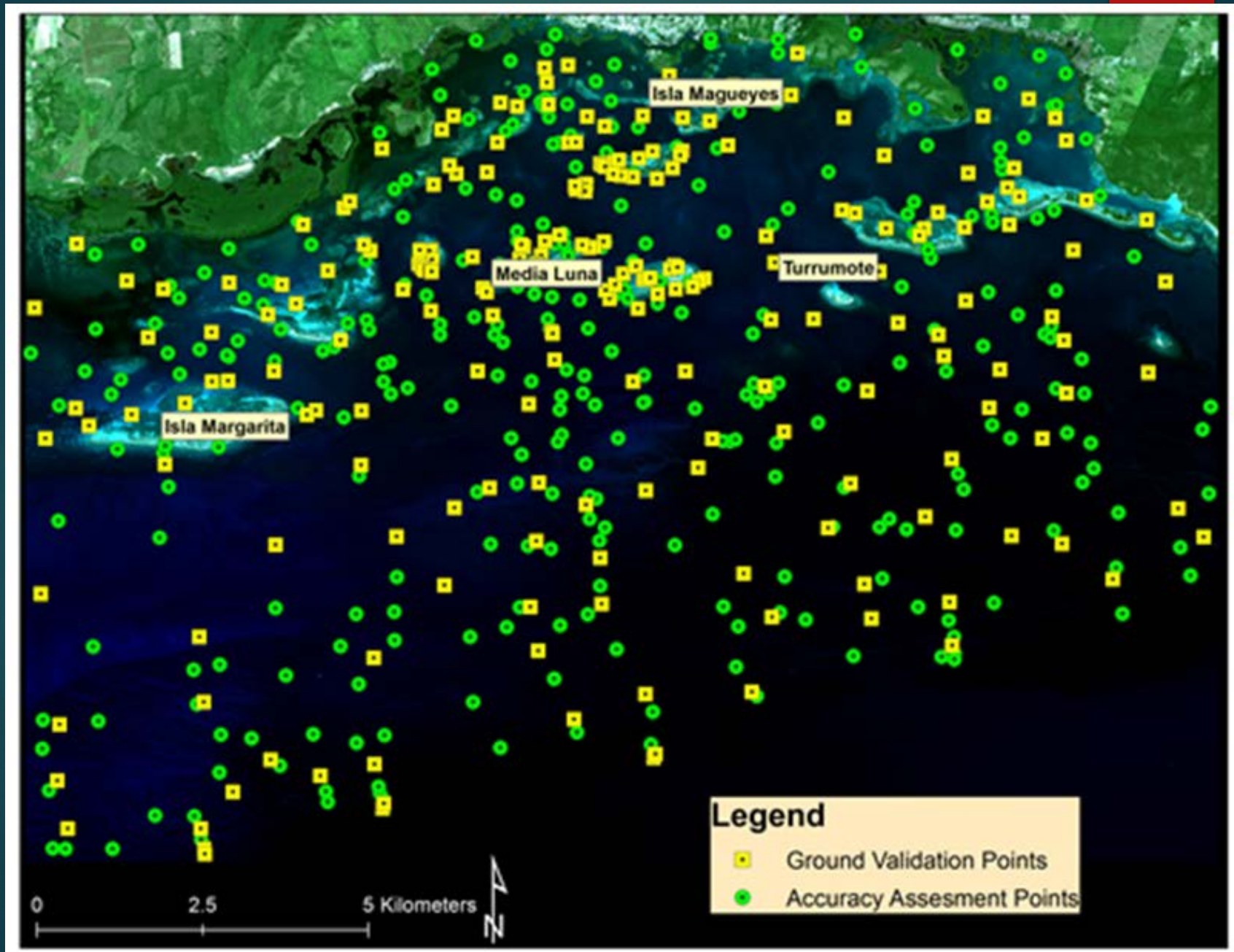
- ▶ Delta Vision Pro
 - ▶ Drop Camera HD Video (1080p)
 - ▶ 10-second video collected
 - ▶ DVR



- ▶ Trimble Juno GPS
 - ▶ 10-second averaging
 - ▶ dGPS
 - ▶ 2 meters
- ▶ Synchronized GPS and video



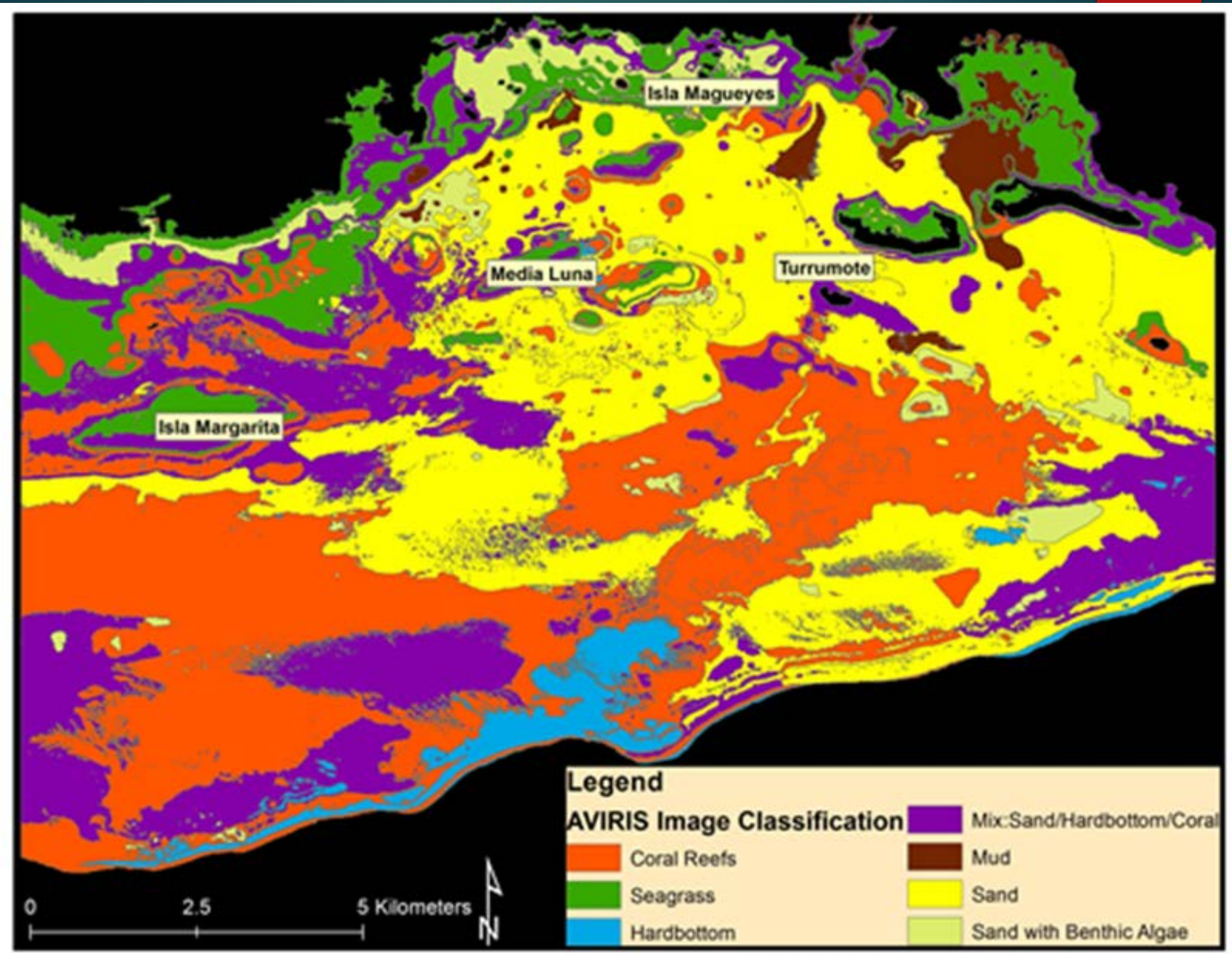
Ground Validation and Accuracy Assessment Points



Classification

- ▶ Clusters obtained from ISODATA classification
 - ▶ 150 clusters with 5 iterations
 - ▶ Identified multiple class / benthic habitat (confused pixels)
- ▶ Converted to polygons in ESRI ArcMap 10.3.
- ▶ Spatial Join Tool
 - ▶ Polygons assigned to a class based on ground validation.
 - ▶ Joining based on spatial location.
 - ▶ Attribute of the nearest point is collected and a distance value is recorded.
 - ▶ Dissolve Tool from ESRI ArcMap 10.3.

AVIRIS (Airborne Visible Infrared Imaging Spectrometer) map of the northern Mesoamerican



Findings

- ▶ Confusion matrix (Jensen, 1996)
- ▶ Overall Accuracy
 - ▶ AVIRIS classification = 63.55%
 - ▶ WV2 classification = 64.81%.
 - ▶ Our study area
 - ▶ ~168 Km²
 - ▶ depth range from 0-41 meters (average depth = ~18 meters).
- Kappa coefficient
 - AVIRIS (55%) and WV2 (57%). “Moderate” classification (Landis and Koch 1977)
- Tau coefficient
 - AVIRIS (59%) and WV2 (60%).

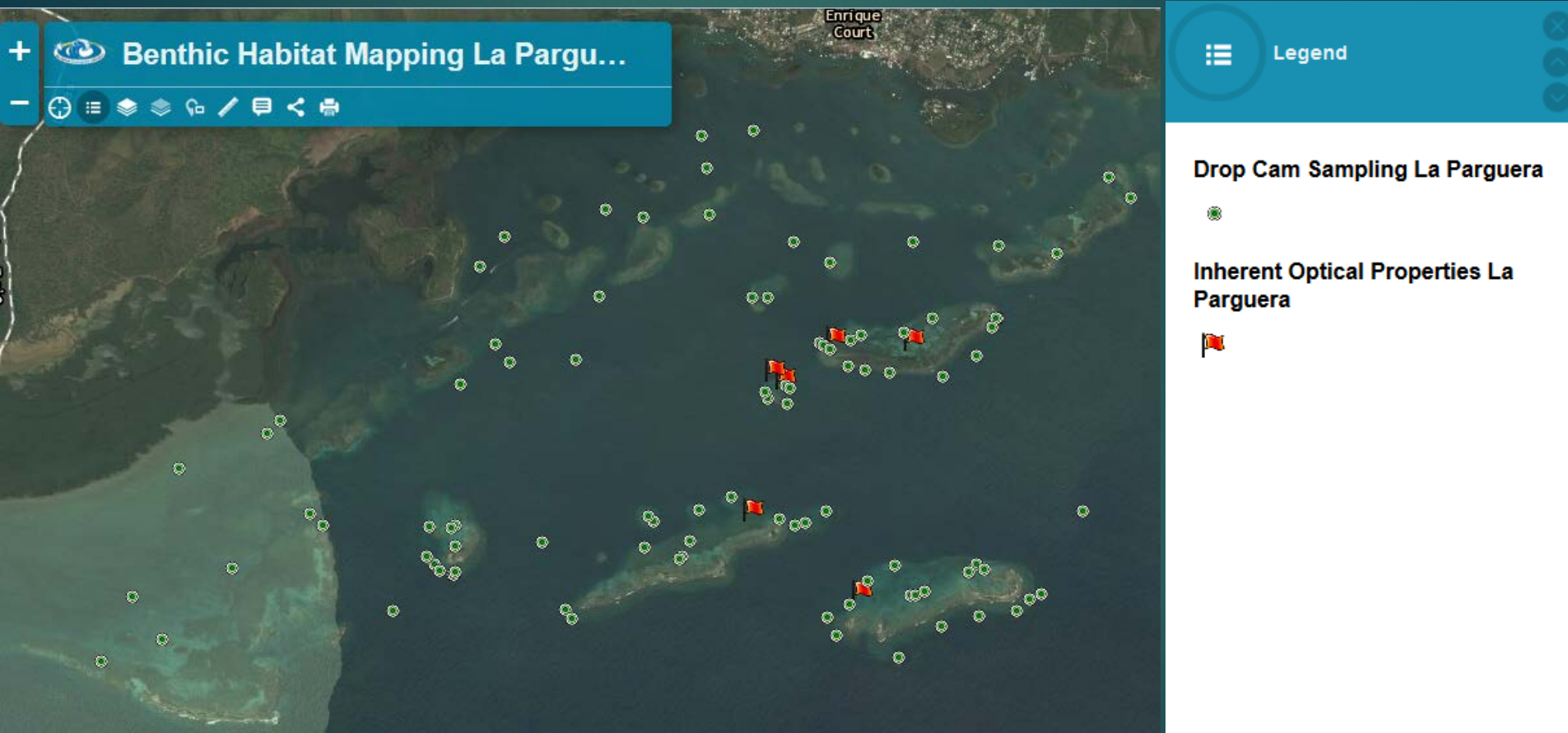
Findings

- ▶ Image acquisition dates.
 - ▶ Massive bleaching event occurred during the AVIRIS image acquisition followed by a coral reef mass-mortality (Eakin et al. 2010).
 - ▶ Detrimental to *Montastraea (Orbicella) annularis* complex resulting in mortalities in the order of 50% (Garcia-Sais et al. 2008).
 - ▶ These factors may explain the difference in the total area covered of the coral reef class between the AVIRIS image (50.32 km²) and the WV2 (22.89 Km²).

Conclusions and Remarks

- ▶ From top-of-atmosphere (TOA) to bottom albedo.
 - ▶ Atmospheric and water column corrections improve benthic habitat mapping.
- ▶ Benthic habitat maps developed from bottom albedo images of both AVIRIS and WV2 sensors.
- ▶ Change detection
 - ▶ Reduction in the coral reefs class total
- ▶ Development of benthic habitat mapping tools for La Parguera Reserve.

Web Mapping Application



Acknowledgements



- ▶ NOAA Cooperative Remote Sensing Science and Technology Center (CREST) program under grant number NA11SEC4810004.
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- ▶ Dr. Liane Guild (NASA) for AVIRIS imagery
- ▶ Digital Globe® for the WV2 imagery.

QUESTIONS?

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BACK UP SLIDES

Benthic Habitat Mapping La Parguera ...



Video 121
Coverage Seagrass
Depth 6.00
Photo [More info](#)



Legend

Drop Cam Sampling La Parguera



Inherent Optical Properties La Parguera

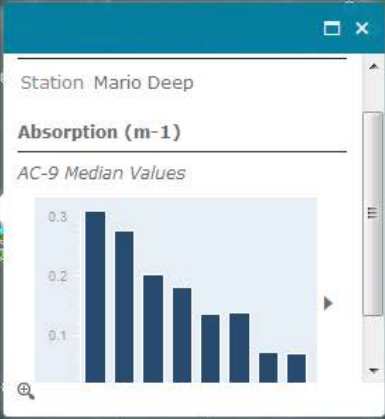


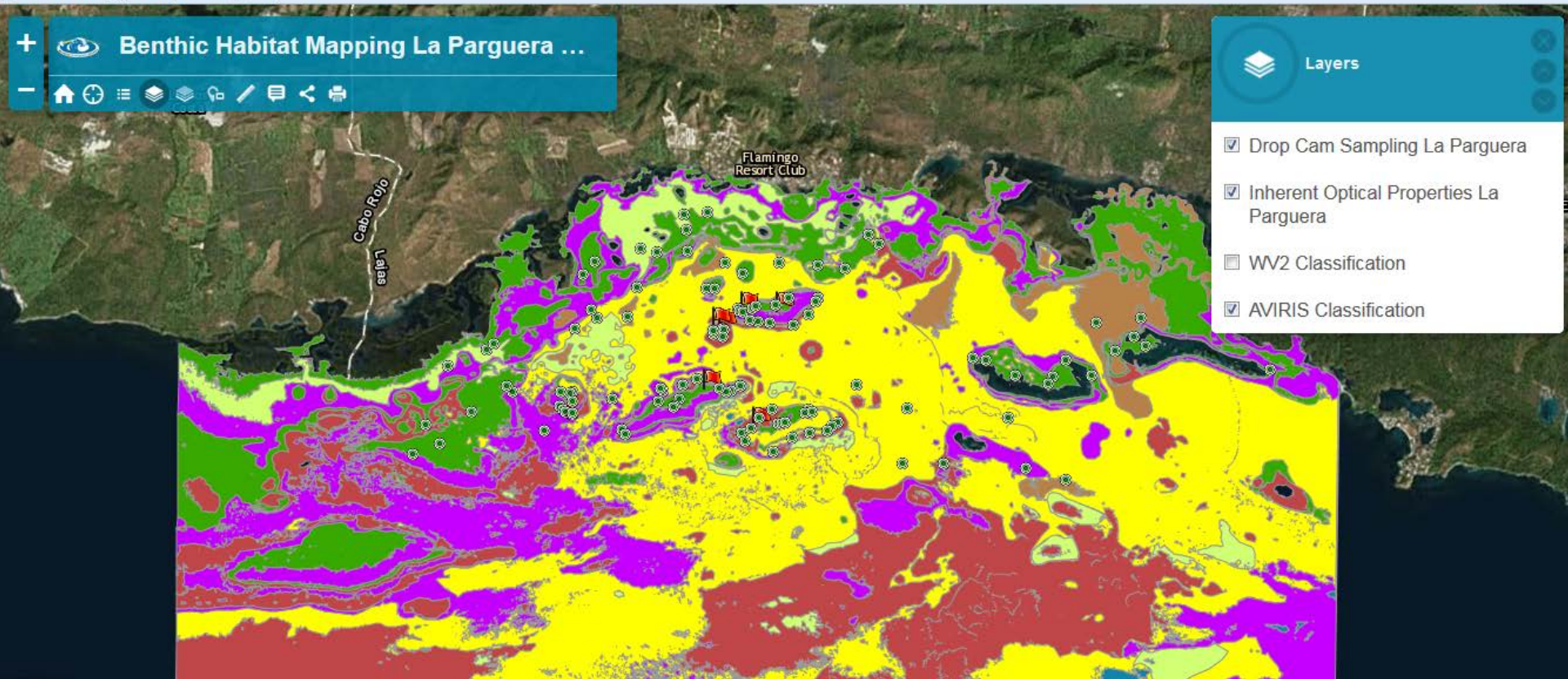
Benthic Habitat Mapping La Parguera ...

Home Map Layers Settings Share Print

Legend

- Drop Cam Sampling La Parguera
- Inherent Optical Properties La Parguera





Layers

- ☒ Drop Cam Sampling La Parguera
- ☒ Inherent Optical Properties La Parguera
- ☐ WV2 Classification
- ☒ AVIRIS Classification