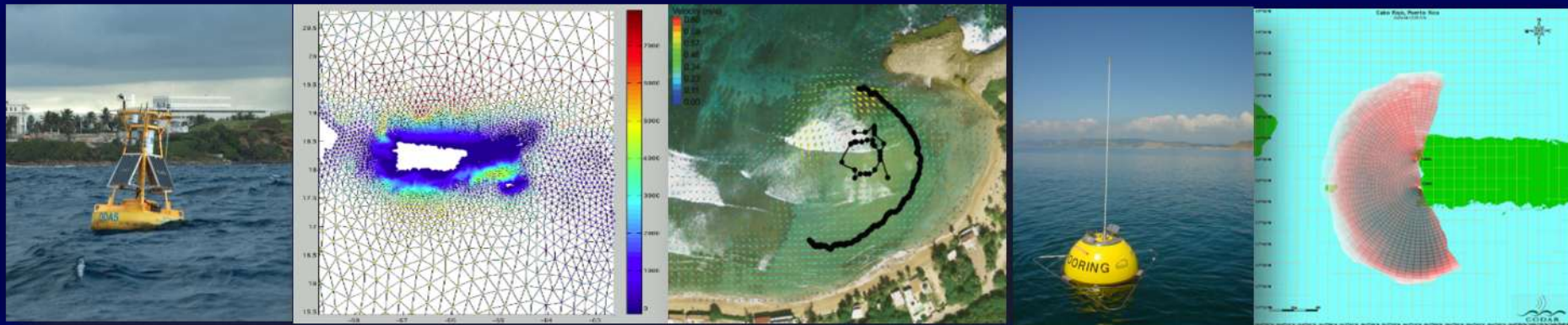


# Development of Remotely Sensed Coastal Water Quality Data Products in Support of Management for the CariCOOS Region



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# CariCOOS

## IOOS Regional Associations

A network of 11 regional coastal ocean observing systems that meet national and regional needs for local ocean observations, data management, and modeling

- Regions meet National missions through...

- Expanded observations and modeling capacity

- Connections to users and stakeholders

- Implementation of national data standards

- Products transitioned to other regions and to NOAA operations



1. Alaska Ocean Observing Systems (AOOS)

2. Caribbean Regional Association (CaRA)

3. Central and Northern California Coastal Ocean Observing System (CeNCOOS)

4. Gulf Coastal Ocean Observing System (GCOOS)

5. Great Lakes Observing System (GLOS)

6. Mid-Atlantic Coastal Ocean Observing System Regional Association (MACOORA)

7. Northwest Association of Networked Ocean Observing Systems (NANOOS)

8. Northeast Regional Association of Coastal Ocean Observing Systems (NERACOOS)

9. Pacific Islands Ocean Observing System (PacIOOS)

10. Southern California Coastal Ocean Observing System (SCCOOS)

11. Southeast Coastal Ocean Observing System Regional Association (SECOORA)

12. Alliance for Coastal Technology (Sensor V & V)

# CariCOOS

The Integrated Ocean Observing System (IOOS) is a tool that provides observations of ocean and coastal areas to ensure

*Improve safety*



*Enhance our economy*

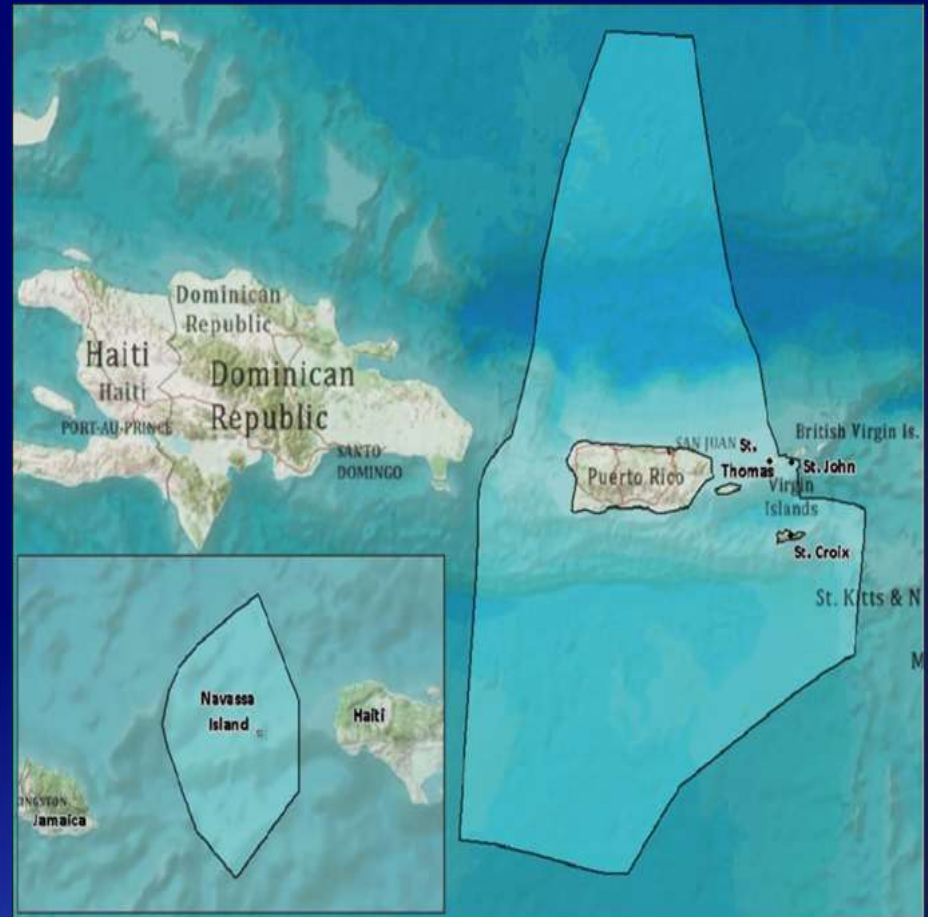


*Protect our environment*

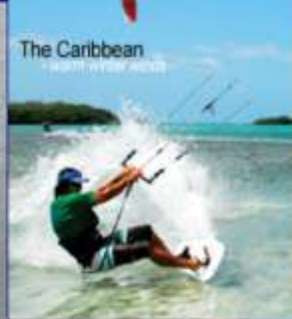


# CariCOOS Domain

- densely populated
- tourism-marine recreation
- PR & VI
- artisanal fisheries
- maritime activity
  - major shipping lanes
  - busy cruise ship ports
- hurricanes & tsunamis
- ocean energy potential  
offshore wind, OTEC
- steep, rugged bathymetry
- multiple international boundaries
- fragile marine ecosystems



# CariCOOS stakeholders



# High-Priority Observational and Forecast Needs

- Coastal waves
- Coastal currents
- Coastal inundation
- Bathymetry (navigation, inundation and wave models)
- Temperature & salinity (climate change, riverine input)
- Benthic habitats
- Water quality (pathogens, visibility, sediments & pollutant plumes)

# Major water quality issues in the region

- Fecal contamination and beach closures,
- Eutrophication and sedimentation frequently driven by riverine input



Warne, A.G., Webb, R.M.T., and Larsen, M.C., 2005, Water, Sediment, and Nutrient Discharge Characteristics of Rivers in Puerto Rico, and their Potential Influence on Coral Reefs: U.S. Geological Survey Scientific Investigations Report 2005-5206, 58 p.

Development of WQ products based on remotely sensed optical properties for the identification of watershed management deficiencies.

# Coastal Water Quality Data

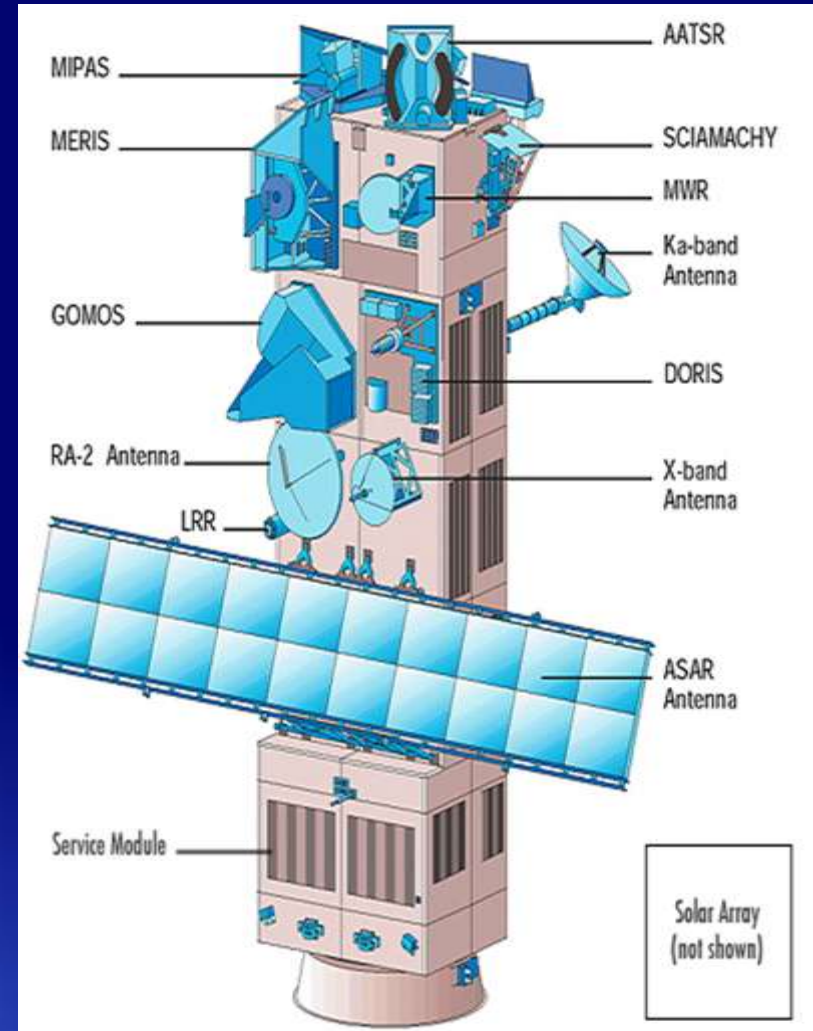
The MEdium Resolution Imaging Spectrometer Instrument (MERIS )

- measures the solar radiation reflected by the Earth
- spatial resolution of **300m**
- 15 spectral bands
  - programmable in width and position
  - in the visible and near infra-red.
- global coverage of the Earth in 3 days.

MERIS mission is the measurement of sea color in the oceans and in coastal areas.

Knowledge of the sea color can be converted into a measurement of:

- chlorophyll pigment concentration
- suspended sediment concentration
- aerosol loads over the marine domain.





# MERIS Ocean Color Data

## Historical Data:

- 2006-2009
- Level L1P

## Near Real Time:

- October 10, 2011
- Level L1P, Level L2w,  
Level L2R

## L1P

- Meta data
- Flag Codings
- Tie-point grids
- Bands
  - radiance

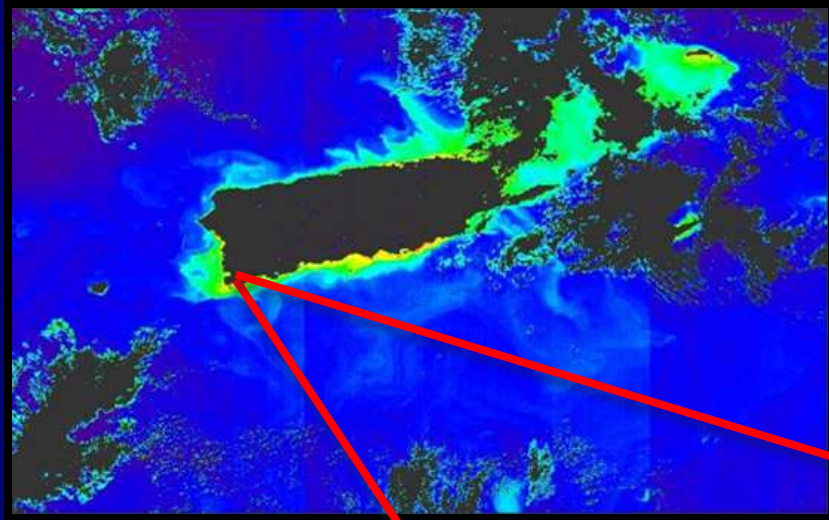
Data to Product : Beam 4.9 Software

Case 2 Regional Processor (MERIS)

## Products

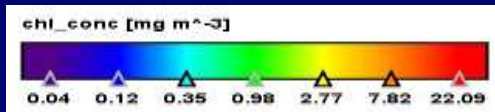
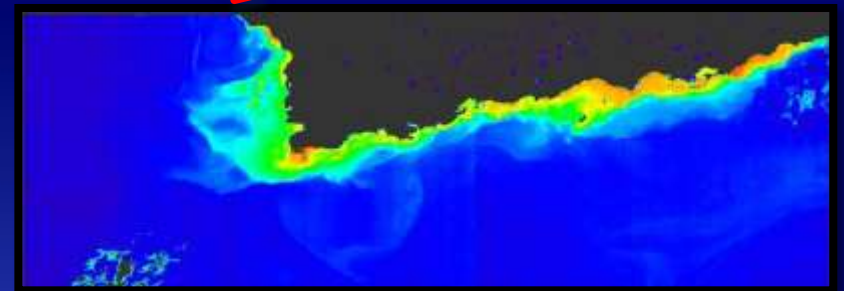
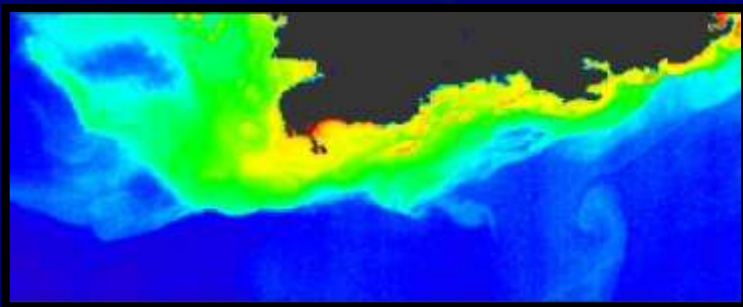
- a\_ys\_443
- a\_pig\_443
- a\_total\_443
- bb\_spm\_443
- tsm
- chl\_conc
- Z90\_max
- Kd\_490
- turbidity\_index

# MERIS Images

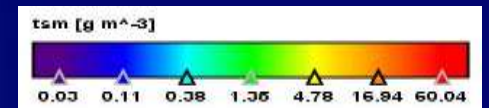


February 23, 2009

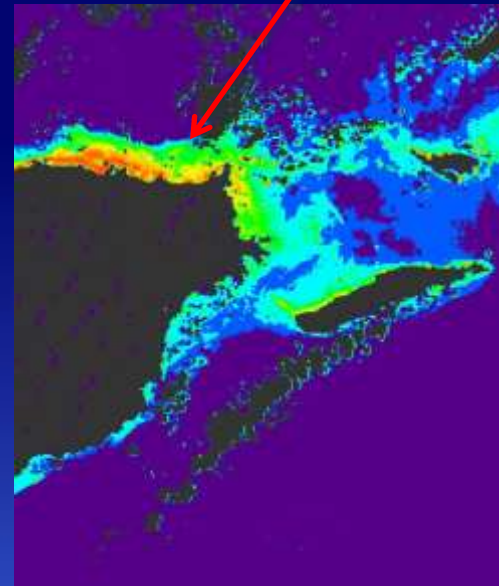
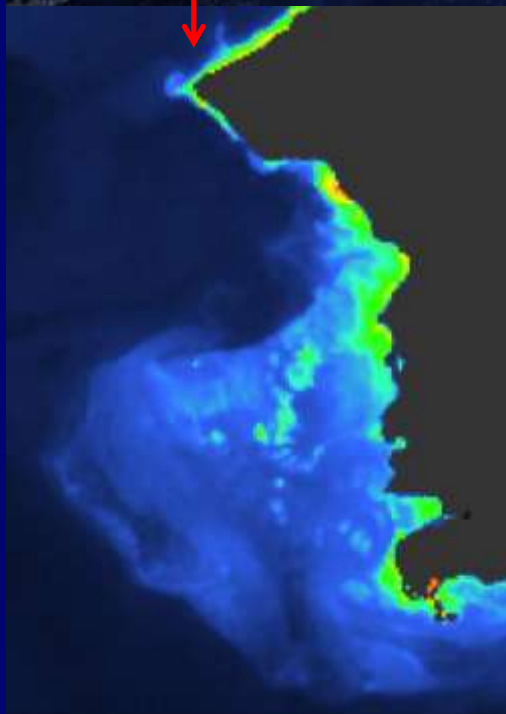
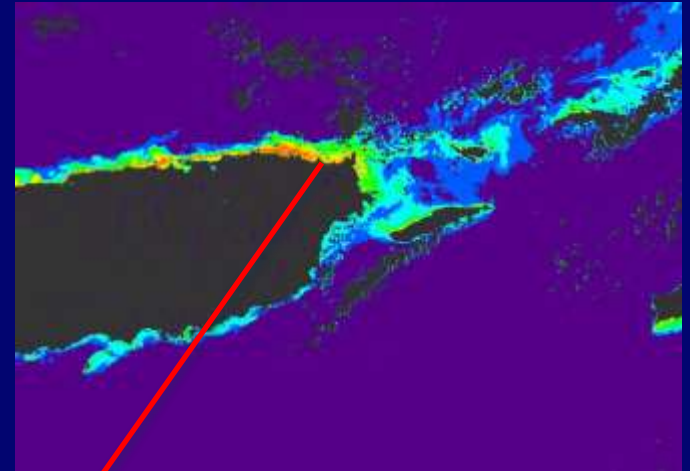
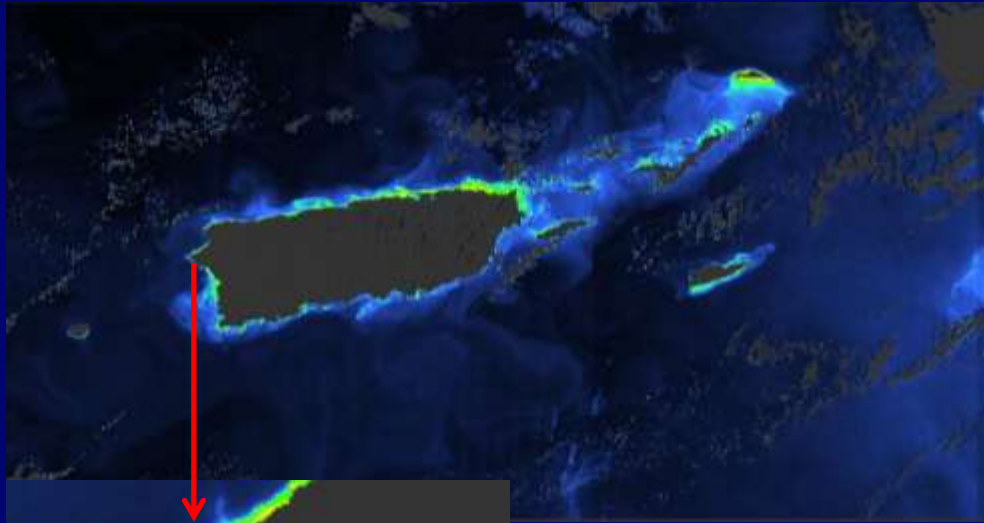
Total Suspended Matter



Chlorophyll *a*



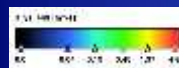
27 de marzo de 2009



Turbidity Index

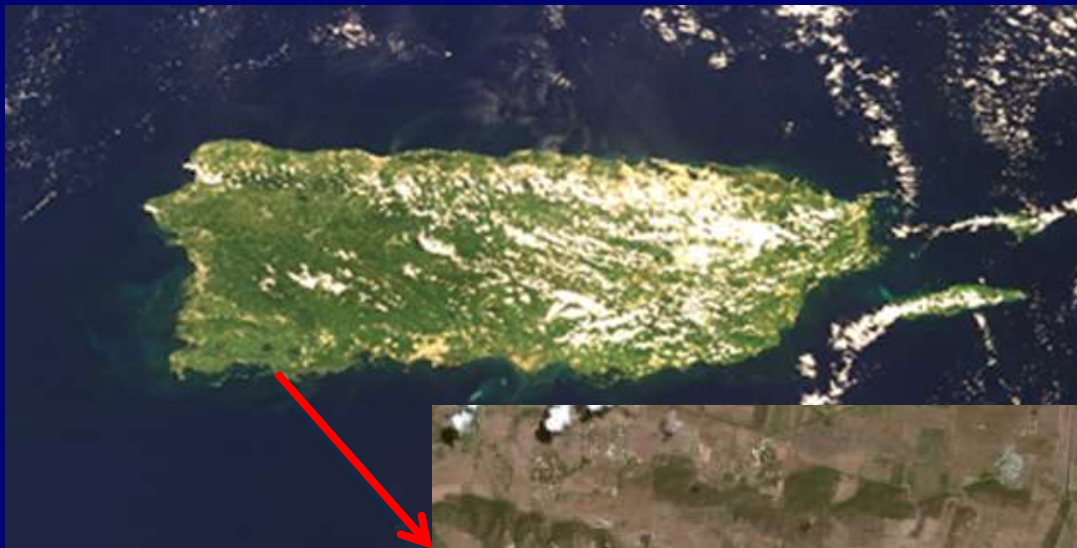


a\_ys\_443

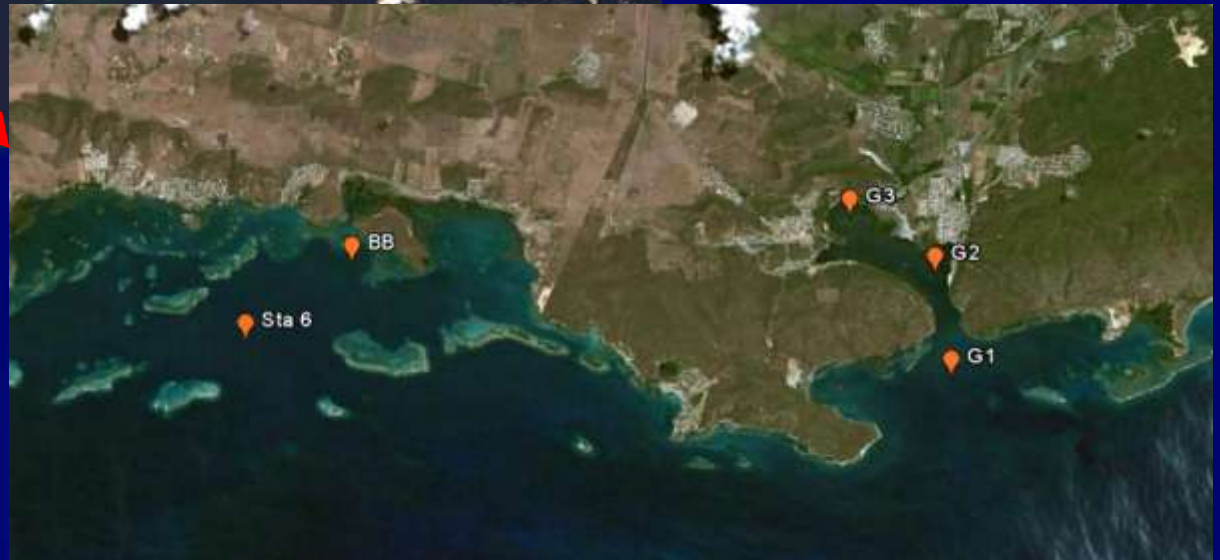


# *In Situ* Data

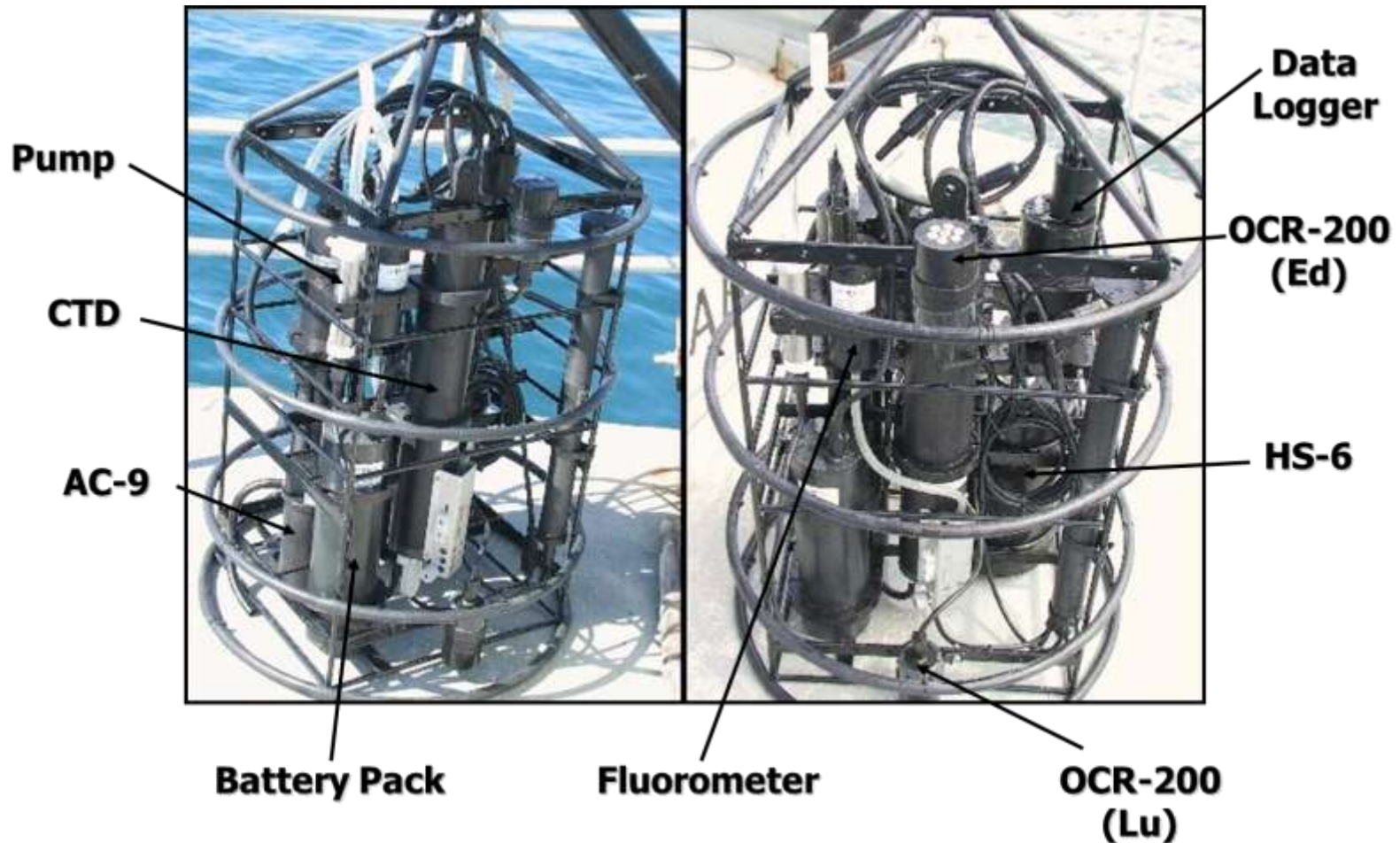
## Study Site



- G1: Outside Guanica Bay
- G2: Inside Guanica Bay
- G3: River plume in Guanica Bay
- BB: Outside Bahia Fosforescente
- Sta 6: Out Enrique Reef



# Optic Rosette



# Sample Procedure and Data Analysis

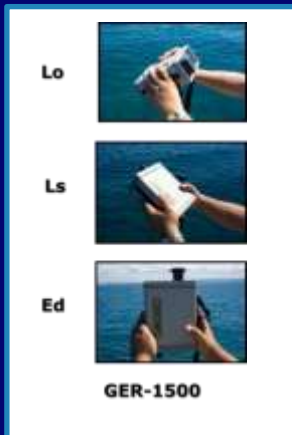
Water collection



Chlorophyll *a* analysis

Total Suspended Matter, CHN

Colored Dissolved Organic Matter

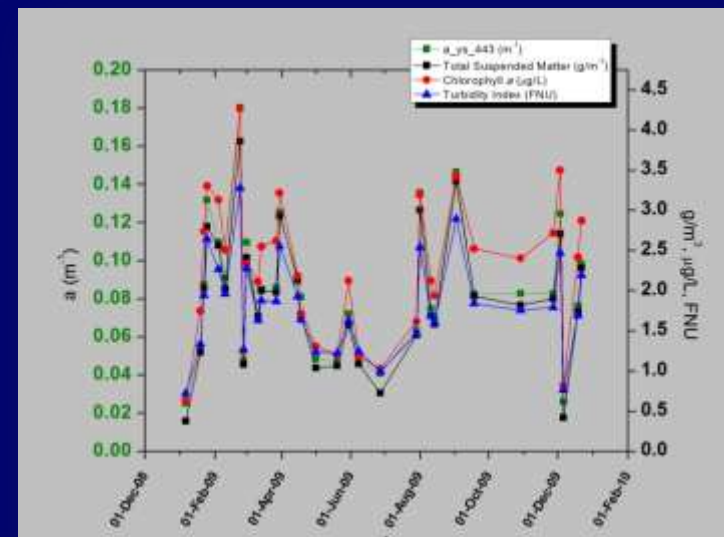
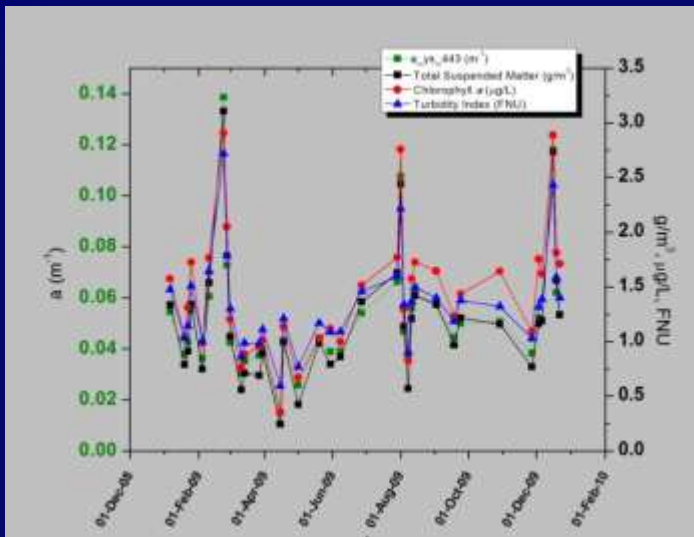


Field Portable  
Spectroradiometer

Optical Rosette

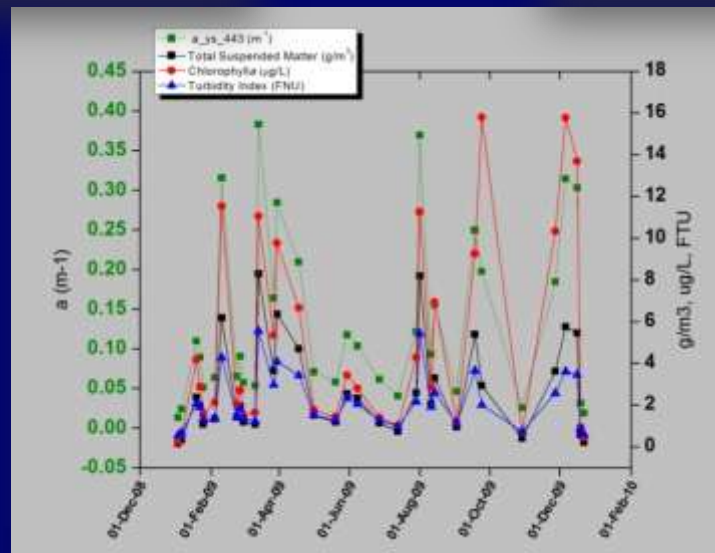
- Absorbance, *a*
- Attenuation, *c*
- Scattering, *b*
- Backscattering, *bb*

# Time Series

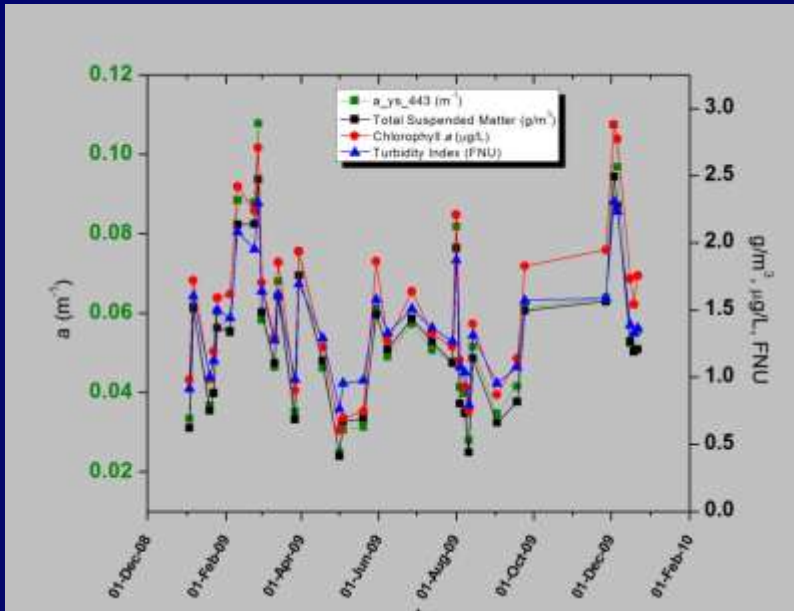


G1

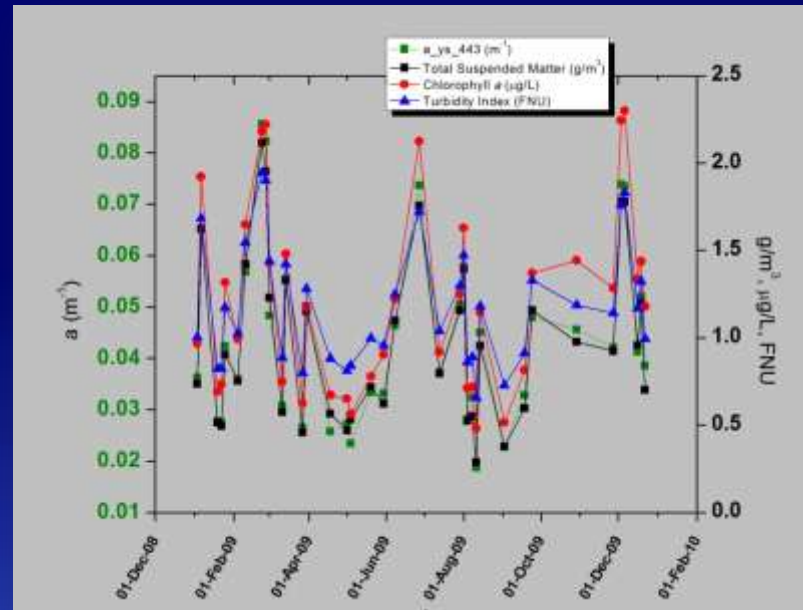
G2



G3



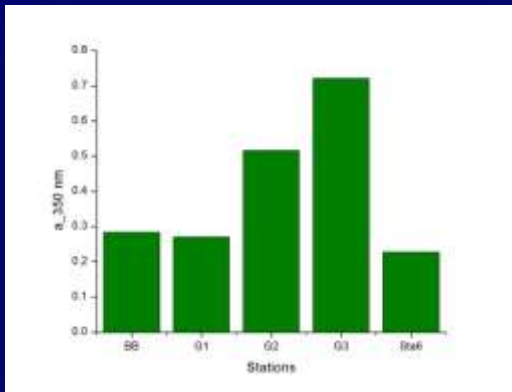
BB



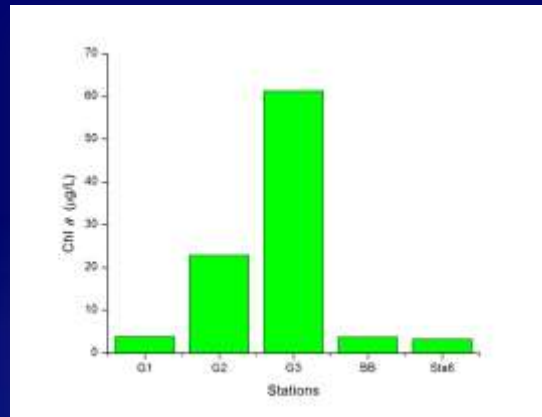


# Validation Effort

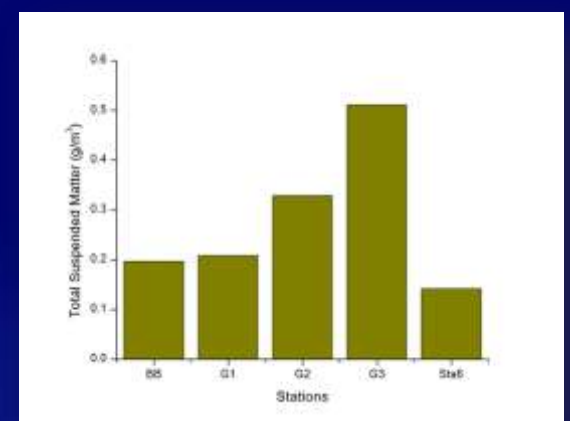
Water Quality Data: *in situ* samples



Colored Dissolved Organic Matter absorption (350nm)



Chlorophyll a



Total Suspended Matter

# Future Work

- ftp available data
- 2006 to 2008 Time Series
- Complete 2010-2011 images set
- Visibility Index (vertical and horizontal)
- Identify regions of interest
- Bottom effect correction
- Install *in situ* instrument

IOOS INTEGRATED OCEAN OBSERVING SYSTEM  
CARIBBEAN COASTAL OCEAN OBSERVING SYSTEM



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Ocean Color



### UPDATE ON 10 YEAR BUILD-OUT PLAN

The CariCOOS 10-year buildout plan has been submitted and is available for stakeholders to download [here](#) (two excel files). A summary of result used to inform the build-out plan will be available shortly. Thanks to all those stakeholders who participated.

We maintain the survey open [here](#) for future reference.

### Winds

Data Table

Follow us on **twitter**

### What is CariCOOS

CariCOOS is the observing arm of the Cari...

Waiting for http://www.caricoos.org/drupal/...

Water Quality Product Development | www.caricoos.org - Mozilla Firefox

http://www.caricoos.org/drupal/node/183

IOOS INTEGRATED OCEAN OBSERVING SYSTEM  
CARIBBEAN COASTAL OCEAN OBSERVING SYSTEM



## Water Quality Product Development

in situ validation effort



- Conditions @  
Rincon 3:35 AM  
Wave height 8.2 ft  
from N17 deg) @ 7.3 sec
- Conditions @  
Rincon 3:05 AM  
Wave height 8.5 ft  
from N17 deg) @ 7.3 sec
- Conditions @  
Rincon 2:35 AM  
Wave height 9.2 ft  
from N17 deg) @ 7.3 sec
- Conditions @  
Rincon 2:05 AM  
Wave height 9.2 ft  
from N17 deg) @ 7.4 sec

Sponsors





Thank You