Development of water quality products derived from NOAA operational satellite sensor (VIIRS) data

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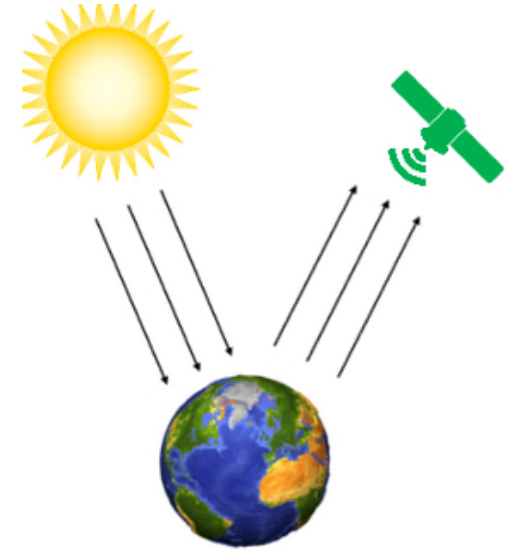
Outline

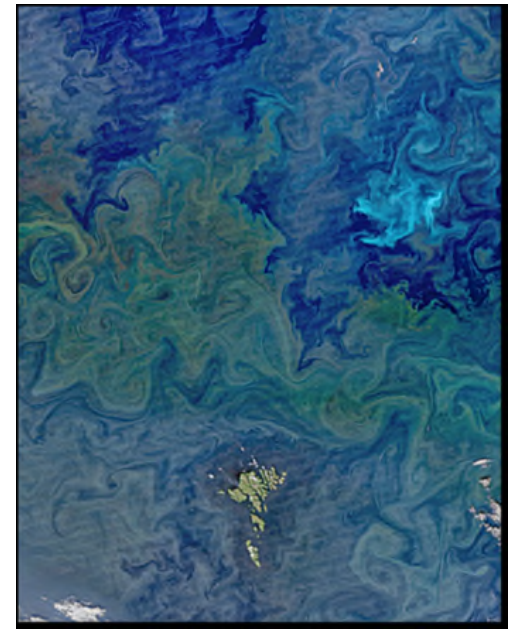
- Introduction
- Water Quality
  - Coral reef
- *Visible Infrared Imaging Radiometer Suite (*VIIRS)
  - Sensor products
  - Virtual Areas
- Results
- Conclusions

Remote Sensing

Benefits of remote sensing:

- collect information over large and remote spatial areas
- characterize natural features or physical objects on the ground
- systematic observation of surface areas and objects
- monitor their changes over time
- integrate data with other information to aid decision-making
- cost effective technologies.





Water Quality

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

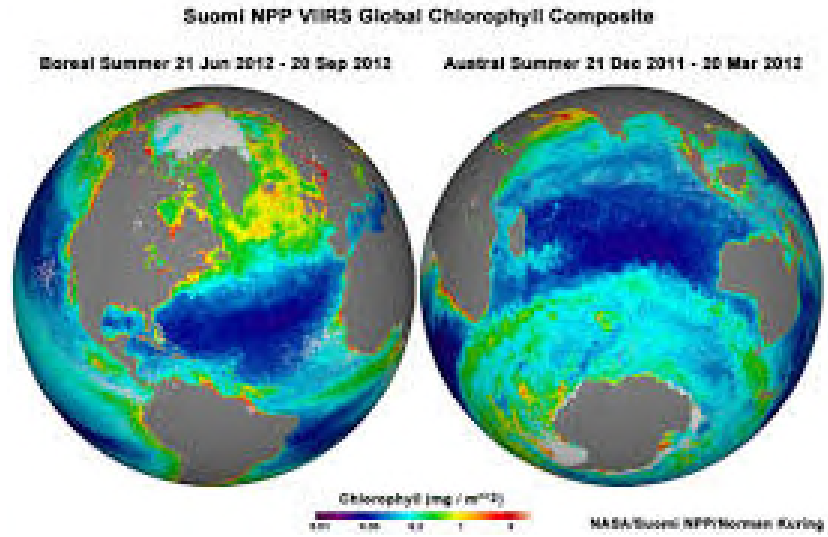
- Cause disease and mortality
- Disrupt critical ecological reef functions that impede growth and reproduction and larval settlement.
- Innovations in Monitoring and Assessment.
- Connecting Coasts, Estuaries, and Freshwater Ecosystems.
- Identifying and Assessing Emerging Risks.
- Measuring Effectiveness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

Honokahua Bay, West Maui. Credit: Bill Rathfon.

Guanica Bay, Puerto Rico Credit: NOAA

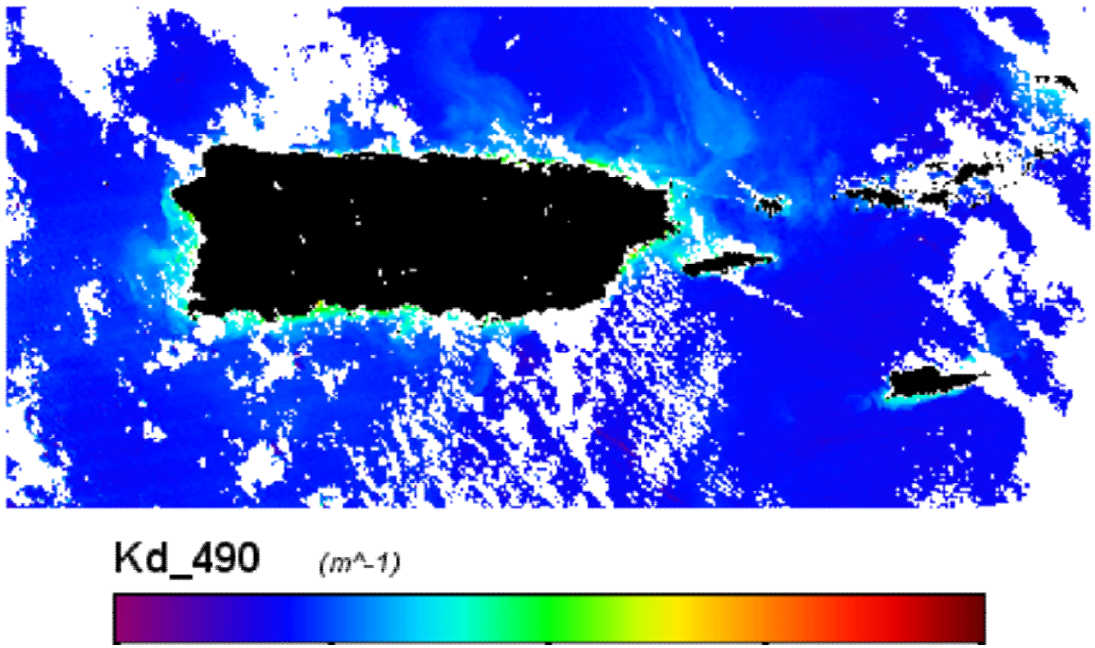
VIIRS

- NOAA National Environmental Satellite, Data, and Information Service (NESDIS) operational satellite.
- 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



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”).

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).

Study Area

Guánica and La Parguera Area (Puerto Rico).

Water Quality Products from VIIRS

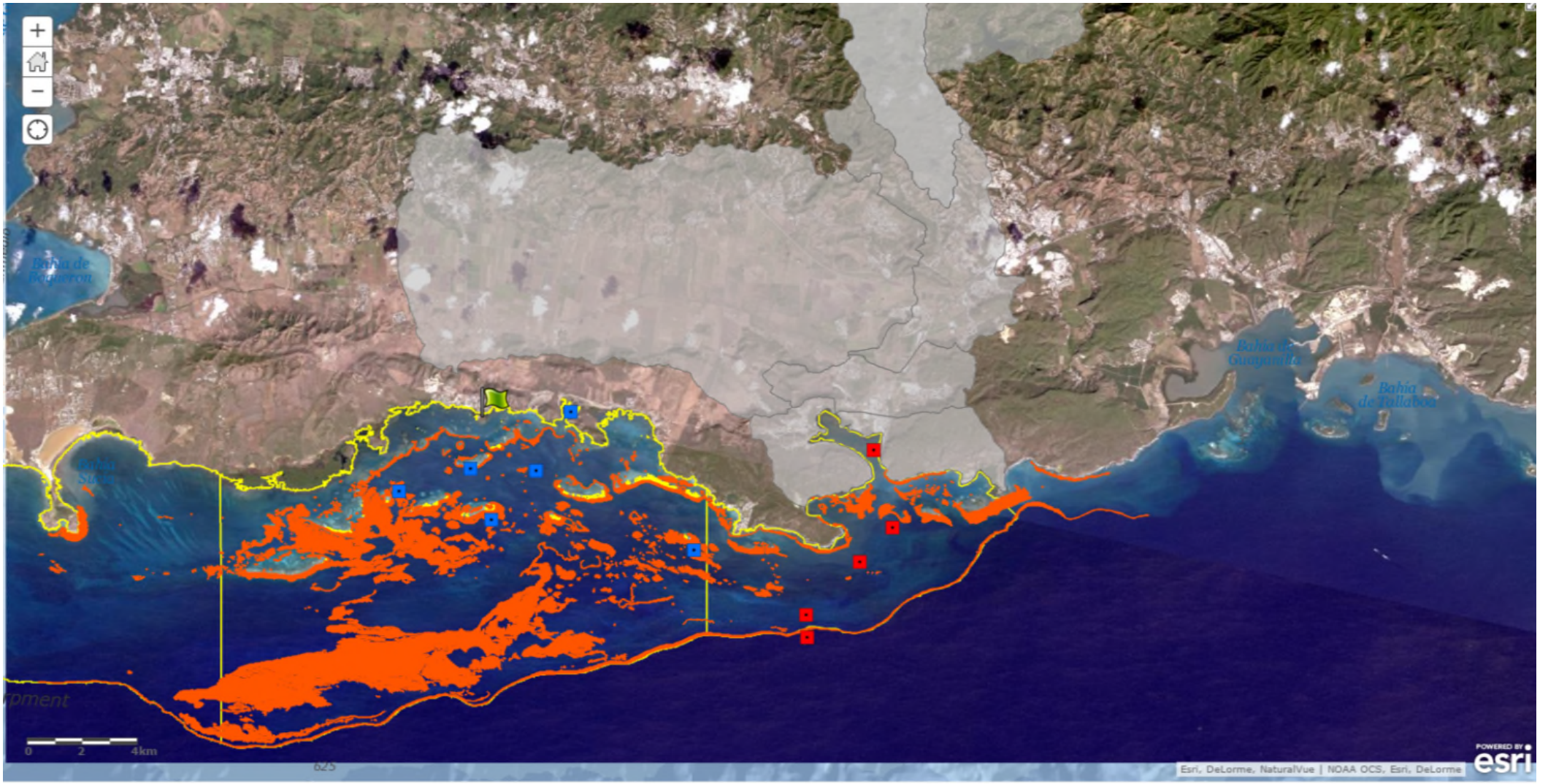
<u>Matching large rainfall events to satellite derived measurements.</u>

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

"Virtual Areas"

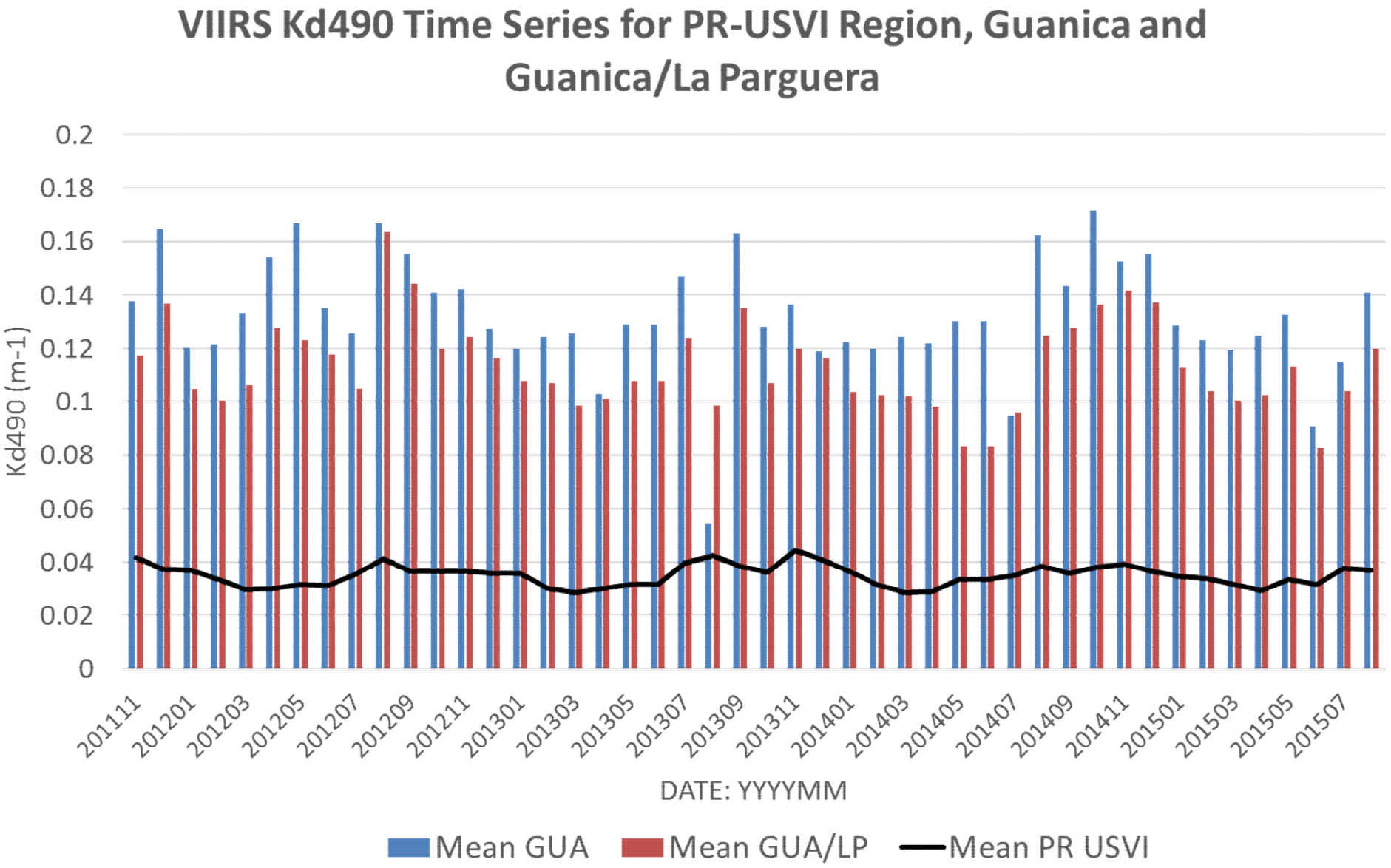
- Establishing virtual areas around watersheds will enable calculation of plume statistics such as:
  - Maximum and average levels of Chl-*a* and Kd(490)
  - Monthly climatologies
  - Variations from "normal" levels through time. (Anomalies).

Study Area



Bahía de Boqueron
Bahía de Guayanilla
Bahía de Tallaboa
0
2
4km
Esri, DeLorme, NaturalVue | NOAA OCS, Esri, DeLorme
POWERED BY esri

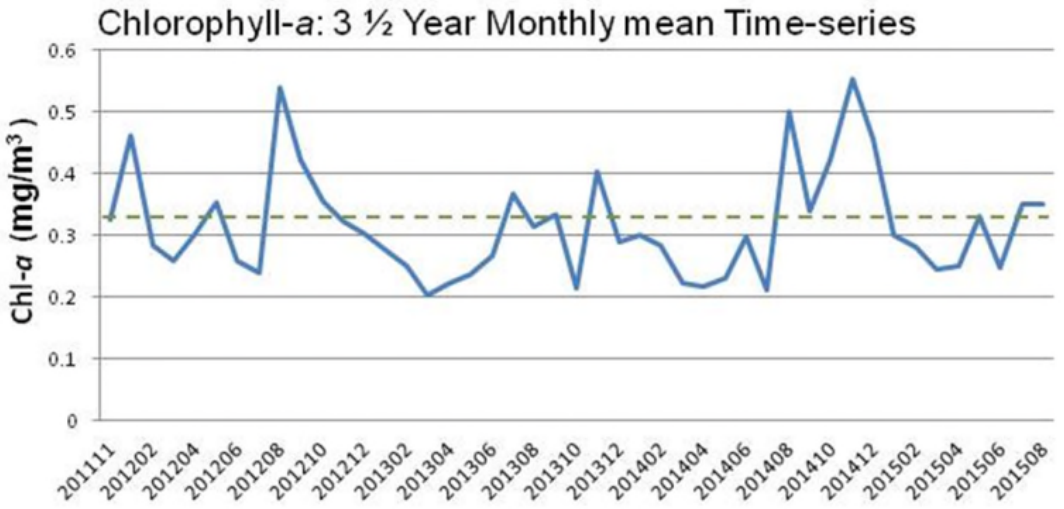
Results

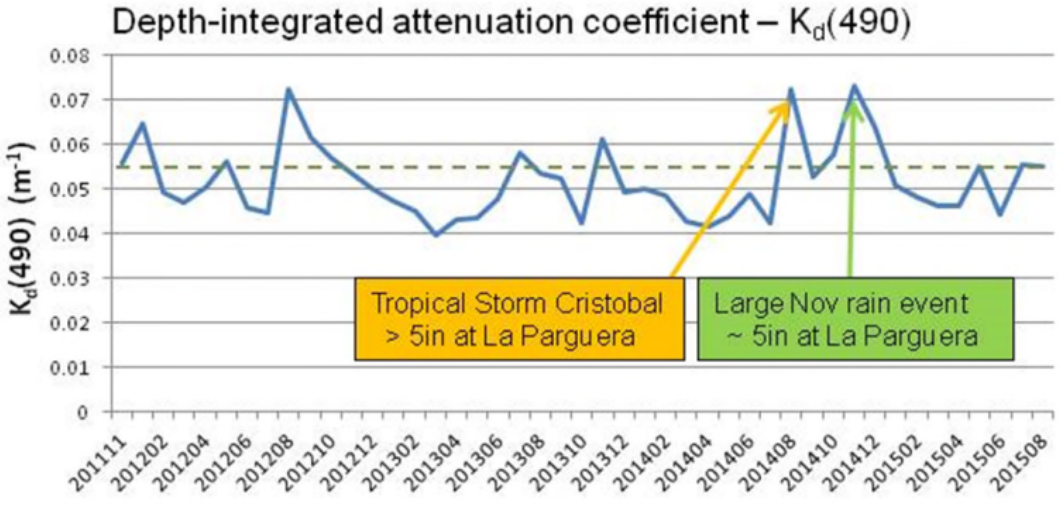

VIIRS Kd490 Time Series for PR-USVI Region, Guanica and Guanica/La Parguera
Kd490 (m-1)
0.2
0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
201111
201201
201203
201205
201207
201209
201211
201301
201303
201305
201307
201309
201311
201401
201403
201405
201407
201409
201411
201501
201503
201505
201507
DATE: YYYYMM
Mean GUA
Mean GUA/LP
Mean PR USVI

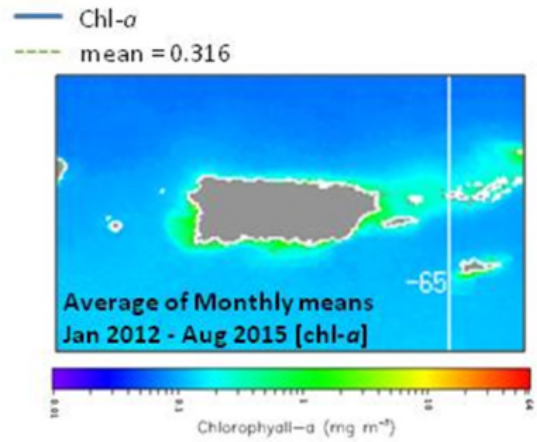
Results

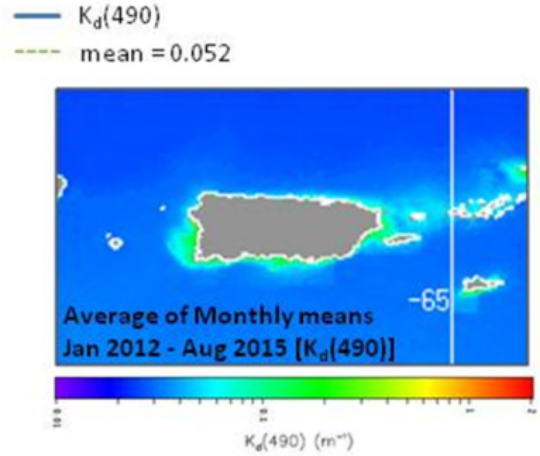
10 km around Point A (17.92347 °N, 66.90108 °W)

Target Site: Guánica watershed discharge site, Puerto Rico

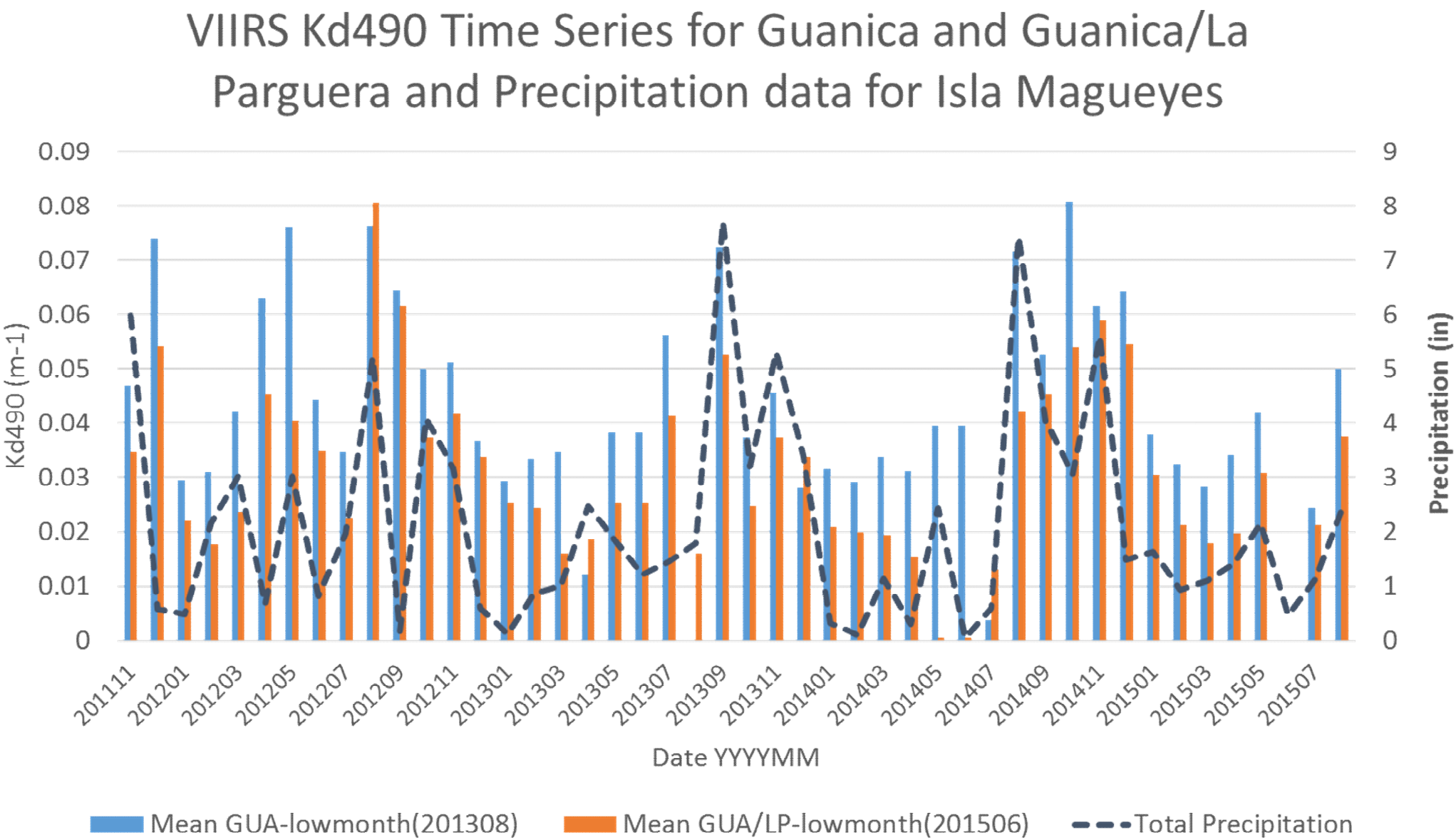






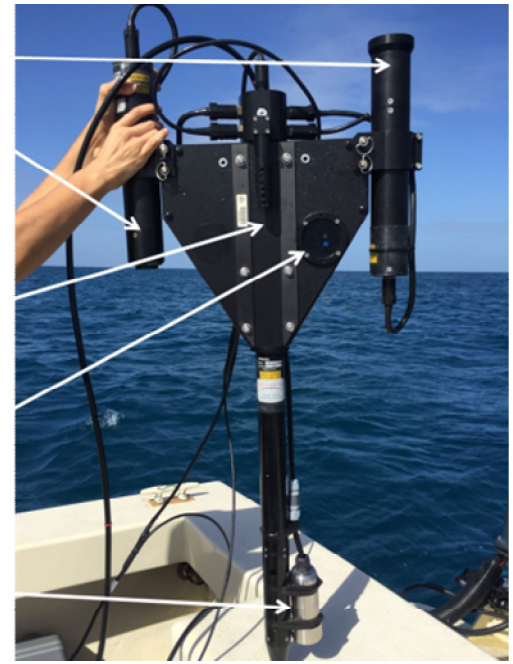


Results


VIIRS Kd490 Time Series for Guanica and Guanica/La Parguera and Precipitation data for Isla Magueyes
Kd490 (m-1)
0.09
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
Precipitation (in)
9
8
7
6
5
4
3
2
1
0
201111
201201
201203
201205
201207
201209
201211
201301
201303
201305
201307
201309
201311
201401
201403
201405
201407
201409
201411
201501
201503
201505
201507
Date YYYYMM
Mean GUA-lowmonth(201308)
Mean GUA/LP-lowmonth(201506)
Total Precipitation

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 samples
    - CHL, TSS, CDOM

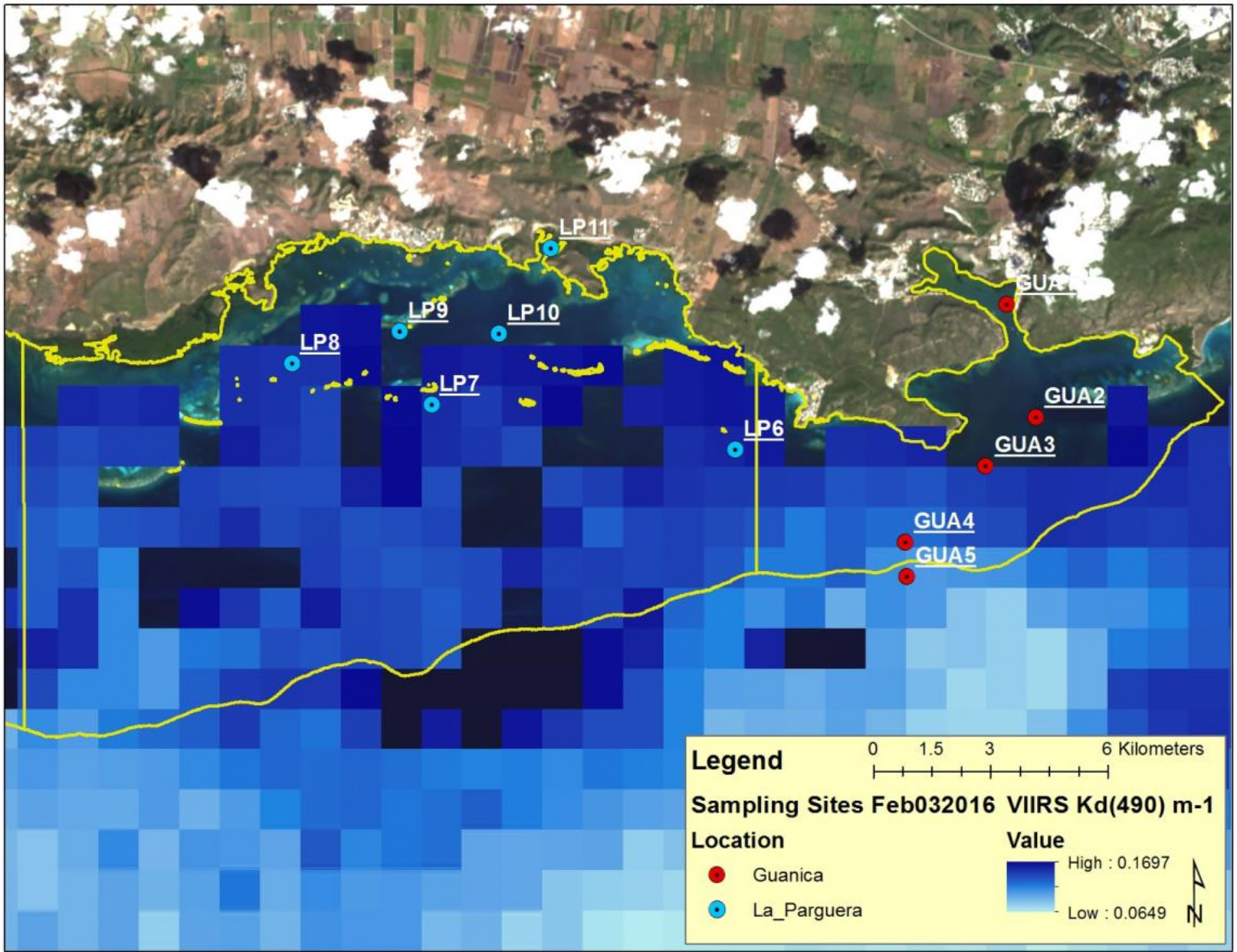


Hydroscat-6

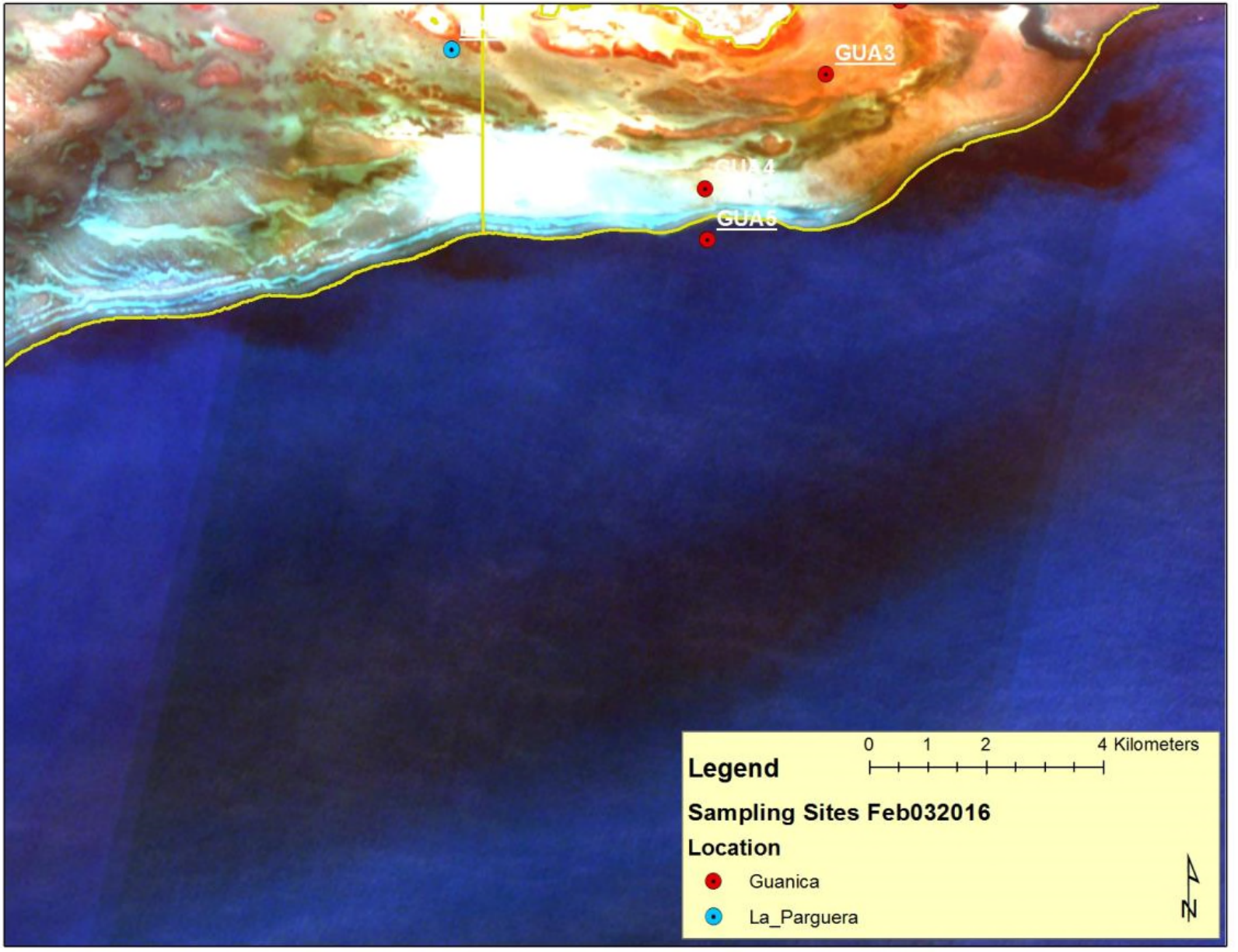
GER1500

SCUFA

Results (VIIRS-Field Sampling)

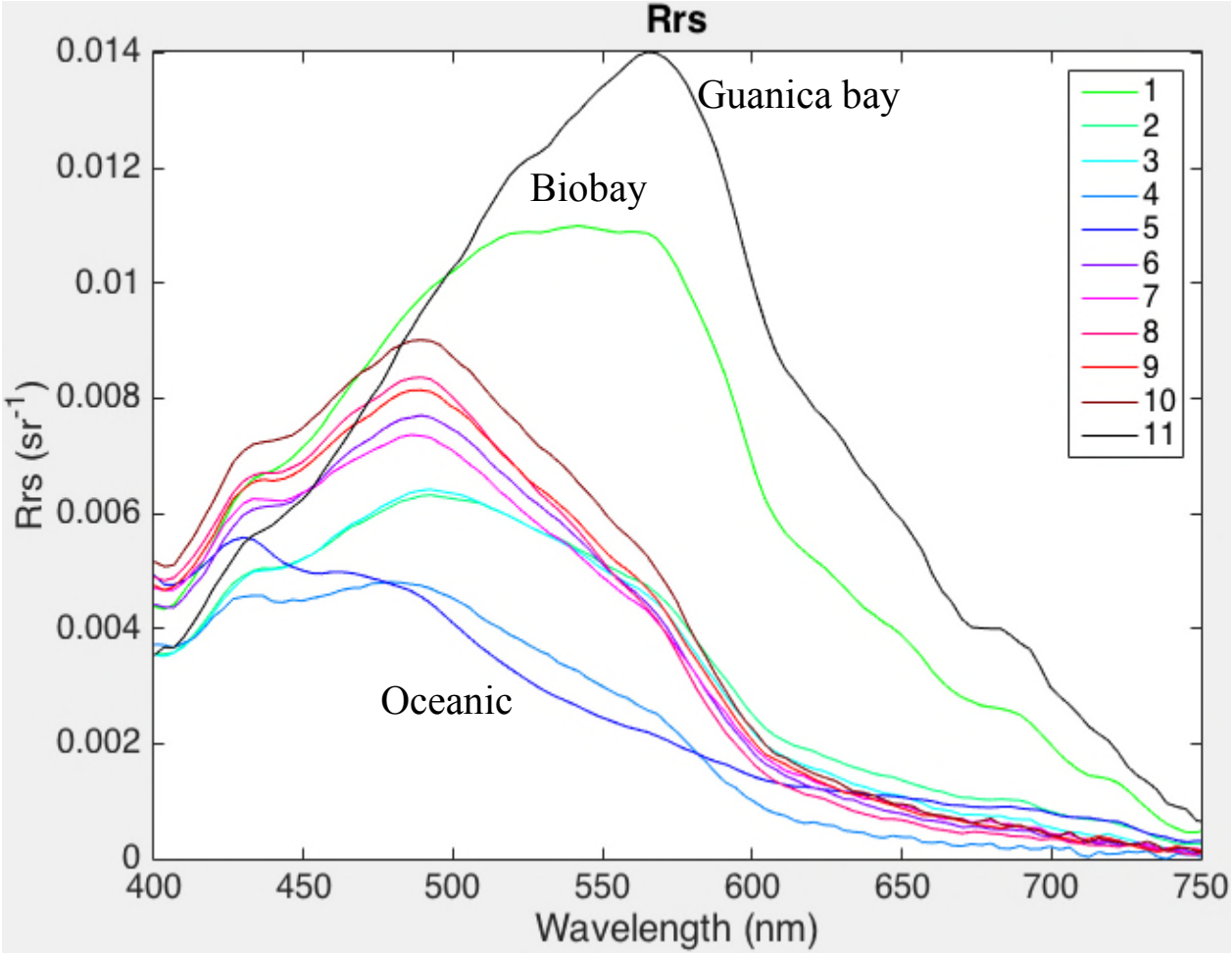


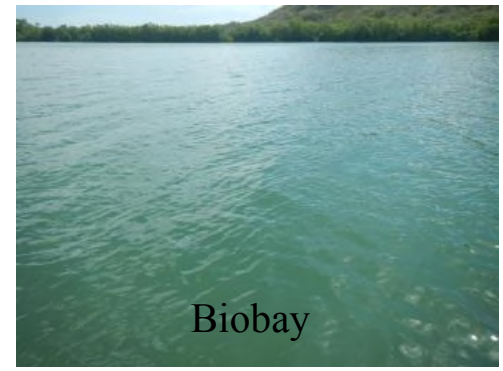
Results (Landsat 8)



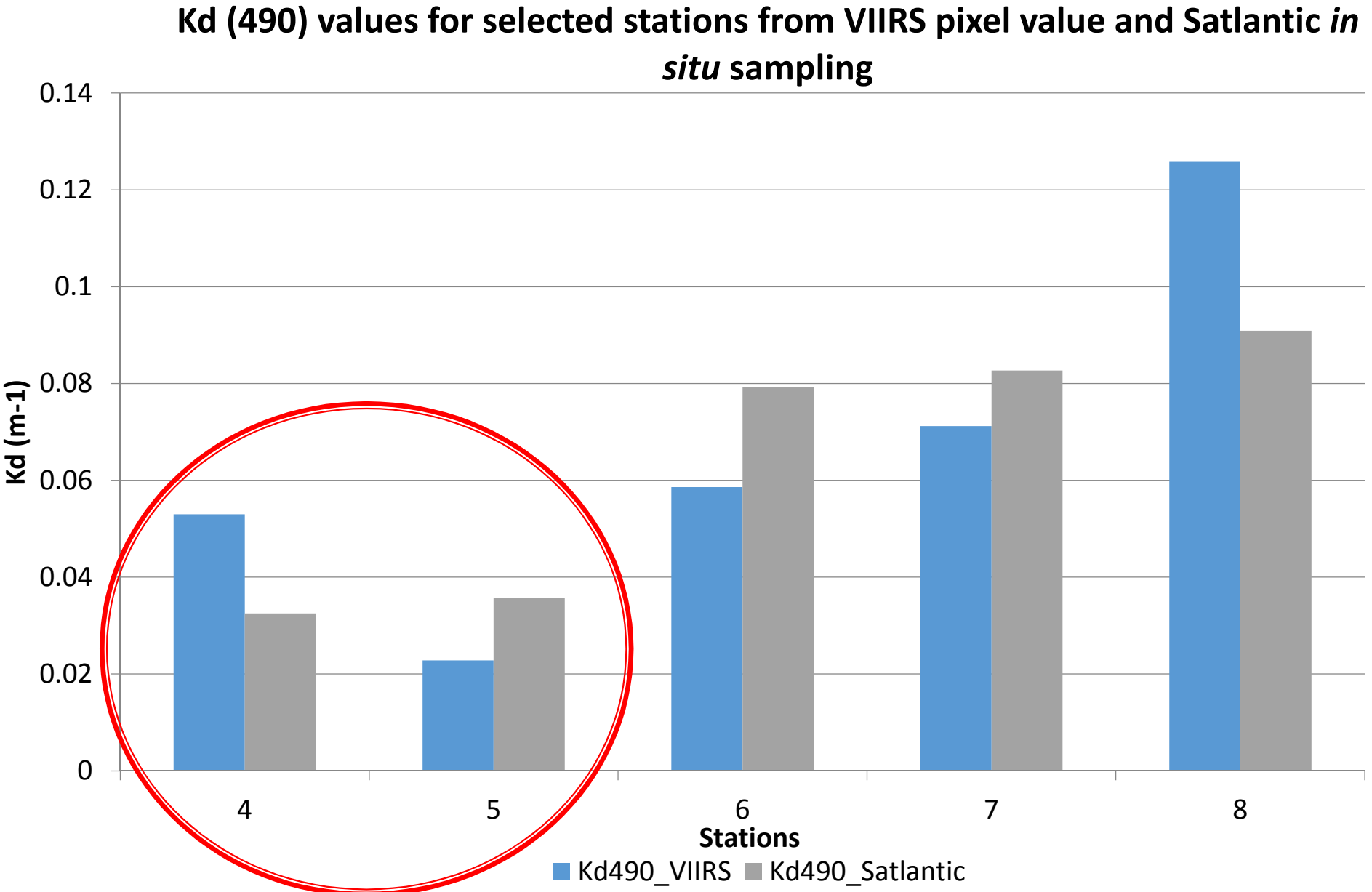
Results- Field Sampling

Satlantic surface remote sensing reflectance



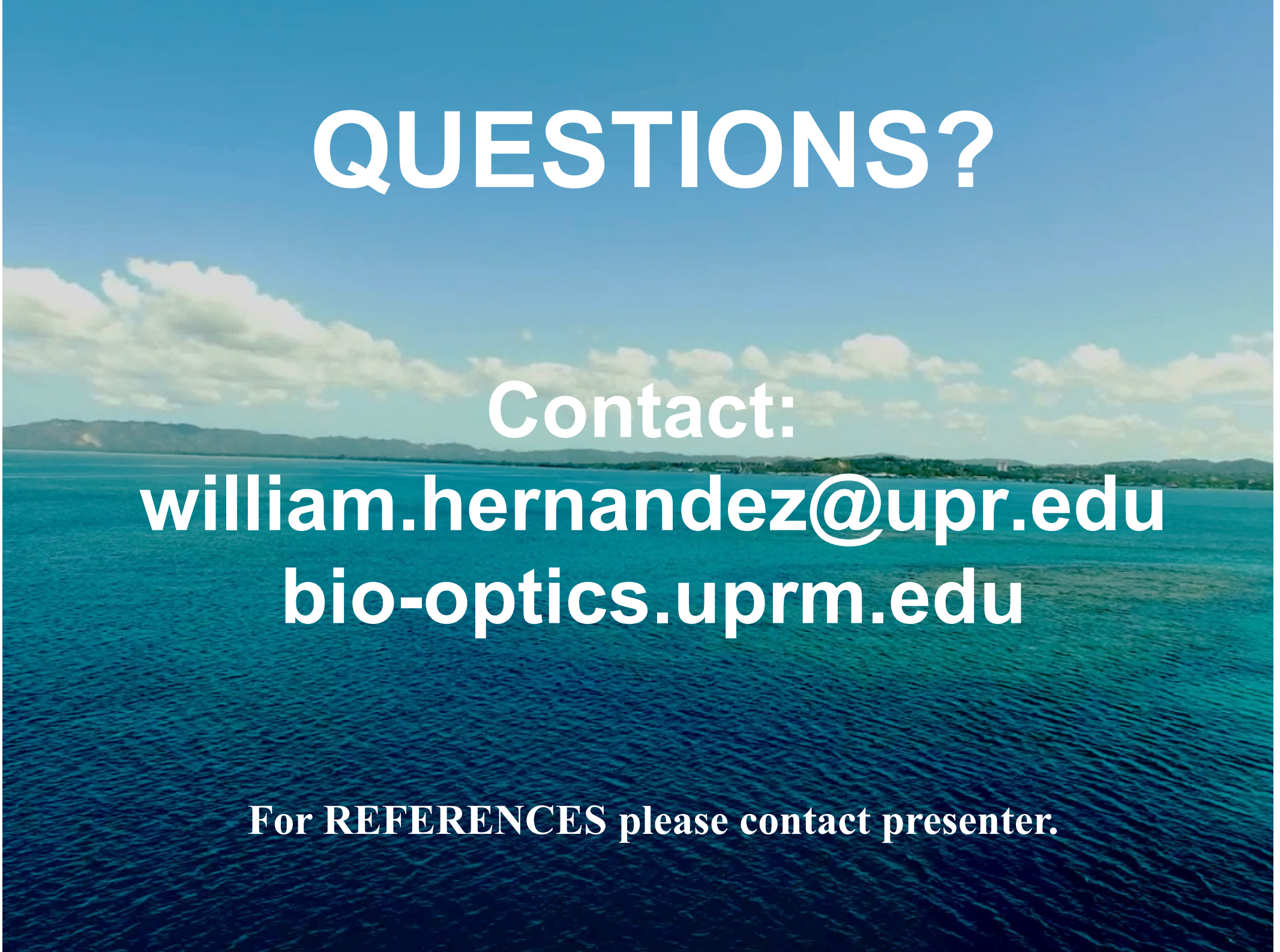


Results- Field Sampling



Conclusions

- Provide *in situ* data for cal/val of satellite remote sensing data and improve local ocean color algorithms.
- Characterize the bio-optical properties of the waters.
- Provide watershed managers a long-term monitoring and near-real time data of water quality (CHL, TSS, CDOM) parameters.
- Develop additional satellite derived products using multi-resolution sensors and field data.


QUESTIONS?
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For REFERENCES please contact presenter.