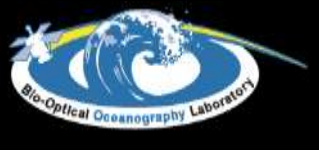
Water Quality Monitoring and Validation from NOAA operational satellite sensor (VIIRS) Data Products in Coral Reef Environments

William J Hernandez, *Ph.D* [1, 4]
Post-Doctoral Researcher

Roy A. Armstrong[1,3], Alan E. Strong, Robert A. Warner[5], Erick F. Geiger[2,4], C. Mark Eakin[4], Menghua Wang[4], Maria A. Cardona-Maldonado[3], Suhey Ortiz-Rosa[1], Jeremy Kravitz[6], Myrna J. Santiago[3]



Decimocuarta Reunión de Percepción Remota y Sistemas de Información Geográfica de Puerto Rico, UPR Mayagüez, Octubre 7, 2016

[1]NOAA-CREST UPRM, [2]Global Science and Technology Inc., [3]NOAA-NCAS UPR Mayaguez, [4]NOAA/NESDIS/STAR, [5]NOAA/NOS/NCCOS, [6]UPR Mayaguez.

Outline

- Introduction
- Water Quality
  - Coral reef
- *Visible Infrared Imaging Radiometer Suite (*VIIRS)
  - Sensor products
  - Virtual Areas
- Results
  - VIIRS products
  - Water quality
- Conclusions

Water Quality

Land based sources of pollution (LBSP) are a major threat to corals:

- Cause disease and mortality
- Disrupt critical ecological reef functions that impede growth and reproduction and larval settlement.
- Innovations in Monitoring and Assessment.
- Connecting Coasts, Estuaries, and Freshwater Ecosystems.
- Identifying and Assessing Emerging Risks.
- Measuring Effectiveness of Water Management Actions.

Honokahua Bay, West Maui. Credit: Bill Rathfon.

Guanica Bay, Puerto Rico Credit: NOAA

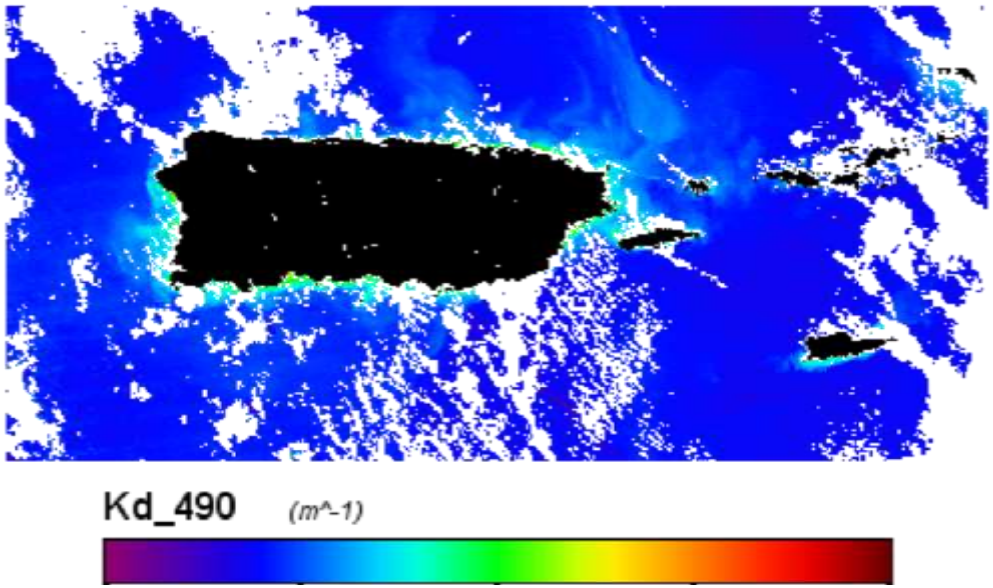
VIIRS

- **Visible Infrared Imaging Radiometer Suite**
- NOAA/NESDIS/STAR
- Spectral coverage: 412nm -12 μm
- 22 bands, 750m, 375m spatial res.
- Daily images
- Products:
  - Cloud cover, aerosols
  - Land & ocean biosphere
  - Sea Surface Temperature
  - Fire detection
  - Imagery

http://www.jpss.noaa.gov/images/img_nppsatellite.jpg

VIIRS

- **Chlorophyll-*a* (Chl-*a*)**
  - Monitoring phytoplankton biomass.
  - Nutrient status (*i.e.* **productivity**).
  - Index of water quality.
- **Kd(490)**
  - Diffuse attenuation coefficient at 490nm.
  - **Turbidity** (measure of the total organic and inorganic matter held in solution and suspension).
  - Index of water quality.



VIIRS Kd(490) product image for Puerto Rico and the USVI after a precipitation event (August 26, 2014).

Why use VIIRS for Water Quality?

- The color of coastal water is related to water quality.
- Satellite ocean color data provide a synoptic view of water quality.
- Continuous monitoring
- Ocean color tools that managers and stakeholders can use to:
  - Track water quality near their reefs
  - Evaluate effect in the coastal water due to changes in the watershed. (“Ridge to Reef”).

Image credit: Bio-optical oceanography Lab, UPRM

Study Area

U.S. Coral Reef Task Force priority watershed sites:

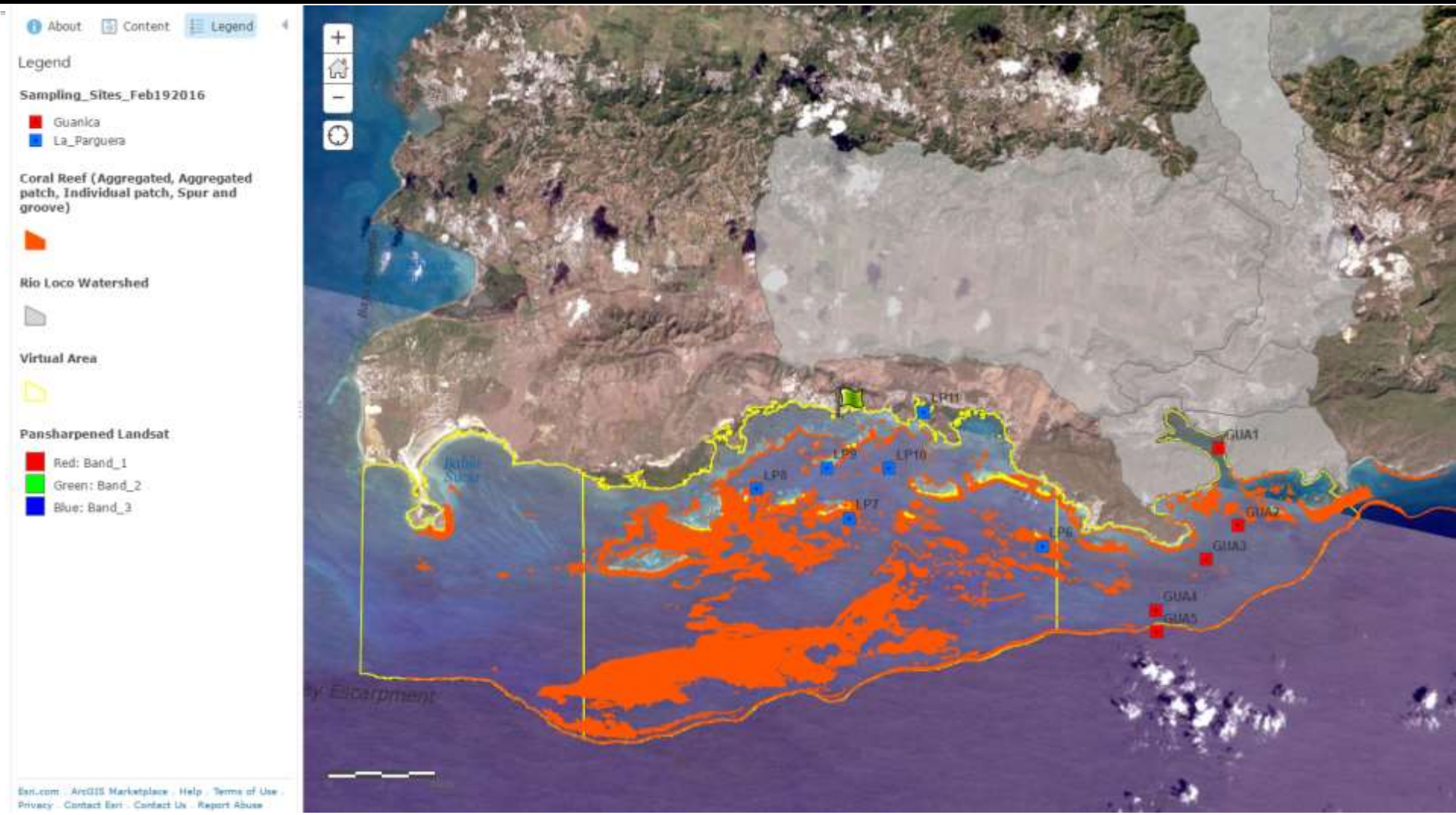
- Ka’anapali (West Maui, Hawai'i)
- Faga'alu (American Samoa)
- Guánica Bay (Puerto Rico).

Image credit: NOAA/NESDIS/STAR/CRW

Study Area

Guánica and La Parguera Area (Puerto Rico).

Study Area


About
Content
Legend
Legend
Sampling_Sites_Feb192016
Guanica
La_Parguera
Coral Reef (Aggregated, Aggregated patch, Individual patch, Spur and groove)
Rio Loco Watershed
Virtual Area
Pansharpened Landsat
Red: Band_1
Green: Band_2
Blue: Band_3
LP11
LP9
LP10
LP8
LP7
LP6
GUA1
GUA2
GUA3
GUA4
GUA5
Esri.com · ArcGIS Marketplace · Help · Terms of Use · Privacy · Contact Esri · Contact Us · Report Abuse

Water Quality Products from VIIRS

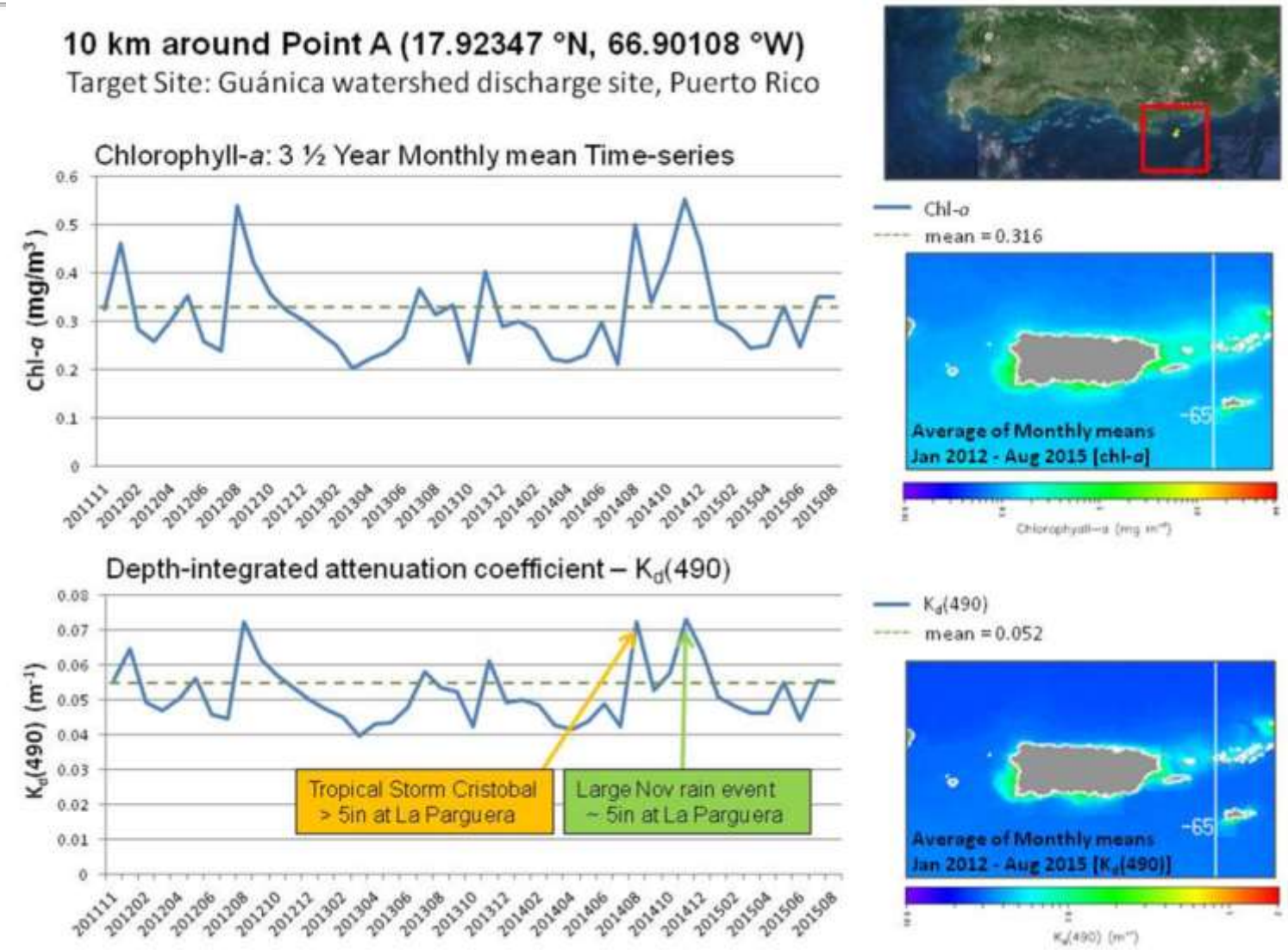
<u>Matching large rainfall events to satellite derived measurements.</u>

- **Chlorophyll-*a* (Chl-*a*)**
- **Kd(490)**

"Virtual Areas"

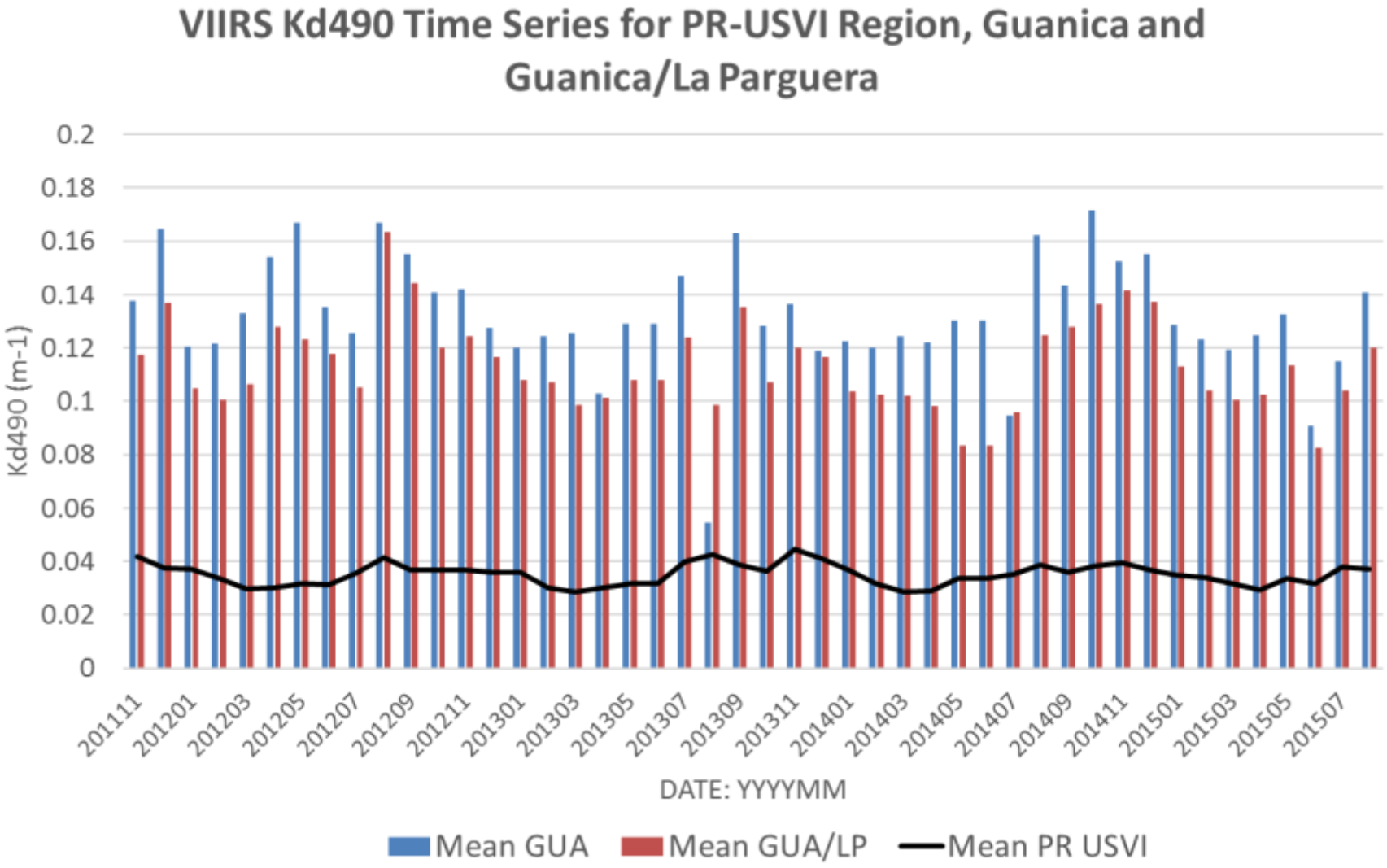
- Establishing virtual areas around watersheds will enable calculation of plume statistics such as:
  - Maximum and average levels of Chl-*a* and Kd(490)
  - Monthly climatologies
  - Variations from "normal" levels through time. (Anomalies).

Results VIIRS (Monthly)

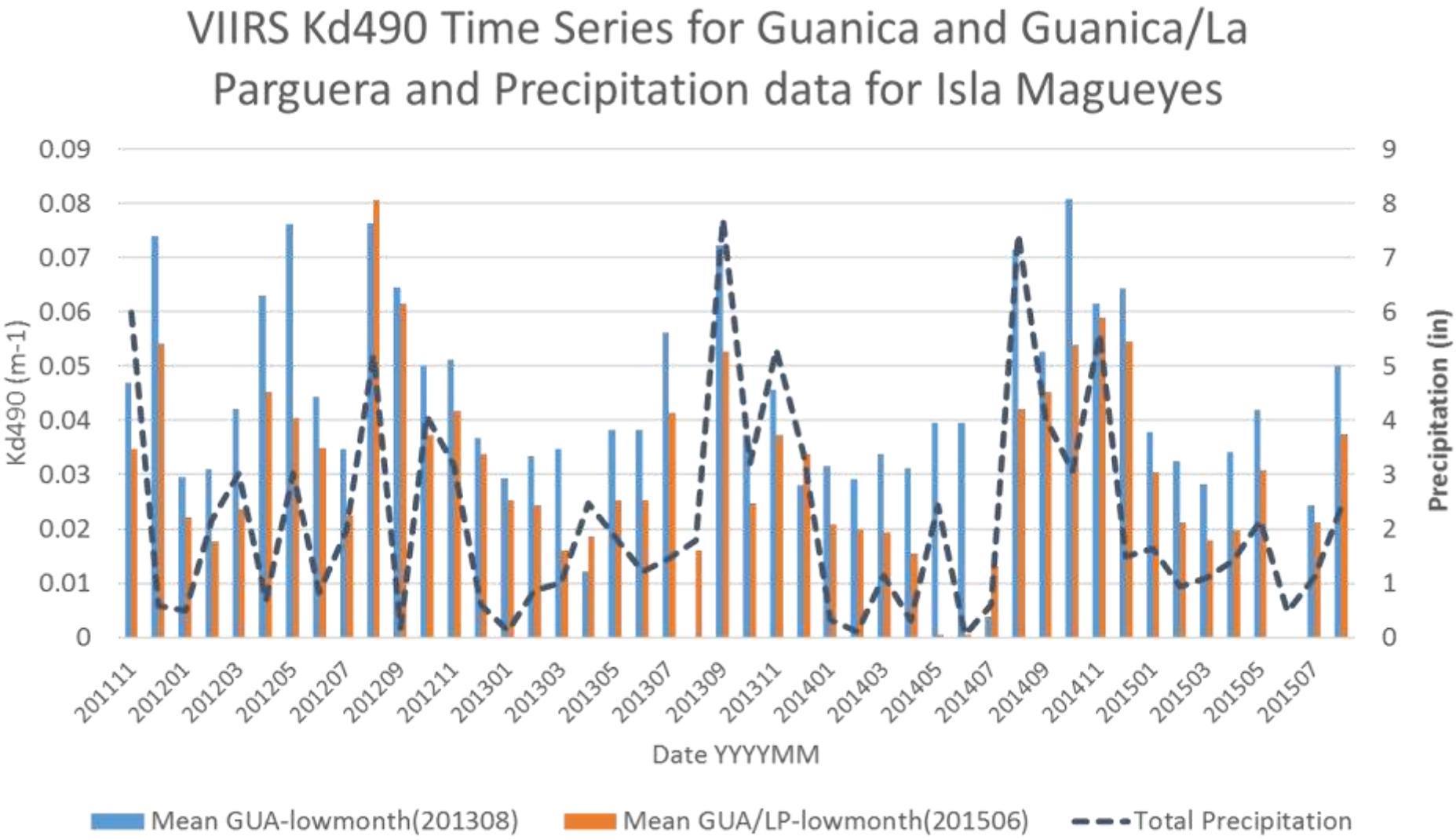


Images credit: NOAA/NESDIS/STAR/CRW

Results VIIRS (Monthly)

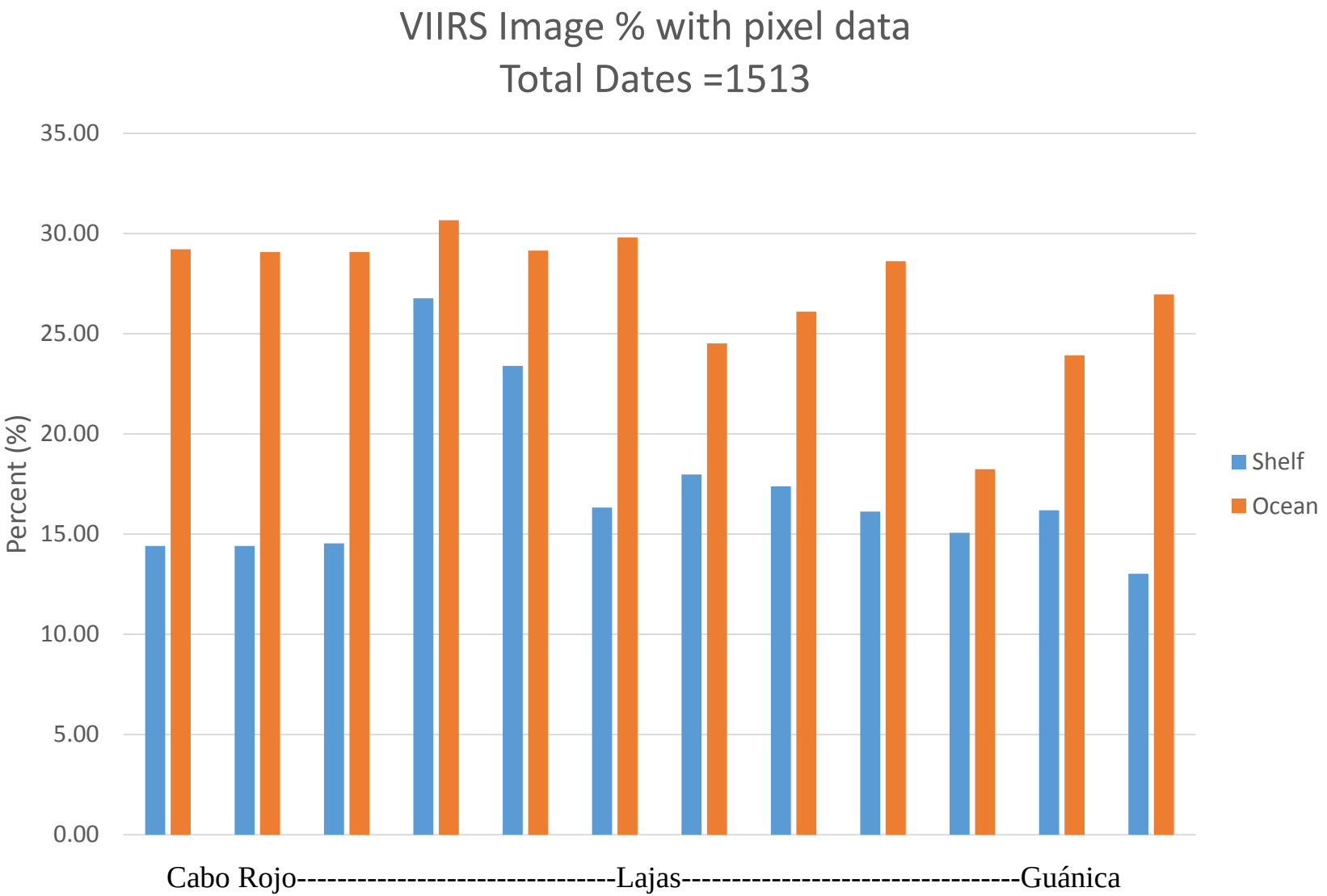


Results VIIRS (Monthly)



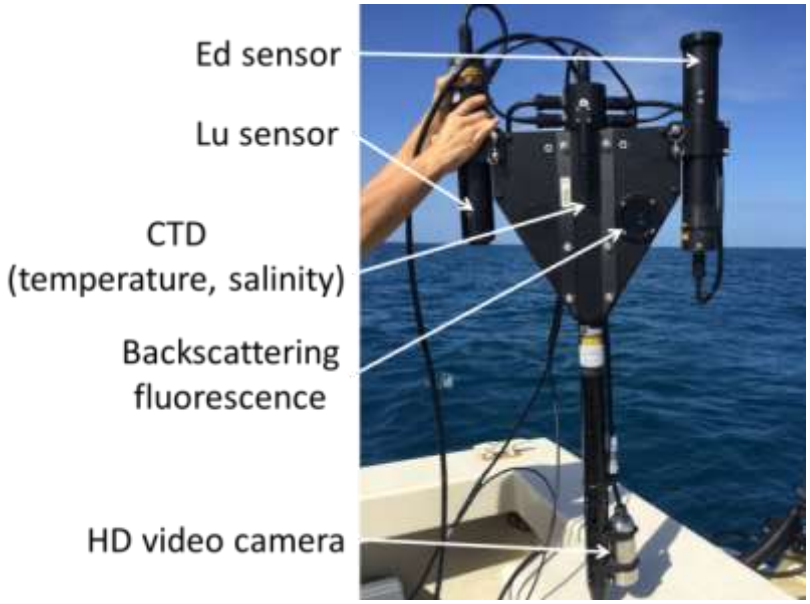
VIIRS Daily image (Cloud Cover)

Results VIIRS Kd(490) (Daily)



Field Sampling

- Simultaneous with Landsat 8 OLI image capture
- Instruments
  - **Satlantic Hyperpro Profiling radiometer (Lu, Ed, Rrs, Lw, Kd)**
  - GER 1500 Spectro-radiometer (Lw, Ed, Rrs)
  - SolarLight Datalogging Radiometer (PAR)
  - Hydroscat-6 (backscattering, flourescense)
  - SCUFA (flourescense, turbidity)
  - Water quality samples
    - CHL, TSS, CDOM

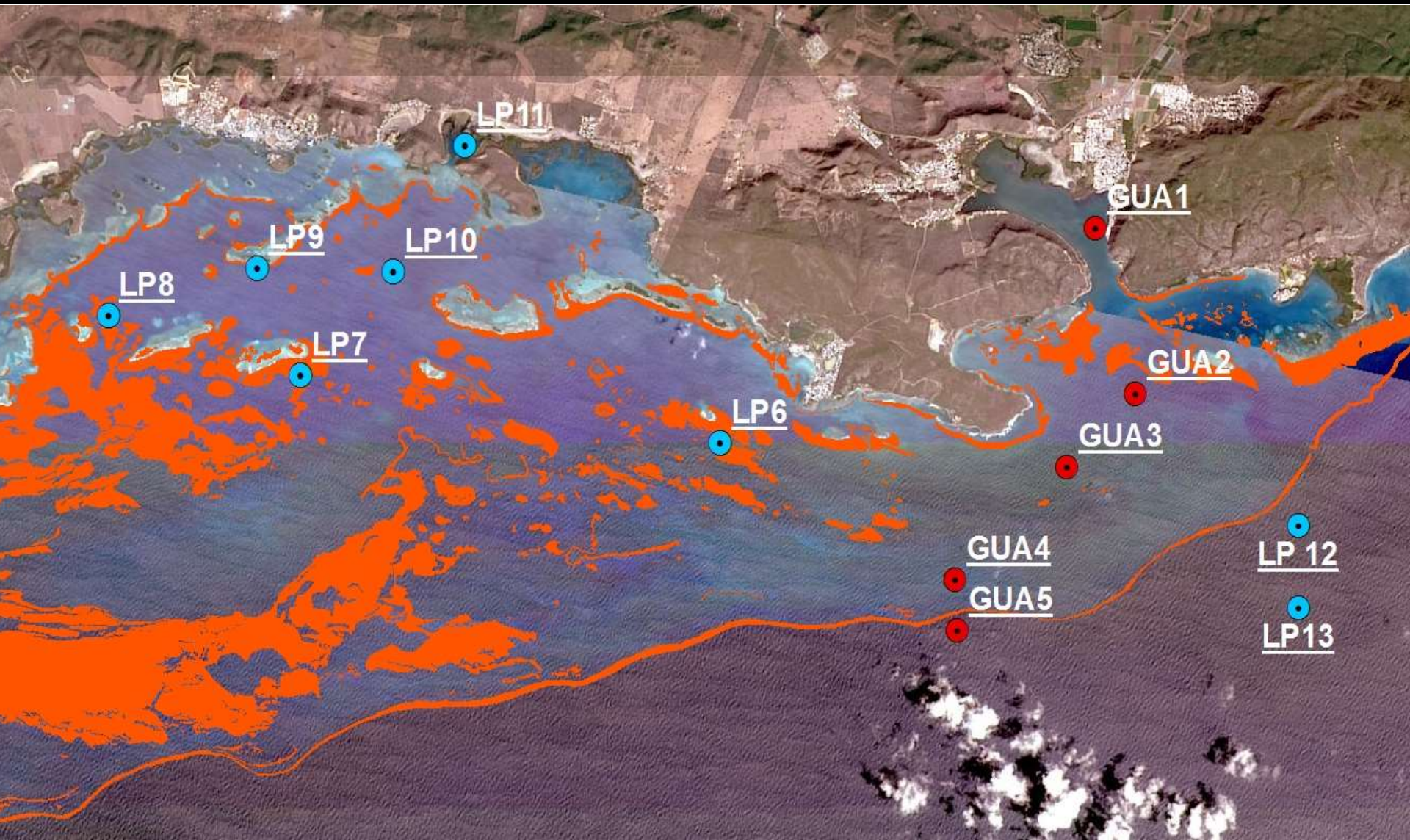


Hydroscat-6

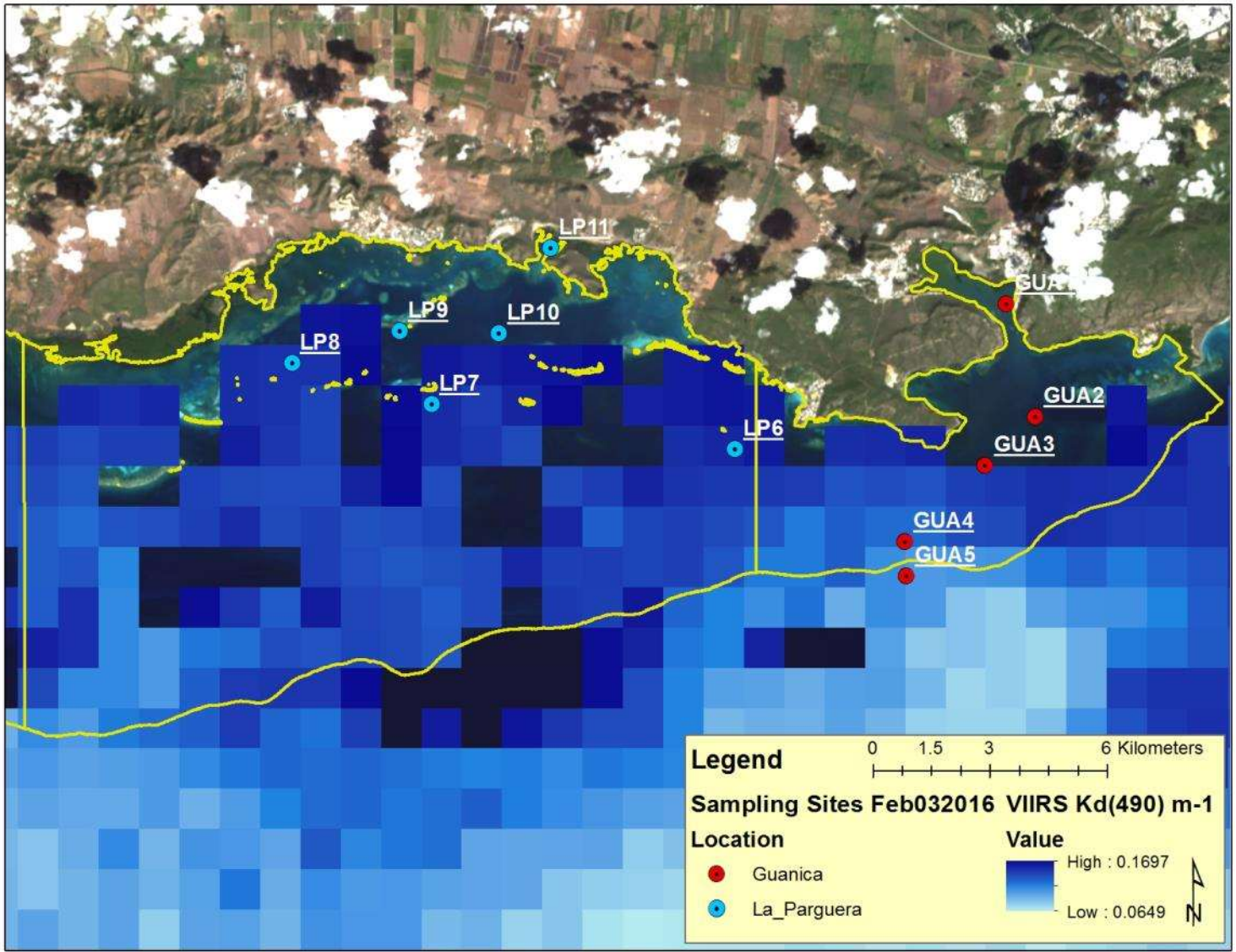
GER1500

SCUFA

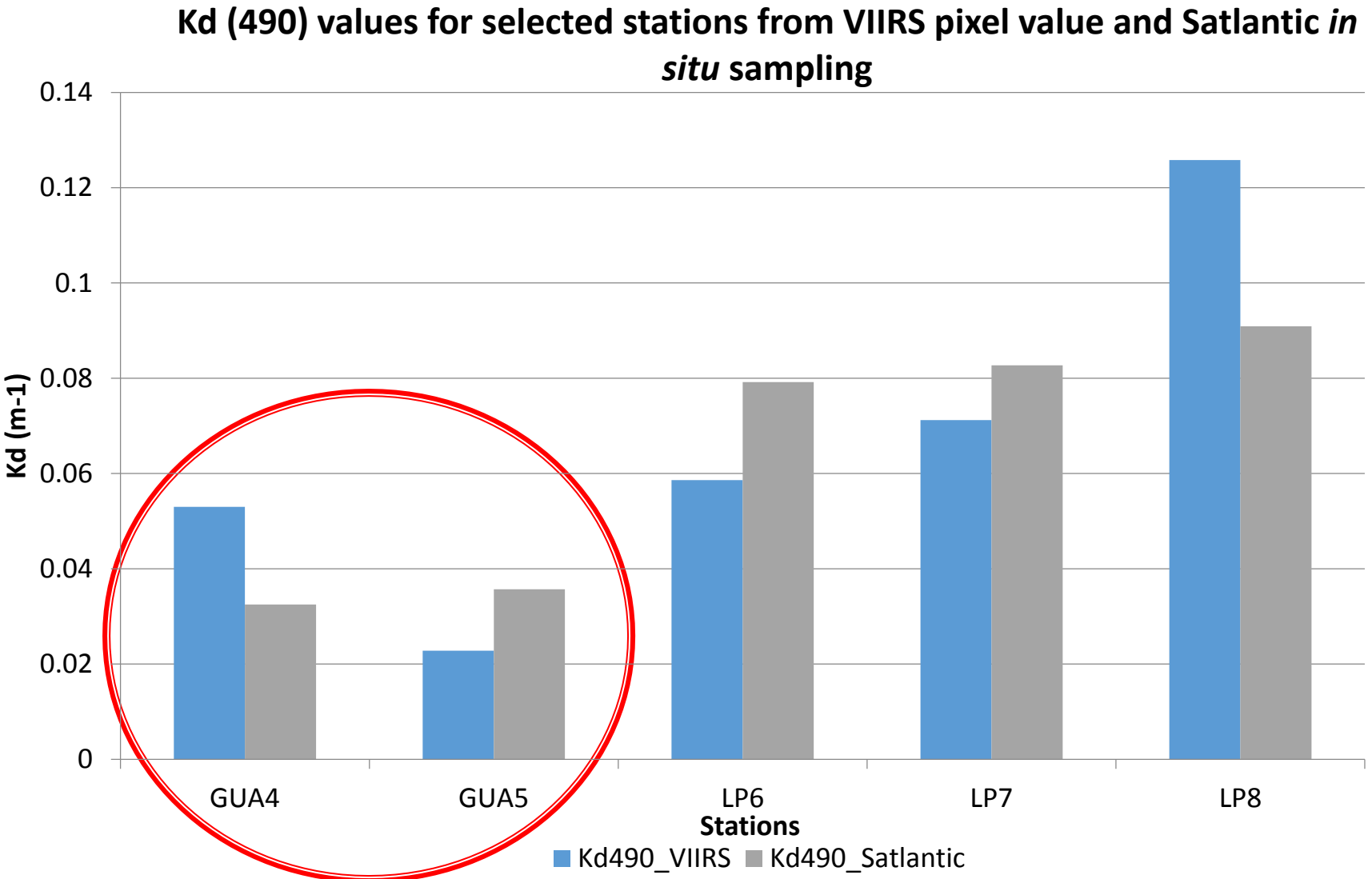
Field Sampling



Field Sampling with VIIRS (Daily)



Field Sampling with VIIRS (Daily)

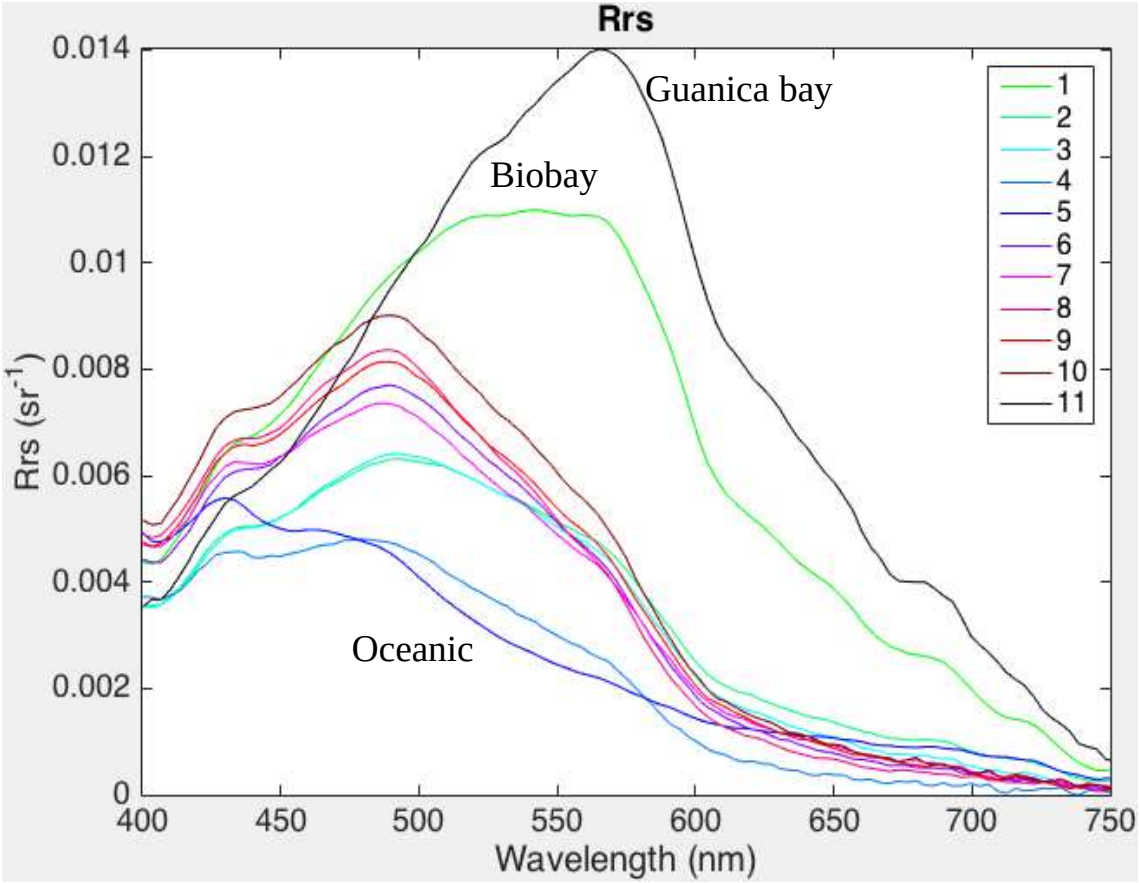


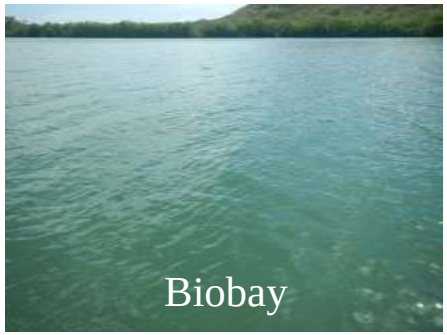
Landsat 8


GUA3
GUA5
0 1 2 4 Kilometers
Legend
Sampling Sites Feb032016
Location
Guanica
La_Parguera
N

Results- Field Sampling

Satlantic surface remote sensing reflectance

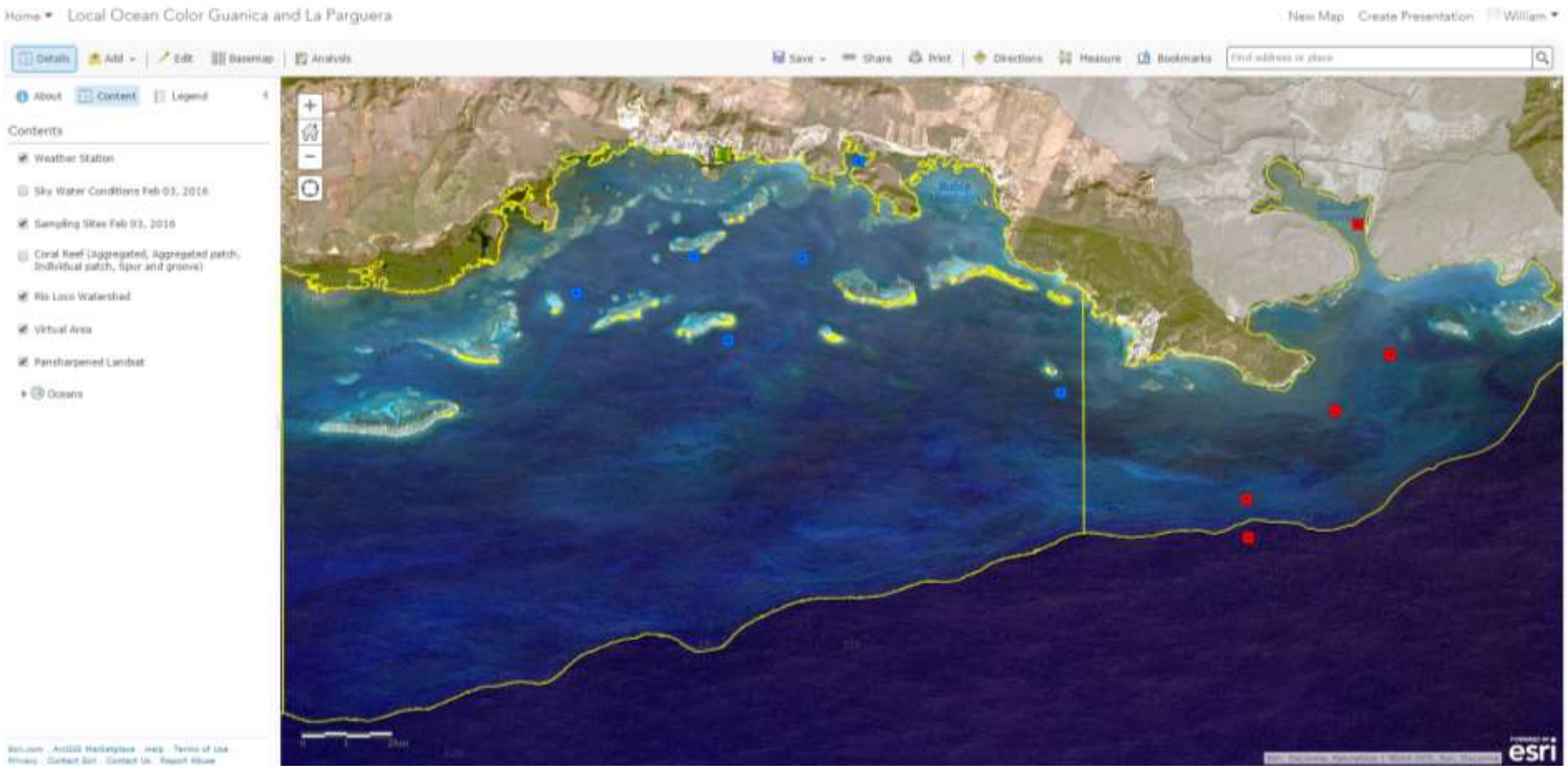




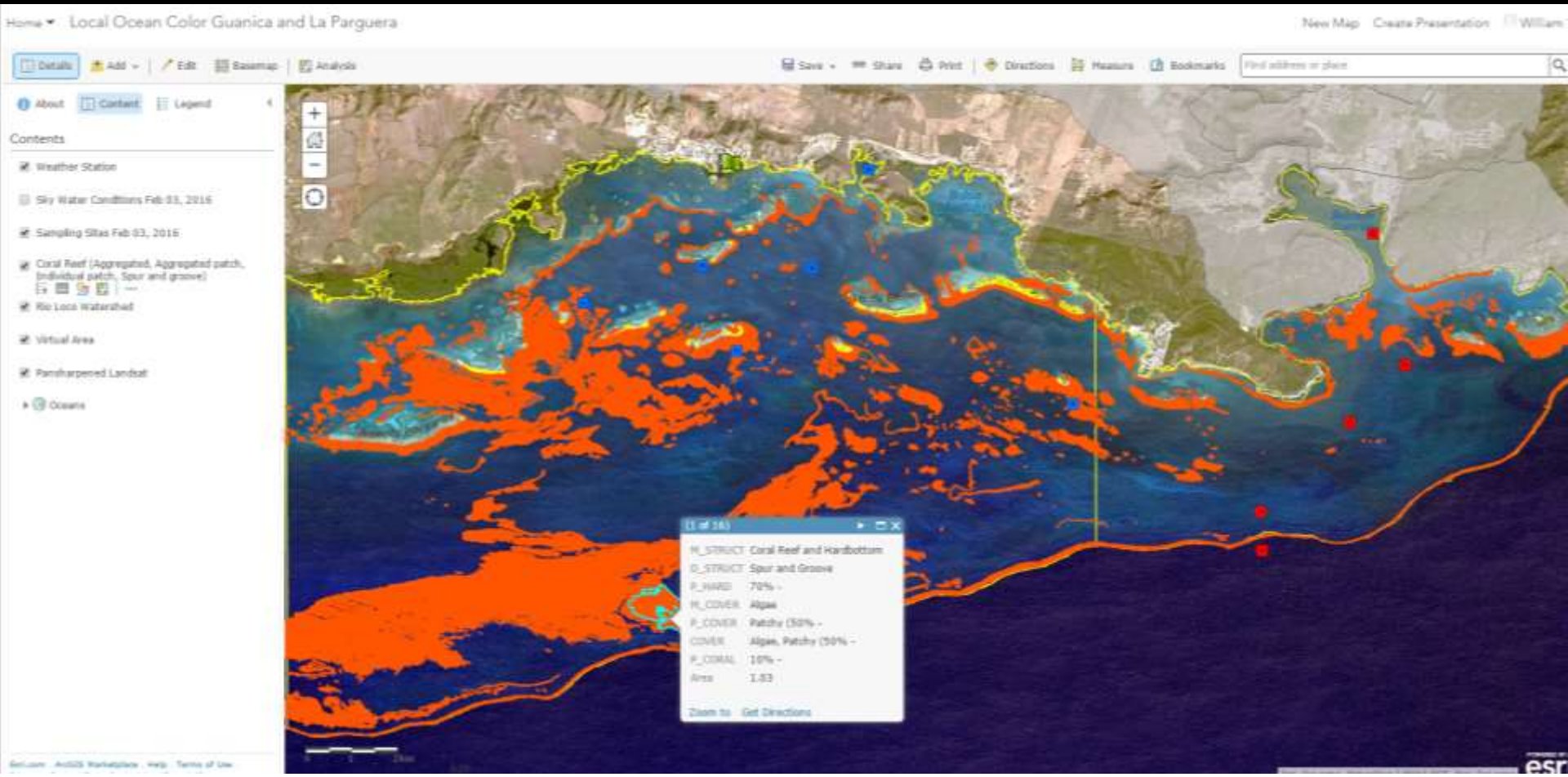
Local Ocean Color ArcGIS Web Map

http://arcg.is/1QpyIL7

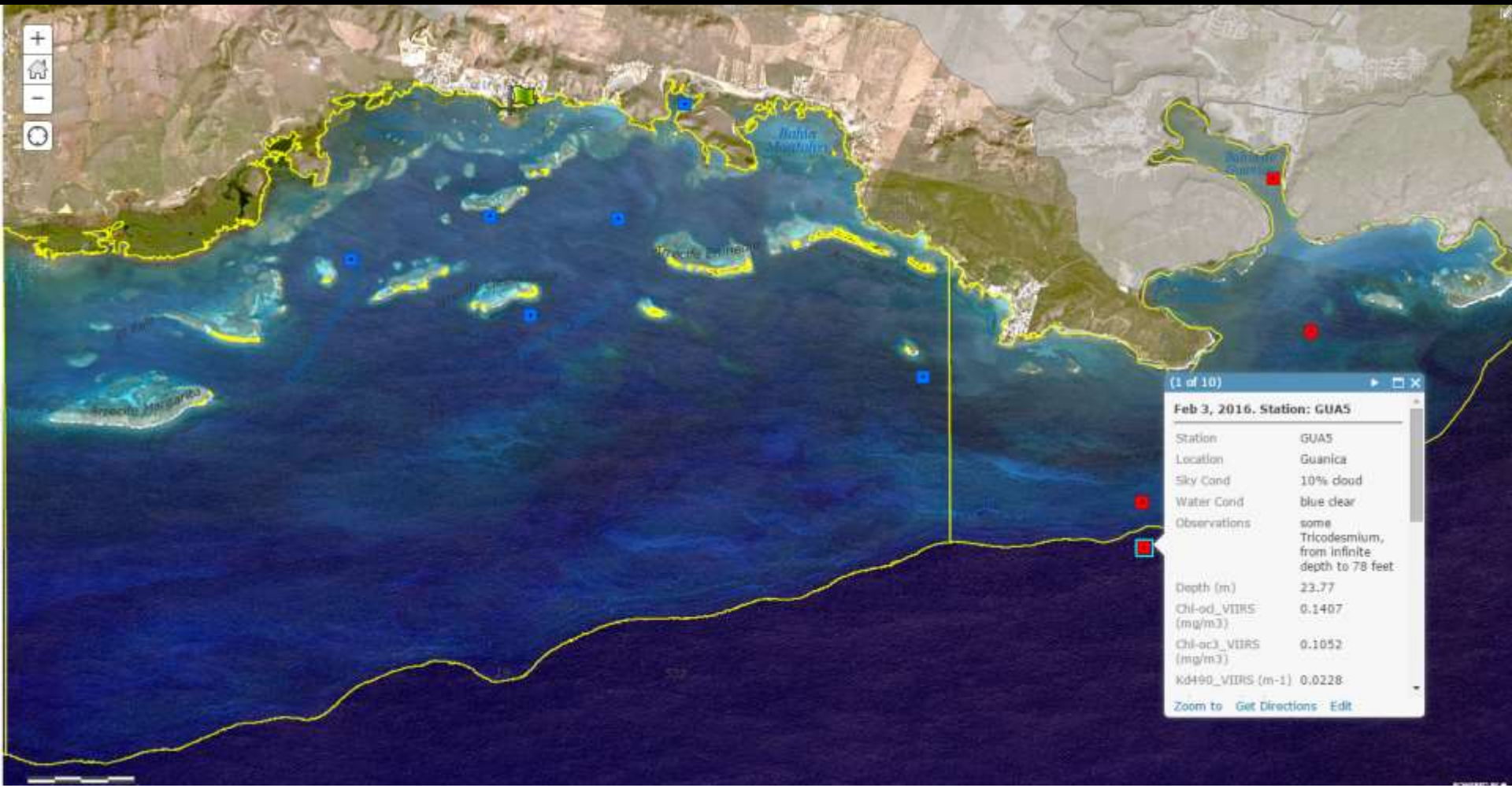
Local Ocean Color ArcGIS Web Map



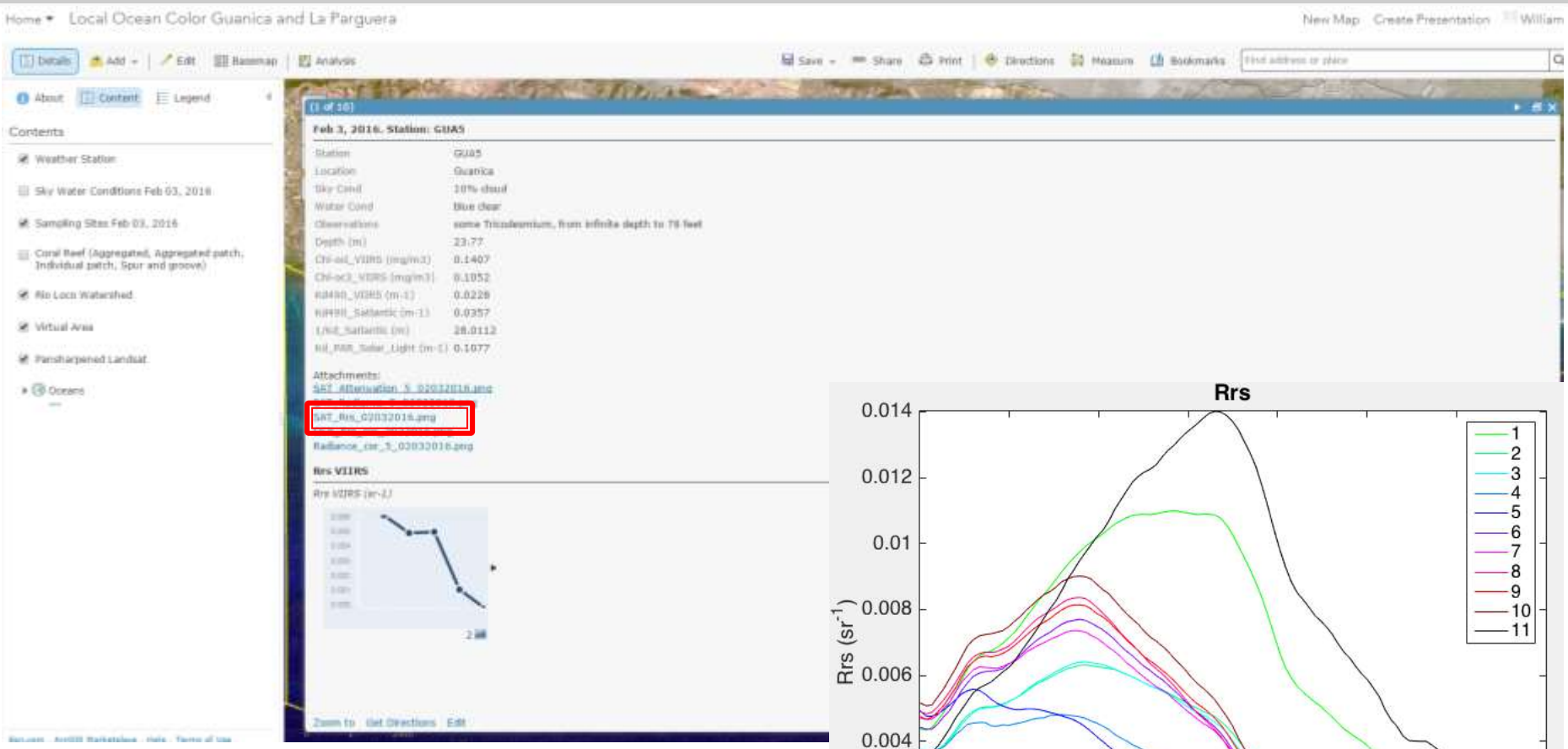
Local Ocean Color ArcGIS Web Map



Local Ocean Color ArcGIS Web Map



Local Ocean Color ArcGIS Web Map



Next Steps

- Local Ocean Color/LSD/SST
  - Continued cal/val data for VIIRS for Guanica and La Parguera. (July-December)
  - Integrate higher-resolution sensor products with field data.(e.g. Landsat 8 OLI,Sentinel-3 OLCI)
  - Extend support to Hawai'i and American Samoa.
  - New instruments
    - EcoPAR, SBE 39plus Temperature (P) Recorder.

EcoPAR

SBE 56

QUESTIONS?

Contact:

william.hernandez@upr.edu

bio-optics.uprm.edu

dy was supported and monitored by National Oceanic and Atmospheric Adm
(NOAA) under NOAA CREST-EPP Grant # NA11SEC4810004.

For REFERENCES please contact presenter.