Roadblocks to Seagrass Recovery: Seagrass Restoration Planning

Tallahassee, March 7, 2016

Welcome and thank you for attending this workshop

Workshop goals and agenda:

1. Introduce and explain this project. Elicit feedback.
2. Locate as much information as possible on historical seagrass cover in Apalachee Bay and the Big Bend.
3. Locate original imagery and ancillary imagery from disparate sources for site-by-site evaluation.
4. Locate published and unpublished data on water and sediment quality.
5. Elicit expert opinion and information on site-specific timelines of seagrass loss and obstacles to recovery and expansion.

Basic Premises:

1. Seagrass recovery and enhancement can offset some habitat damage caused by Deepwater Horizon oil spill.

2. Seagrass transplanting is extremely expensive and the success is variable.

3. However, experience in Tampa Bay and Sarasota Bay has shown that, when favorable conditions are created, natural recovery and expansion of seagrass occurs.

4. In many cases, the roadblocks to seagrass recovery are not the same factors that caused seagrass loss in the first place.

Project funded by NFWF Gulf Environmental Benefit Fund

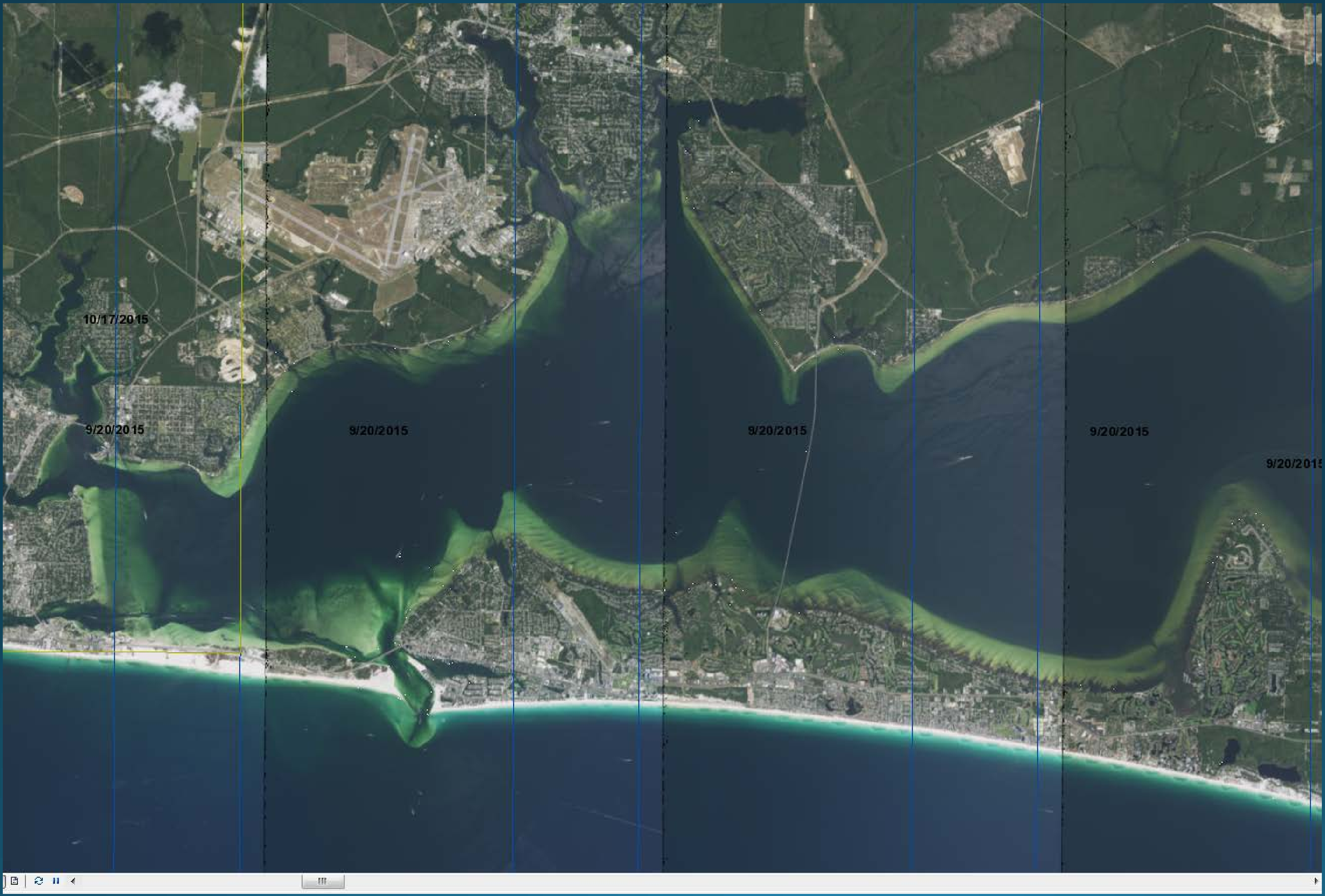
Project Goals:

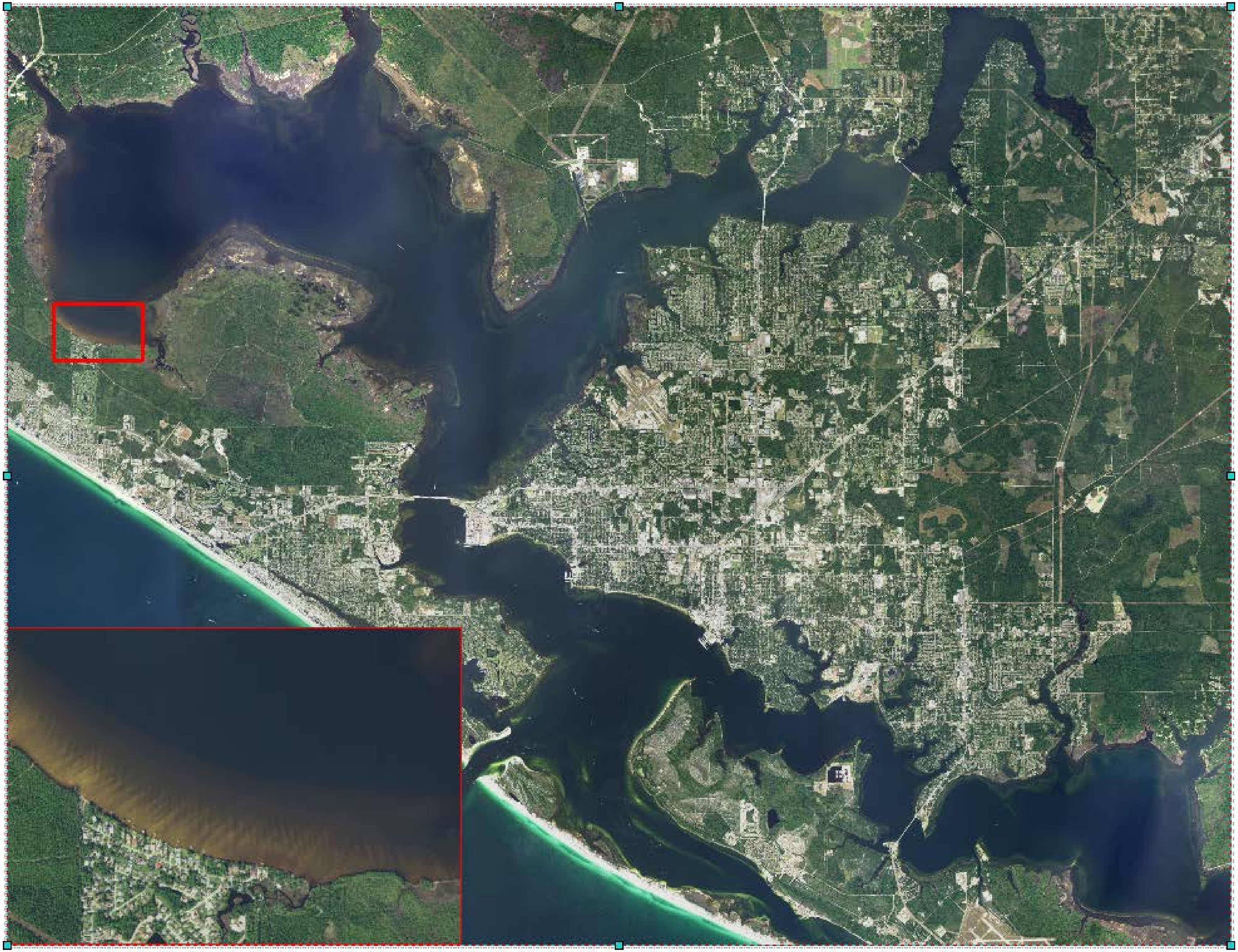
1. Identify obstacles to seagrass recovery and expansion in target estuaries

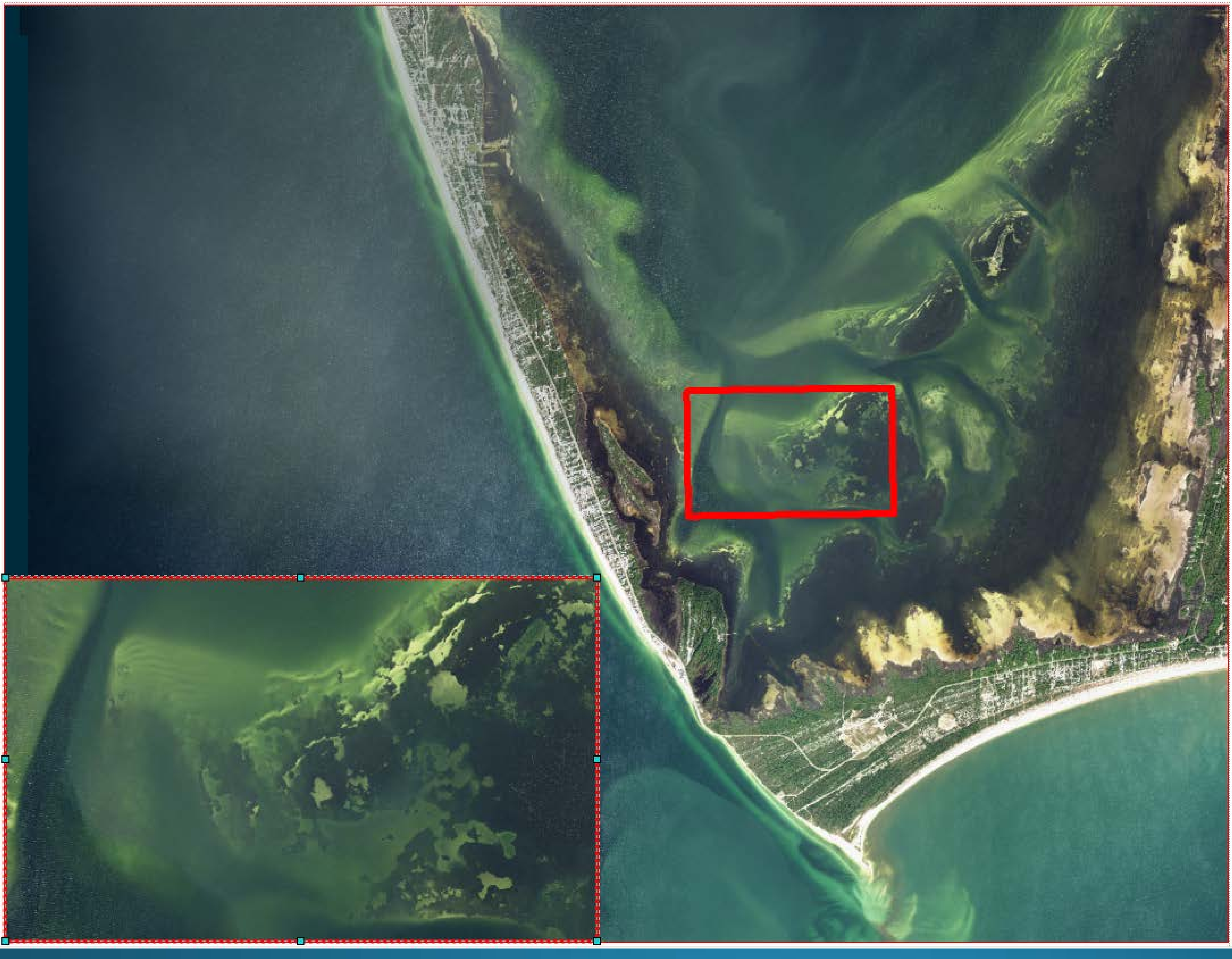
2. Develop a GIS Seagrass Recovery Potential (SRP) model of potential stressors and obstacles to recovery and spread in each estuary

3. Use SRP model to identify candidate areas, methods, tools, and projects for successful seagrass recovery and enhancement.

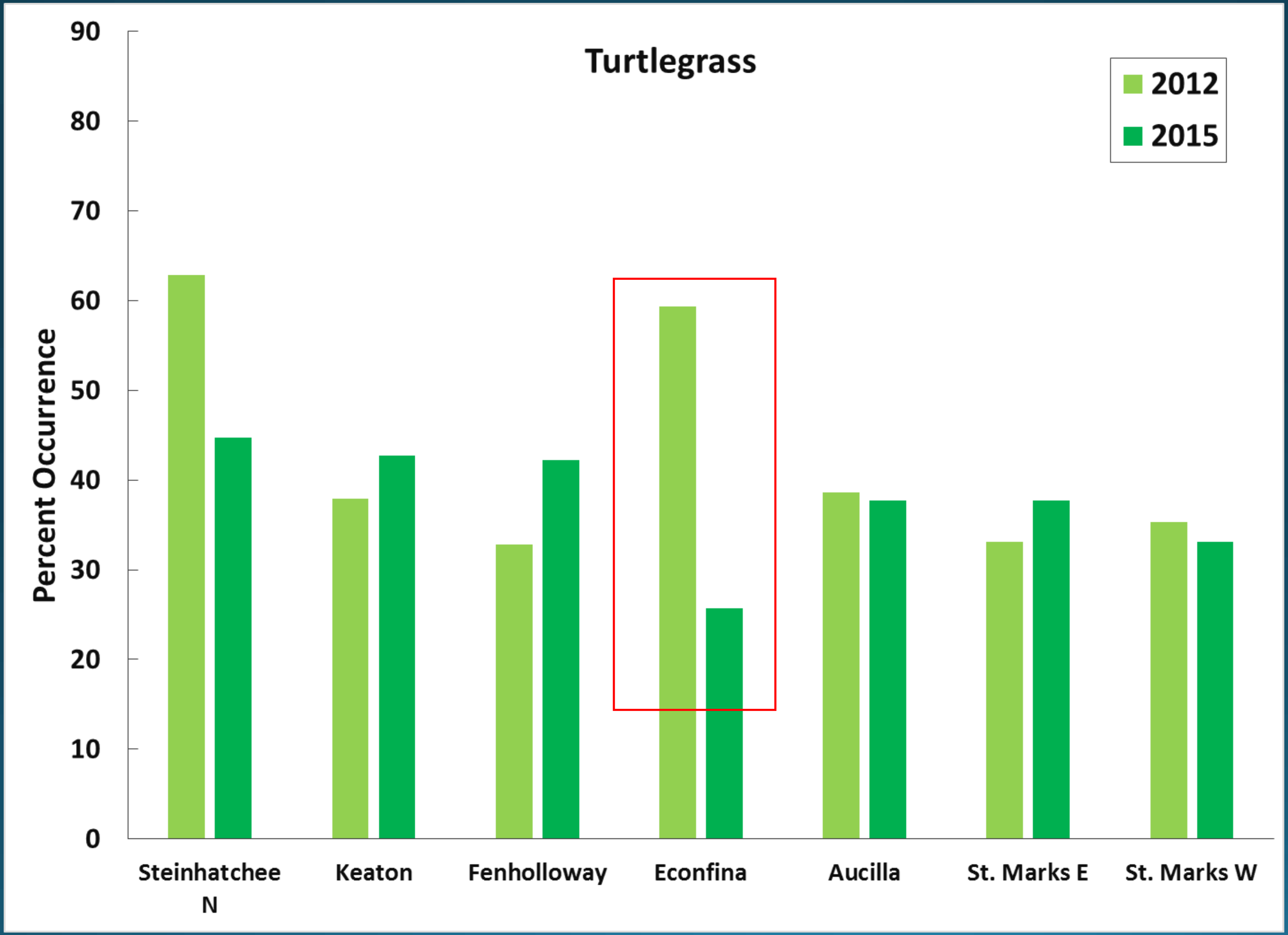
Broad Littoral Shelf- Why so little seagrass?



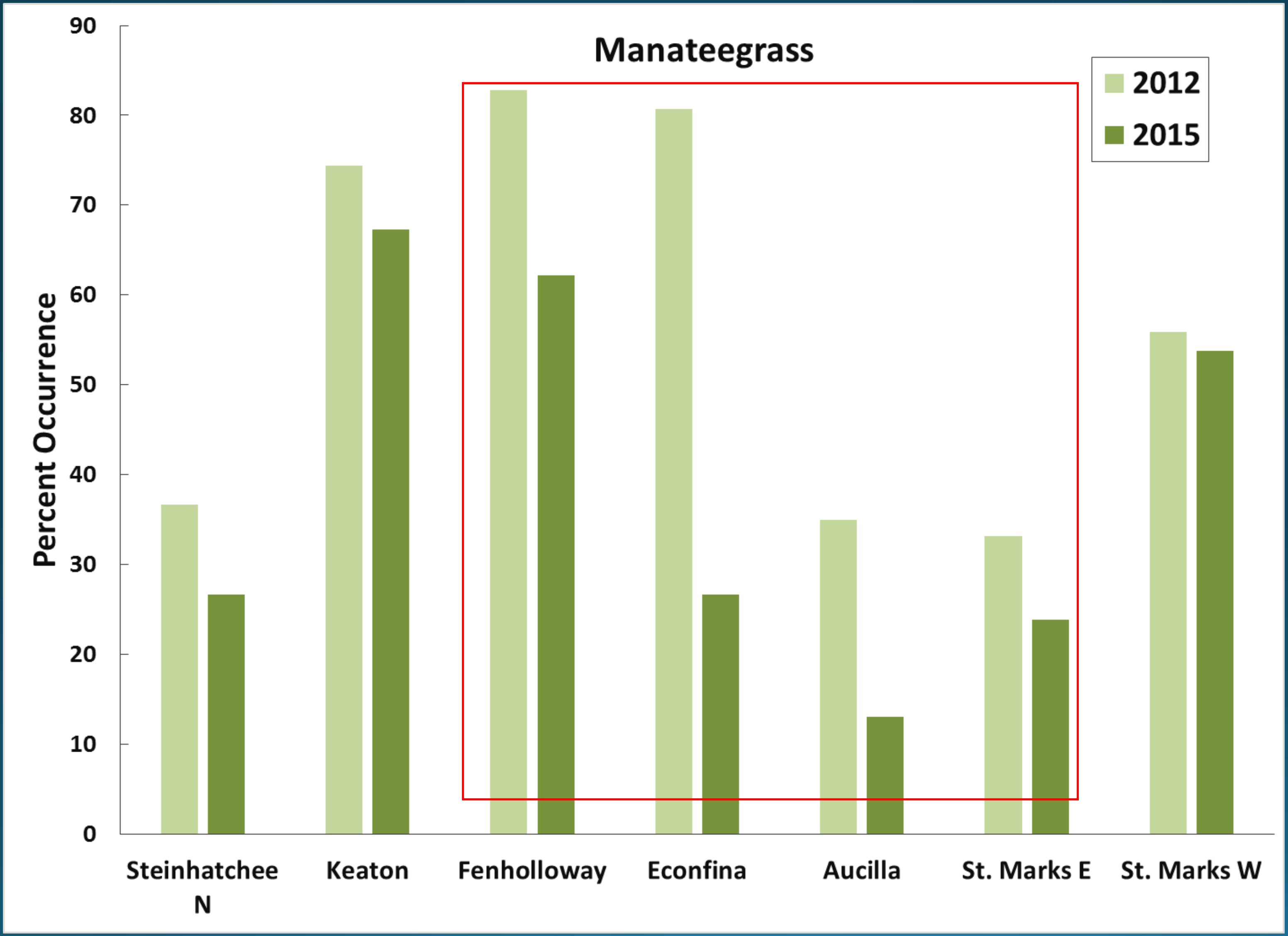




Changes in Turtlegrass occurrence in northern Big Bend between 2012 and 2015



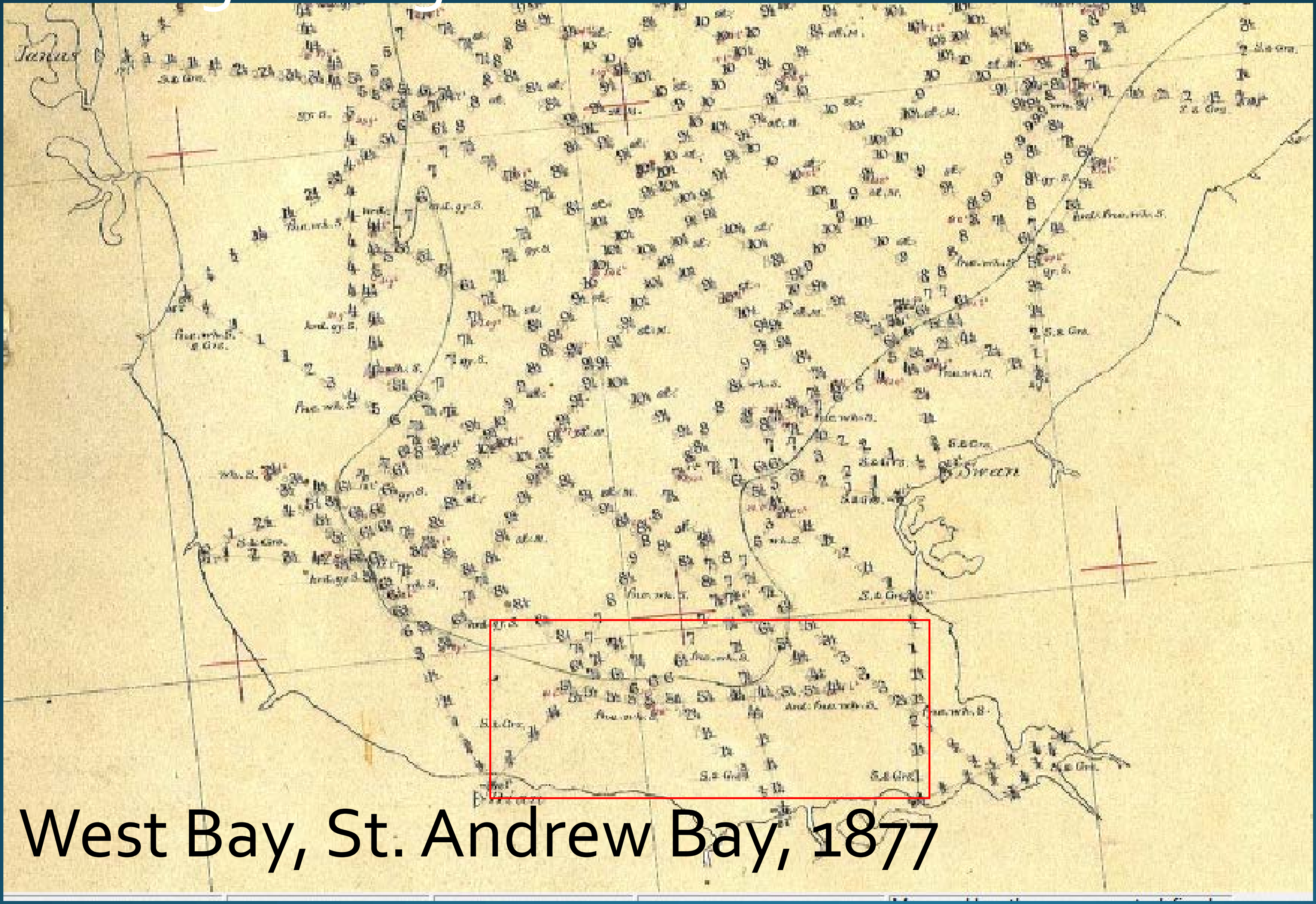
Changes in Manateegrass occurrence in northern Big Bend between 2012 and 2015



Project Tasks and Deliverables

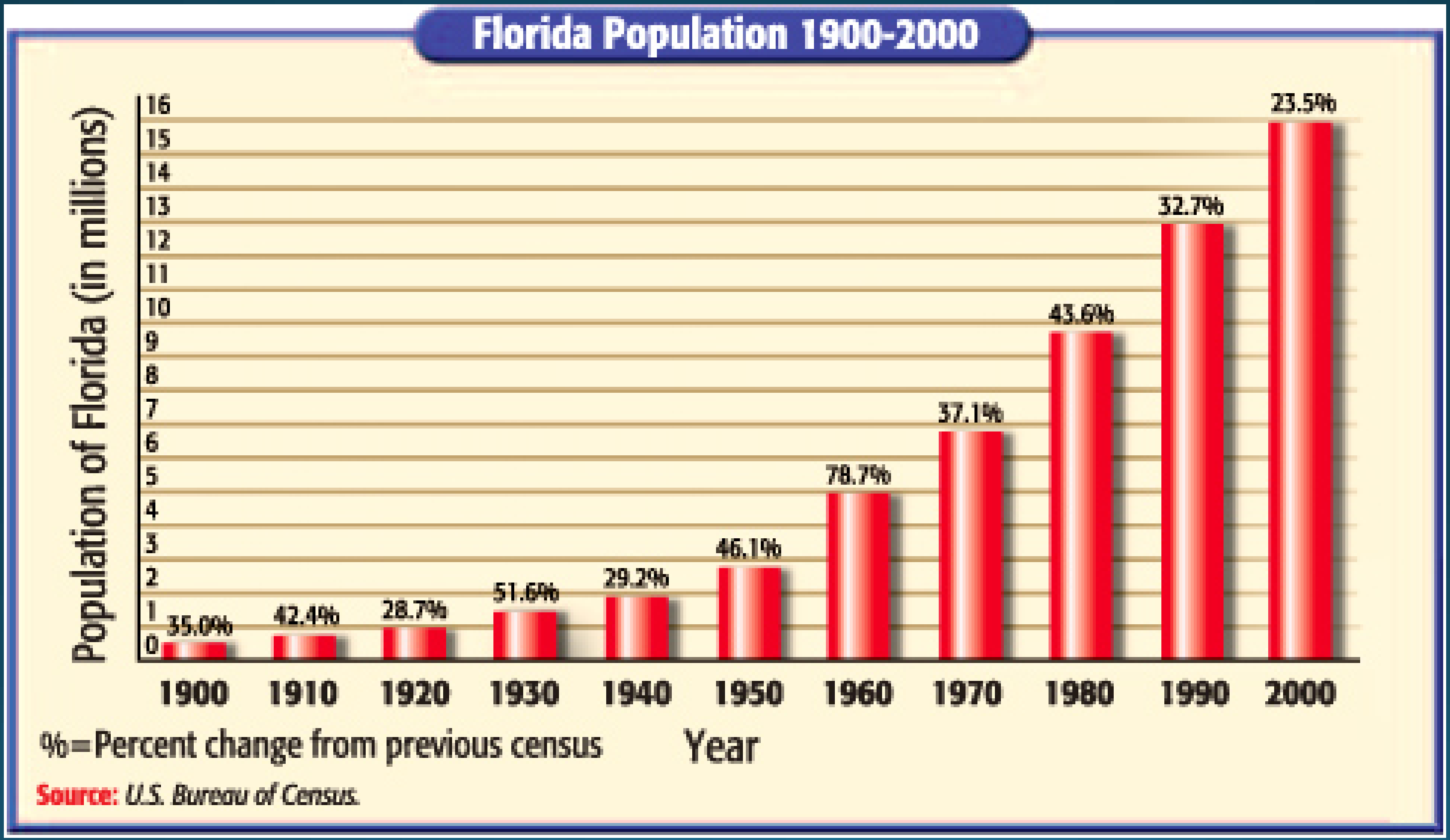
1. Assemble and create, where necessary, seagrass status and trends data for project estuaries.
2. Compare present seagrass distribution to historical target distributions
3. Determine estuary-specific and site-specific roadblocks to seagrass recovery and expansion in target estuaries.
4. Using available data supplemented by field sampling and Modis satellite imagery, construct a time series of optical water quality (OWQ) in target estuaries.
5. Build a user-friendly website for retrieval of OWQ data.

Setting a Seagrass Abundance Benchmark-

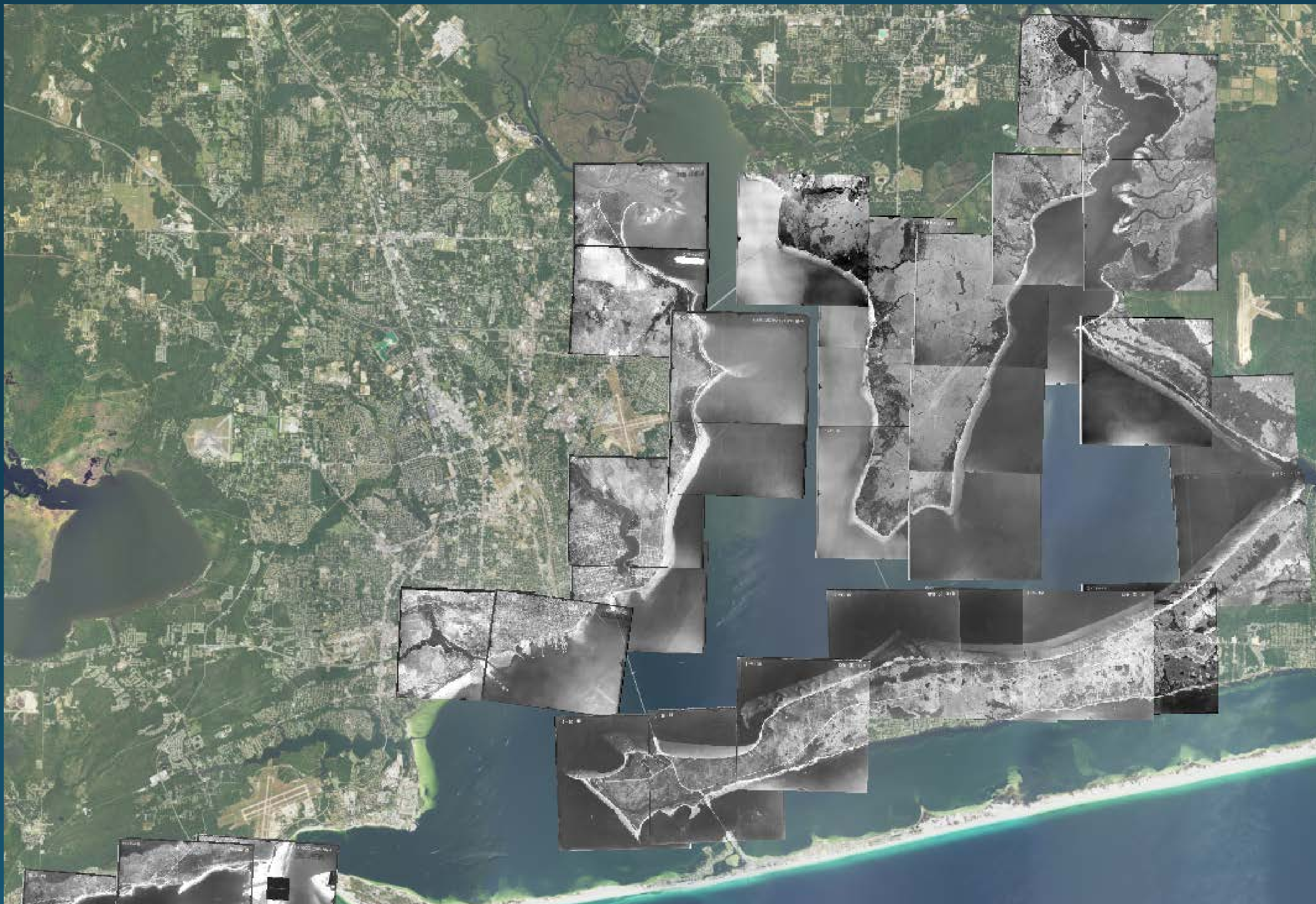


West Bay, St. Andrew Bay, 1877

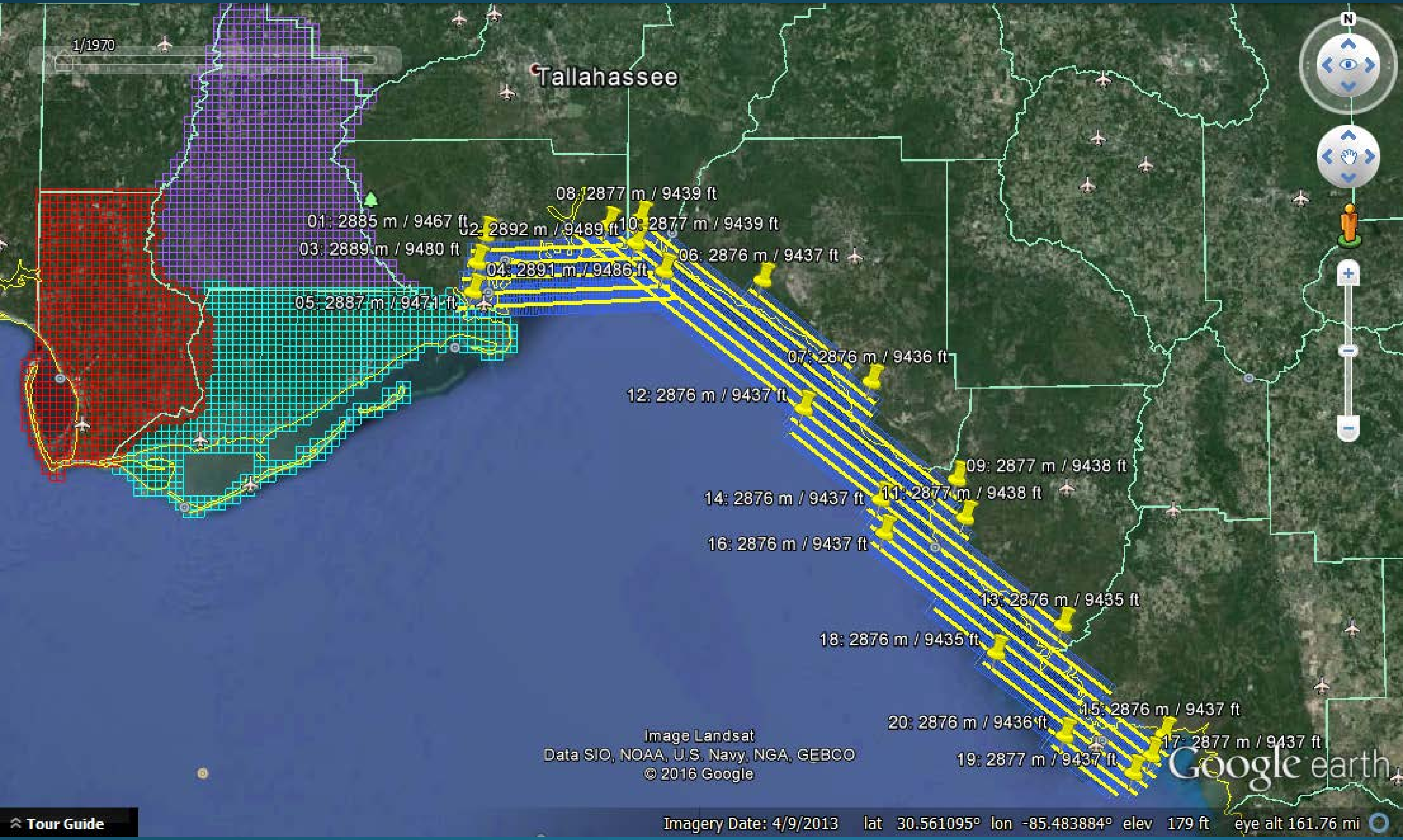
Florida's population began to grow rapidly in the 1950's.



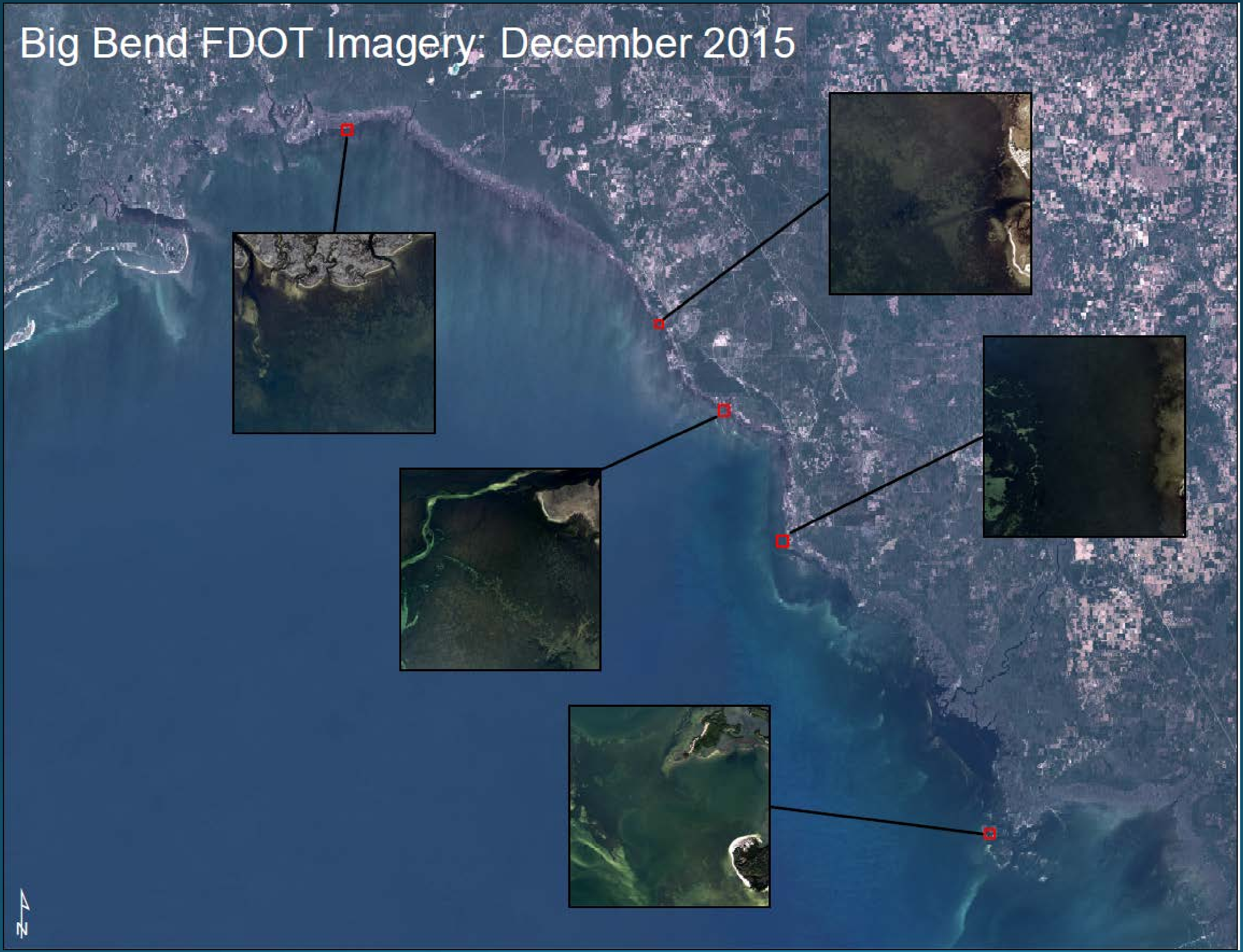
More reasonable benchmark- 1940's aerial photography with painstaking Georeferencing



SIMM aerial acquisitions 2015-2016



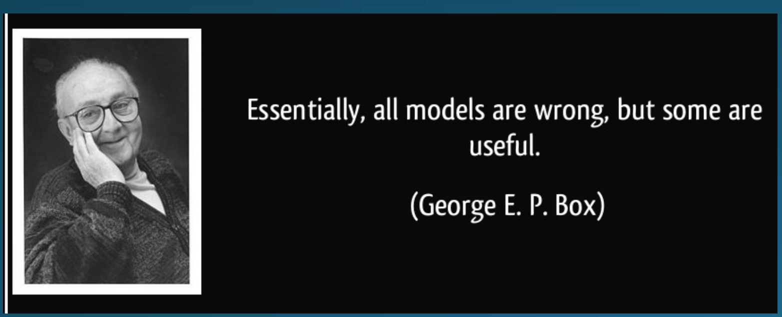
Big Bend FDOT Imagery: December 2015



Winter storms resuspend sediment and rivers discharge large amounts of highly colored dissolved organic matter (CDOM)

Project Tasks and Deliverables (Continued)

6. Based on elements 1-5 above, build a spatial Seagrass Recovery Potential (SRP) GIS model to guide seagrass recovery and enhancement projects.



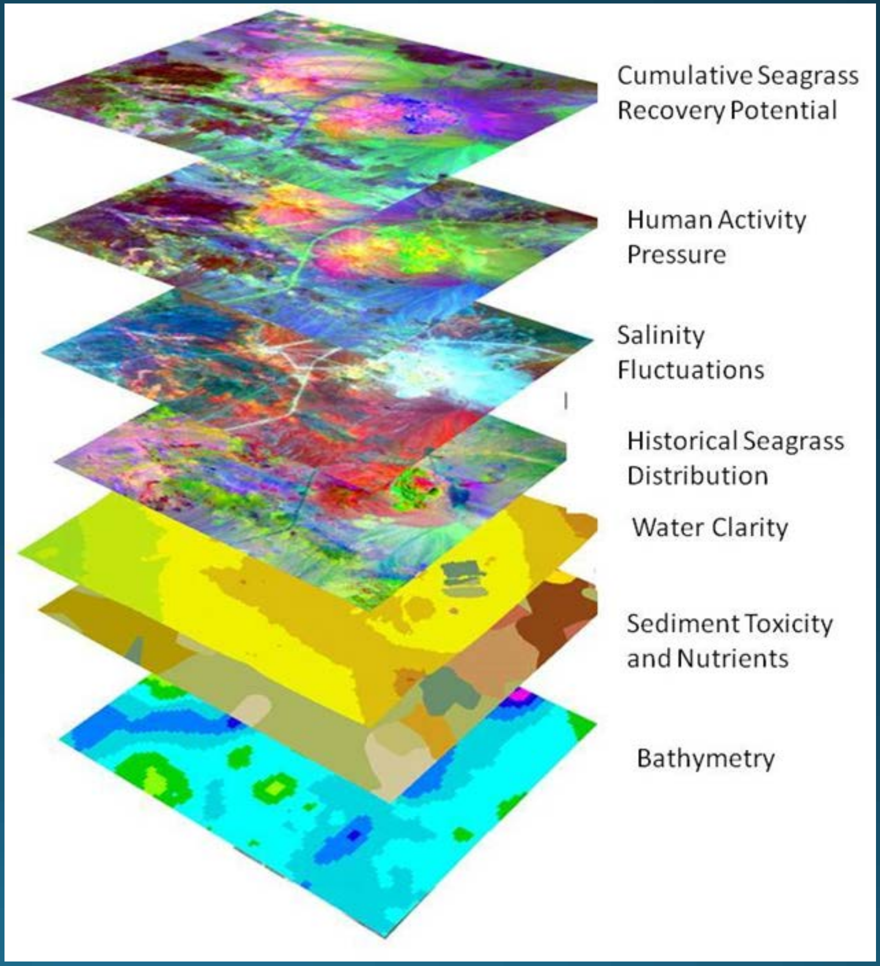
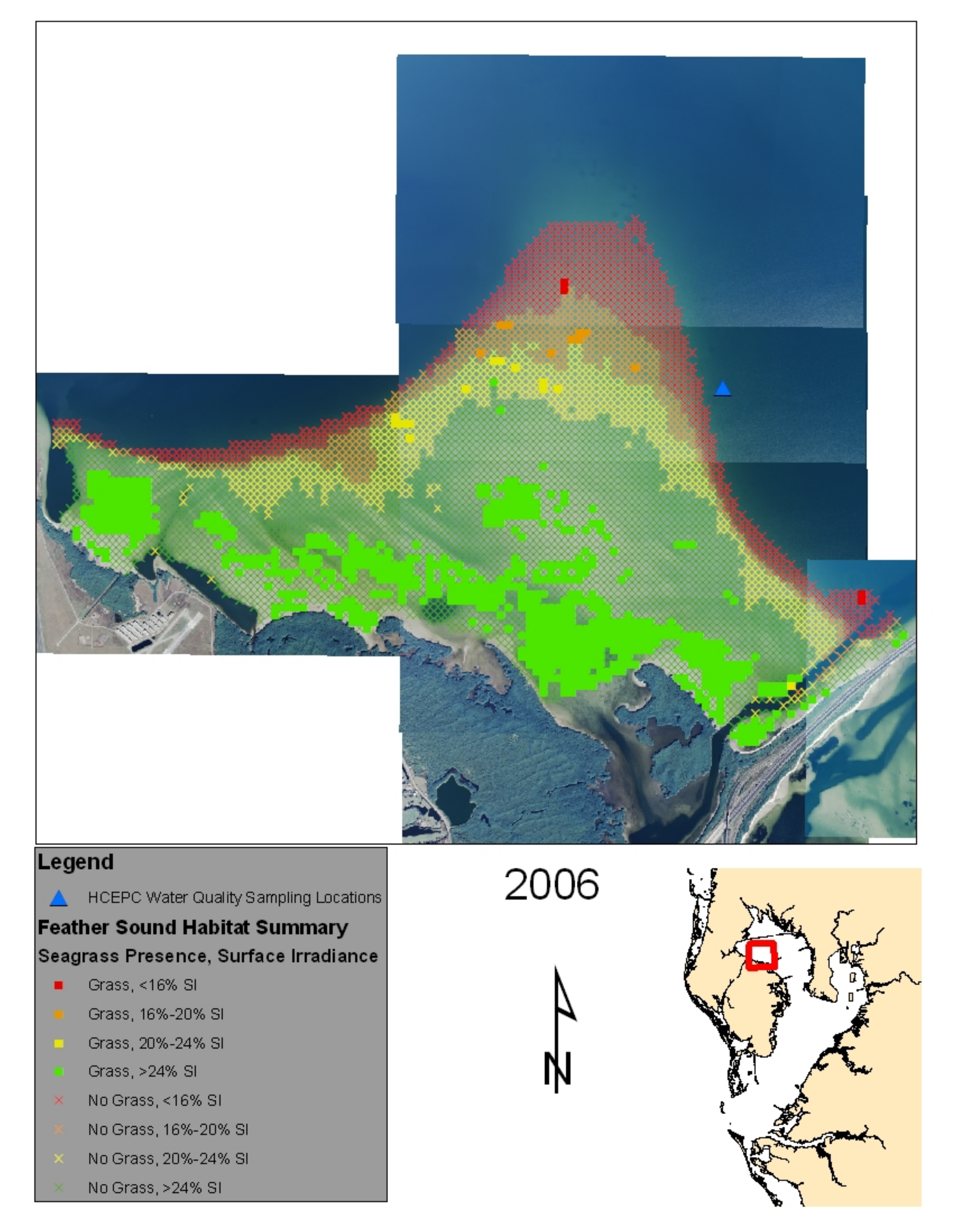


Image Credit: Geological Society of America



Example of Grid-Based Modeling Approach- Feather Sound, Tampa Bay

Inputs:

HCEPC Water Quality Data

Bathymetry Data

Seagrass aerial photos

Process: Use OWQ data to calculate transparency and bathymetry to calculate light availability (%SI).

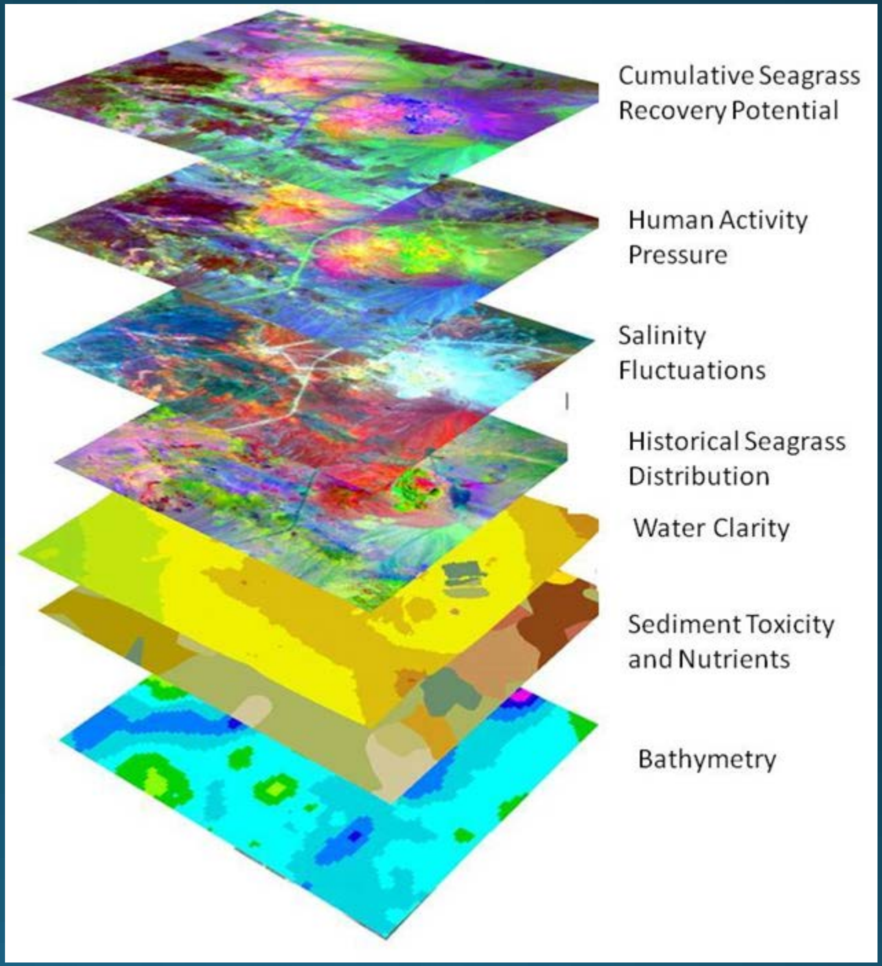
Result- Critical assessment of minimum light requirement for Shoalgrass- Halodule wrightii

Model Layers- Partial List

Current seagrass distribution
Historical seagrass distribution

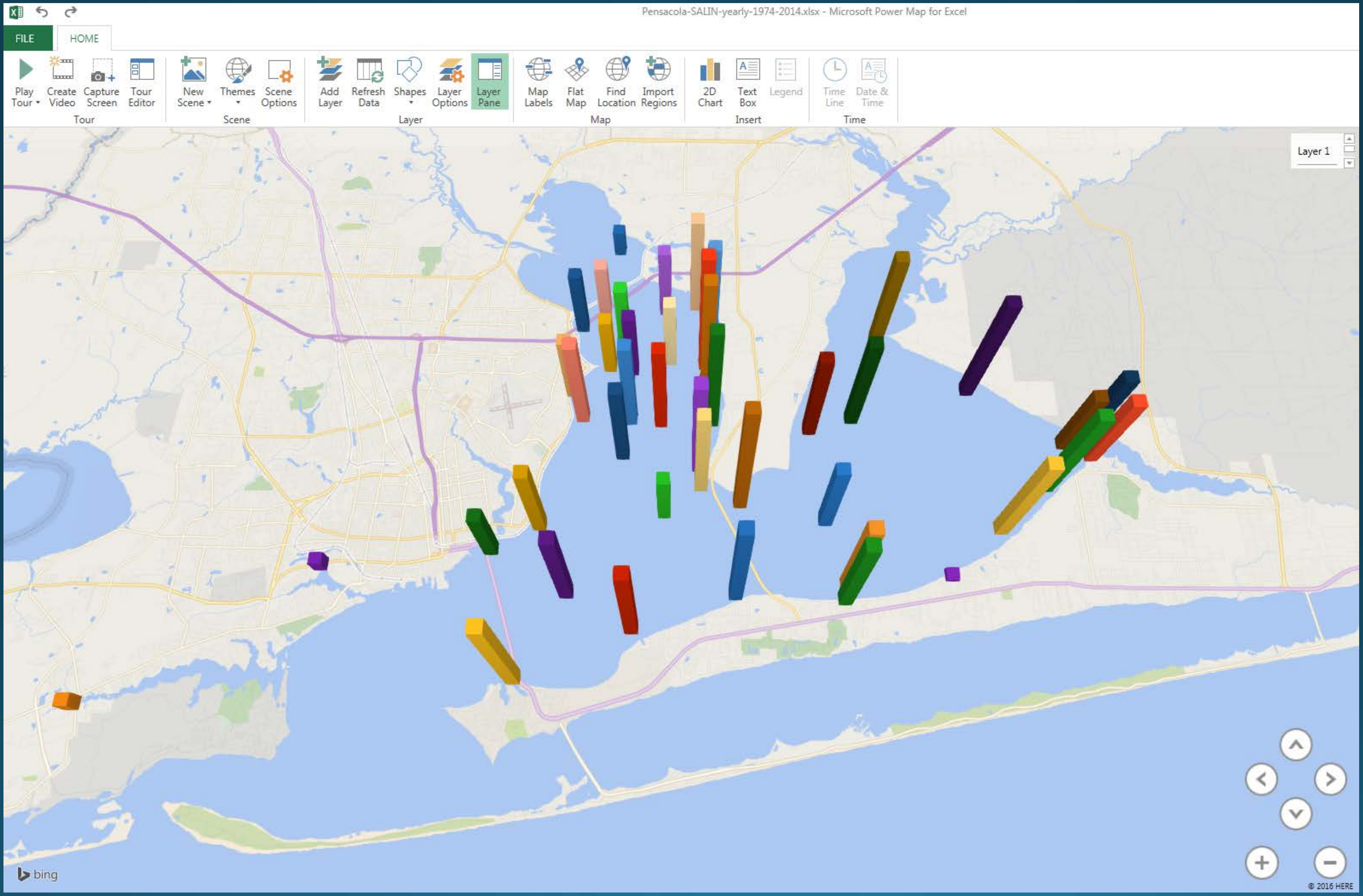
Bathymetry
In Situ Optical Water Quality
MODIS Optical Water Quality

Sediment Toxicity
Physical Disturbance
Animal Disturbance
Salinity Fluctuations
Hypoxia and Anoxia
Human Activity Pressure

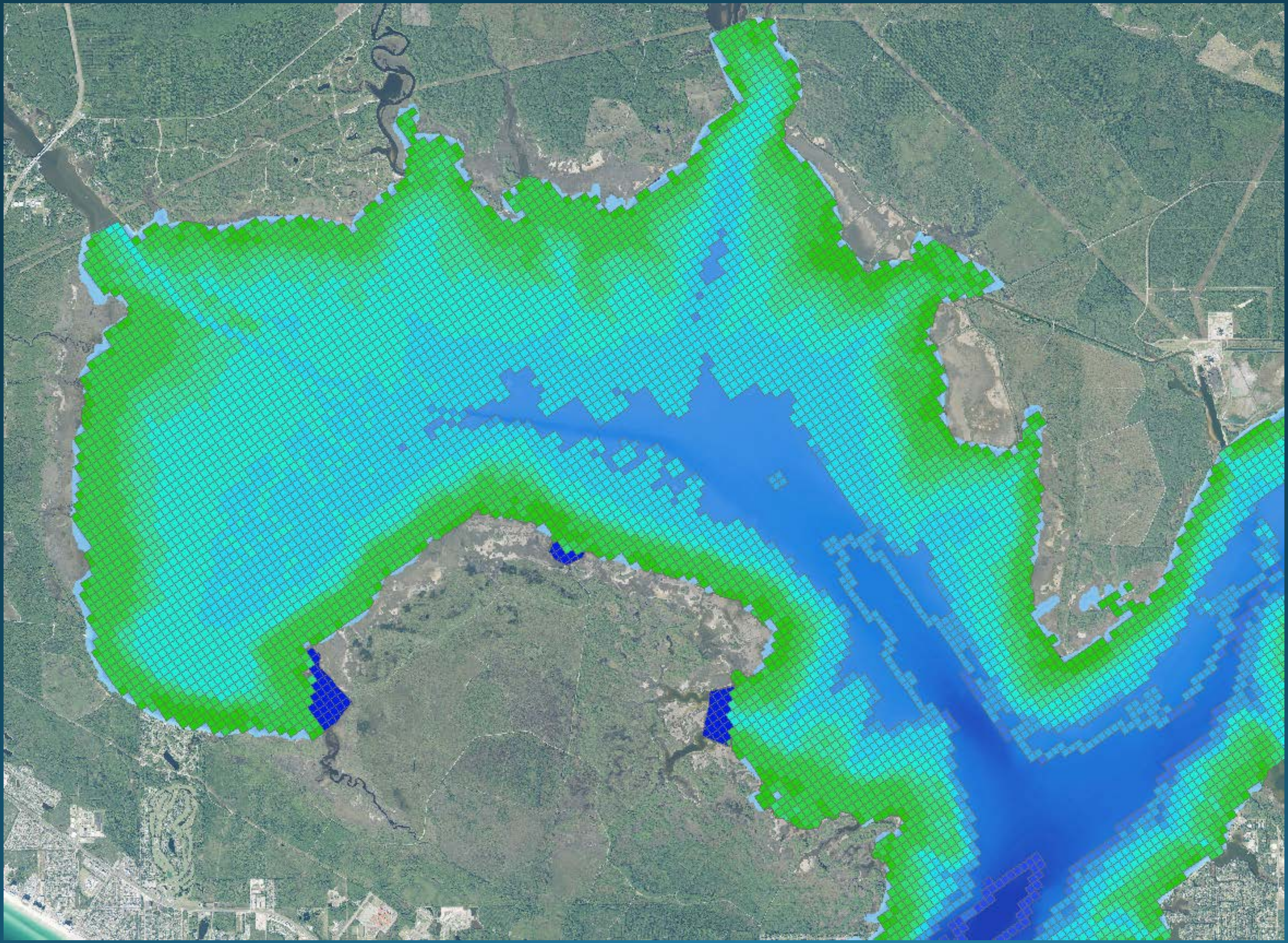


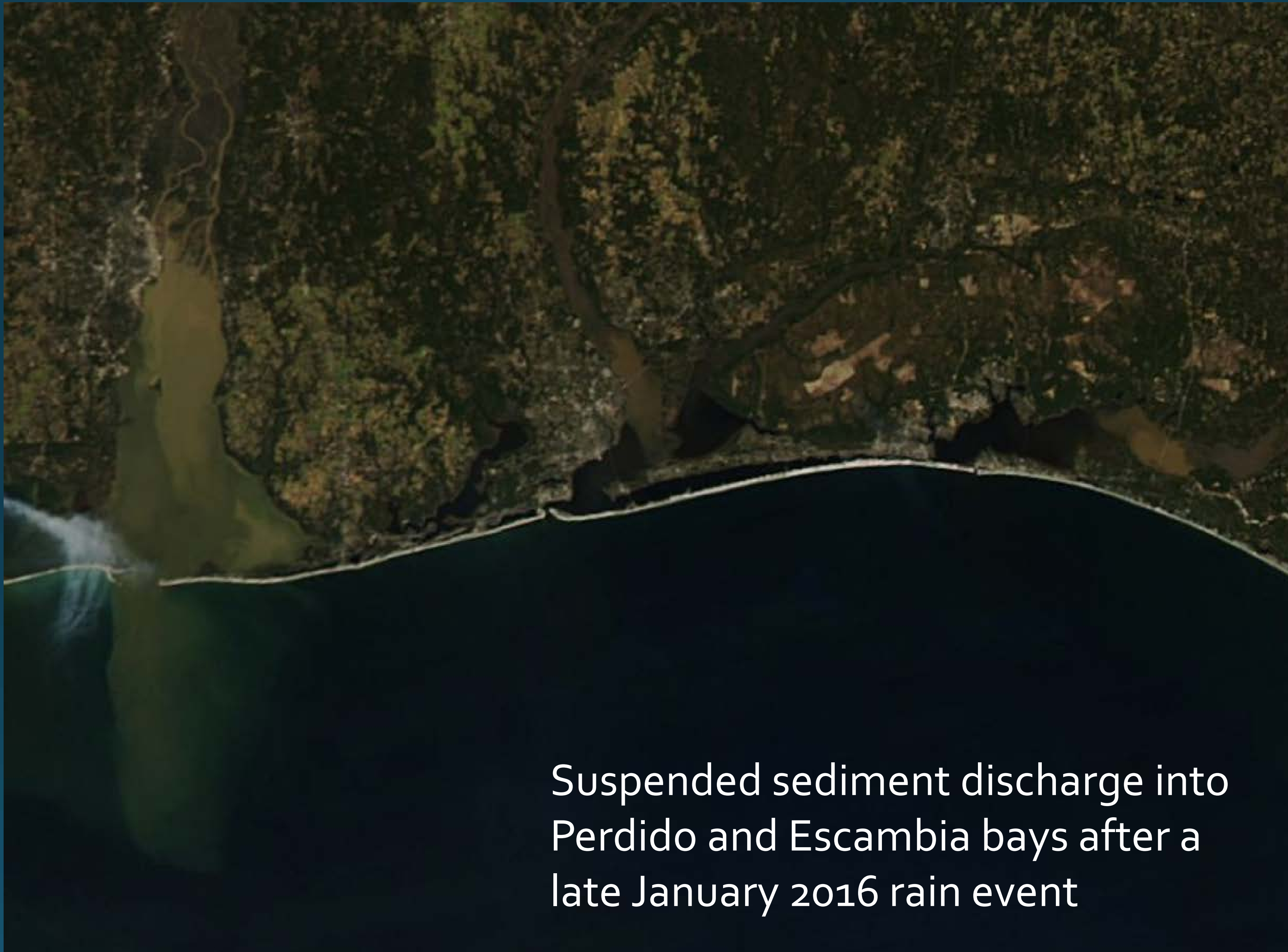
Platform- ArcGIS
Products- Shapefiles and KML

Water Quality Data Mining- Which Datasets and Sampling Programs have the Richest Spatial and Temporal Coverage?



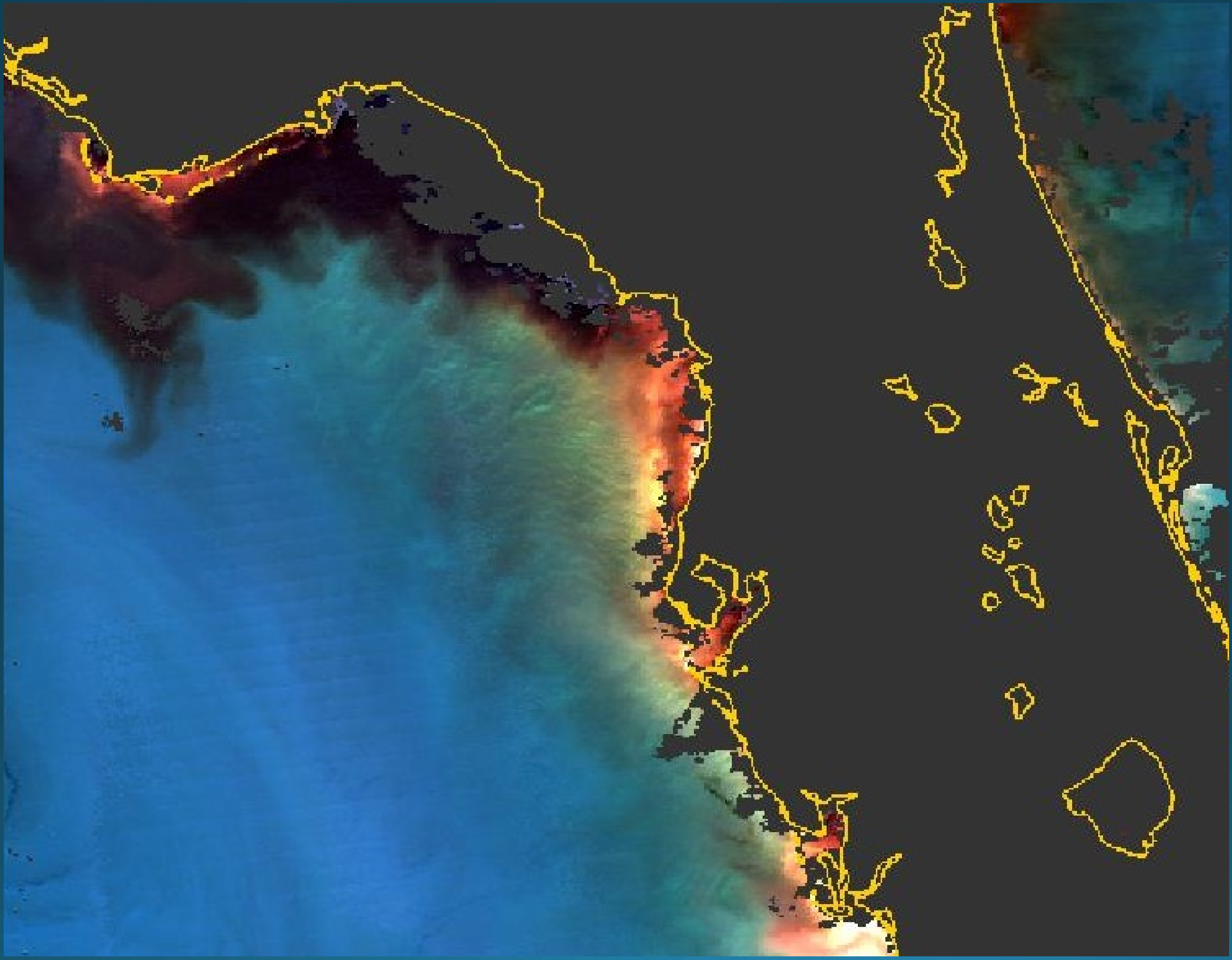
One-hectare model grid cells for St Andrew Bay overlain on bathymetry



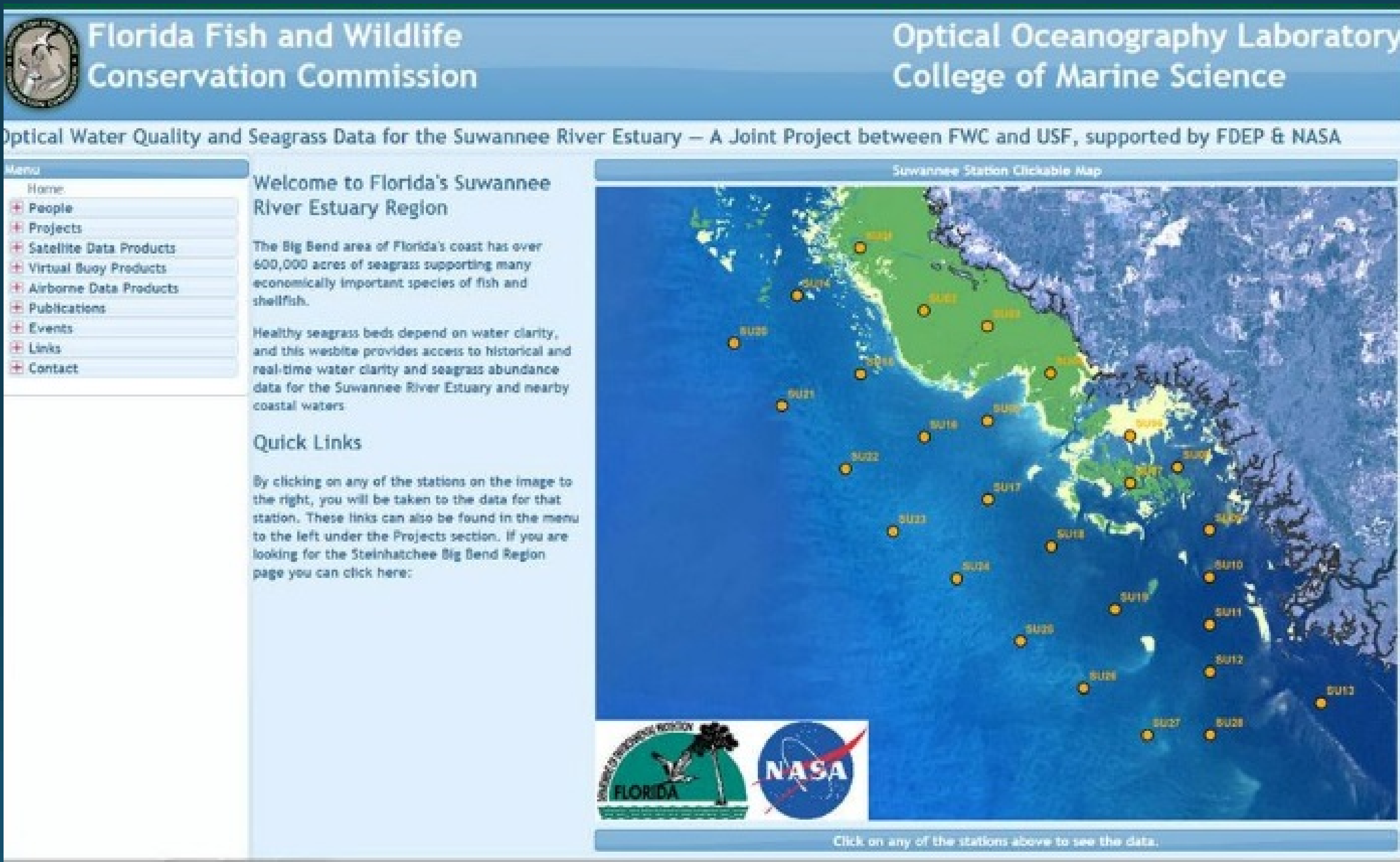


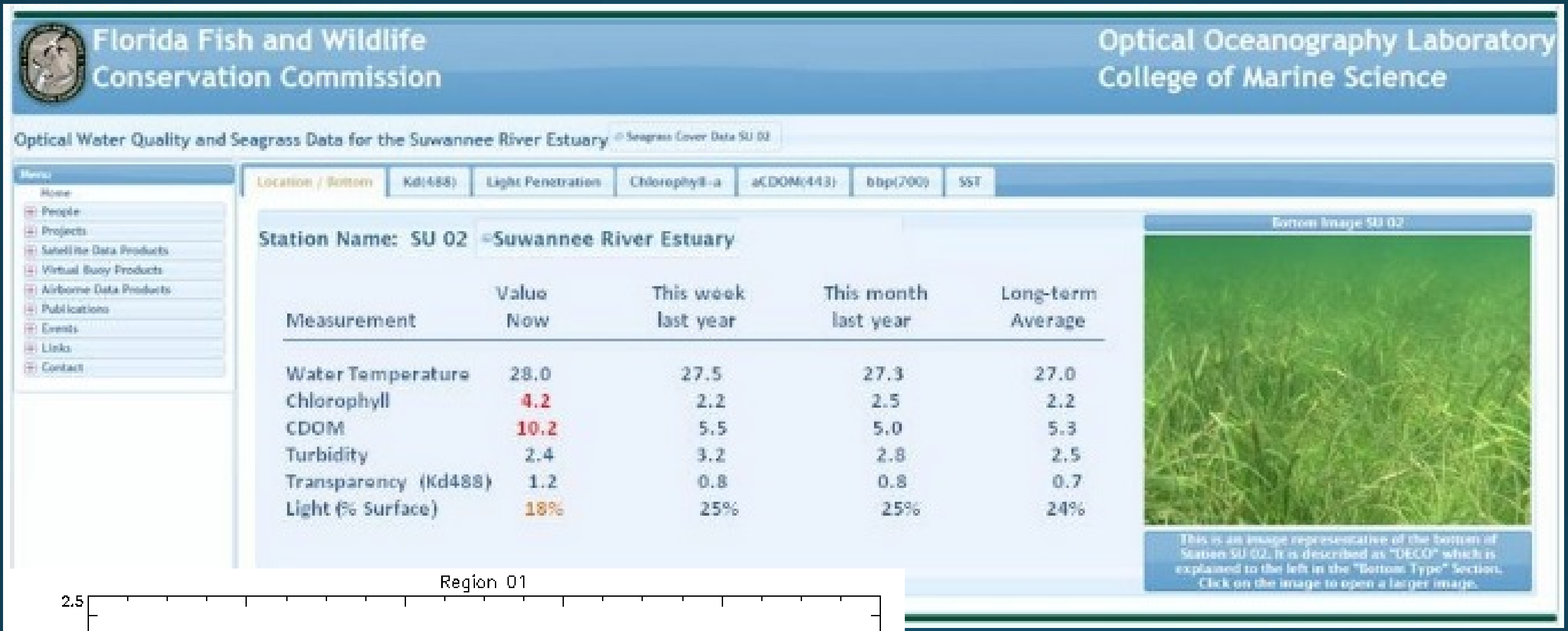
Suspended sediment discharge into Perdido and Escambia bays after a late January 2016 rain event

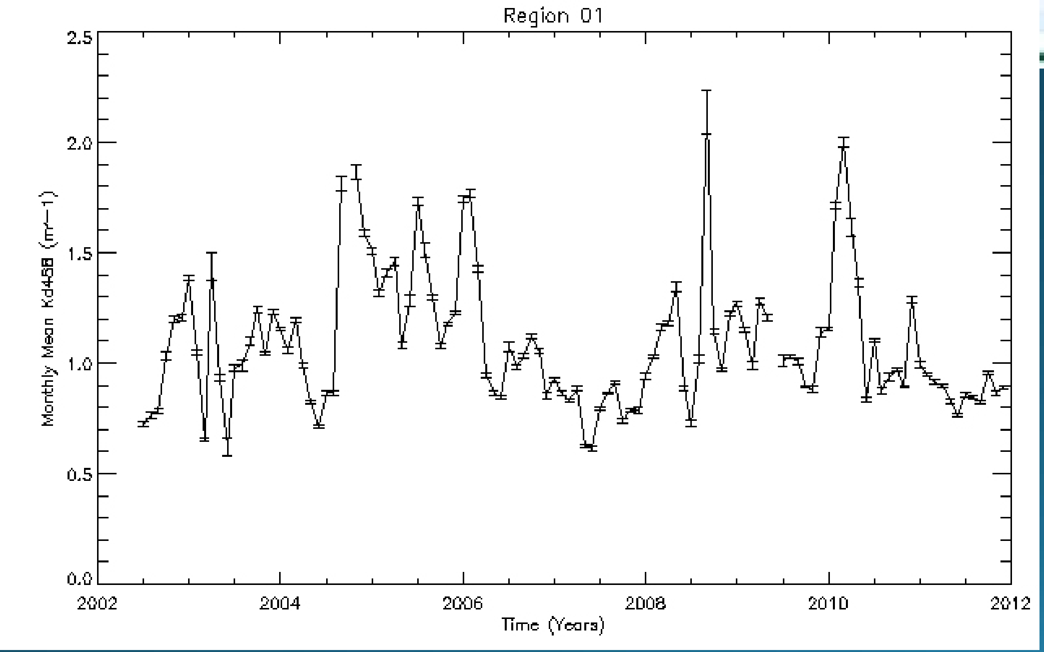
MODIS Image- CDOM from Suwannee and Ochlockonee Rivers



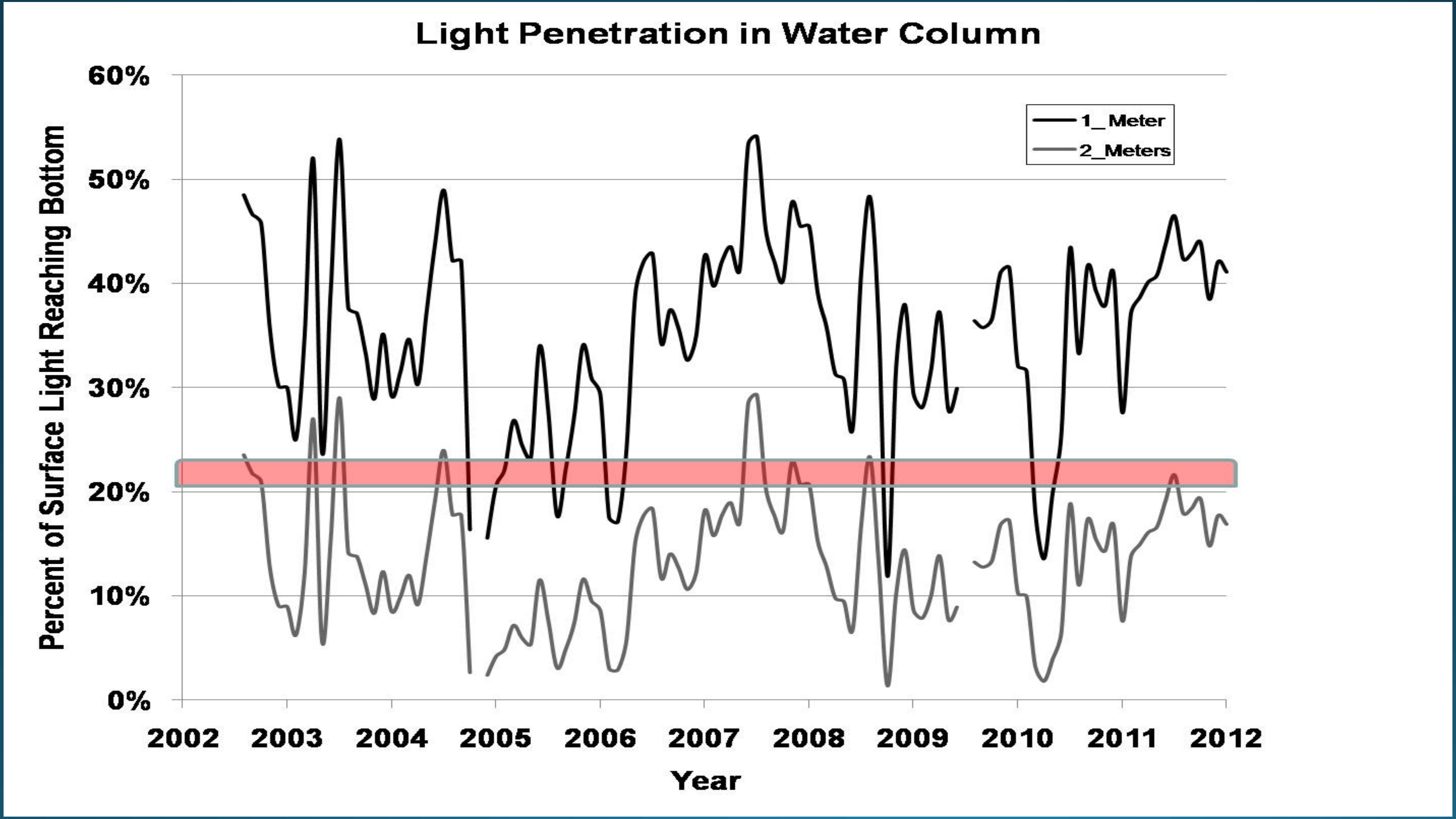
One approach to assessing light limitation: MODIS time series optical water quality (OWQ) data- optics.marine.usf.edu



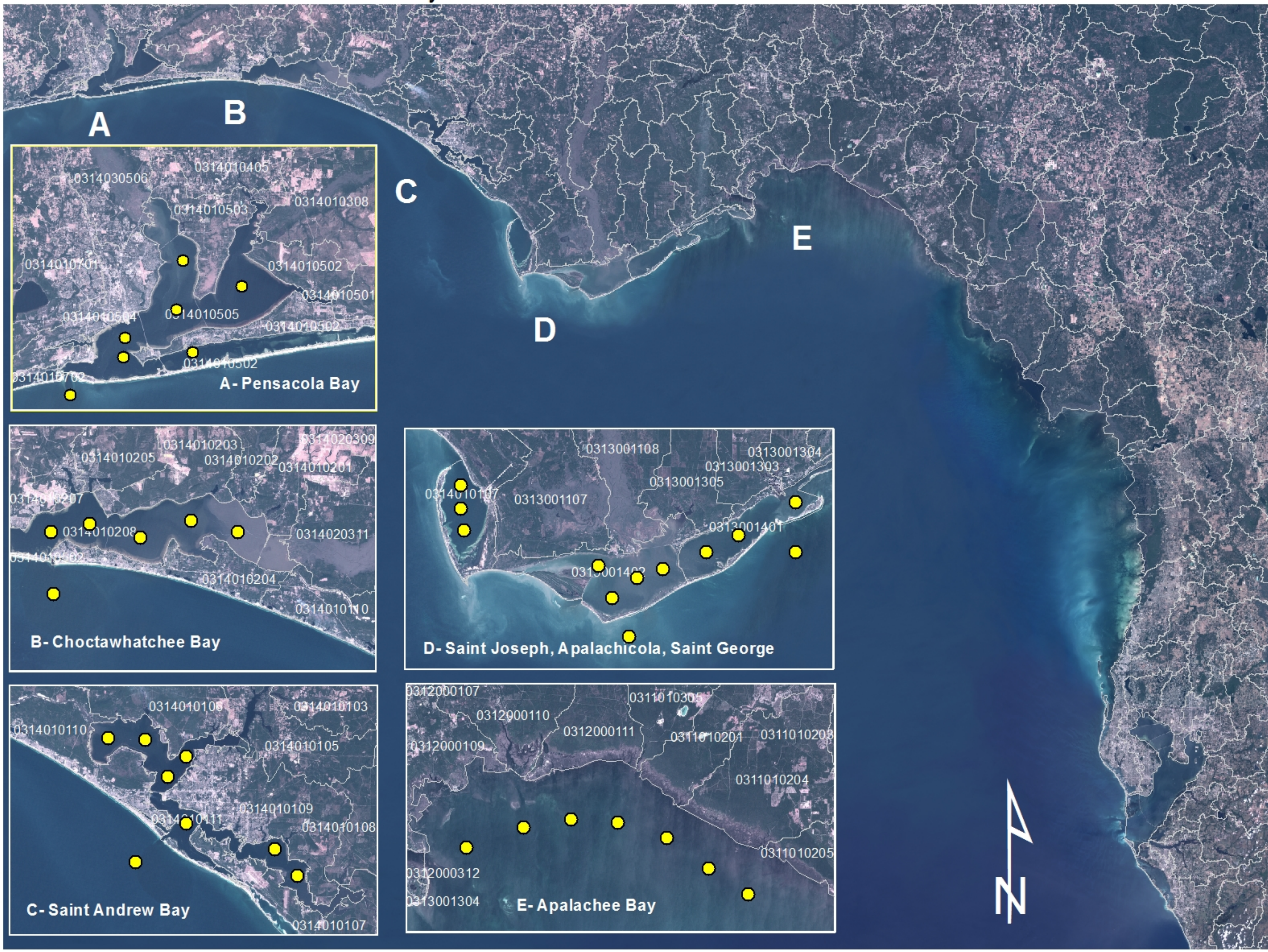

Florida Fish and Wildlife
Conservation Commission
Optical Oceanography Laboratory
College of Marine Science
Optical Water Quality and Seagrass Data for the Suwannee River Estuary
Seagrass Cover Data SU 02
Menu
Home
People
Projects
Satellite Data Products
Virtual Buoy Products
Airborne Data Products
Publications
Events
Links
Contact
Location / Bottom
Kd(488)
Light Penetration
Chlorophyll-a
aCDOM(443)
bbp(700)
SST
Station Name: SU 02
Suwannee River Estuary
Measurement | Value Now | This week last year | This month last year | Long-term Average
Water Temperature | 28.0 | 27.5 | 27.3 | 27.0
Chlorophyll | 4.2 | 2.2 | 2.5 | 2.2
CDOM | 10.2 | 5.5 | 5.0 | 5.3
Turbidity | 2.4 | 3.2 | 2.8 | 2.5
Transparency (Kd488) | 1.2 | 0.8 | 0.8 | 0.7
Light (% Surface) | 18% | 25% | 25% | 24%
Bottom Image SU 02
This is an image representative of the bottom of Station SU 02. It is described as "DECO" which is explained to the left in the "Bottom Type" Section. Click on the image to open a larger image.


Region 01
Monthly Mean Kd488 (m^-1)
Time (Years)
0.0
0.5
1.0
1.5
2.0
2.5
2002
2004
2006
2008
2010
2012

With a water depth of 1 meter, most of the time light is adequate for seagrasses on the bottom. However, if the water depth is 2 meters or more, light is not sufficient for seagrass survival except for brief periods.



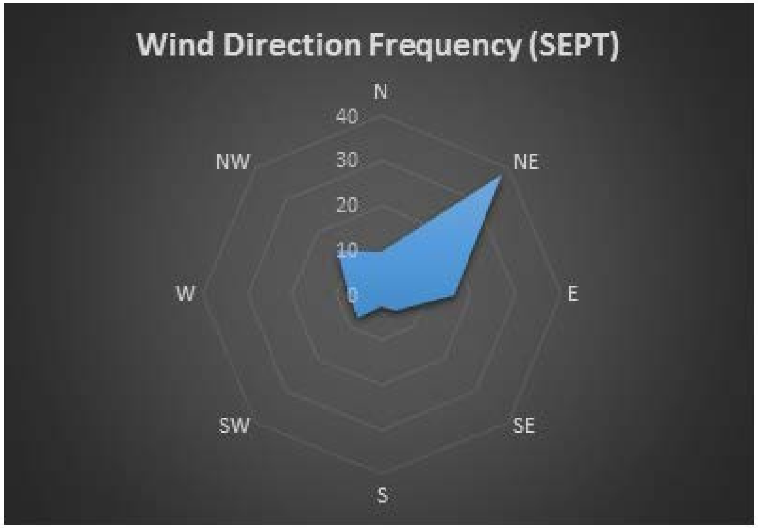
Virtual Buoy Stations for Florida Panhandle Estuaries

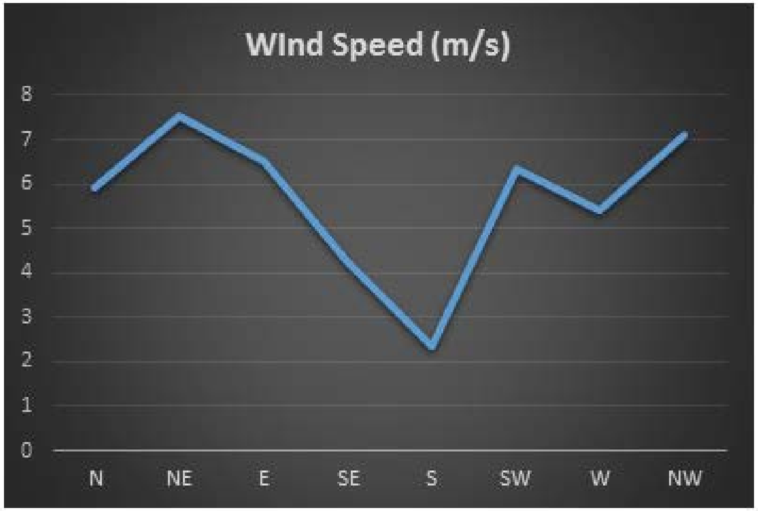


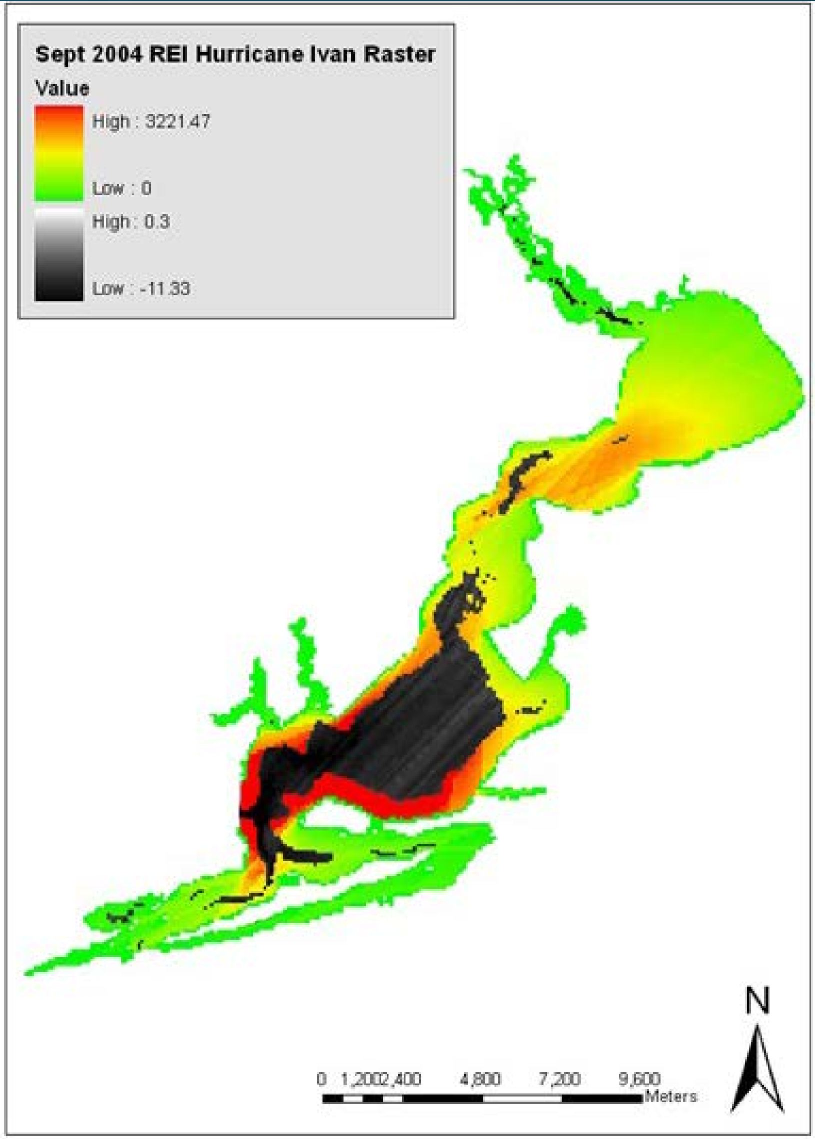
Physical Disturbance Suggested by Sediment Bed Form

NOAA Physical Disturbance Model (WEMo)- Perdido Bay, September 2004

Hurricane Ivan

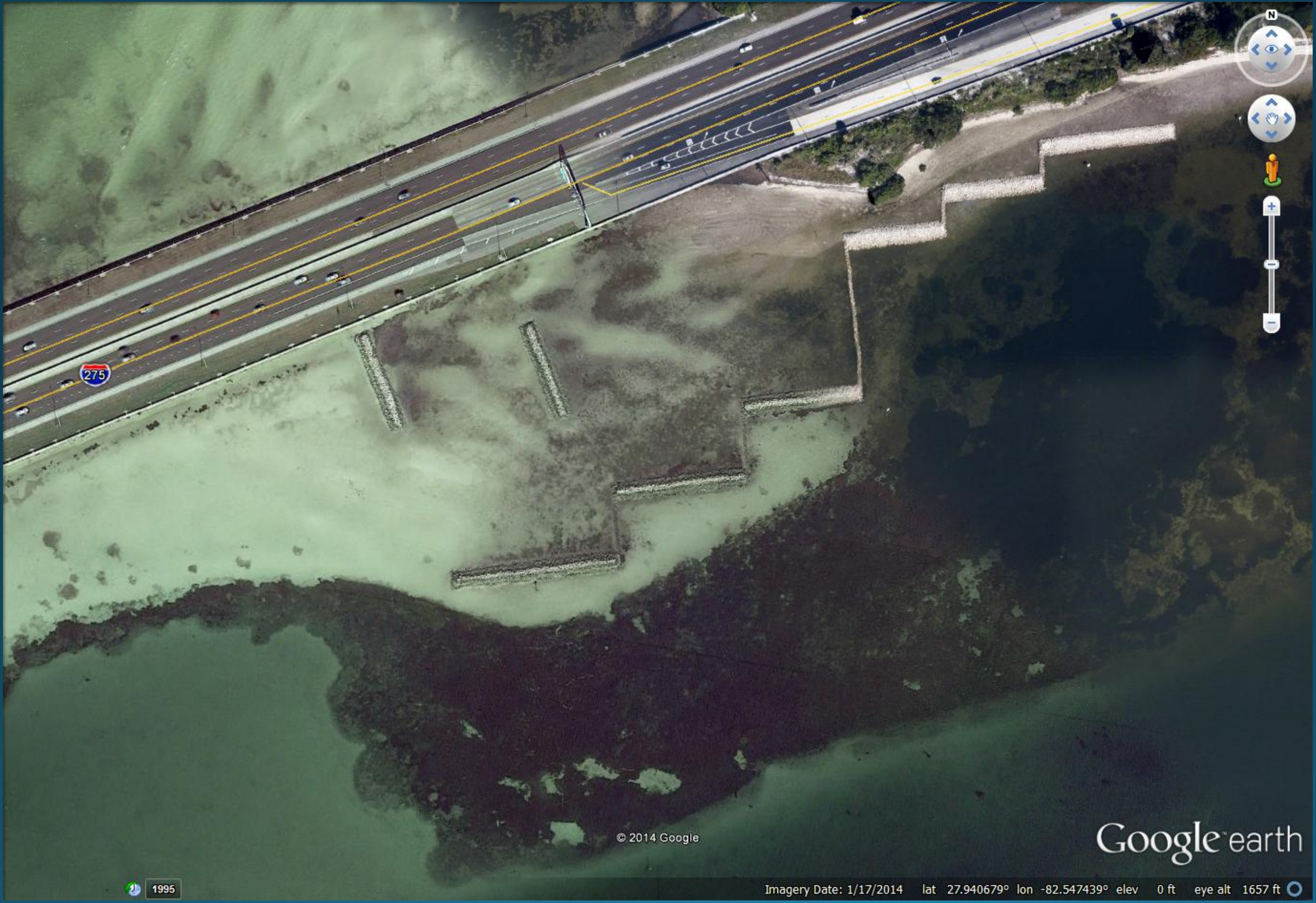






Example of Wave Action and Erosion Along I-275 in Tampa, April 2010

Effect of Rip Rap Barriers, January 2014



Animal Disturbance- Manatees, Stingrays, Cownose Rays, Sea Urchins Inhabit Seagrass Beds

Periodic irruptions of sea urchins have been documented.
Stressors- animal disturbance and water quality- can be synergistic.

Photo: Steve Geiger, FWRI

Human activity impacts include propeller scarring.

Data in progress; obtained from GIS assessment of imagery collected in 2013.

St. Joseph Bay Propeller Scarring			
Score	Description	# Cells	% of vegetated cells
9	Bare bottom visible	1056	
0	Vegetated, no scars	1998	57.3%
1	1-2 scars	646	18.5%
2	3-10 scars	466	13.4%
3	11-25 scars	265	7.6%
4	>25 scars	81	2.3%
5	Cell mostly scarred	29	0.8%
	Total scarred cells	1487	42.7%
	Total vegetated cells	3485	
	Sun Glare	248	
	Unreadable	15	
	Too Deep	2709	

Table 2: Roadblocks to SAV Recovery

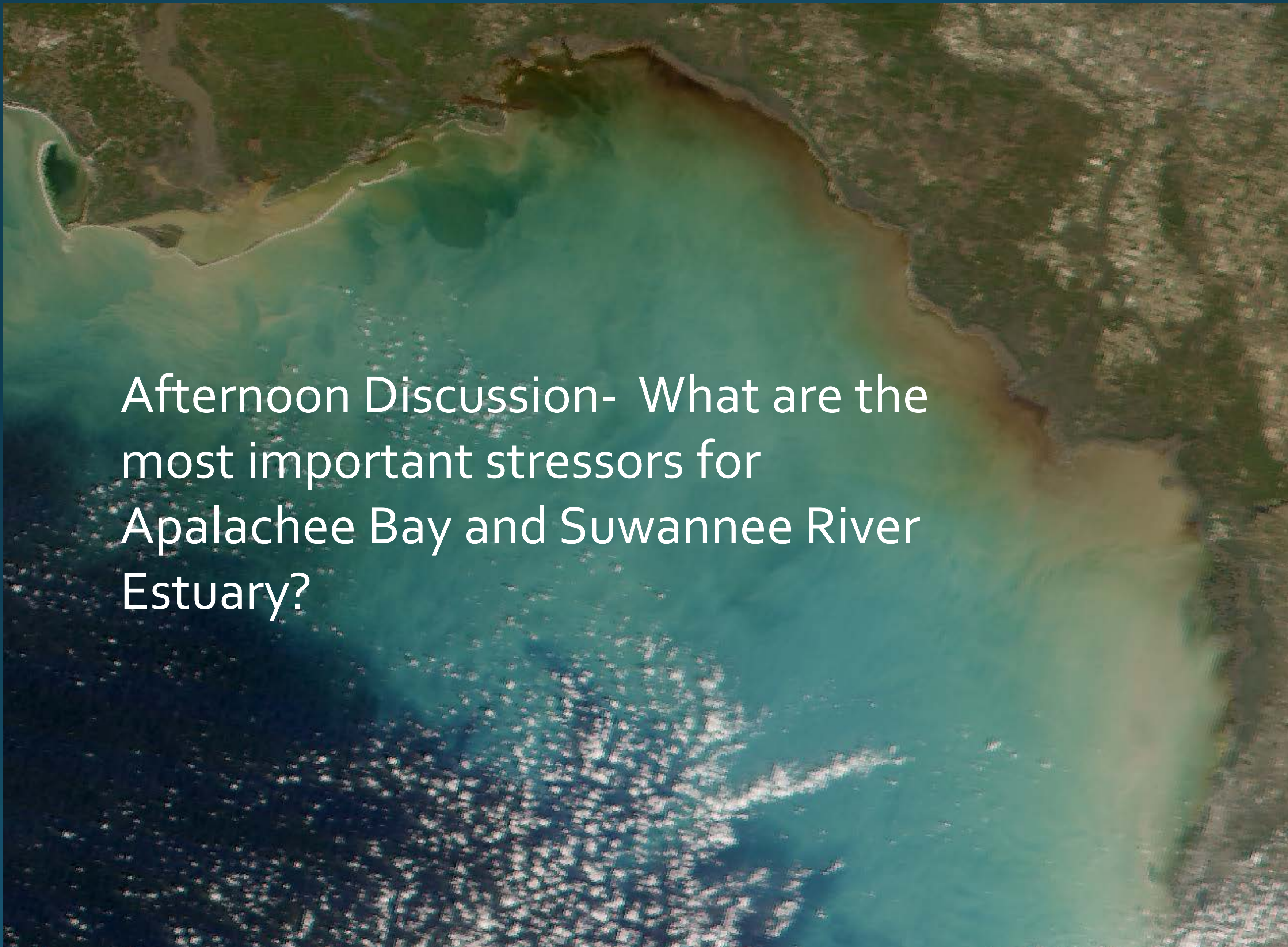
Stressor	Distribution	Severity	Effect(s)	Assessment Methods	Restoration Action(s)
Light Stress	Widespread	Varies by cause	Inhibited growth, death	*In situ* and satellite measurements, nutrient data, TMDL models	Nutrient reduction, sediment reduction, point and non-point source treatment
Salinity Pulses	Widespread	Varies by freshwater source	Metabolic drain	*In situ* salinity measurements, freshwater discharge data, models	Stormwater retention, watershed best management practices (BMPs)
Salinity Stratification	Frequent	Varies with depth, bottom contours	Metabolic drain	*In situ* salinity measurements, rainfall, runoff data, models	Stormwater retention, floodplain restoration, sandbar enhancement
Wind, wave, and tidal action	Frequent	Varies with fetch, depth, tide range	Removal of shoots, sediment resuspension	*In situ* sediment grain size and bedform analysis, models	Physical protection, sandbar enhancement
Sediment toxicity	Common	Alone or synergistic stressor	Acute or chronic; species vary	Sediment sulfide & carbon measurements, FDEP, US EPA, NOAA contaminant data	Removal, *in situ* remediation, source reduction
Bioturbation, Animal disturbance	Common	Locally severe	Grazing or removal	Field surveys for stingrays, cownose rays, sea urchins. FWC seine, trawl data	Exclosures, harvest, removal
Propeller Scarring	Common	Locally severe	Physical damage or death	Targeted aerial mapping	Boater education, signage, exclusion zones, remediation

Thank you again for attending this workshop

We need your help to locate as much information as possible on

1. Historical seagrass cover in Apalachee Bay and Big Bend.
2. Original imagery and ancillary imagery
3. Published and unpublished data on water and sediment quality.
4. Your expert opinions and information on site-specific obstacles to seagrass recovery and expansion.

We will use this information to guide seagrass recovery efforts and all project data will be distributed on the web to guide future projects.



Afternoon Discussion- What are the most important stressors for Apalachee Bay and Suwannee River Estuary?

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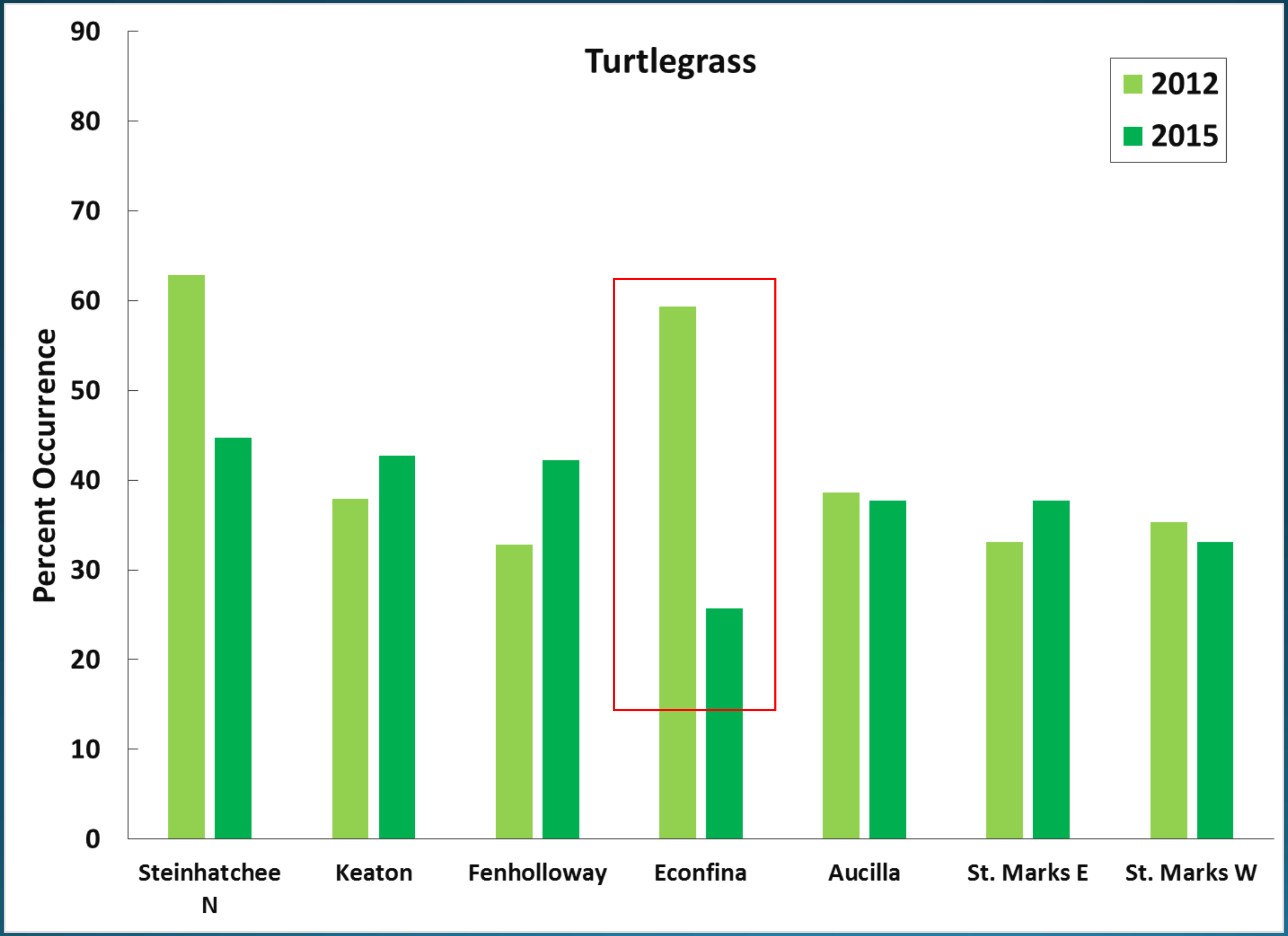
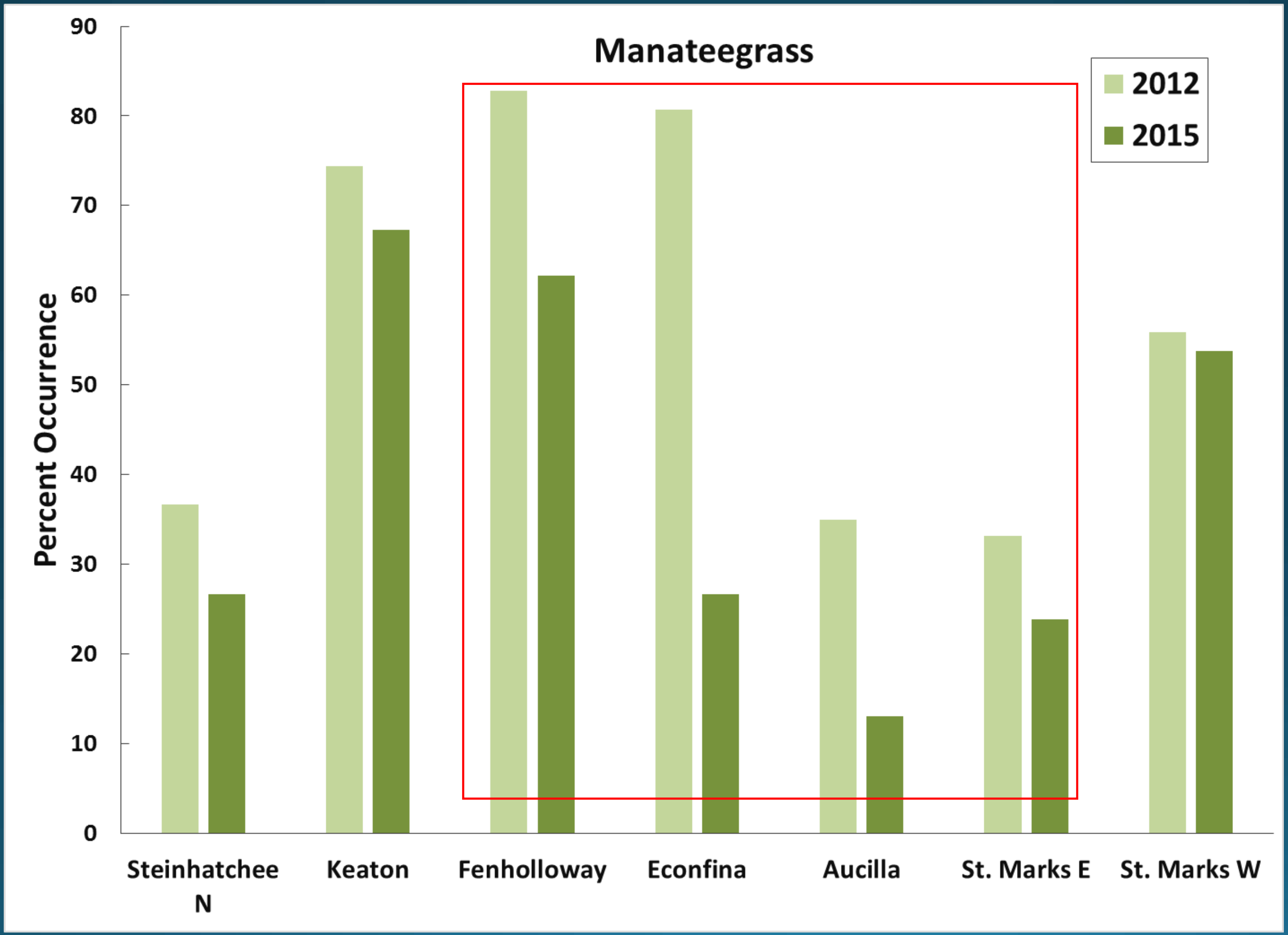
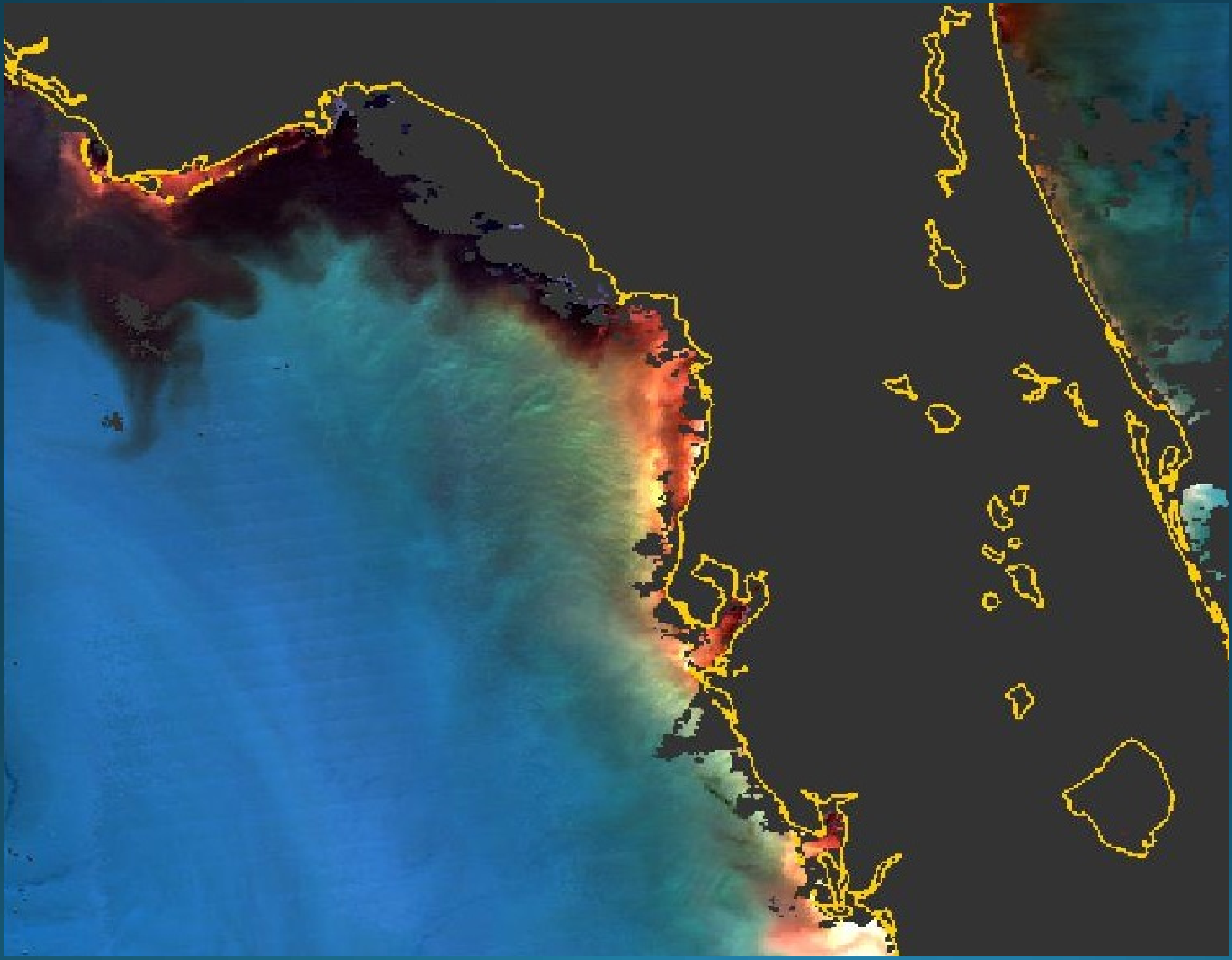
Changes in Turtlegrass occurrence in northern Big Bend between 2012 and 2015



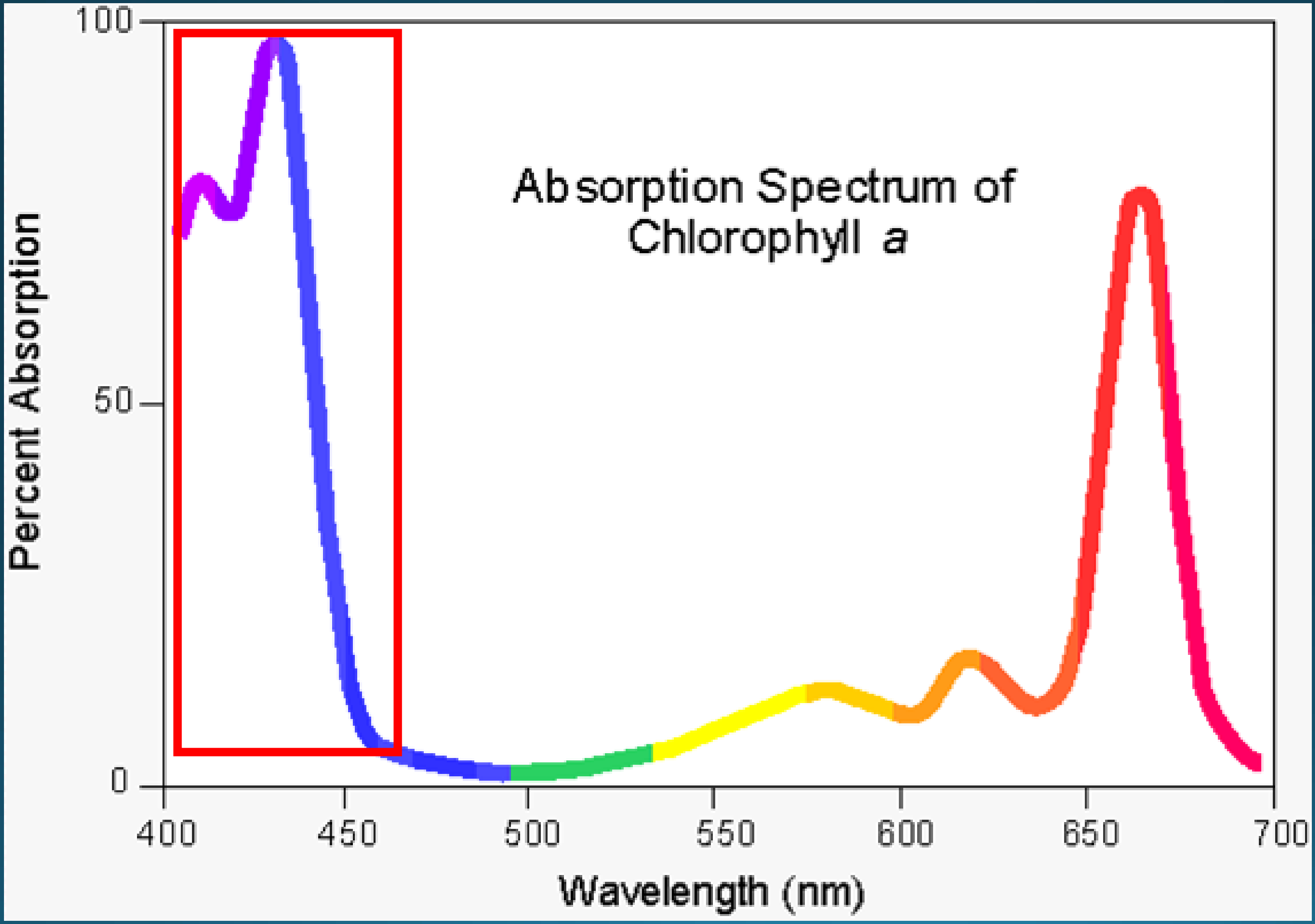
Changes in Manateegrass occurrence in northern Big Bend between 2012 and 2015

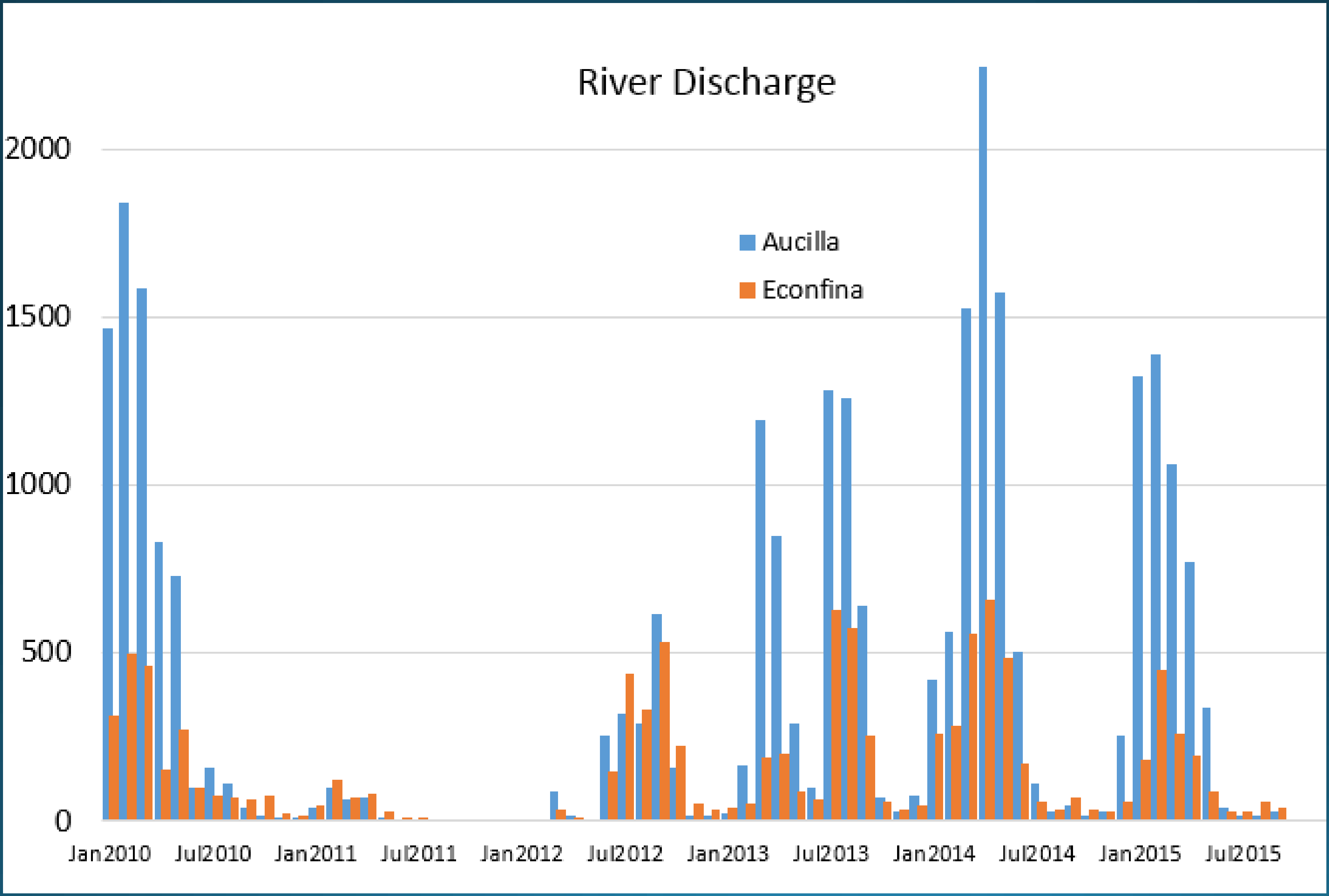


MODIS Image- CDOM from Suwannee and Ochlockonee Rivers



CDOM blocks blue light.




River Discharge
Aucilla
Econfina
2000
1500
1000
500
0
Jan 2010
Jul 2010
Jan 2011
Jul 2011
Jan 2012
Jul 2012
Jan 2013
Jul 2013
Jan 2014
Jul 2014
Jan 2015
Jul 2015

Pearson correlation coefficient matrix for river discharge (SPFLO, SPAUC, SPECO, JUNAUC JUNECO), optical water quality (AUPCU, ECOPCU, AUCCHL, ECOCHL), and water column light attenuation (KPARAU, KPAREC).

Light attenuation in the Aucilla region is strongly correlated with chlorophyll and CDOM. Phytoplankton chlorophyll and CDOM are strongly correlated with spring river discharge.

	SPFLO	*SPAUC*	*SPECO*	*JUNAUC*	*JUNECO*	*AUCPCU*	*ECOPCU*	*AUCCHL*	*ECOCHL*
SPFLO	1.00								
SPAUC	1.00	1.00							
SPECO	1.00	**0.99**	1.00						
JUNAUC	0.80	0.79	**0.83**	1.00					
JUNECO	0.64	0.63	0.66	**0.91**	1.00				
AUCPCU	**0.94**	**0.94**	**0.94**	**0.84**	0.58	1.00			
ECOPCU	0.79	0.80	0.76	0.59	0.45	0.78	1.00		
AUCCHL	0.81	0.81	0.81	0.73	0.45	**0.94**	**0.86**	1.00	
ECOCHL	**0.92**	**0.92**	**0.93**	0.79	0.51	**0.99**	0.74	**0.93**	1.00
KPARAU	0.79	0.80	0.75	0.52	0.22	**0.88**	**0.83**	**0.91**	**0.88**
KPAREC	0.50	0.51	0.45	0.32	0.22	0.51	**0.92**	0.69	0.47