

Long-term water quality observations in South Florida:

Using shipboard data, bio-optical profiling, and satellite imagery to develop a resource management tool for the Florida Keys National Marine Sanctuary

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UM/RSMAS , Miami, FL**

AOML's South Florida Program (SFP)

South Florida Program Colleagues

Tom Lee

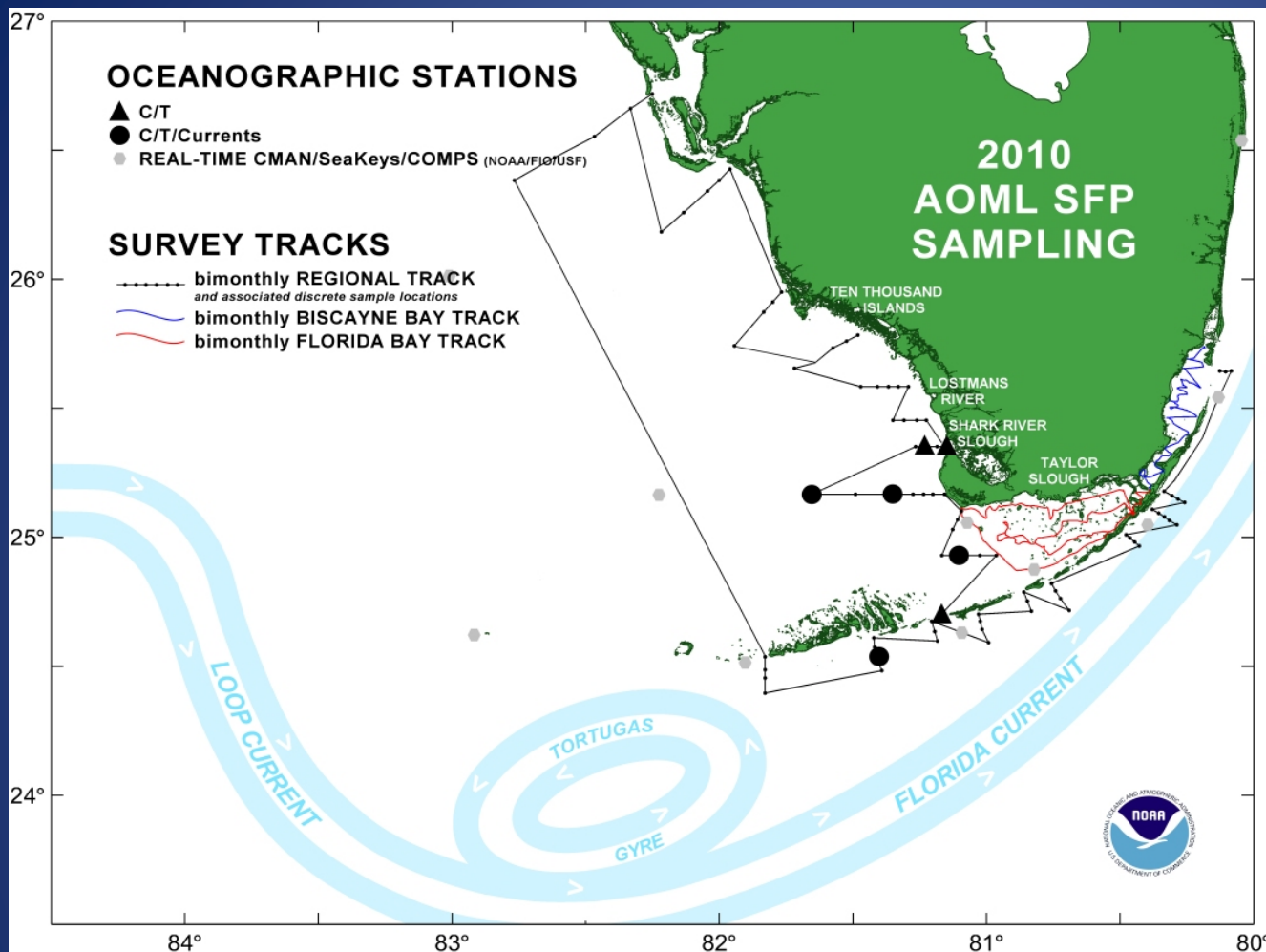
Peter Ortner

Chris Kelble

Nelson Melo

Ryan Smith

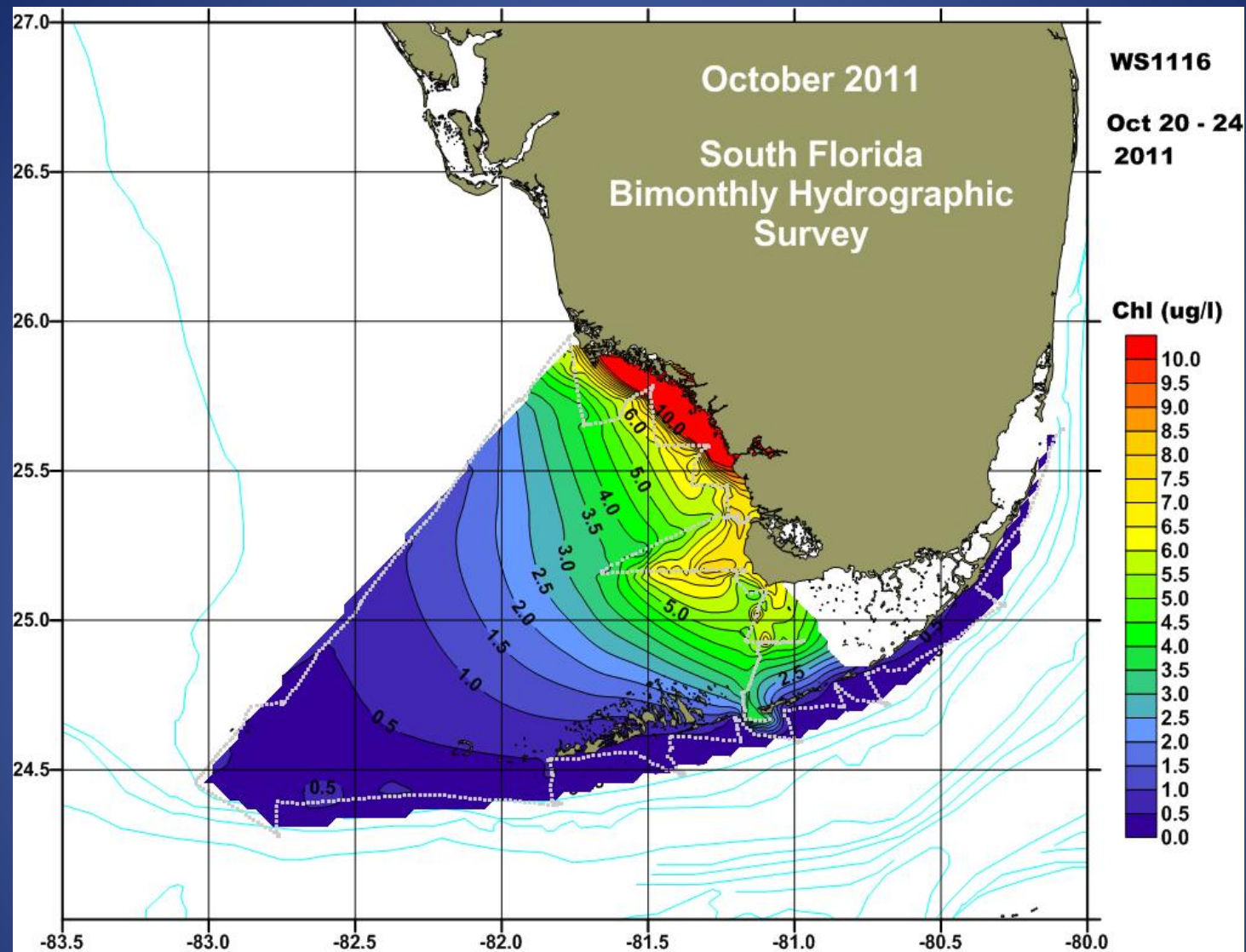
Funding for this project was provided by NOAA's Coastal Ocean Program, the USACE, and Deepwater Horizon supplemental funds.



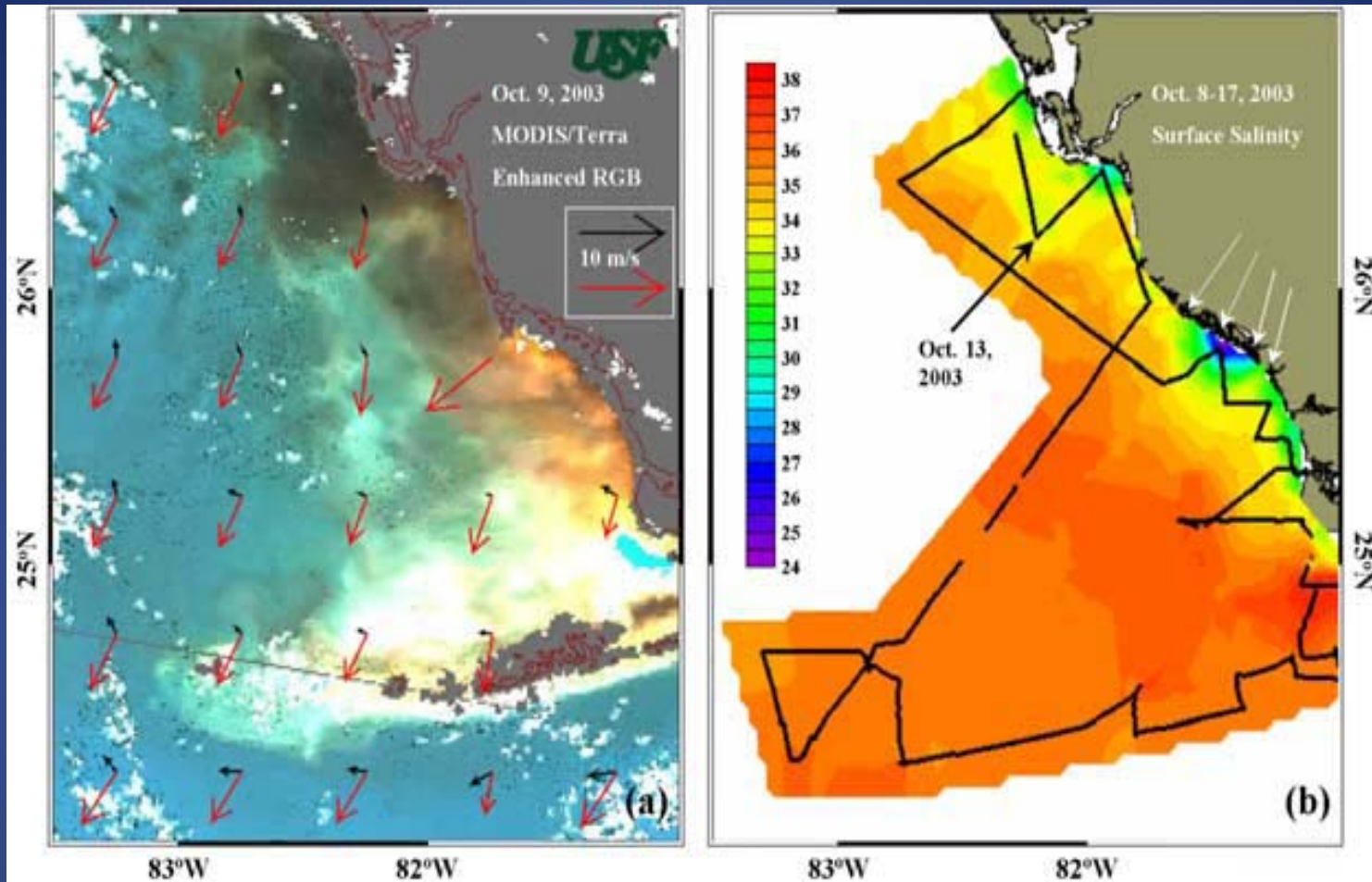
R/V F. G. Walton Smith

AOML's South Florida Program (SFP) cruise tracks, mooring locations, and satellite-tracked surface drifter deployment locations. There have been 76 surveys of this region between January 1998 and August 2012.

Our web site: <http://www.aoml.noaa.gov/sfp>

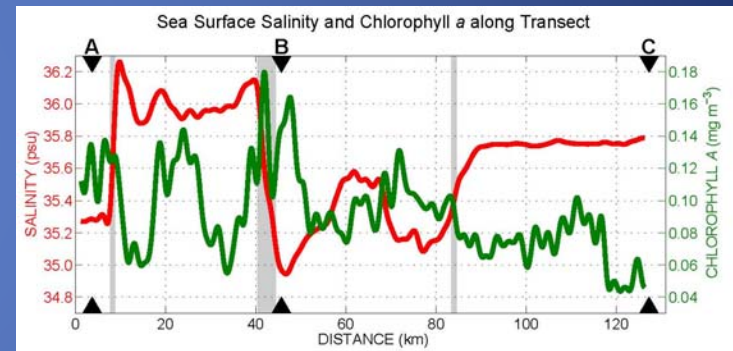
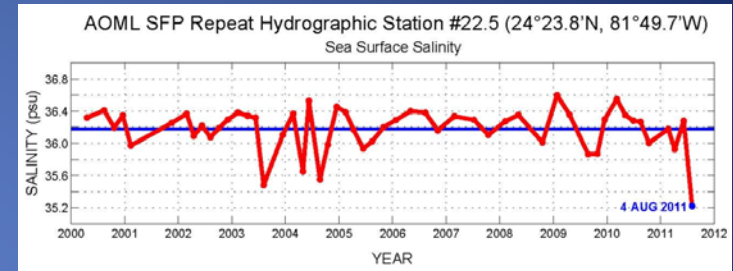
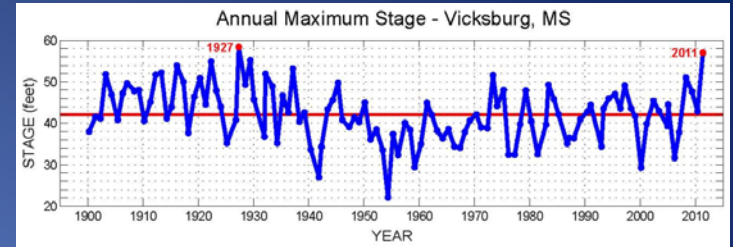
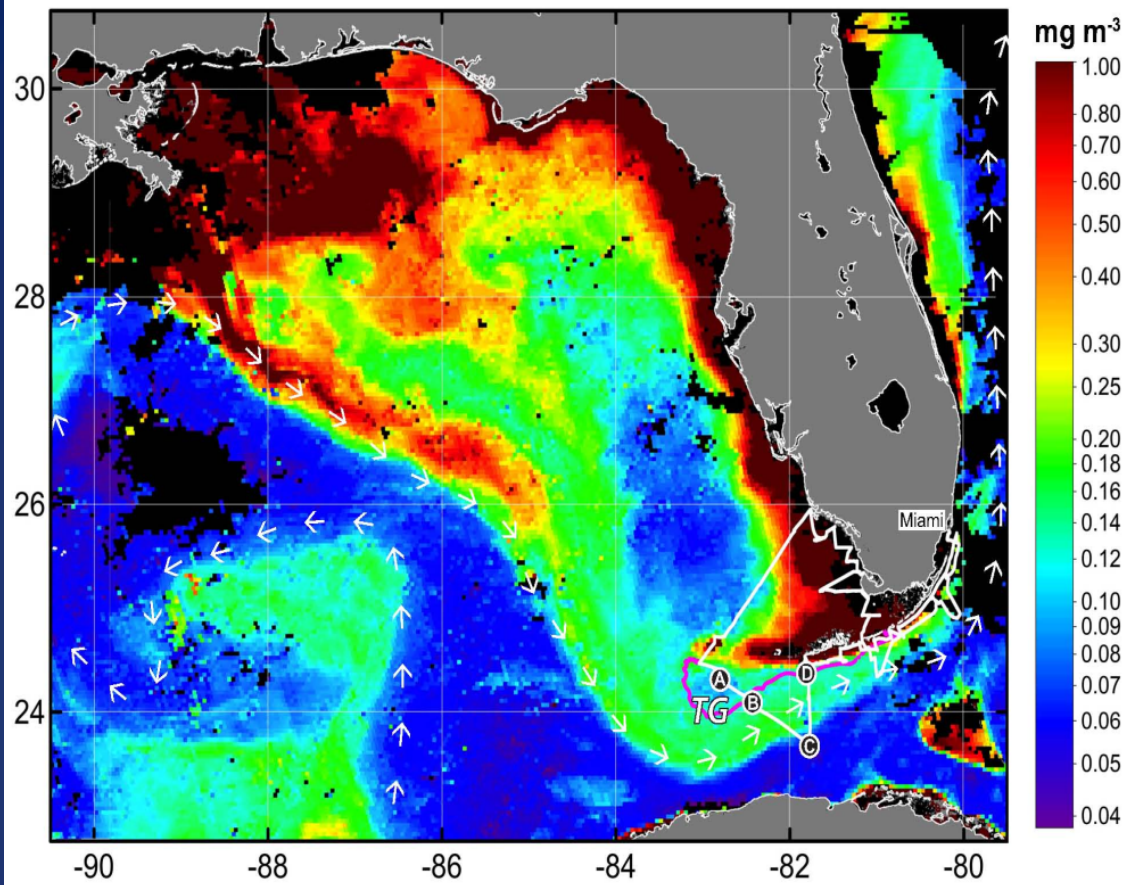


Representative cruise (from October 2011) showing a chlorophyll bloom on the southwest Florida shelf – note the high chlorophyll concentrations exiting Florida Bay toward the FKNMS through the 7-Mile Bridge channel.

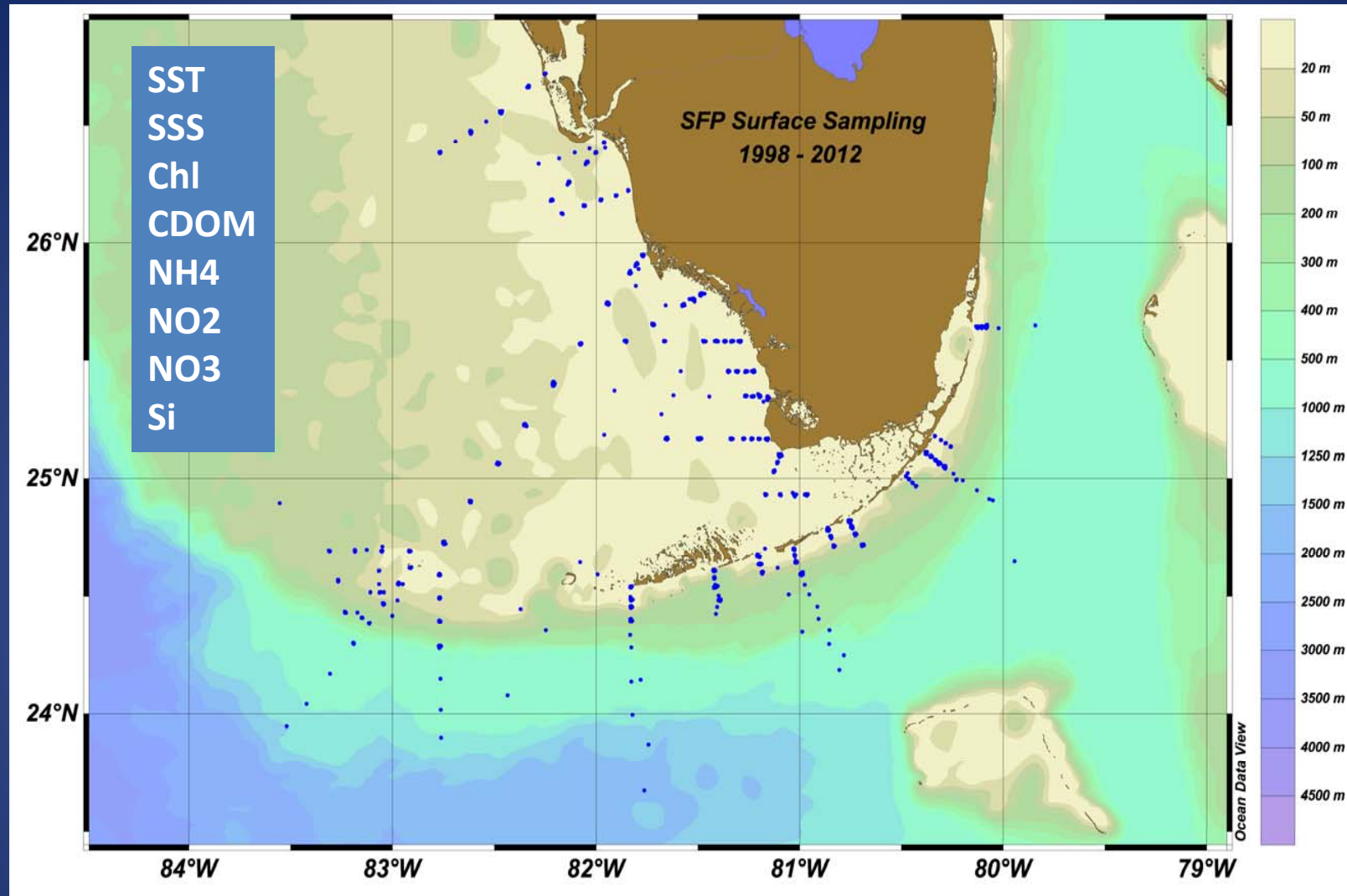


A “black water” event off the southwest Florida shelf during October 2003 was captured by a routine South Florida Program cruise.

Hu, C., F. E. Muller-Karger, G. A. Vargo, M. B. Neely, and E. Johns (2004). Linkages between coastal runoff and the Florida Keys ecosystem: A study of a dark plume event. *Geophys. Res. Lett.* 31, L15307, 4pp.



A low salinity/high chlorophyll plume from the Mississippi River flood of 2011 reached the Florida Keys by early August 2011 and was also captured by a routine SFP cruise. With prior knowledge of this event from the satellite imagery, we were able to modify our cruise track and data collection protocols to improve our understanding of the plume event as it passed through the FKNMS.



We have recently begun using “Ocean Data View” software to organize and analyze the SFP data. Over 6200 surface samples have been entered into the data base. We will be able to more easily produce maps, averages, time series, and many other data products using Ocean Data View.

Bio-optical Sampling

“Establish baseline optical conditions in the Florida Keys coral reefs, and quantify spatial and temporal variability”

CRCP Optics Project Partners:

Frank Muller-Karger (USF)

Chuanmin Hu (USF)

Sean Morton (FKNMS)

Funding for this project was provided by NOAA’s Coral Reef Conservation Program (CRCP).

“Establish baseline optical conditions in the Florida Keys coral reefs, and quantify spatial and temporal variability”

Goals:

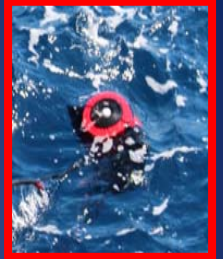
- 1. Characterize the optical properties of the coastal waters in South Florida including over the FKNMS coral reefs.**
- 2. Assess baseline and time-varying water quality attributes such as chlorophyll and turbidity.**
- 3. Provide in situ data to improve satellite algorithms and help to validate satellite ocean color imagery for use as an interpretive and predictive tool.**

This will result in improved science-based decision making capabilities for the south Florida regional coral reef resource managers.

Optical Instruments used on the SFP Cruises since 2009

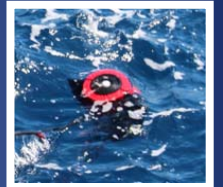
PRR2600 Profiling Reflectance Radiometer System

Instantaneous multi-wavelength profiles of down-welling irradiance (PAR, or Photo-synthetically Active Radiation -- 400-700 nm) and up-welling radiance over the channels 412, 443, 490, 510, 555, 565, 665 nm.



PUV2500 Profiling Ultraviolet Radiometer

Instantaneous multi-wavelength profiles of up-welling irradiance over the ultraviolet channels 305, 340, 380 nm.



Hyper-Profiler and Hyperspectral Ocean Colour Radiometer (HyperOCR)

Instantaneous multi-wavelength profiles of down-welling and up-welling radiance-irradiance (provides 136 channels of calibrated optical data from 350 to 800 nm).



GER1500

Field portable spectro-radiometer covering the UV, visible, and NIR wavelengths from 350 to 1050 nm. Includes an underwater enclosure to measure bottom and benthos.

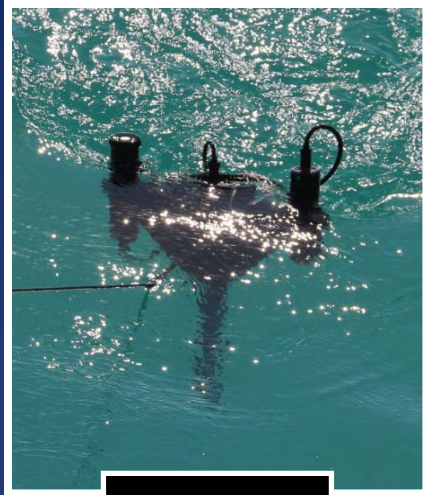


C6 Multi-Sensor Platform (flow through system)

Integrates 4 Cyclops-7 fluorometers (chl, CDOM, turbidity and crude oil) and the onboard TSG flow-through system (temperature, salinity, chl, and CDOM).

CTD profiles from surface to bottom (temperature, salinity, chl, and oxygen).

Optical characterization of the coastal waters in south Florida



HyperPro



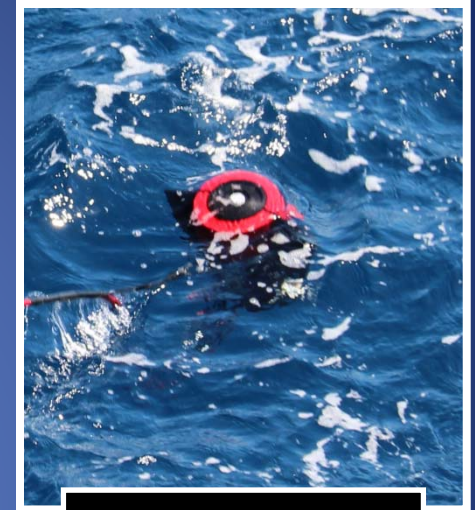
ASD

Cruises done: 11
(Jan 2009 to Feb 2012)

Optical profiles done:

PRR2600:	121
PUV2500:	45
HyperPro:	43
GER1500:	91
ASD:	16
Ozone Monitor:	16

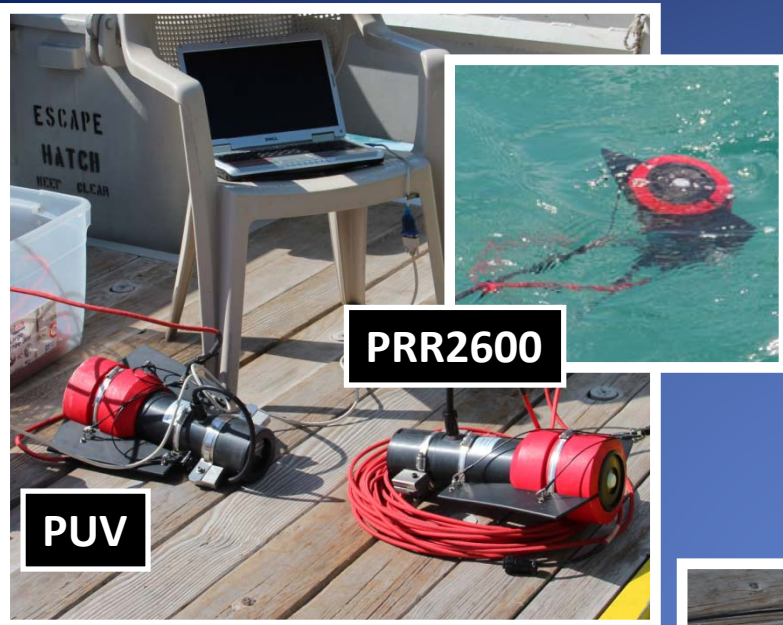
Total profiles = 332



PRR2600 & PUV

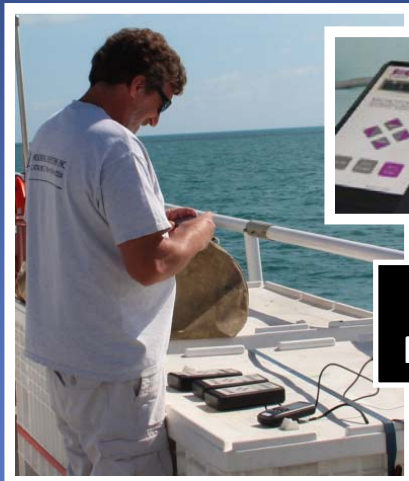


GER1500

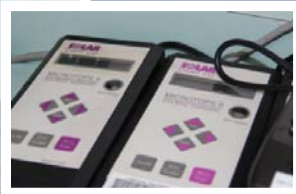


PRR2600

PUV



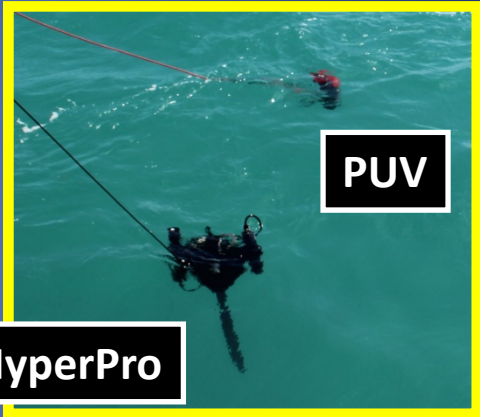
Ozone Monitor



AMD



HyperPro



PUV



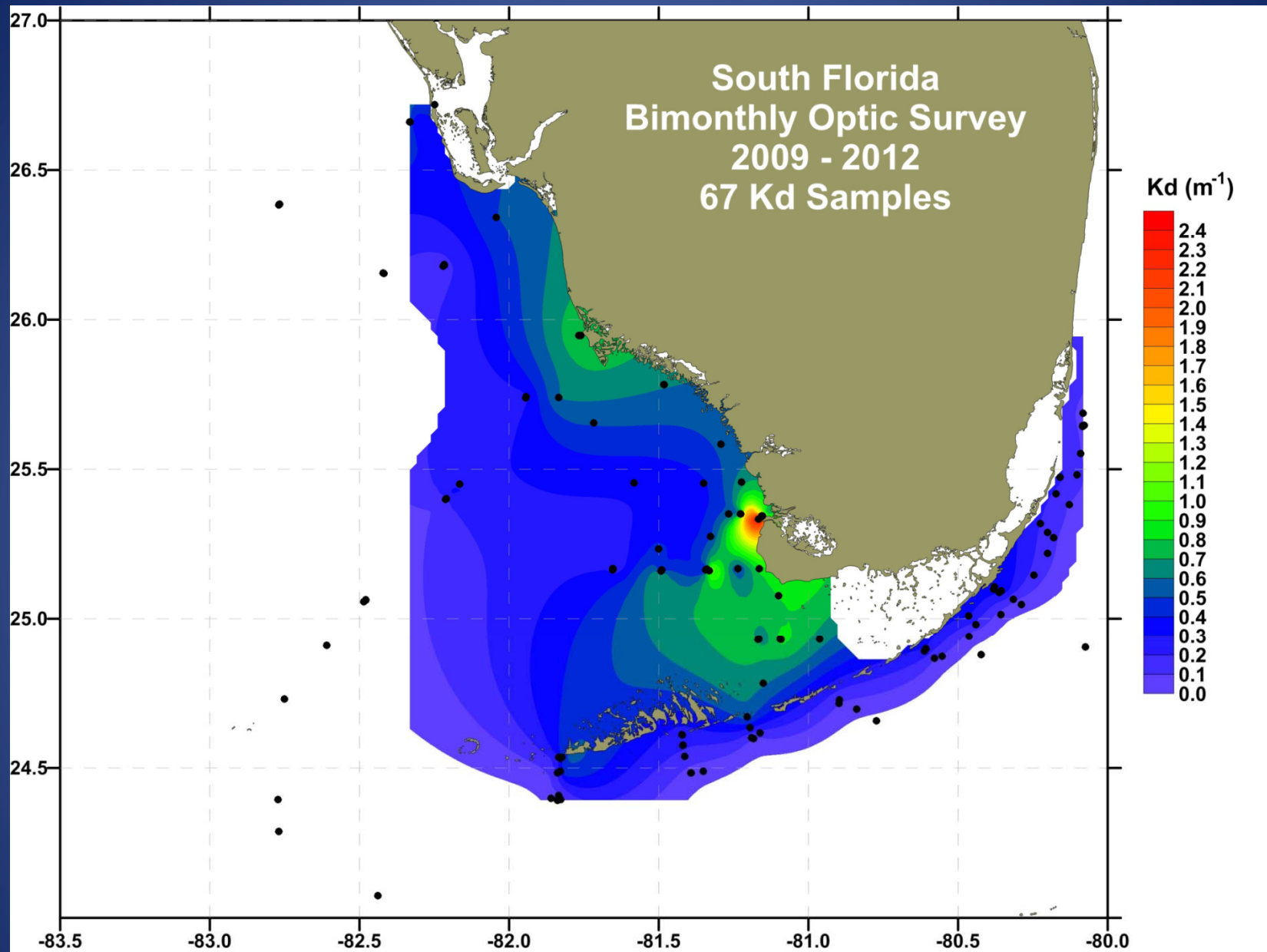
GER1500



Hyper Pro

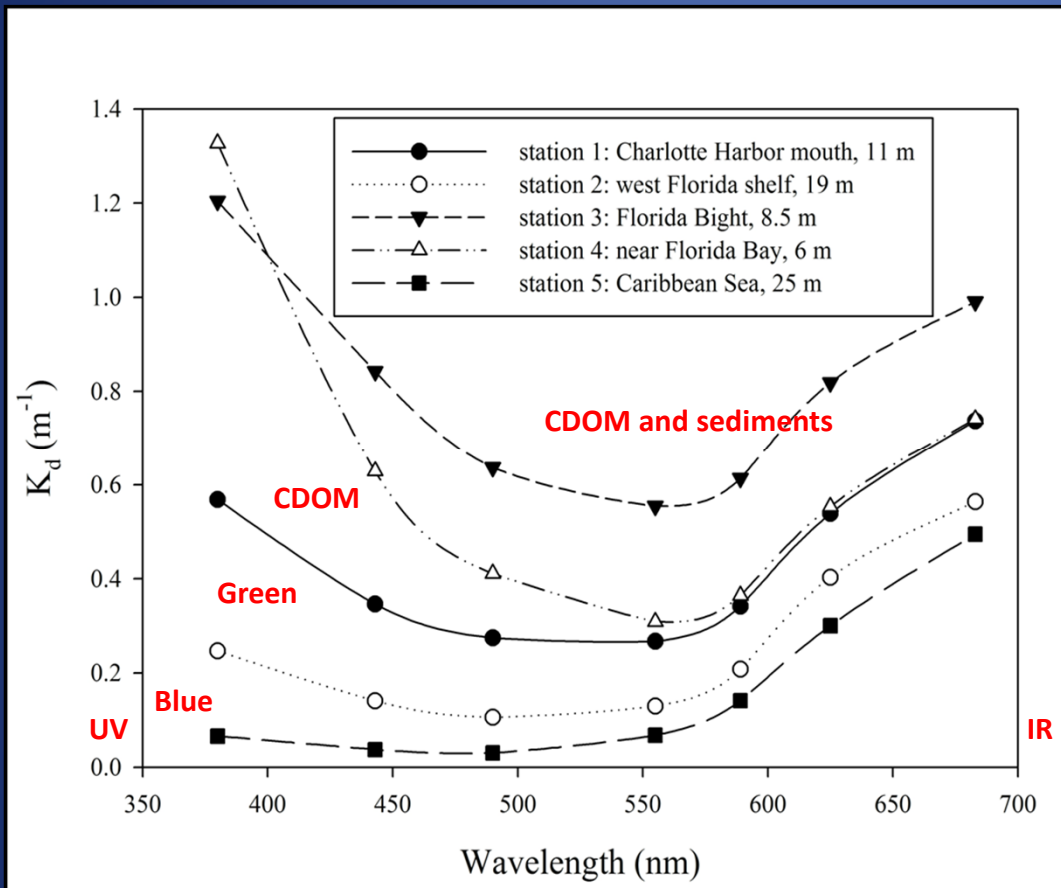


Screen shot

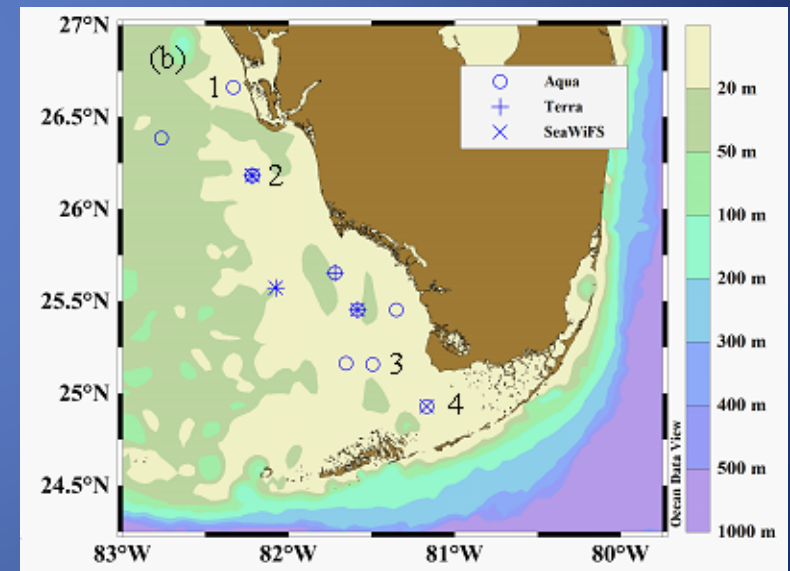


In situ diffuse attenuation coefficient Kd (PAR, or Photo-synthetically Active Radiation)

In situ Diffuse Attenuation Coefficient $K_d(\lambda)$ derived from the PRR2600 measurements



PRR2600



Zhao, J., B. Barnes, N. Melo, D. English, B. LaPointe, F. Muller-Karger, B. Schaeffer, and C. Hu (2013). Assessment of satellite-derived diffuse attenuation coefficients and euphotic depths in south Florida coastal waters. *Remote Sensing of Environment*, vol. 38-50, 131.

Lower Florida Keys

Optics Experiment Field Deployment

Sugarloaf Key

Key West



Patch Reefs Area

Moored Optics

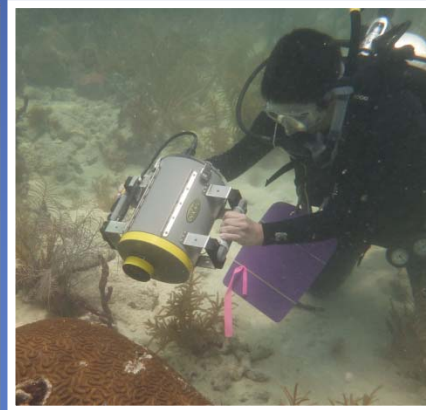
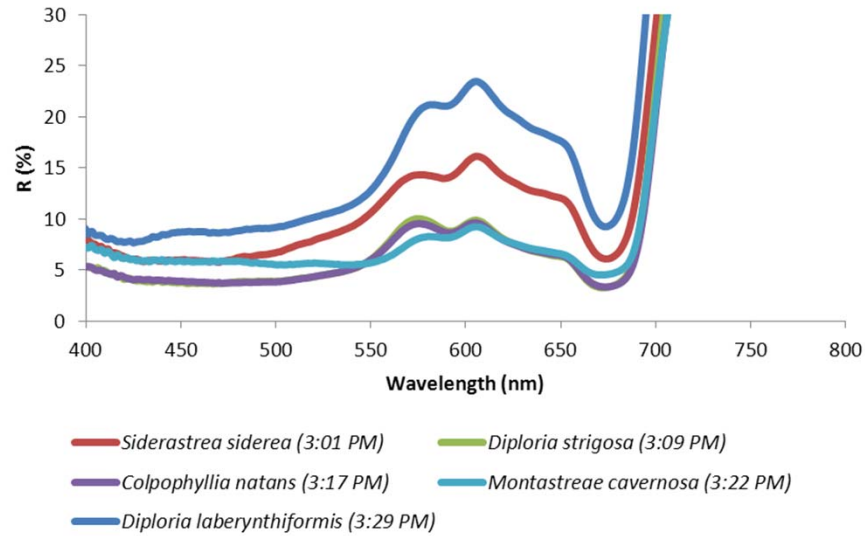
Patch Reef 2

Patch Reef 1

Intensive bio-optical experiment in the middle Keys involving shipboard, unmanned aircraft, satellite, underwater diving operations, and moored optical instruments.

Underwater reflectance of stony corals, seagrass, and sand offshore of Sugarloaf Key, May and October 2012

Underwater reflectance of several stony corals (Oct 19, 2012)

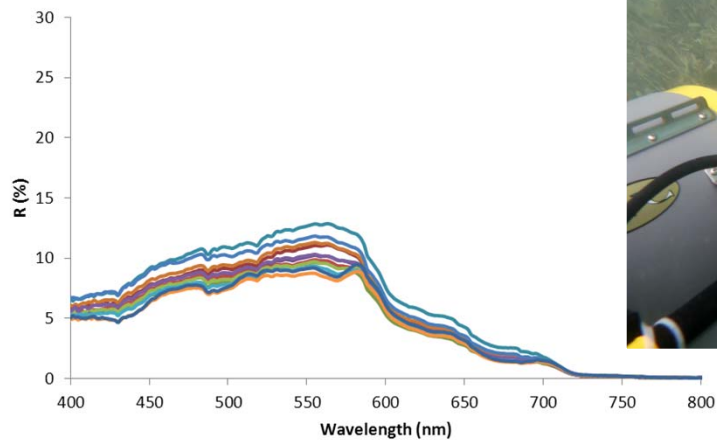


coral



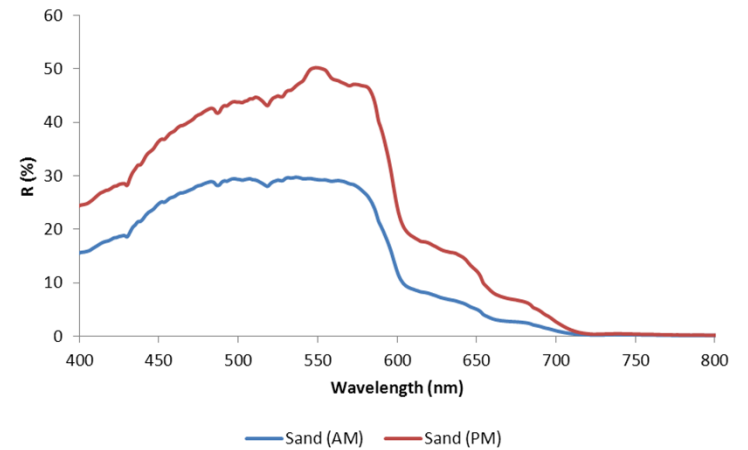
sand

Underwater reflectance of seagrass on May 16, 2012



seagrass

Underwater reflectance of sand (May 18, 2012)



Recent SFP publications (2012 – 2013)

OCEAN ACIDIFICATION REFUGIA OF THE FLORIDA REEF TRACT

D. Manzello, I. C. Enochs, N. Melo, D. K. Gledhill, James Hendee, and E. M. Johns (2012).
PLoS ONE, 7(7): e41715. doi:10.1371/journal.pone.0041715.

ASSESSMENT OF SATELLITE-DERIVED DIFFUSE ATTENUATION COEFFICIENTS AND EUPHOTIC DEPTHS IN SOUTH FLORIDA COASTAL WATERS

J. Zhao, B. Barnes, N. Melo, D. English, B. Lapointe, F. Muller-Karger, B. Schaeffer, and C Hu(2013).
Remote Sensing of Environment, vol. 38-50, 131.

ON THE ACCURACY OF SEAWIFS OCEAN COLOR DATA PRODUCTS ON THE WEST FLORIDA SHELF

J. Cannizzaro, C. Hu, K. L. Carder, C. R. Kelble, N. Melo, E. M. Johns, and G. Vargo (2013).
Remote Sensing of Environment, in press.

SATELLITE-OBSERVED BLACK WATER EVENTS OFF SOUTHWEST FLORIDA: IMPLICATIONS FOR CORAL REEF HEALTH IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY

J. Zhao, C. Hu, B. Lapointe, N. Melo, E. M. Johns, and R. H. Smith (2013).
Remote Sensing. Vol. 5(1), 415-431; doi:10.3390/rs5010415.

OPTICAL CHARACTERIZATION OF THE COASTAL WATERS IN SOUTH FLORIDA

N. Melo and co-authors. (In preparation).

Summary

- The management of coastal resources requires systematic assessments of water quality (temperature, salinity, chlorophyll, CDOM, nutrients, turbidity, and optical properties).
- This is important for assessing productivity (phytoplankton biomass), euphotic state, and other ecosystem characteristics.
- Satellite ocean color measurements for the region contain substantial errors because of the region's optical complexity (due to water quality, benthos, sediments, and bottom reflection.)
- Ground-truth, in situ shipboard data such as obtained from the SFP can be used to improve the algorithms for interpretation of the regional satellite imagery, and reduce these errors.
- This will allow for the development of a real-time, highly spatially- and temporally-resolved, satellite-based resource management tool for the FKNMS and other south Florida (and Caribbean) coastal marine and estuarine environments.

Questions?