Post Irma Water Quality Interagency web meeting to share Water Quality sampling results

Nov. 14, 2017

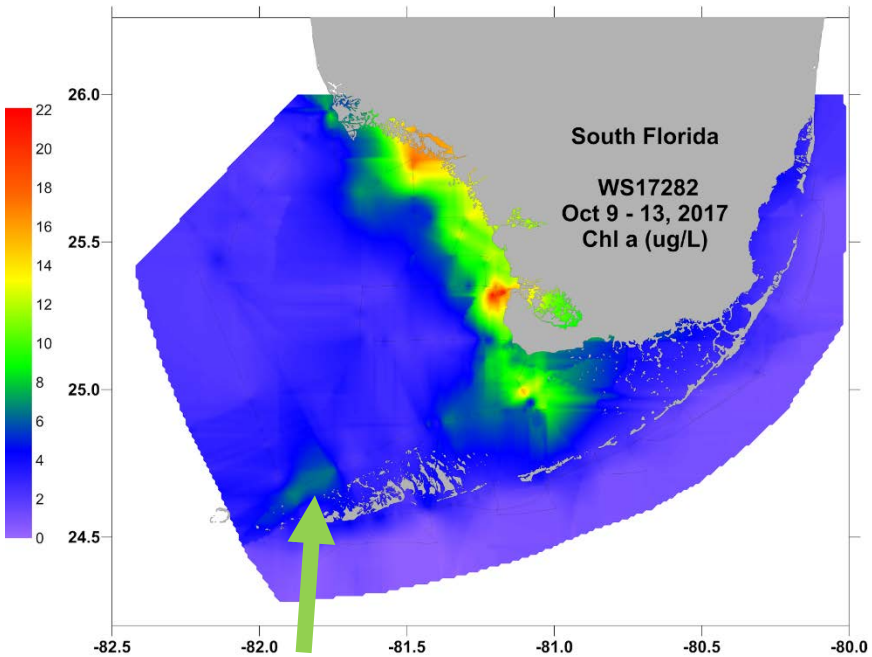
Presentations were provided by the following people/agencies:

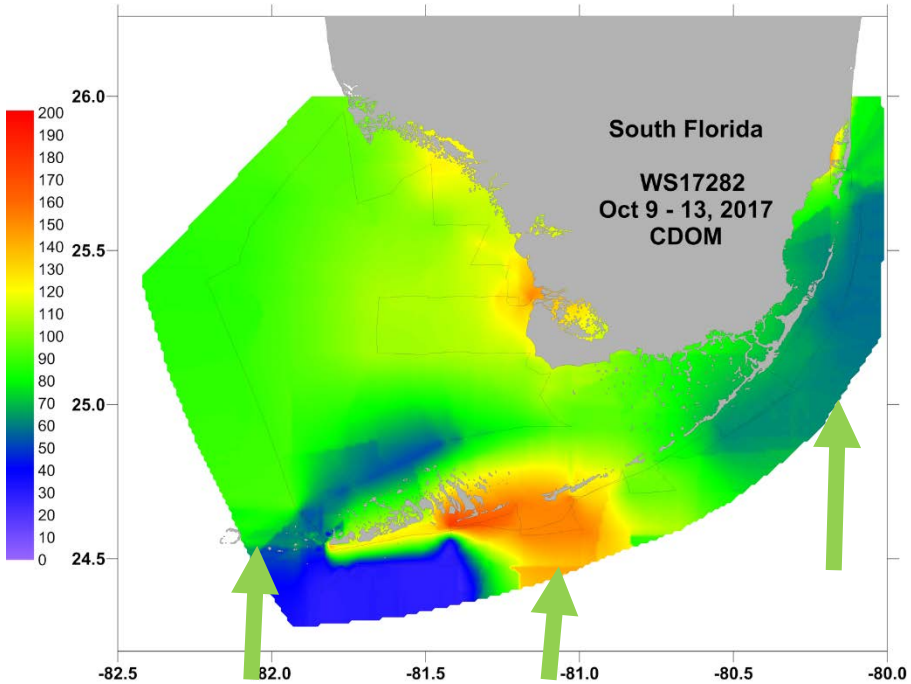
- Chris Kelble –results of regional sampling, Florida Bay spotted sea trout sampling, Biscayne bay sampling
- Dan Otis USF St. Pete ocean remote sensing
- Chris Madden SFWMD Florida Bay sampling
- Christopher Kavanagh western and central bay results
  (sampling sept 26 to 29)
- Christian Avila—RER (Miami-dade derm)
- Anna Wachnika SFWMD Phytoplankton in BB including canals

Participants

Robert Lusic AOML
Chris Kelble AOML
Christopher Kavanagh NPS ENP
Christian Avila
Chris Madden SFWMD
Dan Otis USF
Thomas Dreschel
Frank Muller-karger USF
Tylan Dean NPS
Steve Kelly SFWMD
Amanda Theresa
Dave Rudnick SFWMD
Jamie Monty Miami Dade
Anna Wachnicka SFWMD

Chris Kelble **AOML Regional surveys** with in situ instrumentation aboard the 96 foot RV Walton Smith vessel





High chlorophyll signature where rivers are entering the gulf and higher than normal signal in the vicinity of the lower keys bayside where the dissolved organic matter is also high. An even high organic matter signal is present on oceanside of the lower keys, too, but these waters may get dispersed by the currents before causing a bloom there. CDOM is also elevated in the vicinity of the upper keys, but doesn't seem to be associated with a bloom (although a time lag is expected between the nutrient input and chlorophyll increases).

Additional comments:

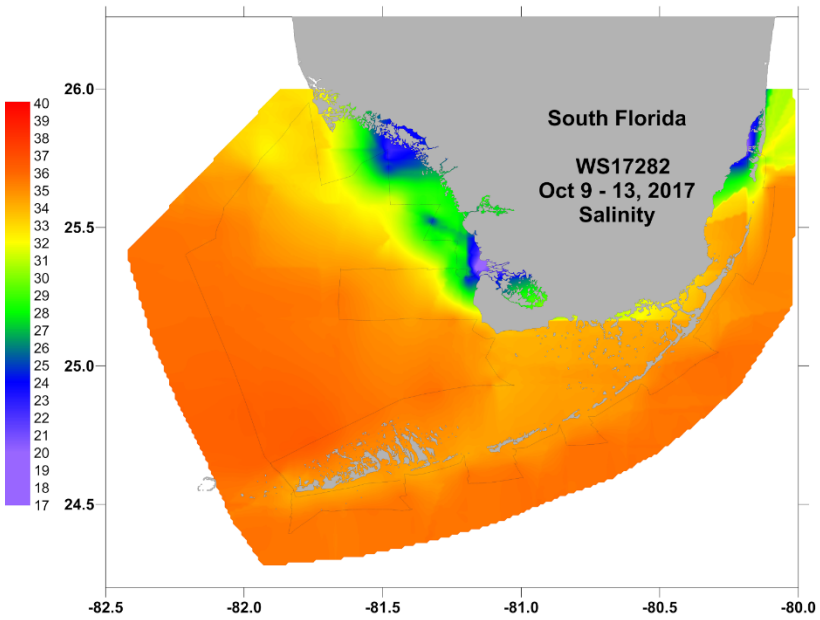
ChL values were about 15 micrograms per liter, probably mostly composed of diatoms

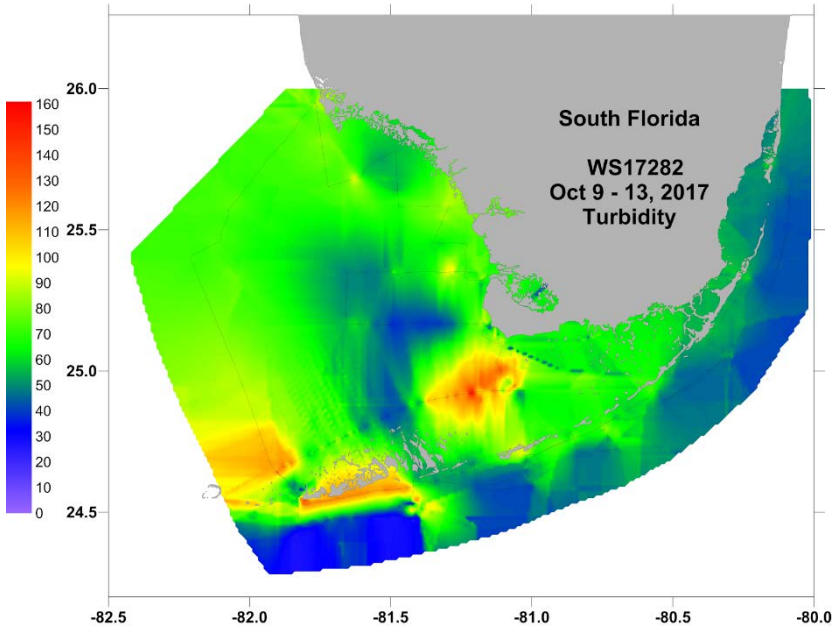
DO– Dissolved oxygen was not so low in general

Turbidity—generally pretty high

CDOM (dissolved organic matter)– an unusual signal of high CDOM was observable in the Lower Keys oceanside;

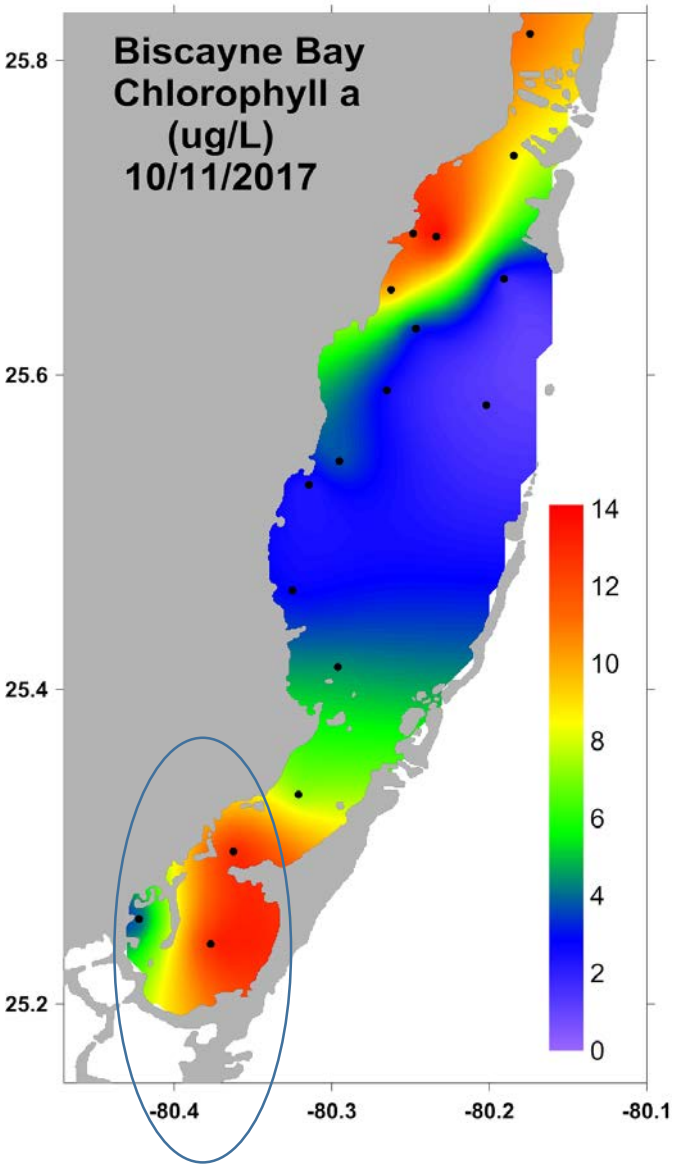
They also took samples for Splenda analysis—an indicator of wastewater





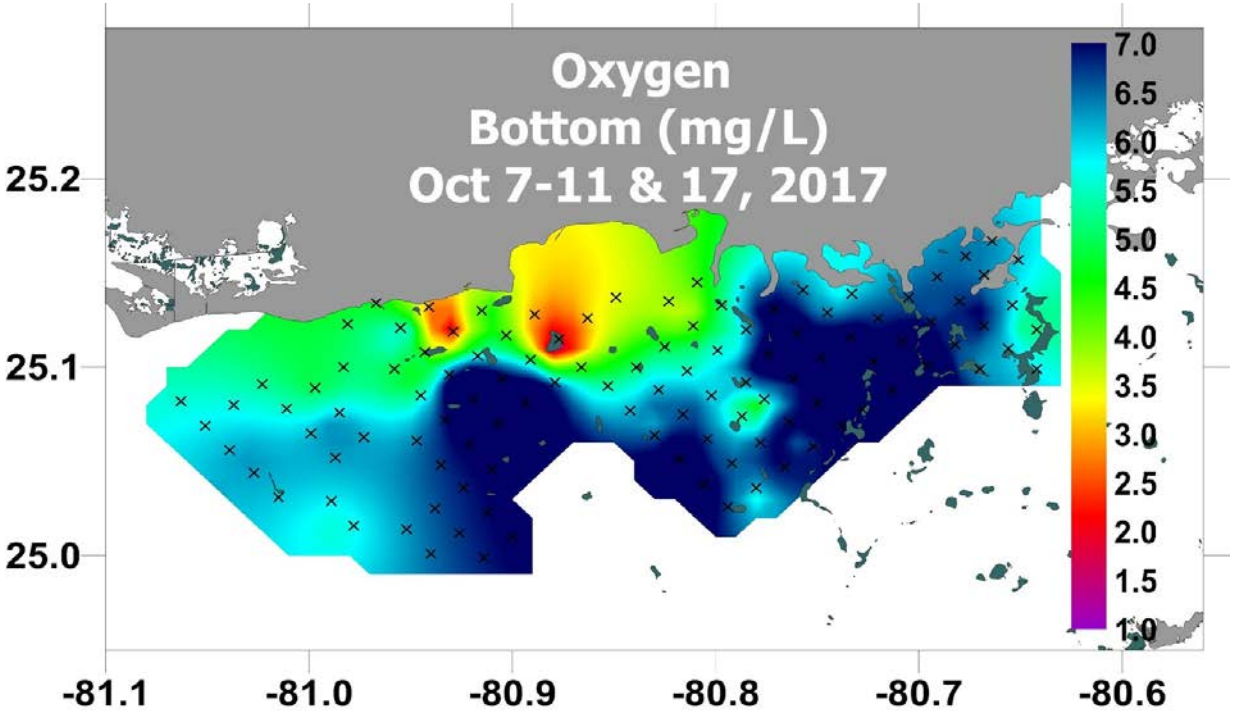
Freshwater inputs are visible on southwest coast (and in Biscayne Bay where there will be little impact to most of the keys, if at all.) Note: Real time data from the noaa buoys NDBC in the same area shows more freshwater in the region than when these data were collected. Turbidity measurements were high on the bayside of the keys…

Note: Important to note that this vessel doesn't go into Florida Bay….so the data in the interior there probably should be masked. Chlorophyll values are generally high in the bay, too, based on grab samples from ENP, etc.



Biscayne Bay sampling
Shows hot spot in southern bay, card and barnes sounds

Spotted Sea Trout Study AOML

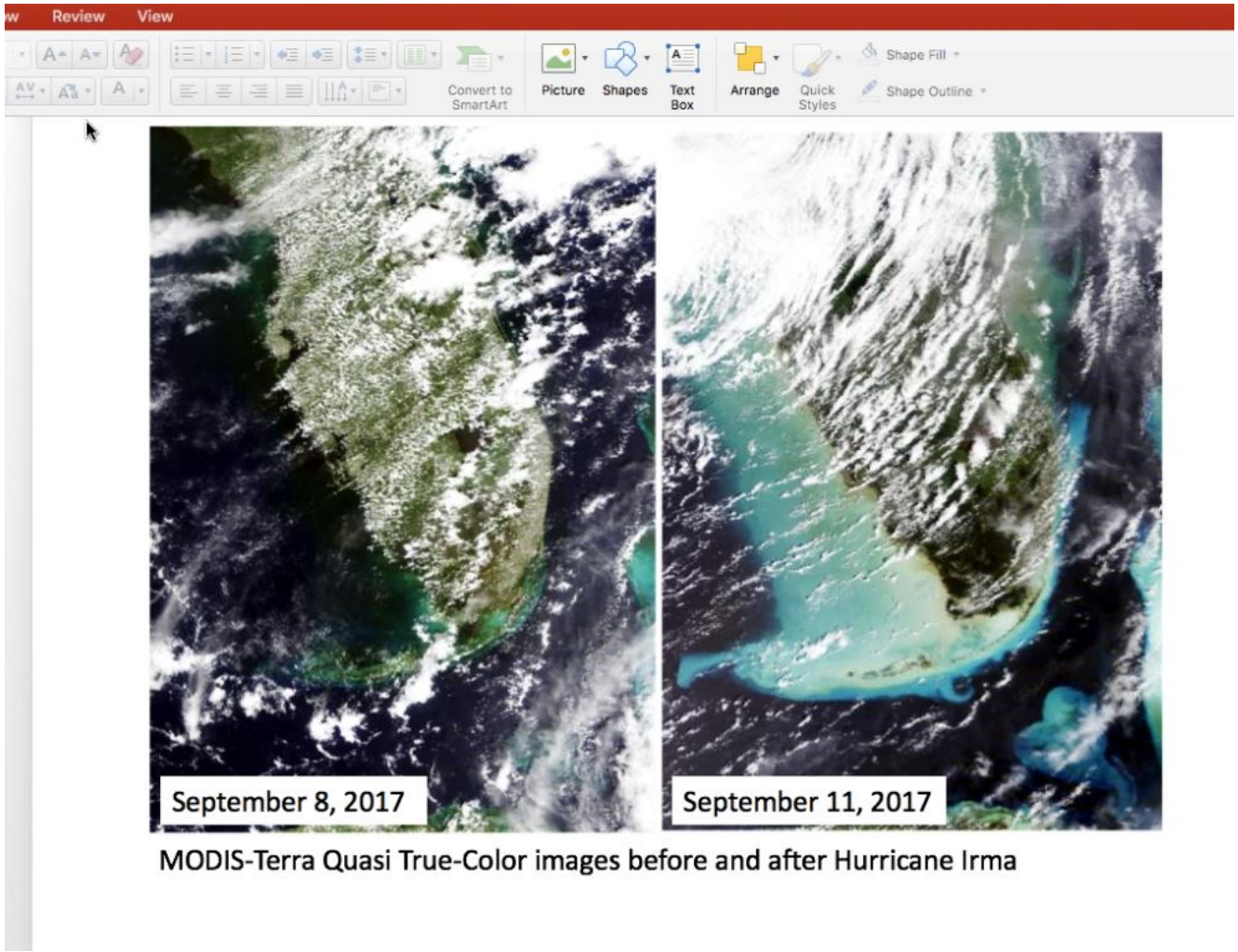


Dissolved oxygen was generally good; the team caught a record number of sea trout and believe that sea trout have responded to this influx of freshwater; will know more with additional monthly sampling

Note: Values in inland areas/lakes are an artifact and should be masked; vessel could not operate in such shallow water. Chris Madden's data from SFWMD could be used to fill in the info in inland lakes.

Note: lower than 2 mg/l is considered hypoxic.

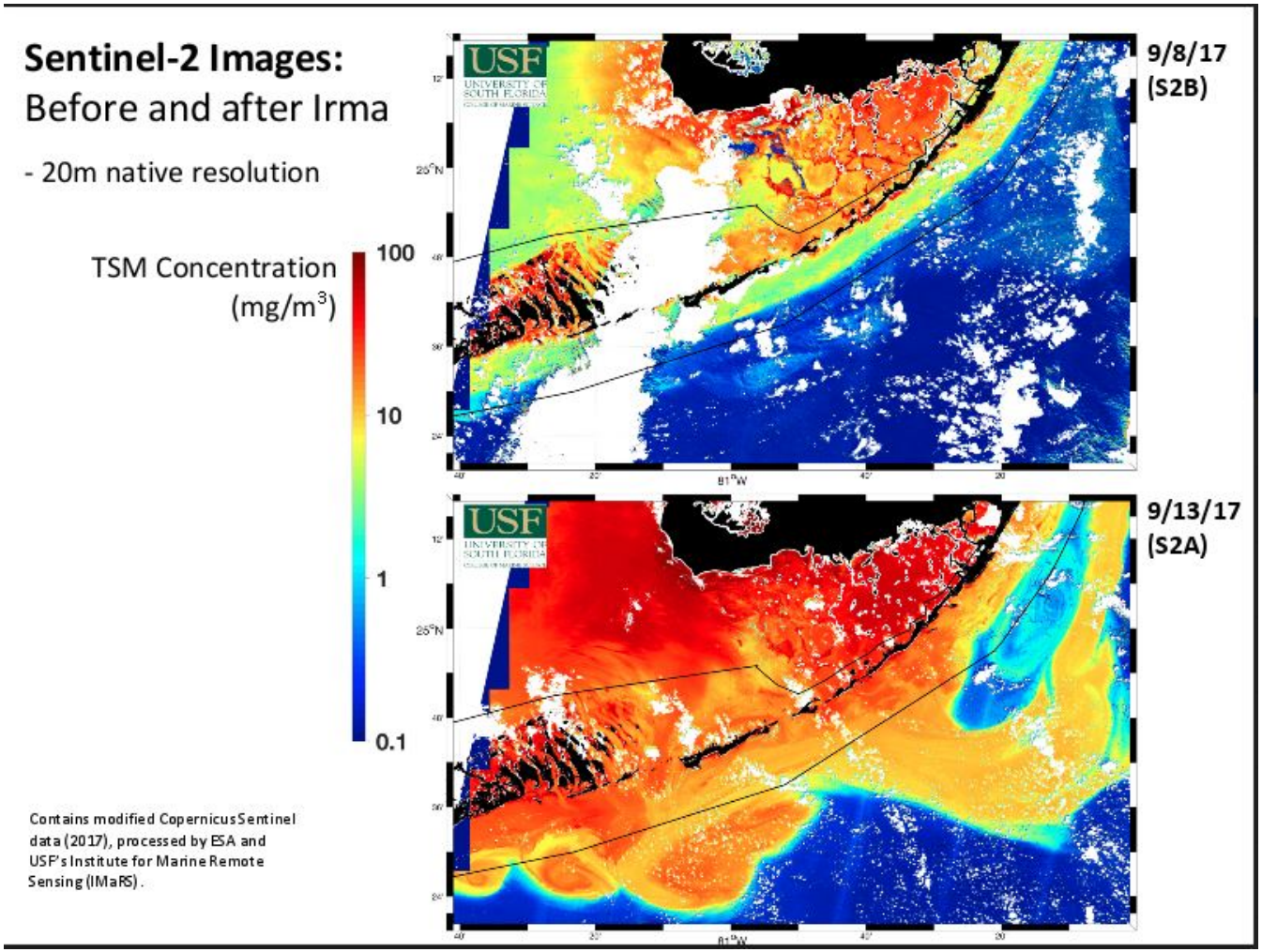
Dan Otis USF Satellite interpretation



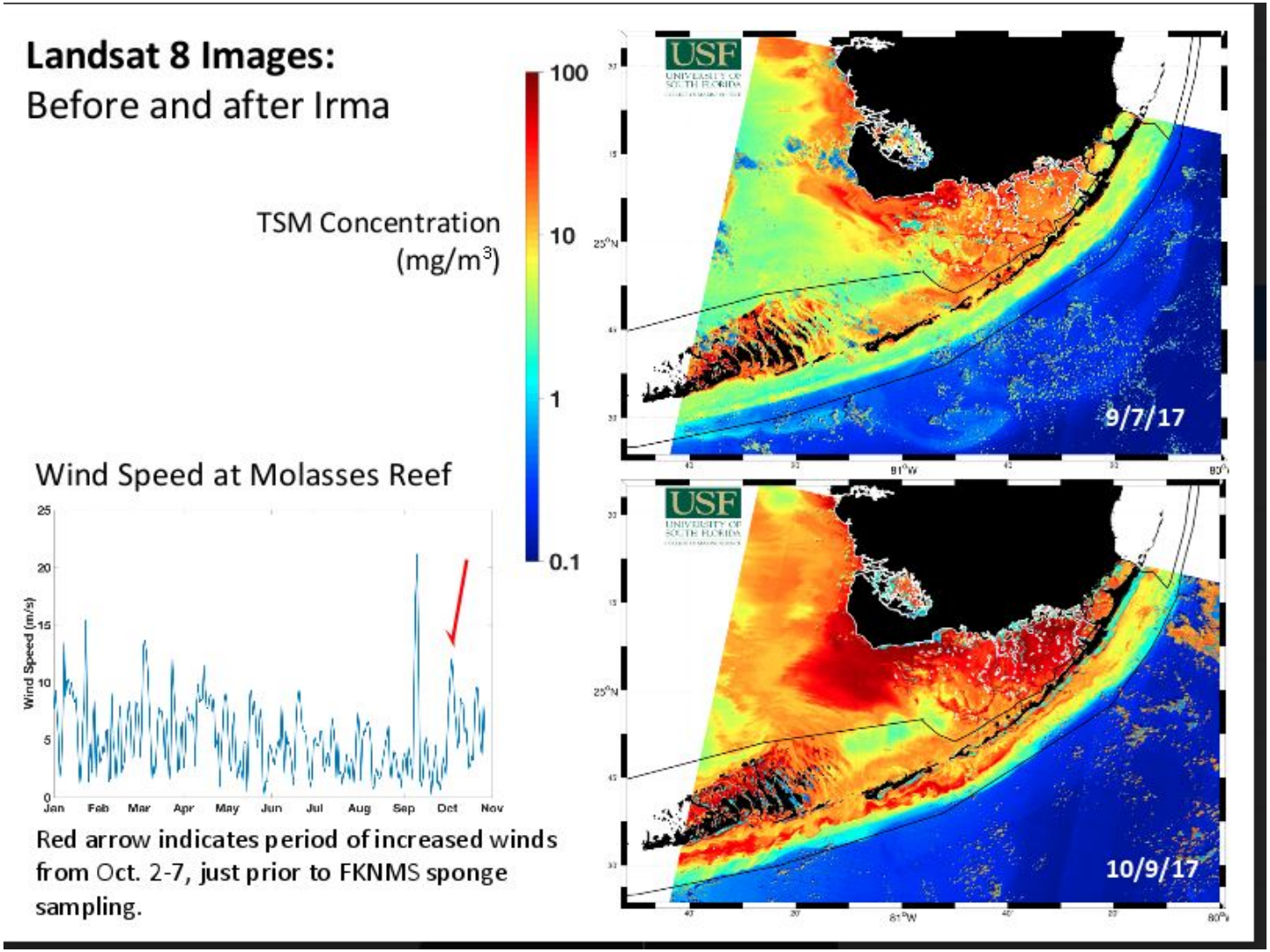
MODIS-Terra Quasi True-Color images before and after Hurricane Irma

Dan noted that the white/blue color after the hurricane represents turbidity

Note: I have the link for getting more true color images, if needed.

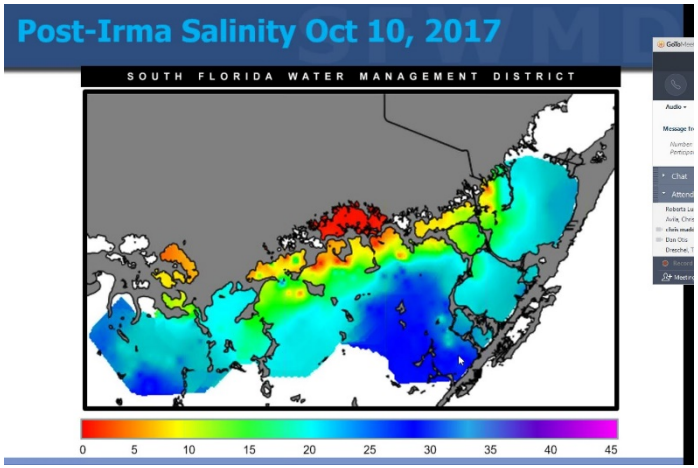


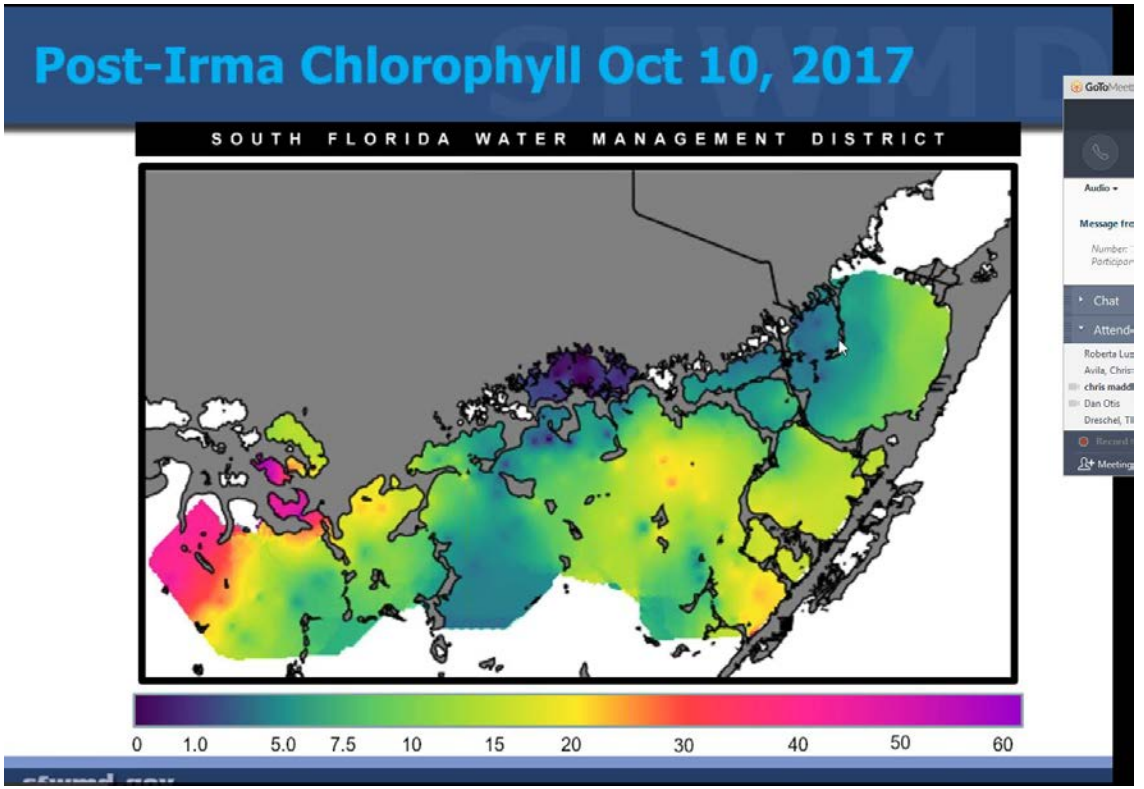
Sentinel 2 European satellite; total suspended matter TSM conc. Sept 8 and sept 13; Lots of sediments, Dan commented that he had never seen that signature before; top image is background; striking amount of sediments moving out from land to sea. Note how far TSM shows up beyond the keys. Sentinel 2 has associated CDOM and Chlorophyll products.



Landsat 8 images sept 7 and oct. 9 (in vicinity of sponge mortality) total suspended matter TSM
Lots of sedimentation in lower keys oceanside; spike in wind in Oct. caused resuspension of sediments;
Chris Kelble added that he observed a great amount of turbidity in Hawk's channel.

Salinity





Florida Bay Water levels—dropped to -3 when storm passed the Duck Key station (and elsewhere) in northeast Florida Bay. Chlorophyll values in the bay are as high as 40 micrograms/liter.
Phycocyanin (an indicator of cyanobacterial/blue green blooms)—central bay low level, two hot spots for phyco—indicate blue green bloom (not shown)
In Oct, DO levels were generally good (not shown).

Chris Madden—the general trend is for increases in Total Phosphorus after dieoff of seagrass (2016) ; evident in central bay, but not northeast bay; chlorophyll follows same trend as TP usually, but is back down by summer, now it's back up again (see summary slide, next)
Note: freshwater inputs near coast in north central bay are probably not causing a bloom there because the water is washing through quickly. High blooms are evident in southwest bay.

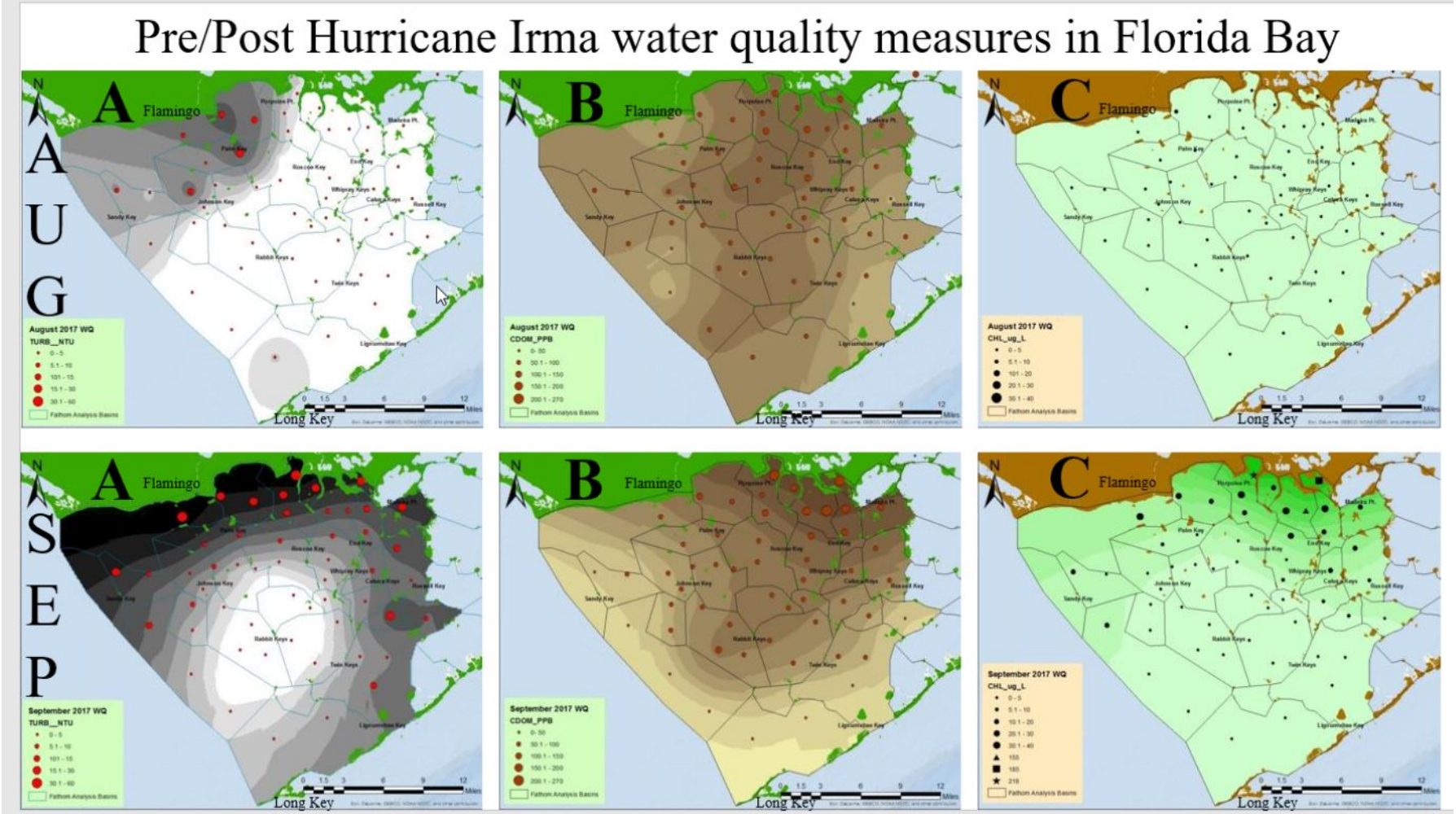
- Chris Madden SFWMD Florida Bay sampling

Summary

- Historic drought during 2015
- Seagrass die-off begins June 2015
- Nutrient increase begins after initial die-off in late 2015 and 2016
- Dramatic chlorophyll increase in summer 2016
- Die-off possibly arrested 2016 with freshwater input
- Irma hit in September 2017: Loss of SAV, freshwater pulse, rapid bloom, decreased DO, blue-green bloom
- Is this a devastating event or has the hurricane reset the system?

Everglades National Park Florida Bay

Chris Kavanagh western and central bay results (sampling sept 26 to 29)



A comparison of August with Sept for A—Turbidity, B—CDOM and C-- Chlorophylla

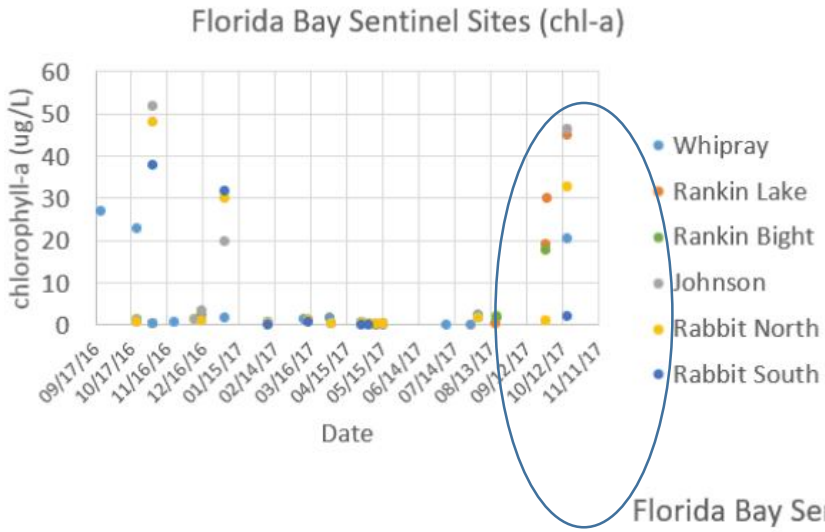
Everglades National Park Florida Bay

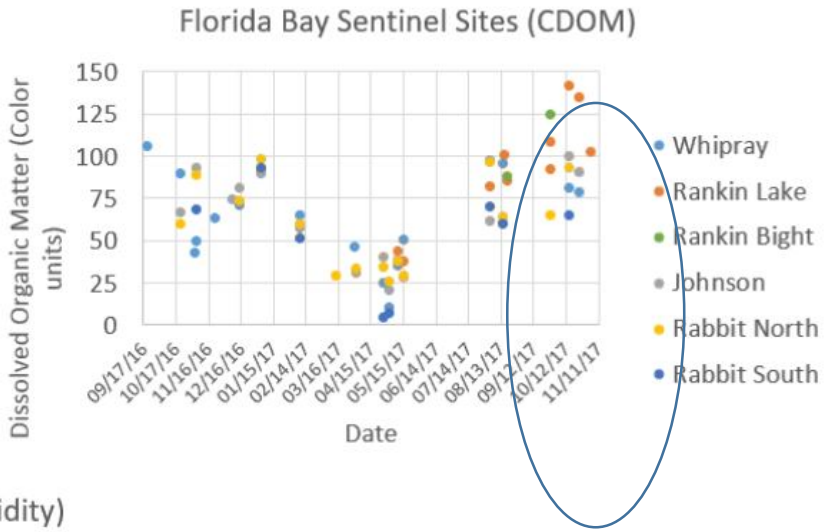
August to Sept comparison
Change from august to sept in chlorophyll is striking; highest chlorophyll values at that time were near the mainland in the bights (Terrapin and Garfield)
November sampling just took place and high cyanobacteria in some areas near mainland in north central bay (Murray key) (not shown).

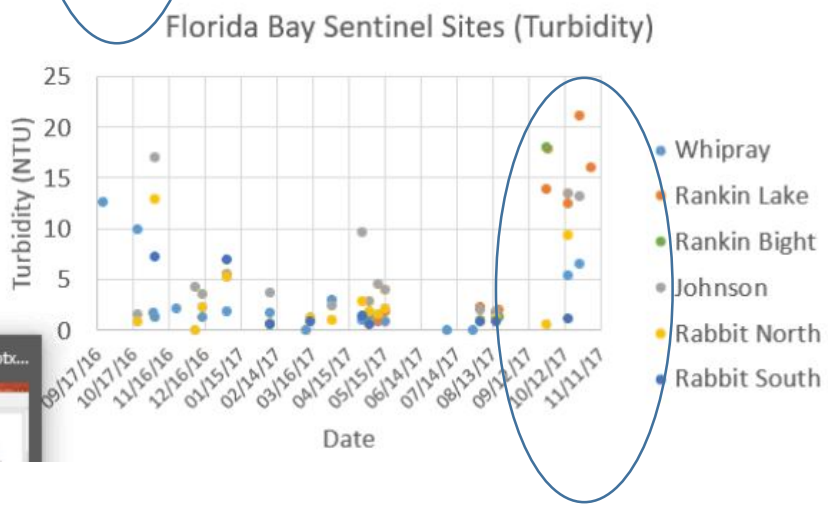
Fall 2016 really high chlorophyll values too, but exceeded in 2017;
DO after storm was low in several locations; DO came back to saturated levels and has remained that way; mixed water column, shows up on top and bottom
Low DO picked up now in Garfield and terrapin areas
Park's Marine monitoring network stations—remained intact (except 1); recording during most of storm; he is not presenting those data now;
Significant wind events since Irma 2 week intervals; impacted turbidity and some of the other measures;

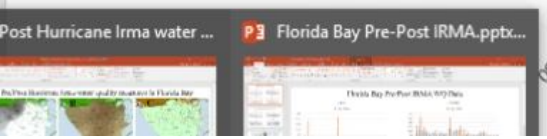
Picture from cape sable some grass 2 meters deep; tried to convert volume measurements to biomass; going out on a limb but they estimated 4,000 plus metric tons of seagrass on beach 20 km of beach; primarily rhizomes of thalassia, halodule and sargassum mixed in. Most seagrass on beach is still there; washed up to tree lines and still caught up there. In general, though, people noted less floating seagrass in the bay itself.

NPS EVER Florida Bay Water Quality Sentinel Sites









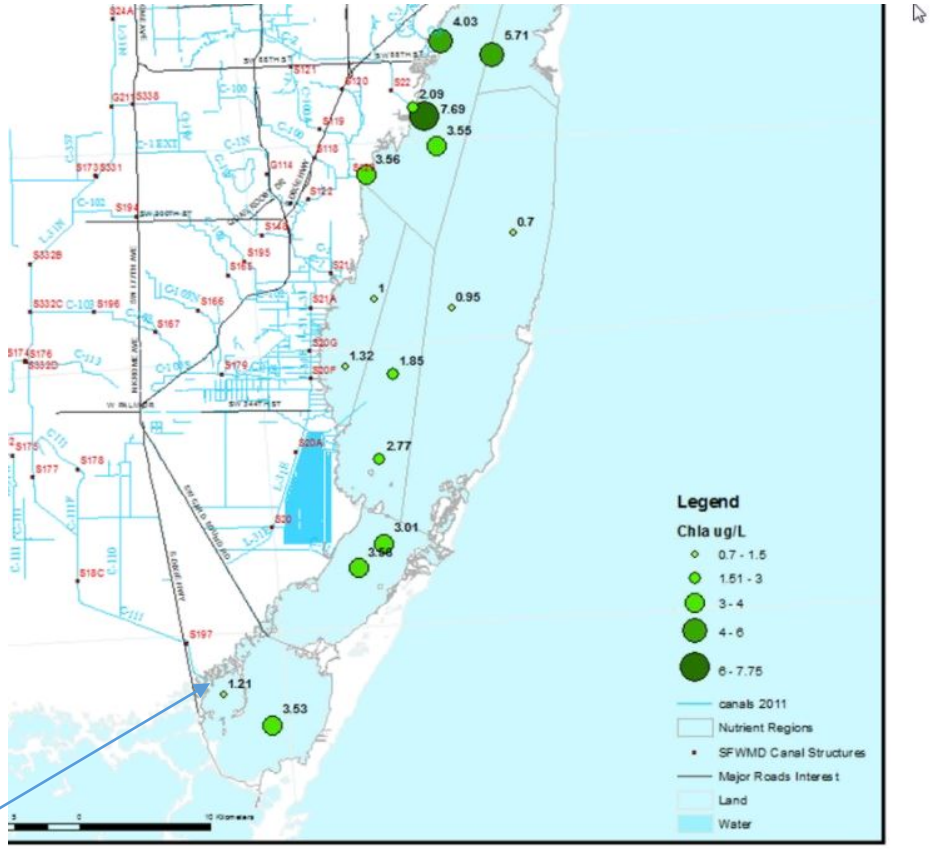
These charts show one year of park data from several stations. Note the peaks in October 2017 compared to same time in 2016. Note seagrass dieoff in Florida Bay began in June 2015.

Christian Avila—RER (Miami-dade derm) Biscayne Bay, including Barnes, manatee and Card sound areas

Miami Dade conducts monthly sampling of Biscayne Bay including the southern bay in fknms.

They noted that post storm chlorophylls (October, see map) were much higher than background, which is about .2; high values for barnes and card sound after storm; pretty high for those regions;

Barnes has been higher in 2005 event; usually background is less than 1 in this area



Manatee Bay receives freshwater from the C111 canal, a major drainage canal managed by South Florida Water Management District; has high flows during and post storms.

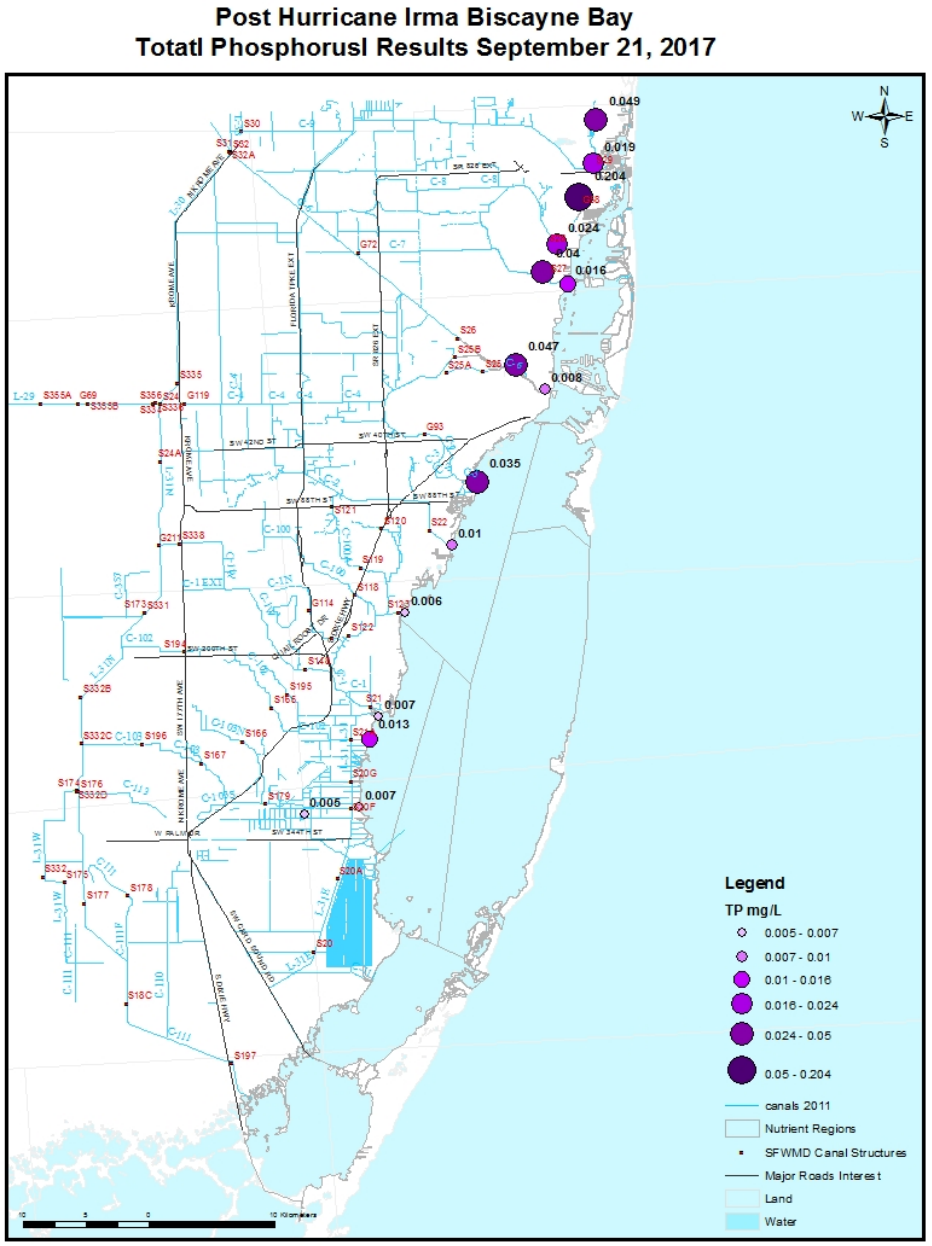
Total Phosphorus maps

Not much TP coming in from c111 canal in manatee bay area (this is good)

2013 was the last Biscayne Bay bloom; look at nutrient data from that time; bloom was in manatee, card, barnes, etc.

Currently sampling baywide now

Christian Avila—they are sampling barnes this quarter; like to get another round of sampling done before December, but …..weather time…..



Anna Wachnicka SFWMD Phytoplankton in BB including canals

Anna is a phytoplankton taxonomist who works for SFWMD and has funding from NOAA and SFWMD for this study on the species that are appearing in the bays.

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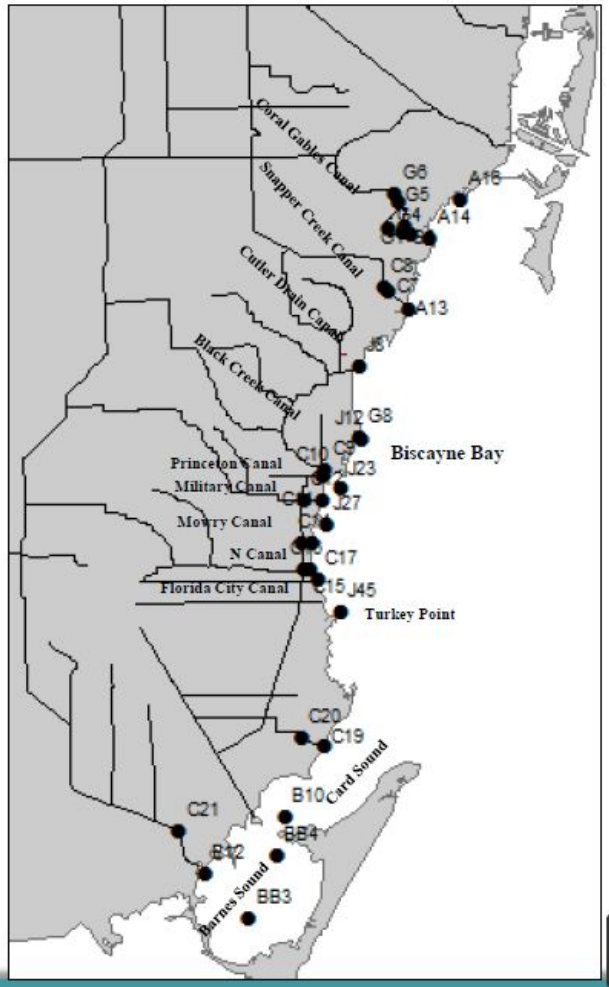
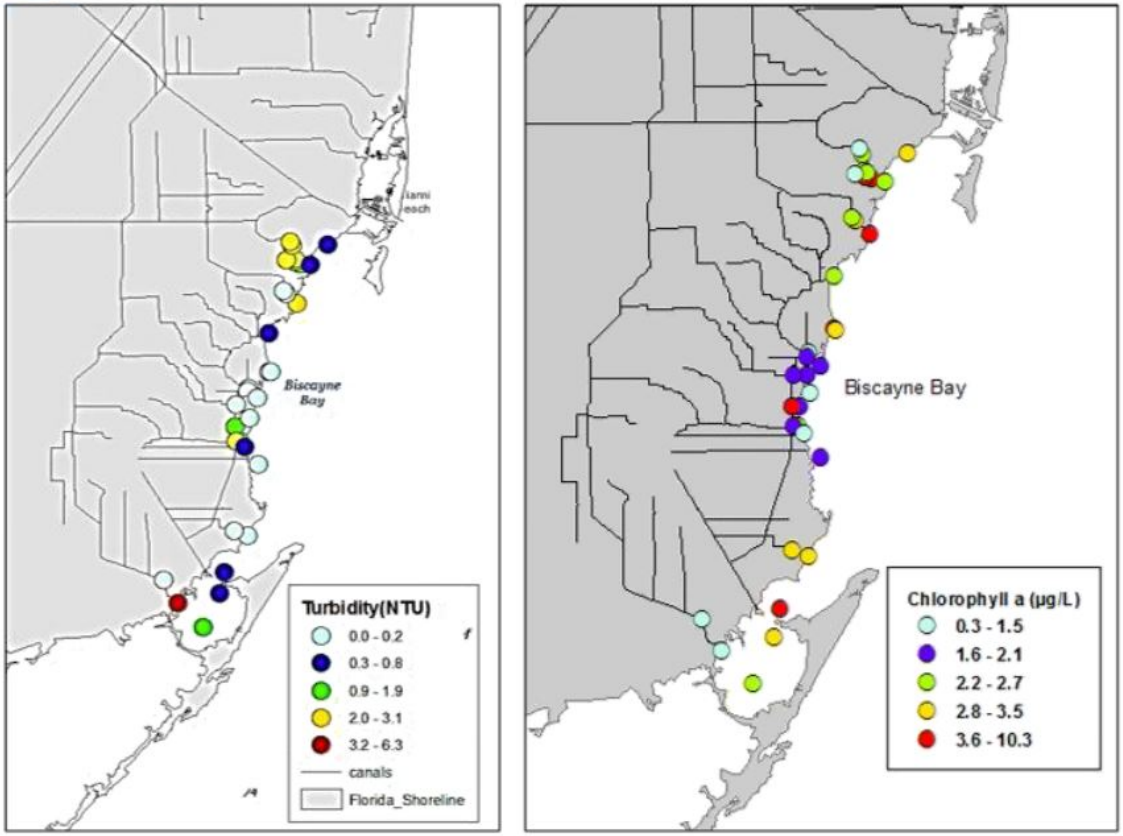


- Collaborative effort between SFWMD (A. Wachnicka) and NOAA (J. Browder, T. Jackson, L. Visser, C. Kelble)
- A total of 33 sites surveyed on 09/23-24/2017 and 09/30/2017: nearshore, canals, Manatee Bay, Barnes Sound and Card Sound
- Data collected: surface & bottom salinity, temp., pH, DO, chl a, turbidity
- Lab analyses: algal pigments, nutrients (in progress)

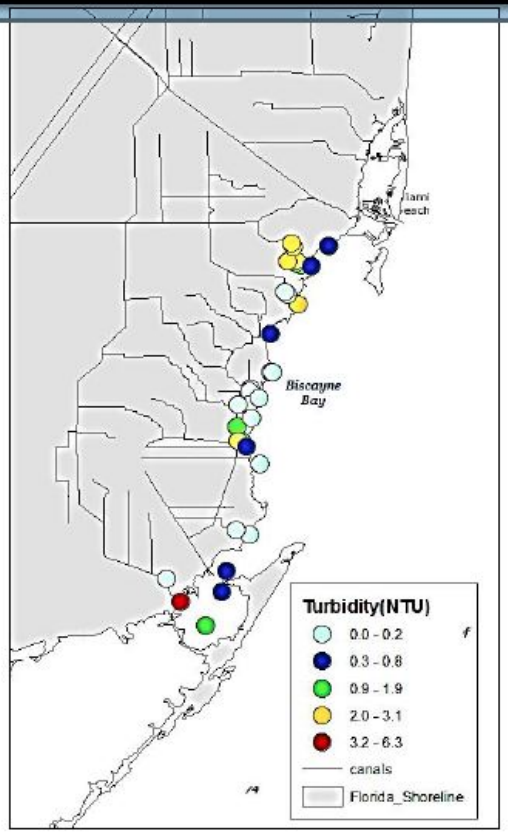
Descriptive Statistics

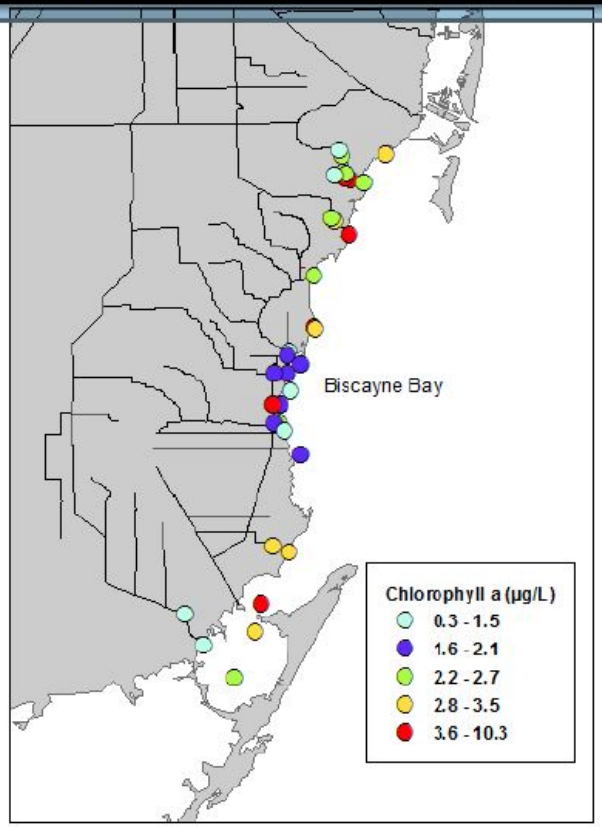
Variables	# of Sites/Measurements	Range	Minimum	Maximum	Mean	Std. Dev.	Variance
Surf Sal	33	29.9	0.3	30.1	12.2	10.4	107.2
Bottom Sal	33	29.9	0.3	30.2	17.3	10.6	111.8
Surf Temp. (°C)	33	4.4	27.8	32.3	29.7	1.1	1.2
Bottom Temp. (°C)	33	4.3	27.8	32.1	29.7	1.1	1.2
Surf pH	33	0.8	7.1	7.9	7.5	0.2	0.0
Bottom pH	33	0.9	7.0	7.9	7.4	0.2	0.1
Surface Chl A	33	9.9	0.3	10.3	2.8	1.8	3.2
Bottom Chl A	33	8.7	0.1	8.8	2.8	2.1	4.5
Surf Turb	33	6.3	0.0	6.3	1.0	1.4	1.9
Bottom Turb	33	4.8	0.0	4.8	0.8	1.1	1.2
Surf DO (mg/L)	33	6.1	1.1	7.2	4.3	1.5	2.3
Bottom DO (mg/L)	33	6.8	0.0	6.8	3.9	1.7	2.9
Surf DO (%)	33	92.6	7.4	100.0	57.1	25.2	633.1
Bottom DO (%)	33	92.7	7.4	100.0	55.2	26.2	684.7

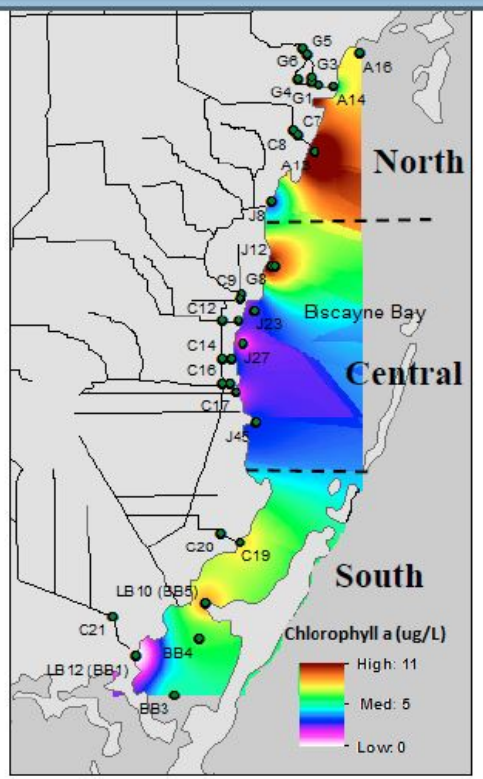
Post-Irma Water Quality Conditions at Nearshore and Canal Locations in Biscayne Bay (09/23/2017-09/24/2017)



- **Turbidity** varied between 0-6.3 NTU, with **highest values recorded at the mouth of the C111 canal in Manatee Bay (site LB12)**
- **Chlorophyll a** (rough estimate of algal biomass) varied between 0.3-10.3 µg/L, with **highest values recorded upstream in the Coral Gables Canal (site G10 and G8; 10.3 µg/L and 5.2 µg/L) and the mouth of the Snapper Creek Canal** (site A13; 5.8 µg/L).







Chl a (µg/L) interpolations

- **Turbidity varied between 0-6.3 NTU. Highest values recorded at the mouth of the C111 canal in Manatee Bay (LB12; 6.3 NTU)**
- **Chlorophyll a varied between 0.3-10.3 µg/L. Highest values recorded upstream in the Coral Gables Canal (G10 (10.3 µg/L) and G8; (5.2 µg/L)) and the mouth of the Snapper Creek Canal (A13; 5.8 µg/L)**

SFWMD Phytoplankton in BB including canals

Turbidity high in manatee bay. (sanctuary basins shown in blue text here.)

Phytoplankton assemblages south of Turkey Point were dominated by cyanobacteria.

•Diatoms dominated phytoplankton assemblages in Coral Gables Canal (sites G4, G6), Lakes by the Bay (site J12), south of the Black Creek Canal (site J23), and Princeton Canal (sites C11, C12) and at the mouth of the C111 canal (site C21)

•Dinoflagellate abundance was elevated in the Military Canal (site C14) and Barnes Sound (site B4)

•The highest overall pigment concentration was recorded at sites A16 (north of Dinner Key), G10 (Coral Gables canal) and between Turkey Point and Card Sound
Elevated in cyanobacteria in northern and southern part of bay card and northern barnes

Card sound usually diatom blooms, but now just like after 2005 bloom, have more cyanobacteria, although chlorophylls are lower than in 2005

Presence of a toxic taxon was discussed; found by researcher earlier in the bay; Dave—look for this info; taxonomic analysis

Chris Kavanagh—taxonomic analysis is being paid for by ENP

Chlorophyll Nicole Millet, AOML, stated that she is about to publish results that show the areas that suffered from blooms in 2005 never fully recovered; chlorophyll values came down a lot, but the baseline was slightly raised by that event;

Long sound (ENP near mainland) is only one that returned to pre bloom conditions;

It was mentioned that there was a significant loss of sponges in Blackwater sound. Note: I saw massive mortality in the early 1990s here with high freshwater input that were at the time probably coming mostly through C111. Now, inputs could still be freshening this area directly from sheet flow to the north in ENP.

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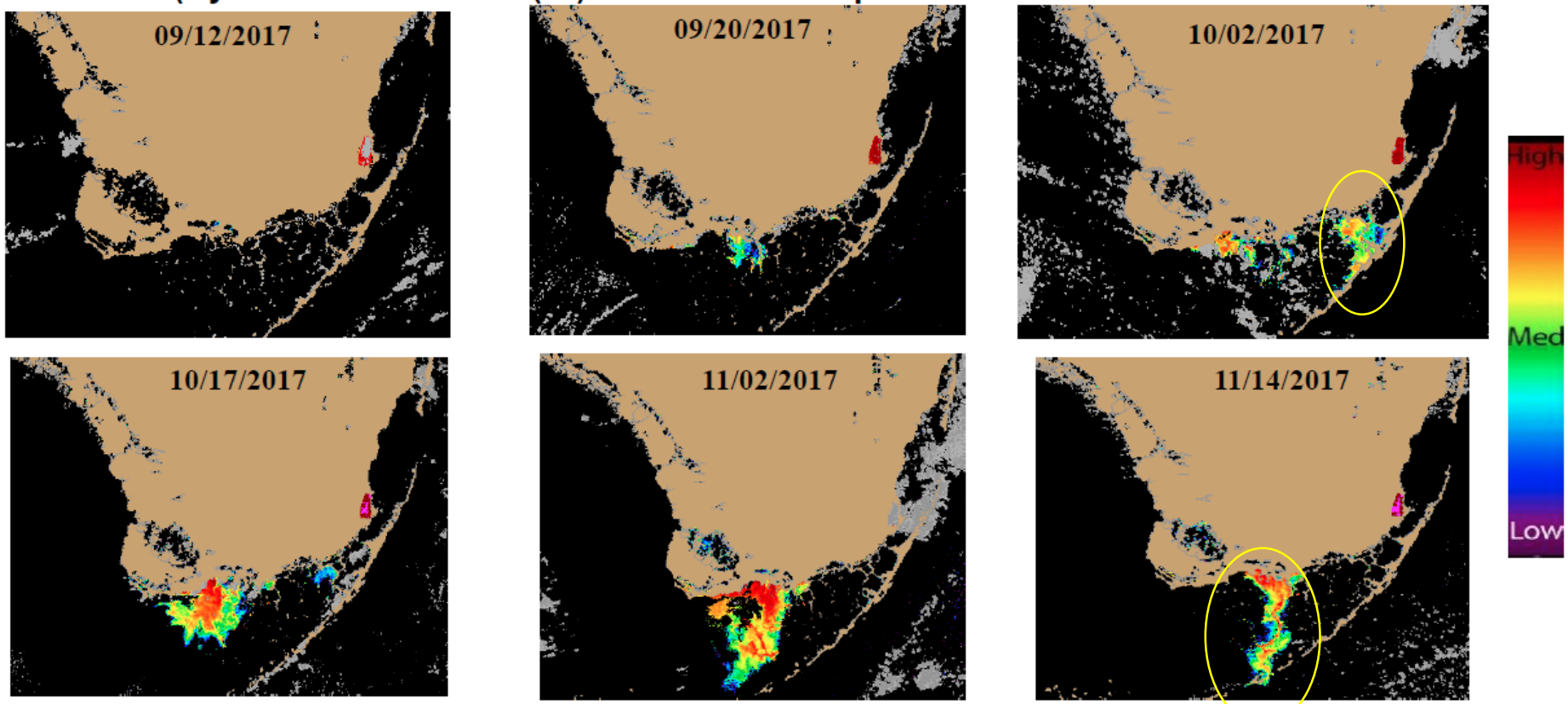
Cyanobacteria Bloom Potential Maps for Southern Estuaries
(Cyanobacterial Index (CI) derived from Copernicus Sentinel 3 OLCI data

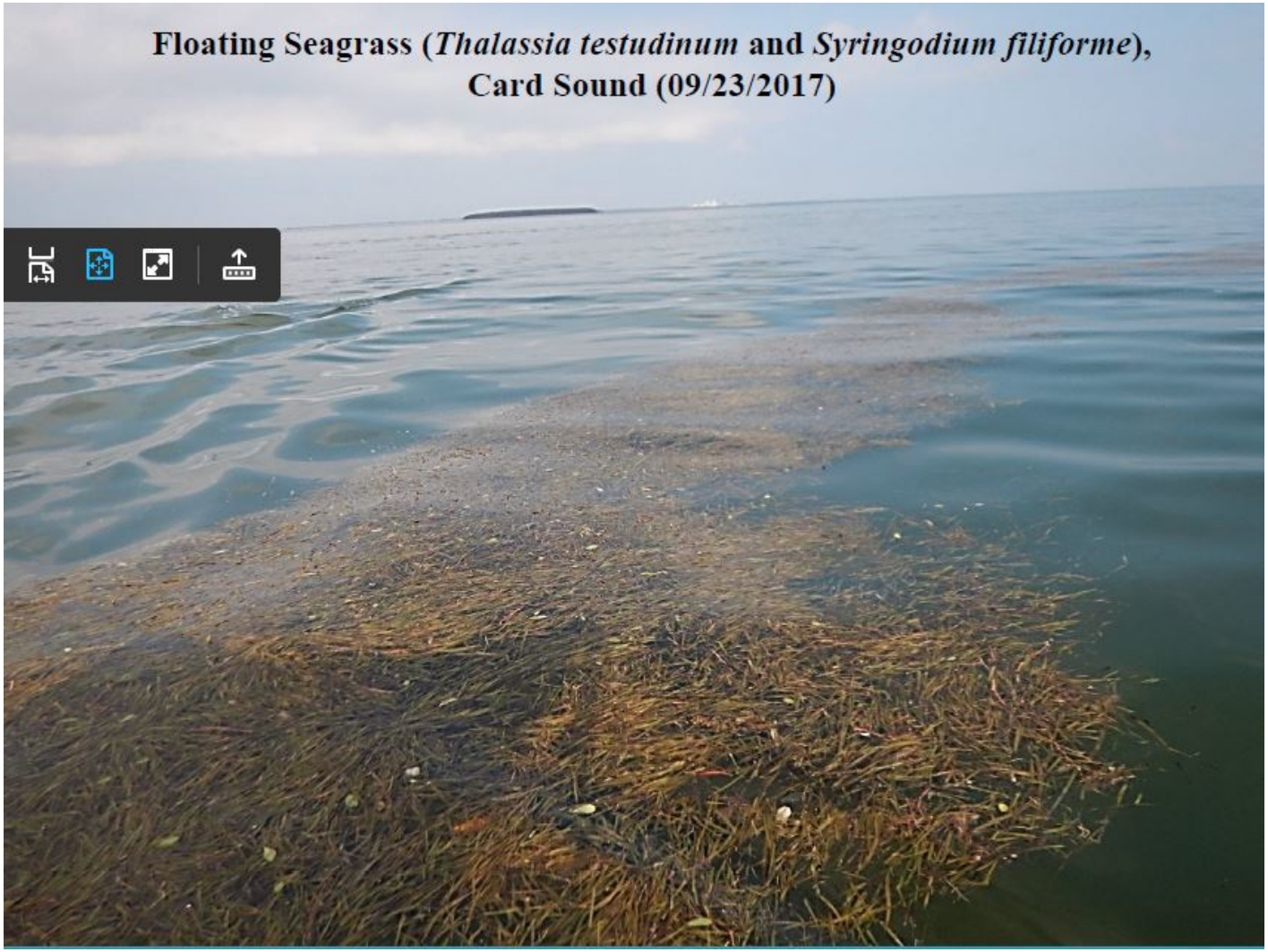


- NOAA/NCECOS maps indicate that the post-Irma blooms in Biscayne Bay (and other southern estuaries), except for the nearshore sites, were NOT cyanobacteria blooms
- Other southern estuarine regions, except for Florida Bay, also experienced non-cyanobacteria blooms

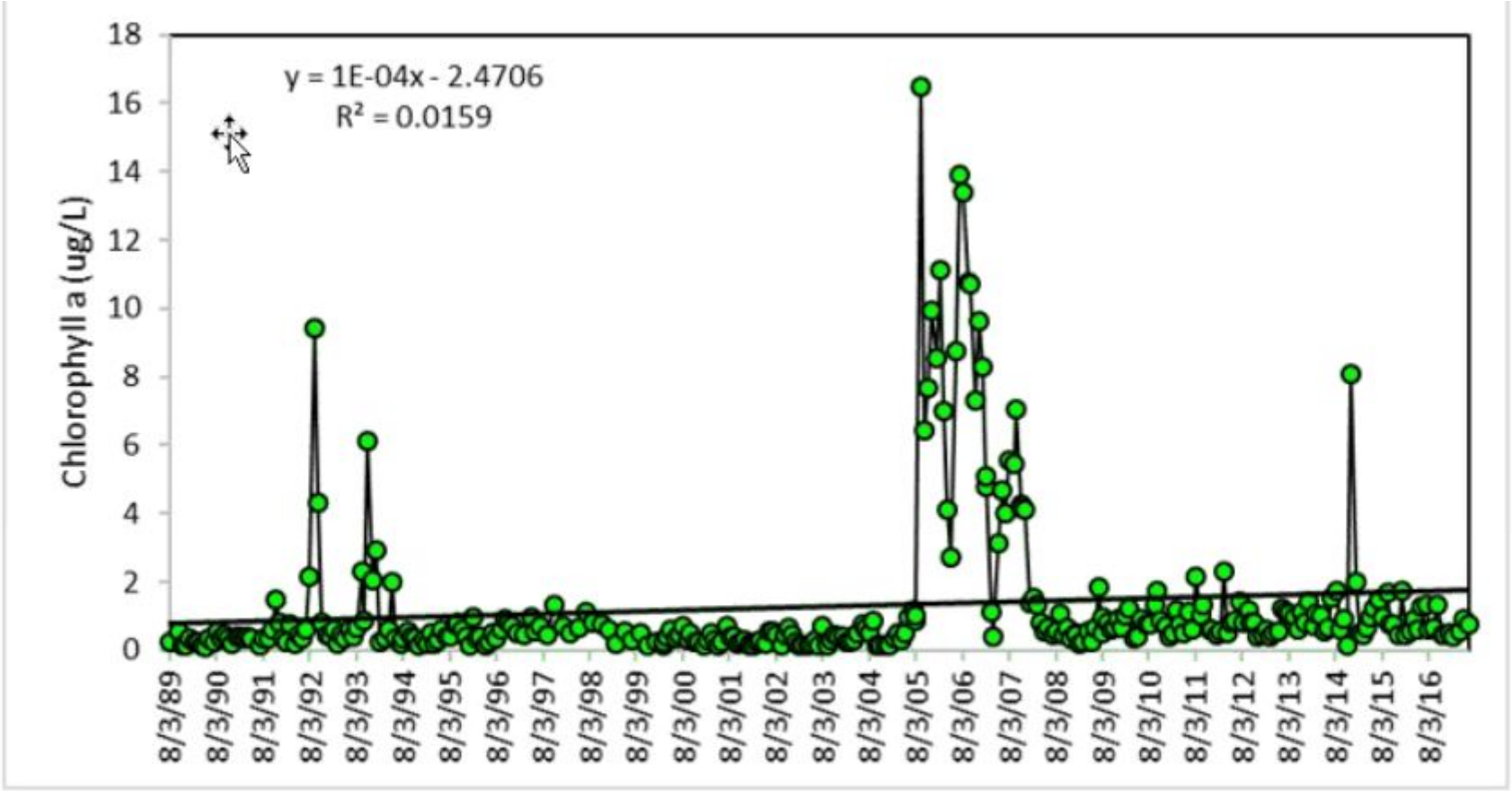
sfwmd.gov

Source: NOAA/NCECOS

Elevated in cyanobacteria in northern and southern part of bay card and northern barnes and elsewhere



Floating Seagrass (*Thalassia testudinum* and *Syringodium filiforme*), Card Sound (09/23/2017); floating grass has been noted in Florida Bay in large amounts (except scientists report that it has lessened since just after the storm.) Decaying plant matter contributes to microalgal blooms.



Spikes in Chlorophyll show peak blooms in Biscayne Bay over the years; including card, barnes, manatee

Wrap-up Discussion

Concerns about trends…getting better or worse

Additional sampling will help

Occurrence of blooms is not surprising, but the magnitude is on concern; is it phyto, bluegreen, etc.

Is resiliency being lost with additional hurricanes; is recovery time greater with each additional event?

Overall seeing increasing trends in BB in nutrients over long term.

Seagrass dieoff from 2 years ago released nutrients, high CHl expected, confounded by hurricane now; the combo could produce a long lasting bloom…..Fred Sklar

One year after seagrass dieoff in Fla Bay did see bloom in central basins, that bloom end in February 2017 (went back to background levels); bloom was across multiple basins and then stopped; now bloom is back in some areas