

GEER 2019 Coral Springs, Florida

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Florida Bay Algal Blooms

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*Pelican Key Basin
Mark Parry – ENP
September 22, 2016*

Algal Blooms

Operational Definition



A phytoplankton bloom is a rapid increase in the population of aquatic microscopic algae or cyanobacteria, such that one or two forms dominate the community and reproduce to extraordinary cell densities.

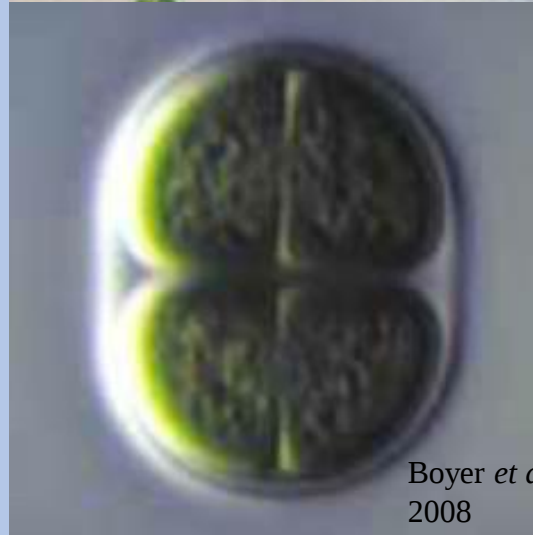
Algal Blooms in Florida Bay

Cyanobacteria Primary Component



Synechococcus

- Globally distributed & highly productive
- Single cells; cylindrical/spherical (0.6 to 35 μm)
- Phycoerytherin
- Can use inorganic and organic sources of N/P
- Toxins- None reported*



Plankton Category	Size (μm)	Plankton Type
Femto	0.02-0.2	Viruses
Pico	0.2-2.0	Bacteria
Nano	2.0- 20	Cyanobacteria
Micro	20-200	Diatoms Dinoflagellates
Meso	200-2000	Zooplankton

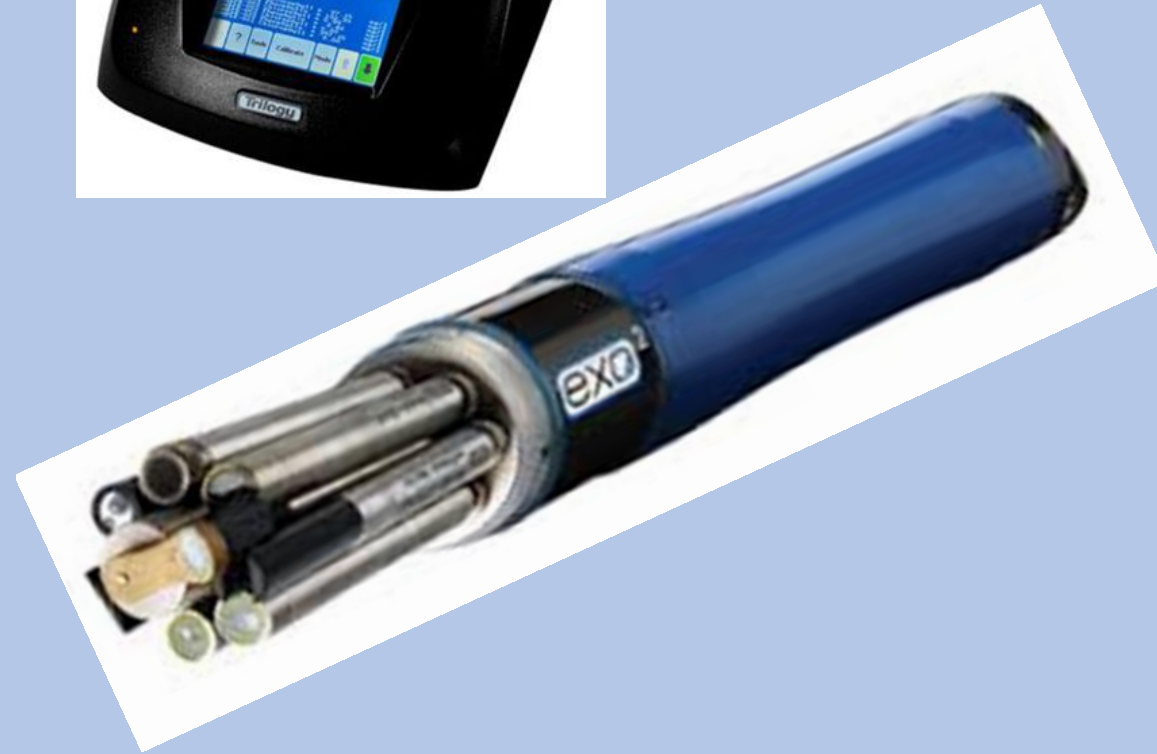
Chlorophyll-a Measurement



Chlorophyll-a Proxy ($\mu\text{g/L}$)

Methods

- Spectrophotometry
- High Performance Liquid Chromatography
- ✓ Laboratory Fluorometry
- ✓ In-situ fluorescence with optical probe (YSI EXO)

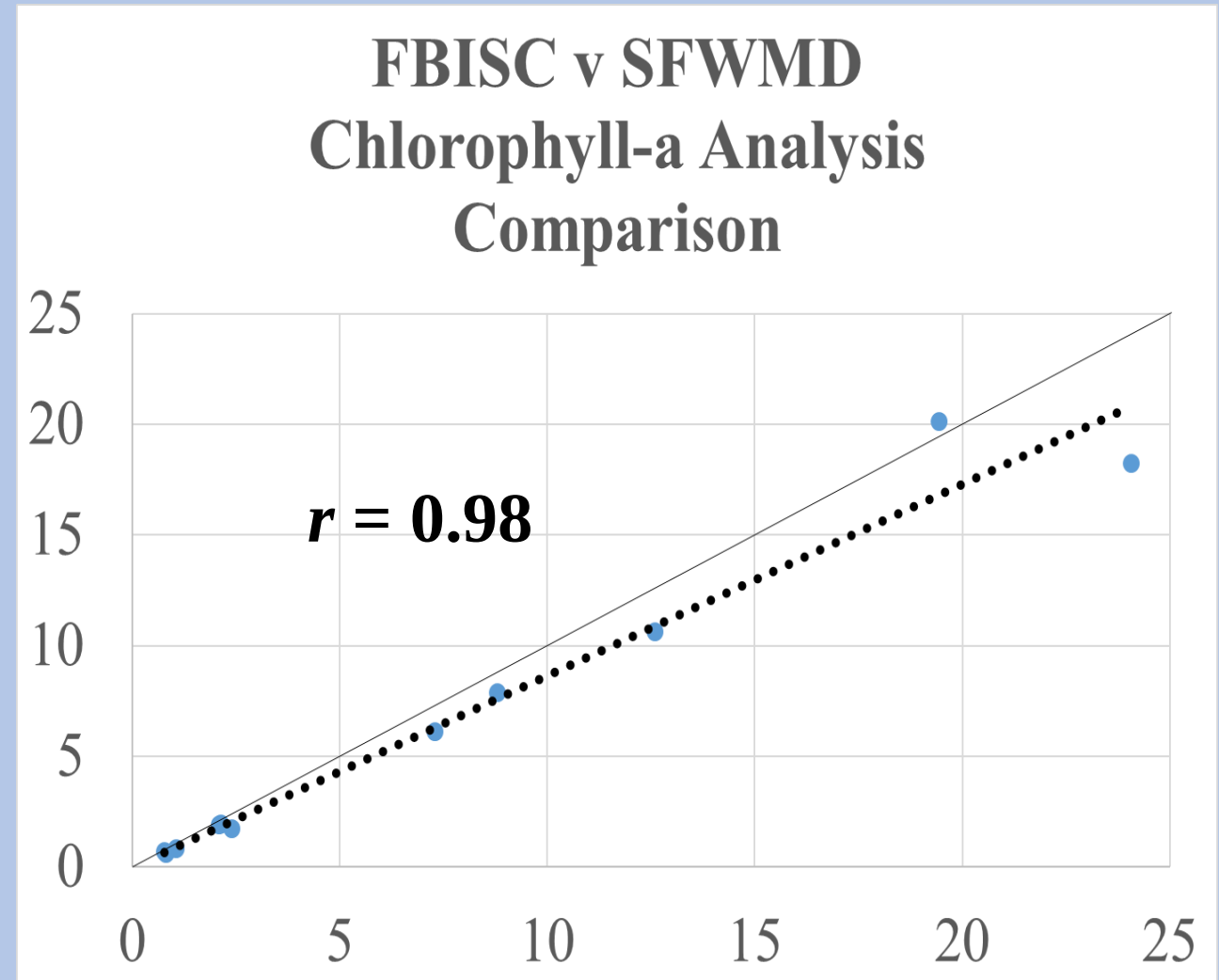


Laboratory Method Interagency Comparison



EPA Method 445

- Sample Water Collection
Cell Filtration
Chlorophyll Extraction
- Measure fluorescence on
benchtop instrument



Algal Blooms in Florida Bay

Area of Interest



Florida Bay Zones

(1) Eastern Basins

(2) Northern
Central Basins

(3) Western Bay

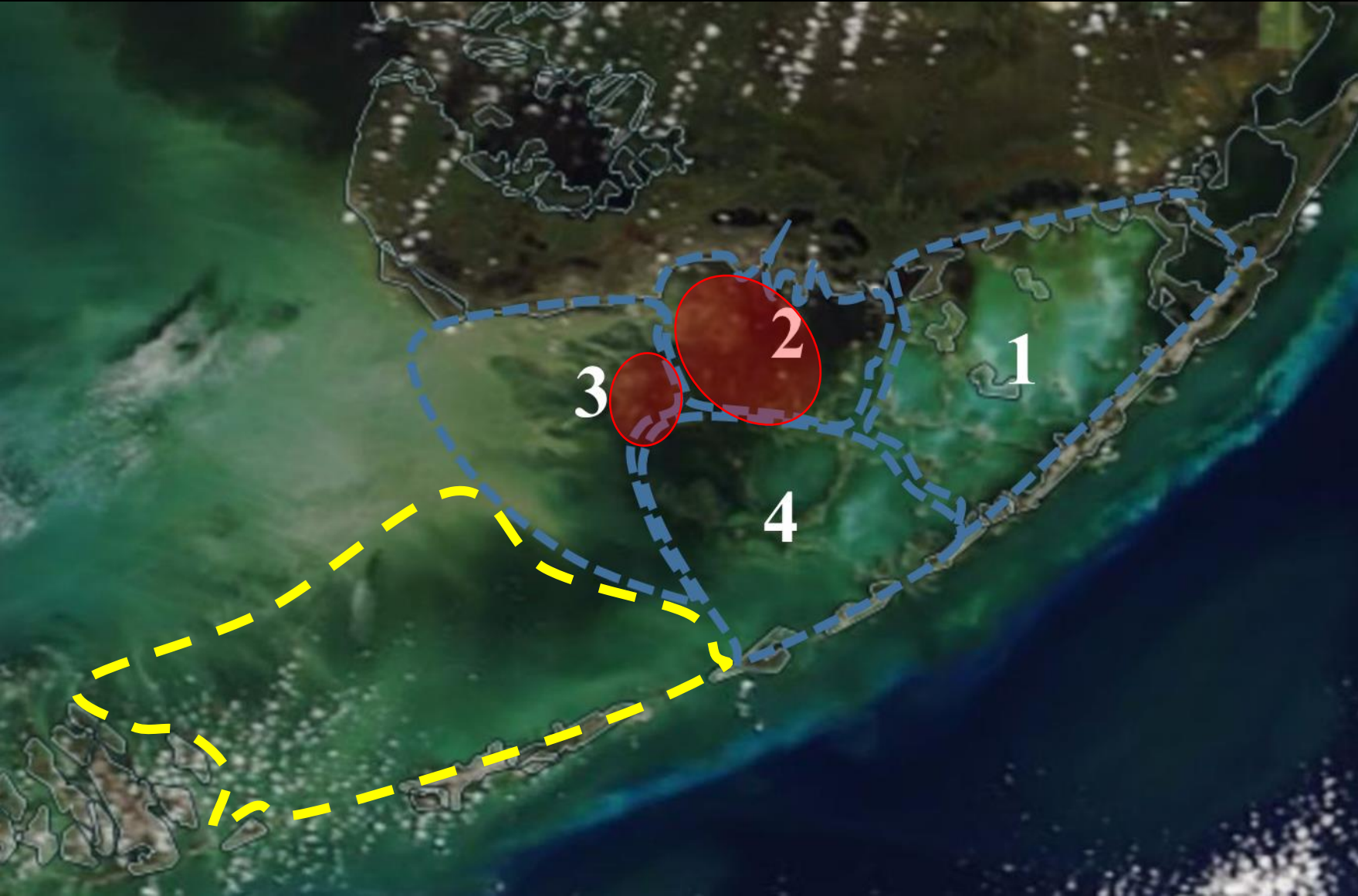
(4) Southern
Central Basins

Algal Blooms in Florida Bay

Area of Interest



**Primary Areas
affected by the
Seagrass die-off
in 2015**



Algal Blooms in Florida Bay Historical Reports



1987-1991

1990's

1999

2005-2007

2013-2014

Florida
Bay
Seagrass
Die-off

Butler, 1995
(MEPS)
Phlips, 1999
(L & O)

S Central &
N Central Bay

Peak Chl-a
µg/L

22 & 38

I
R
E
N
E

N Central
& Western
Bay

22 to 36

Synthesis
Report
December
2008

Eastern Bay
(Barnes Sound)

10 to 15

Dissertation
Dan Hoer
2015

S Central Bay
(Mystery basin)

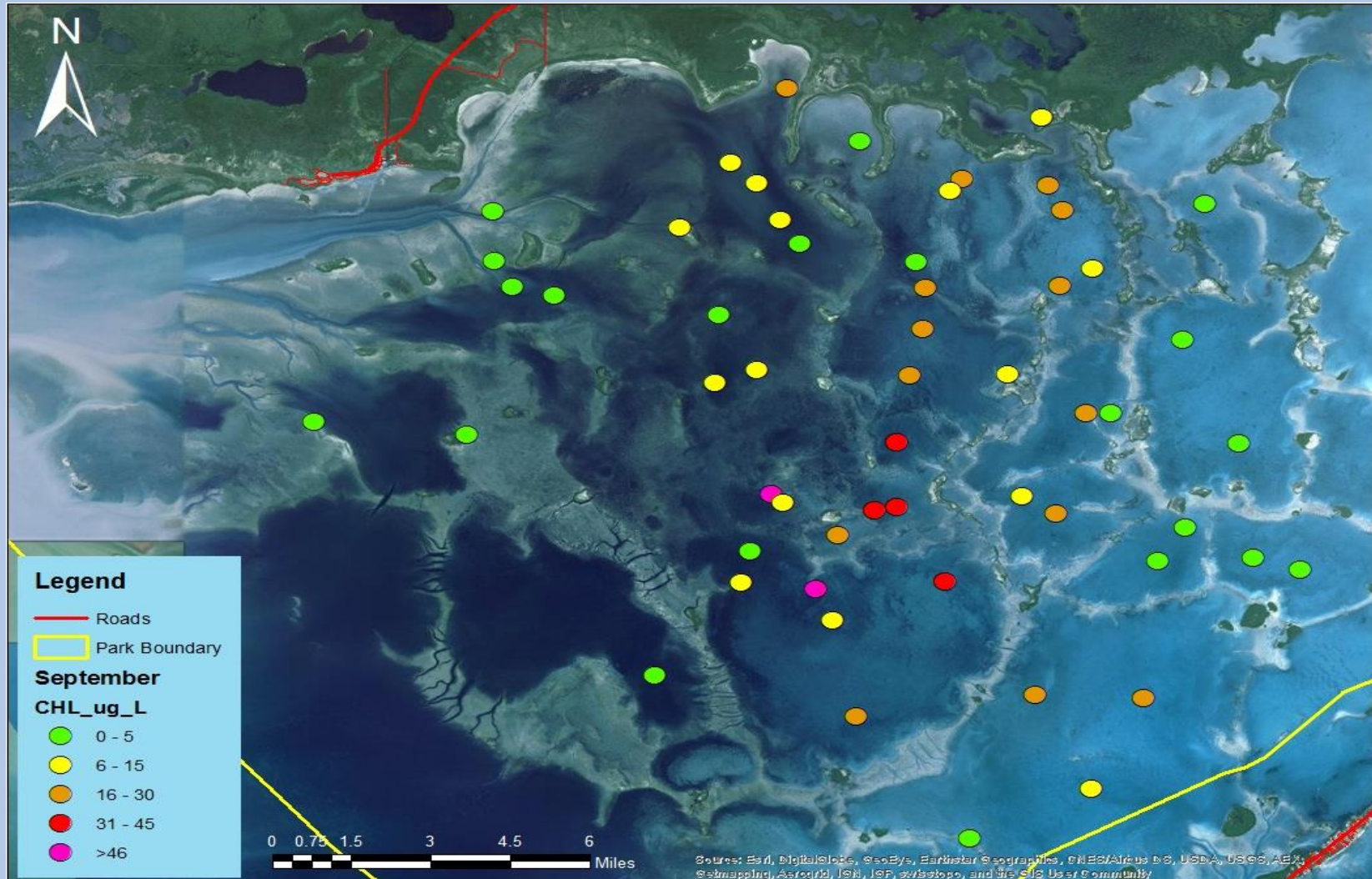
20 to 33

Algal Blooms in Florida Bay Historical Reports



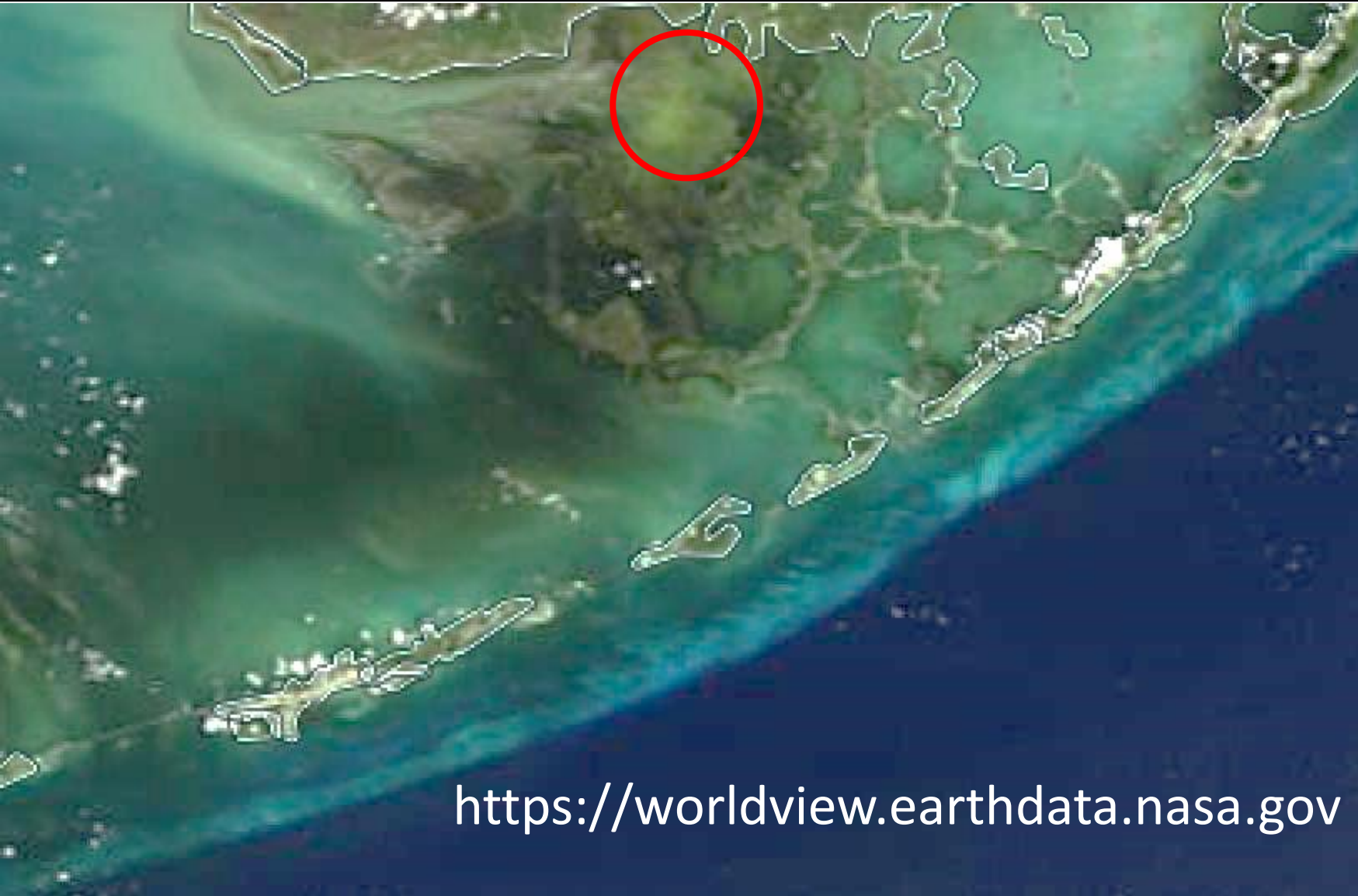
2015-2016	2016-2017	2017-2018
Florida Bay Seagrass Die-off	August 2016 Rankin Lake Bloom	September 2017 Hurricane IRMA
	N Central Bay to Atlantic	Coastal Bights/ N Central Bay
Peak Chl-a µg/L	50 to 64	218 & 185

Central Bay Algal Bloom September 2016 Bloom Sampling



Central Bay Algal Bloom

August 2016 Satellite Imagery (EOS Terra)



BLOOM INITIATION

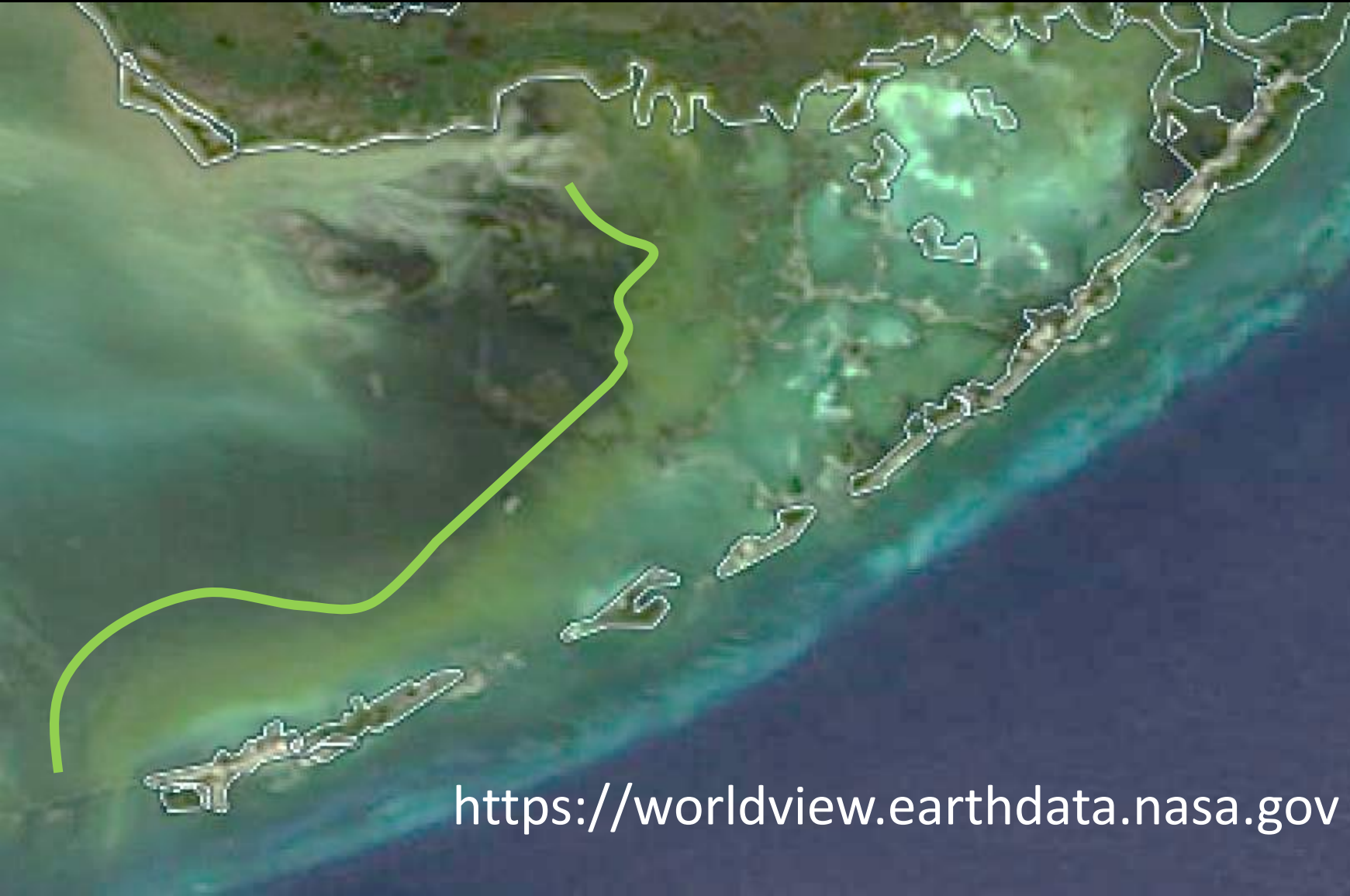
**Rankin Lake Area
August 2016**

**Dissolved Oxygen was
hypoxic in Rankin
Lake at initiation but
bloom water was
saturated thereafter.**

<https://worldview.earthdata.nasa.gov>

Central Bay Algal Bloom

October 2016 Satellite Imagery (EOS Terra)



<https://worldview.earthdata.nasa.gov>

CYANOBACTERIA

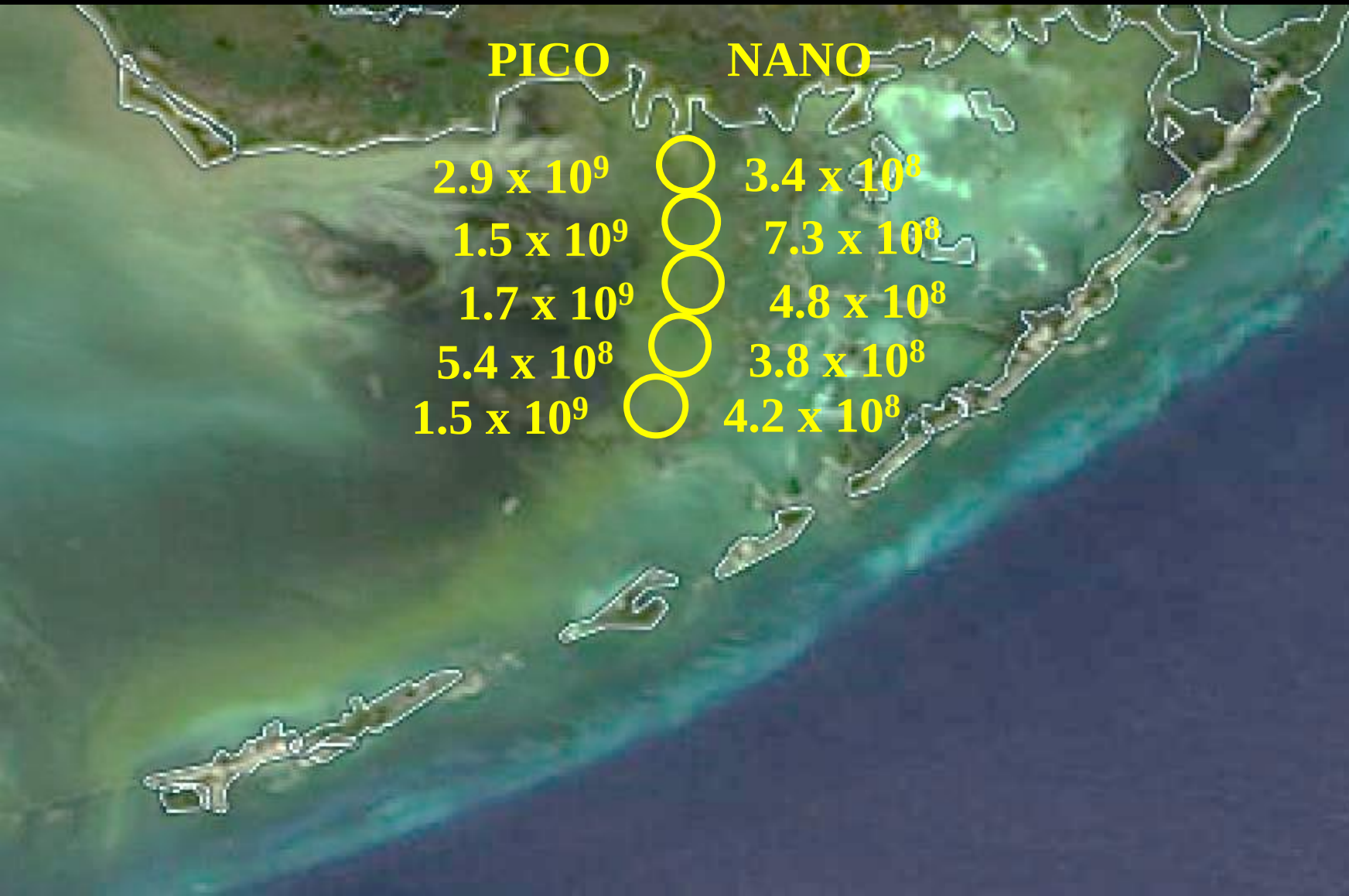
- Picoplankton
single cells, colonies,
clusters and bacteria-
like cells
- Nanoplankton
similar to picoplankton
and *Synechococcus*-like
cells

DINOFLAGELLATES:

- *Pyrodinium bahamense*
- *Ceratium hircus*
- *Karenia longicanalis*
- *Prorocentrum spp*

Central Bay Algal Bloom

October 2016



CYANOBACTERIA

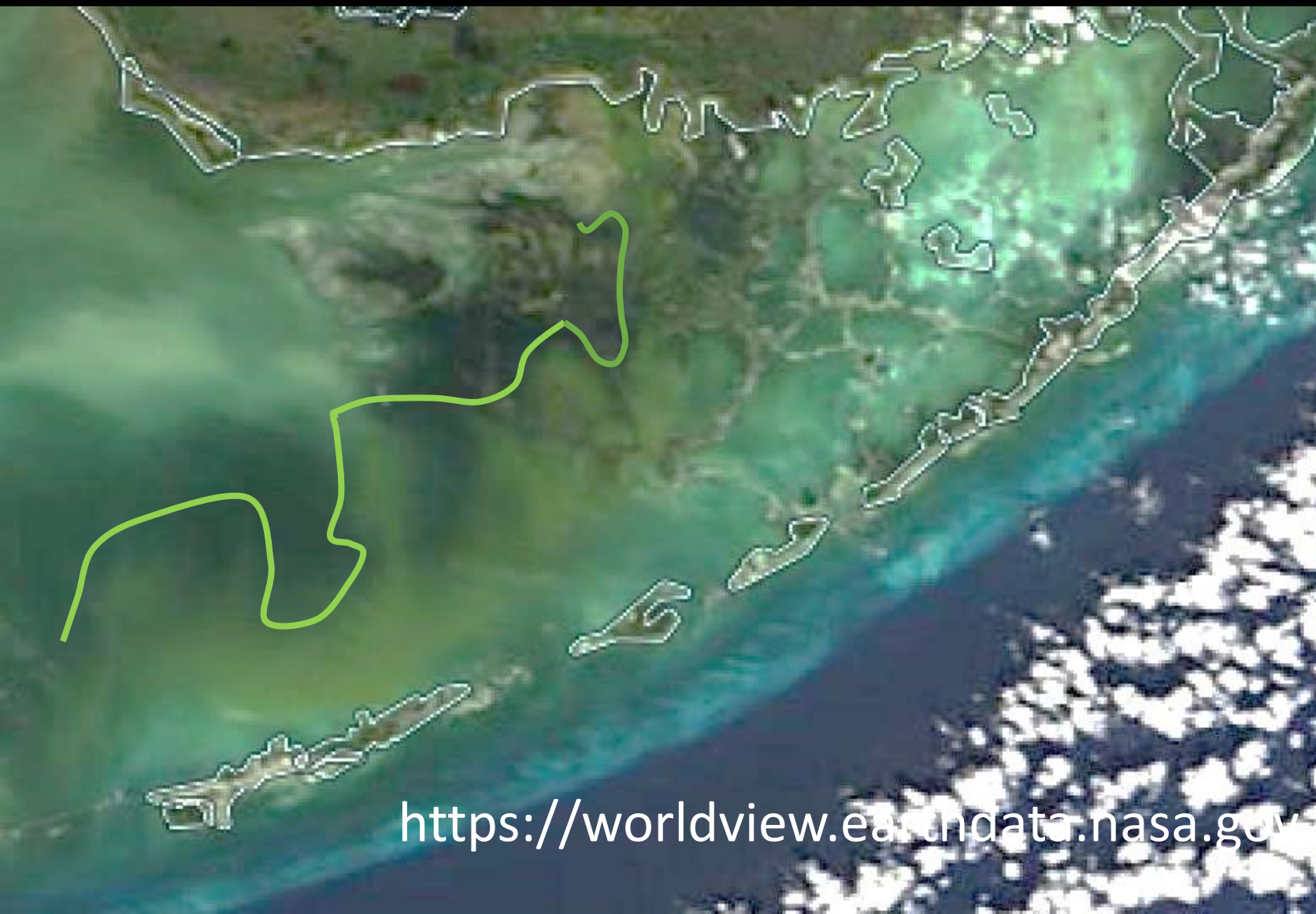
- 10^9 cells/L Picoplankton
- 10^8 cells/L Nanoplankton

DINOFLAGELLATES

- 10^2 cells/L of *Pyrodinium*
- 10^2 cells/L of *Ceratium*
- *Karenia brevis*-
Not Present

Central Bay Algal Bloom

November 2016 Satellite Imagery (MODIS)



<https://worldview.earthdata.nasa.gov/>

CYANOBACTERIA

(cell count decreased)

- Picoplankton
- Nanoplankton
- Unidentified Cyanobacteria

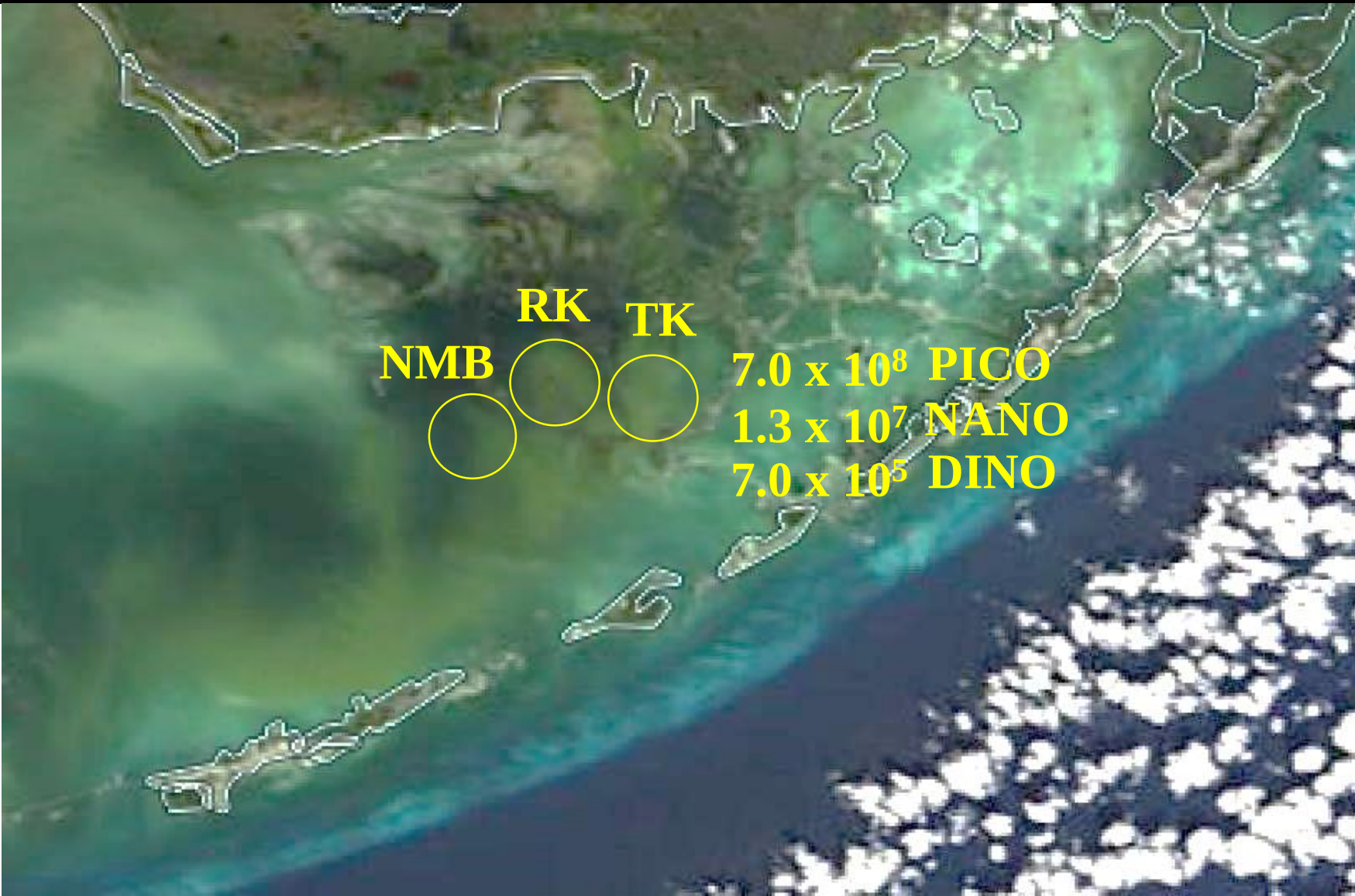
DINOFLAGELLATES

(cell count/diversity increased)

- Unidentified Flagellates
- *Karenia longicanalis*
- *Heterocapsa* spp
- *Prorocentrum* spp
- *Prorocentrum micans*
- *Gyrodinium* spp
- *Karlodinium* spp

Central Bay Algal Bloom

Late November 2016



CYANOBACTERIA

- 10^8 cells/L Picoplankton
- 10^7 cells/L Nanoplankton
- 10^6 cells/L Unidentified

DINOFLAGELLATES:

- 10^5 cells/L Dinoflagellates (unidentified) most <10 μm ; unarmored
- 10^4 cells/L of *Heterocapsa*
 10^3 cells/L of *Karenia longicanalis*
- *Karenia brevis*-
Not Present

Algal Blooms in Florida Bay

Peak Concentrations



BASIN	DATE	CHL μg/L	SECCHI (cm)
JOHNSON KEY	11/04/16	64	20
SNAKE BIGHT	12/20/16	55	30
TWIN KEY	09/22/16	54	40
RANKIN LAKE	12/14/16	50	35
AVERAGE	02/08/17	1.2	CTB



Clear to bottom

Algal Blooms in Florida Bay

Hurricane IRMA September 2017

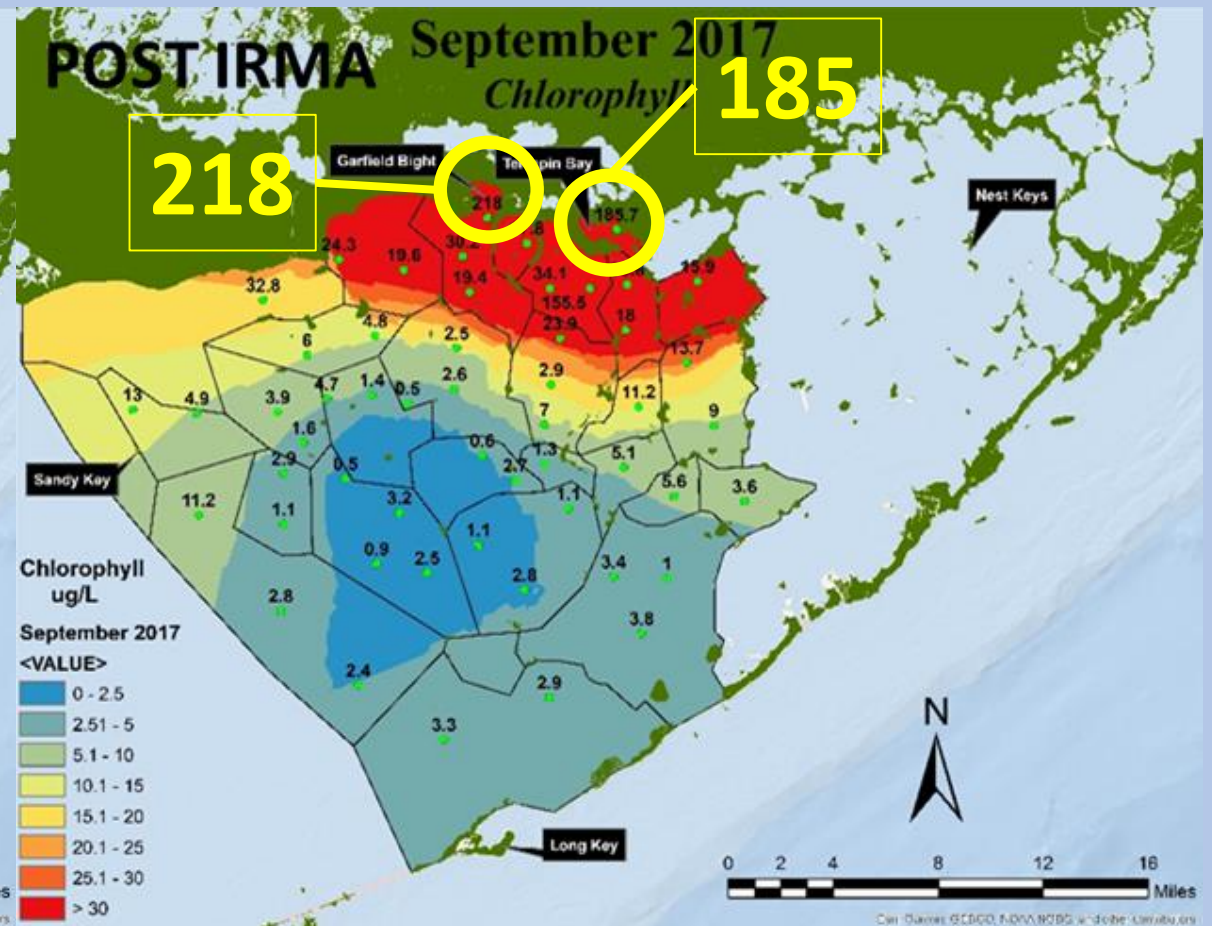
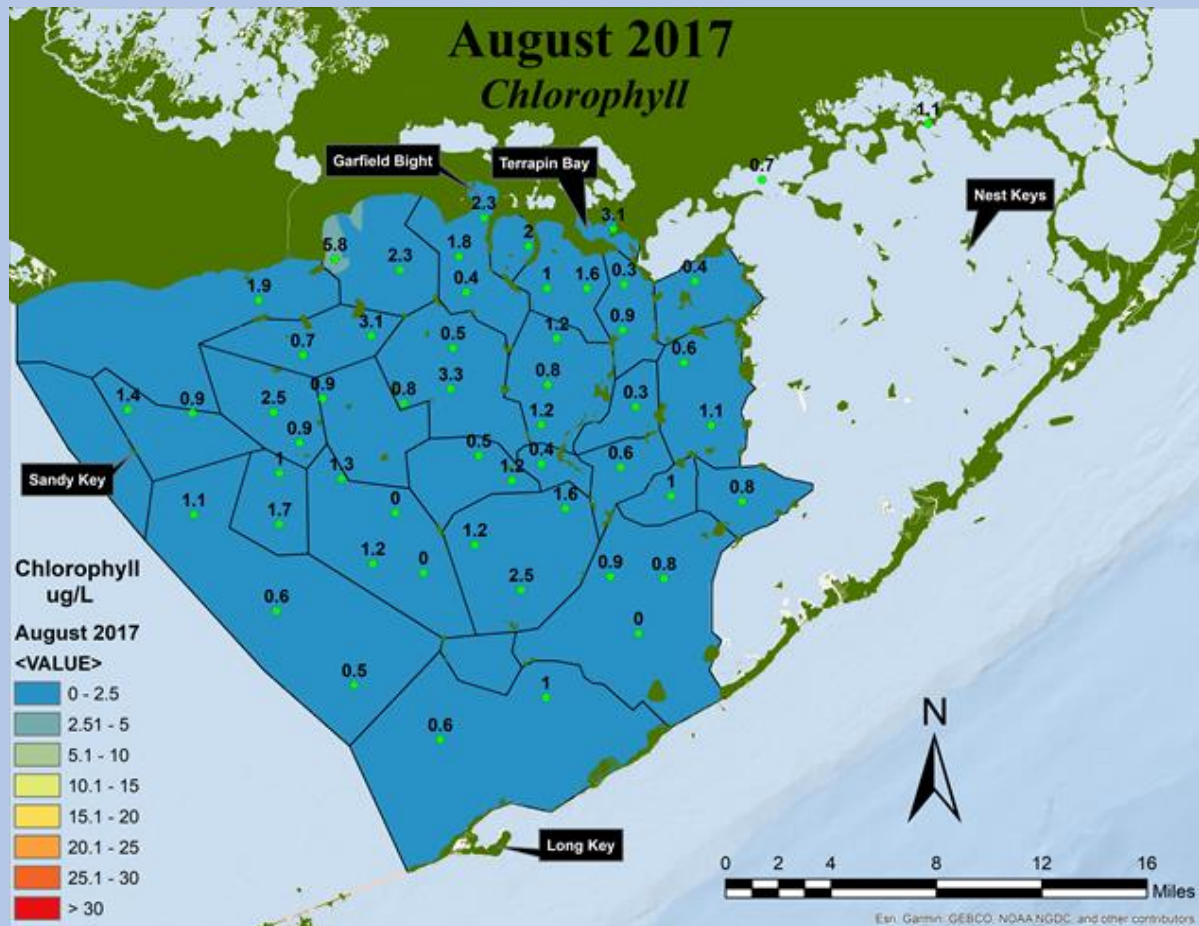


Florida Bay Water Quality Sampling Sites

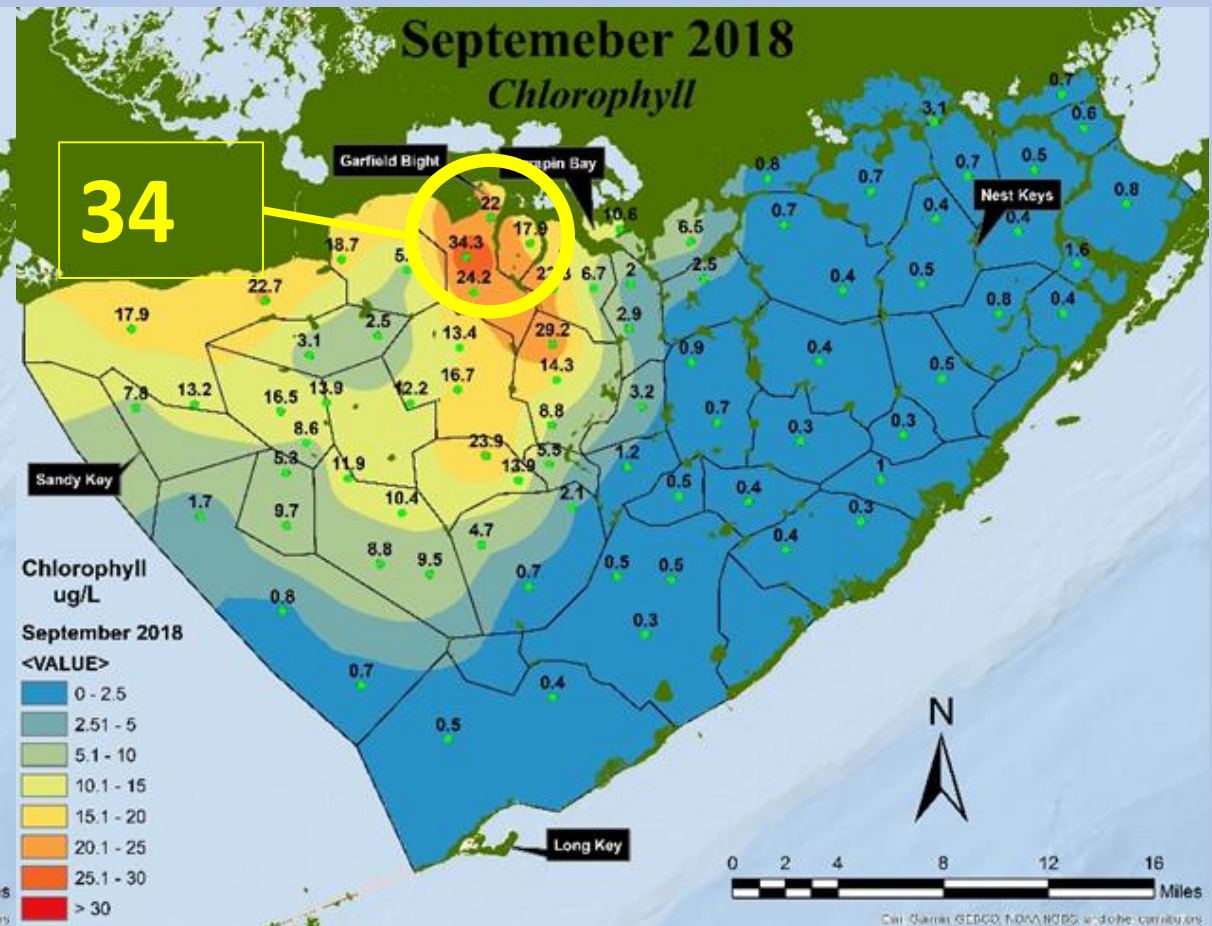
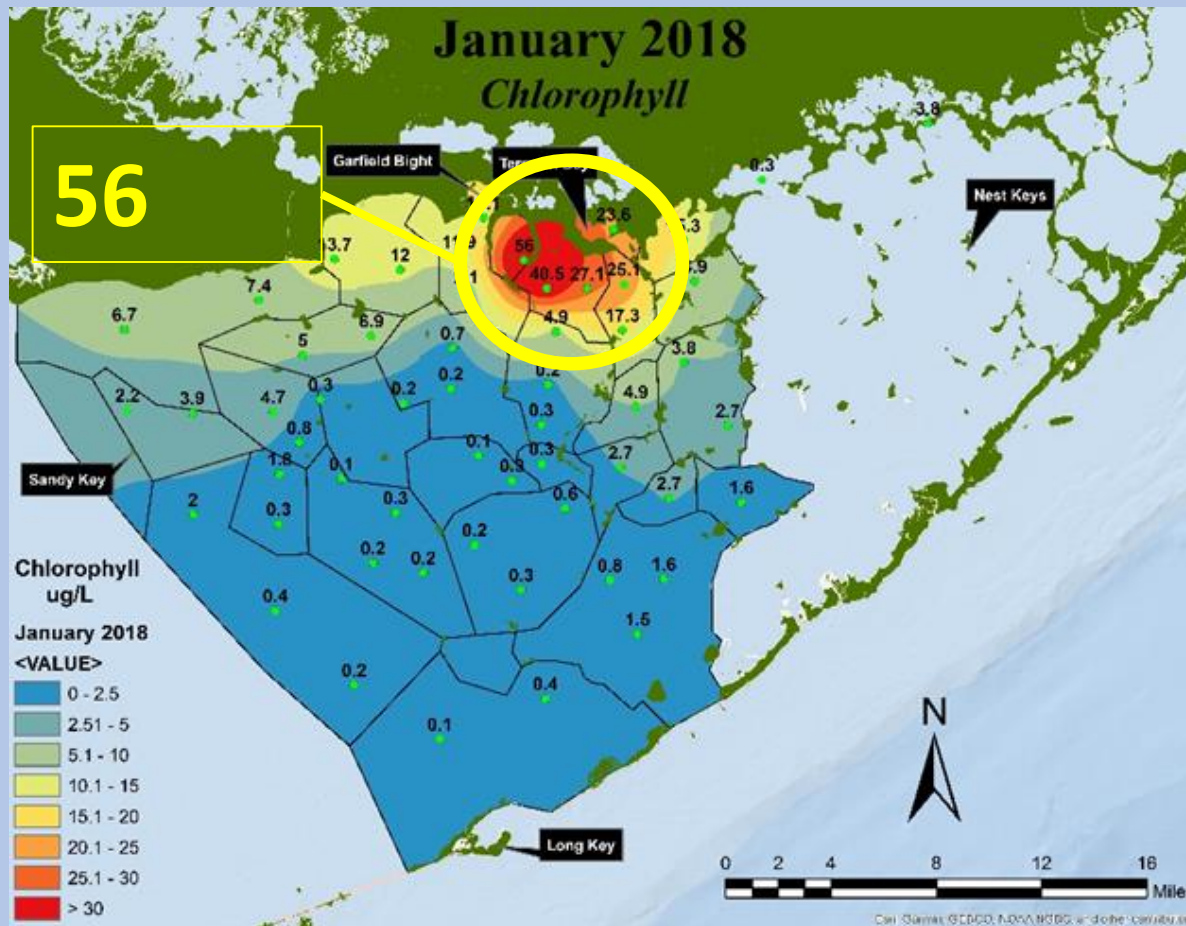


Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroX, GeoMapping, AeroGRID, IGN, IGP, swisstopo, and the GIS User Community

Florida Bay Post IRMA Chlorophyll-a



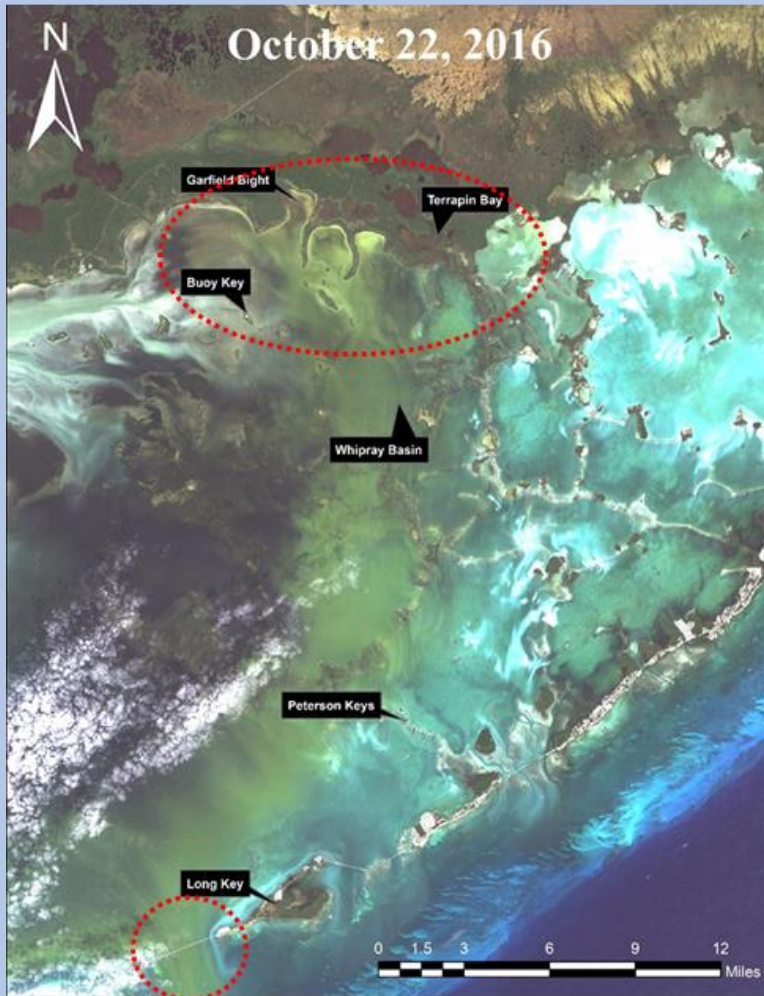
Florida Bay Post IRMA Chlorophyll-a



Florida Bay Coastal Bights to Reef Tract Connection



First Algal Bloom



Post IRMA Algal Bloom



Recurrent Algal Blooms



Conclusion



- **The extreme responses of cyanobacterial blooms to recent perturbations in Florida Bay (in terms of biomass and spatial extent) may indicate degraded resilience of the ecosystem.**
- **The connection of central coastal Everglades conditions to the Middle Keys reef tract can be clearly seen during recent cyanobacterial bloom events.**