

# **Algae as a Tool for Ecological Assessment and Management in Florida Coastal and Marine Ecosystems**

***Anna Wachnicka, PhD and Joan Browder***

***NOAA HABITAT FOCUS***

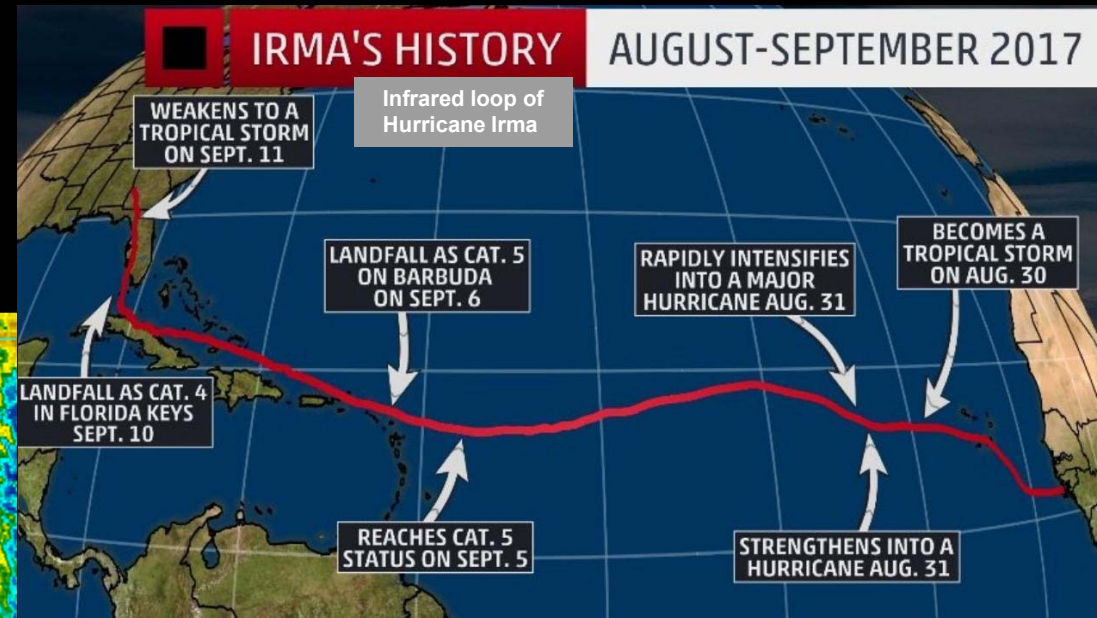
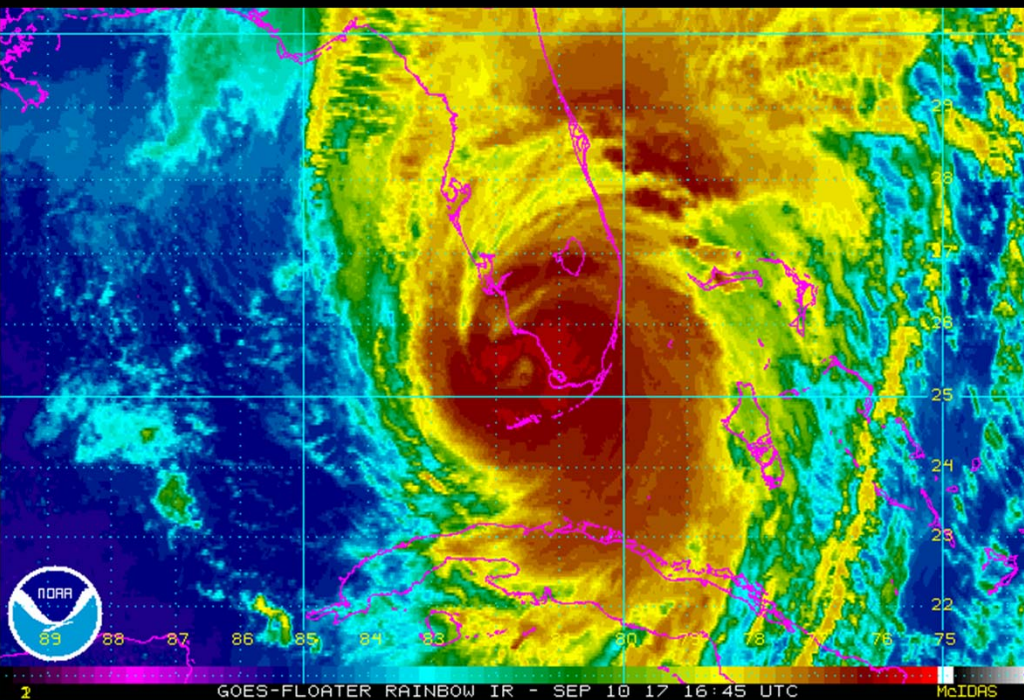
***CONTRIBUTIONS OF DATA FROM SFWMD, BNP, MD-DERM***

## **II. Evaluating the Effects of Extreme Weather Events and Emergency Operations**

### **Study Goals:**

- 1. Assess impact of Hurricane Irma and emergency freshwater inflows from coastal structures on Biscayne Bay water quality**

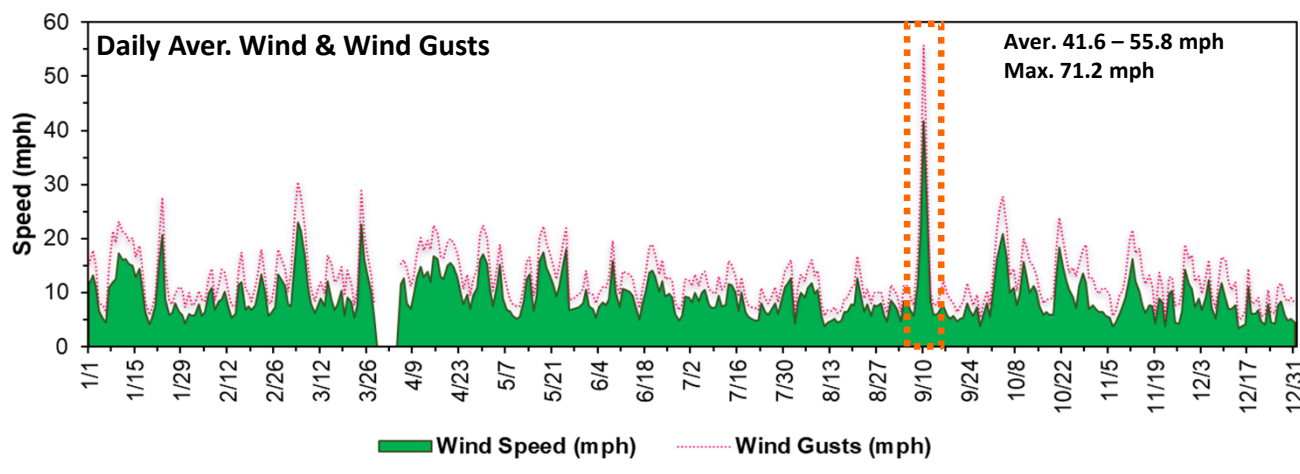
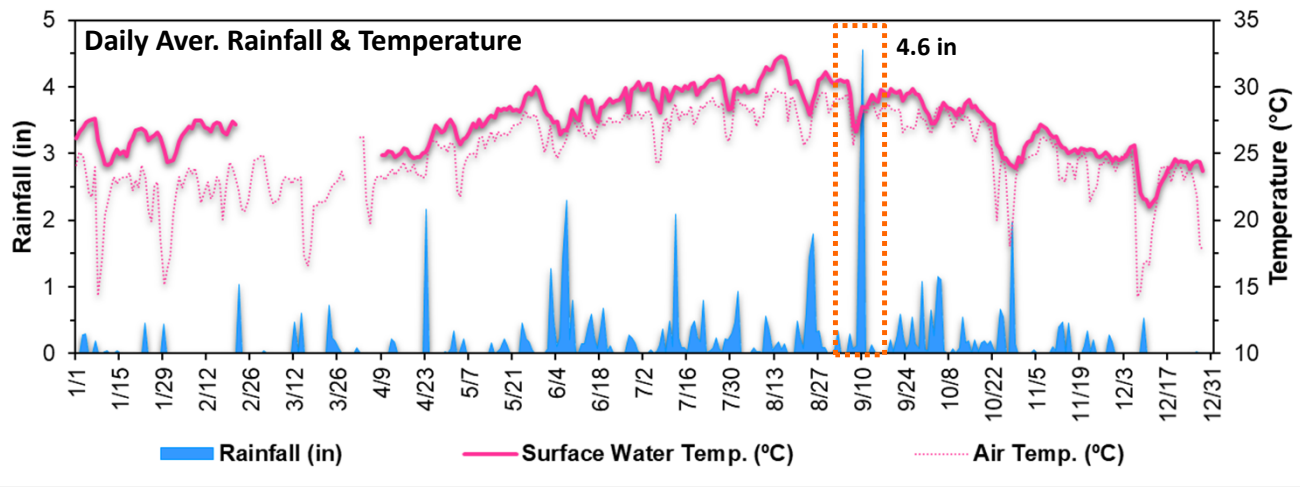
# Hurricane Irma (08/30 – 09/16/2017)



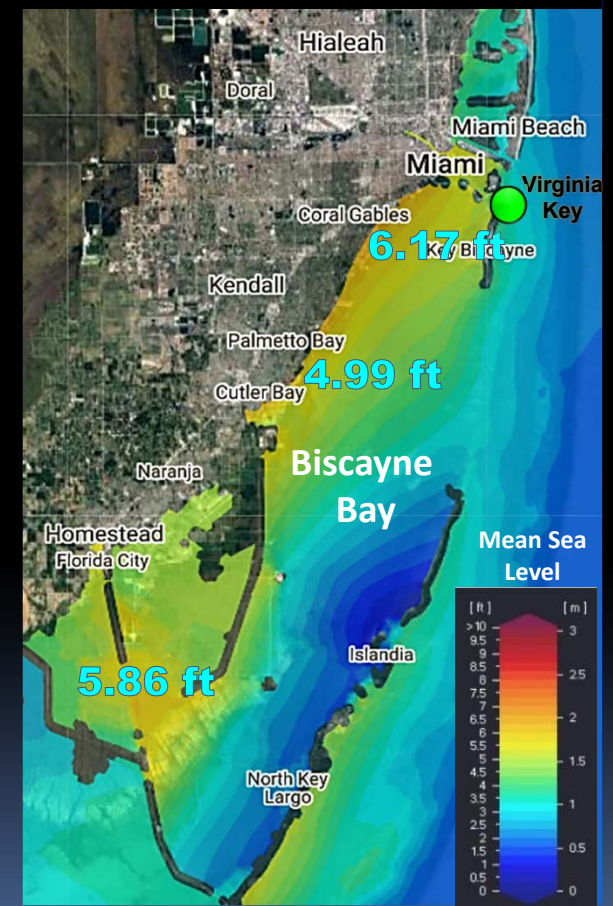
## Most Powerful Atlantic Hurricane in History!

- 185 mph max. winds for 37 hours
- 200 mph max. wind gusts
- 914 hPa lowest pressure
- 29 mi eye diameter
- 650 mi max diameter

# Hydrological and Atmospheric Conditions during Hurricane Irma



## Expected Maximum Water Height Above Mean Sea Level



Rainfall Data Source: NEXRAD  
 Wind and Temperature Data Source: NOAA  
 Source: Coastal Emergency Risk Assessment

Source: Wachnicka et al. 2019



# Study Area

**A total of 81 Monitoring Sites**

- 33 SFWMD/NOAA
- 30 Miami Dade DERM
- 18 Biscayne National Park

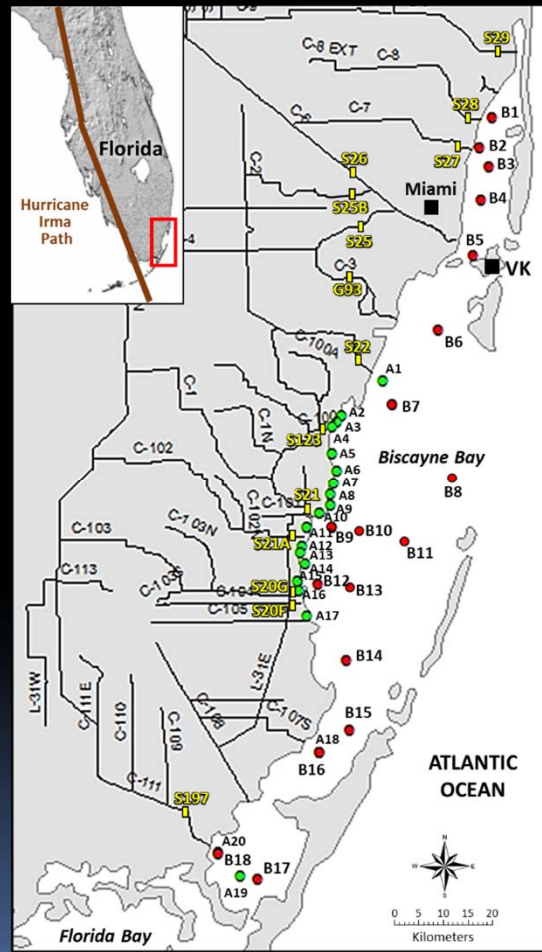
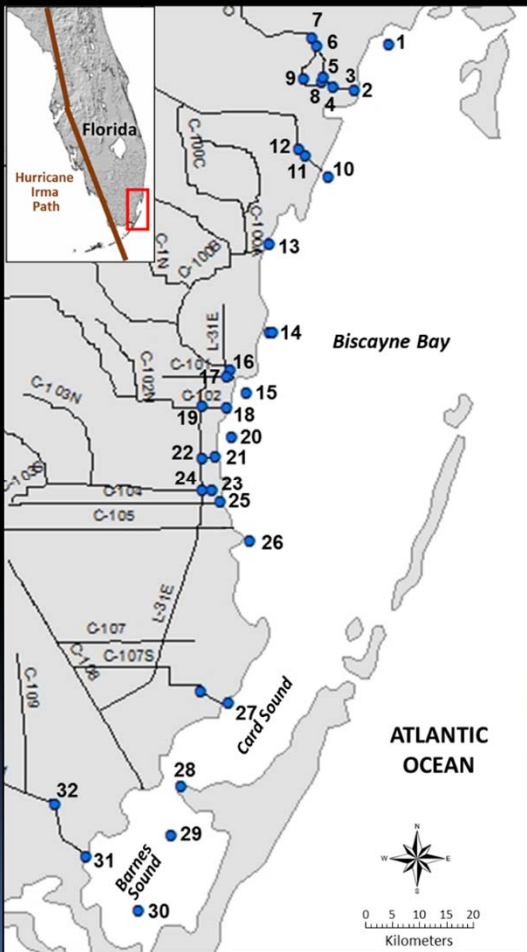


Photo Source: SFWMD

# Methods

## Continuous Data Recording



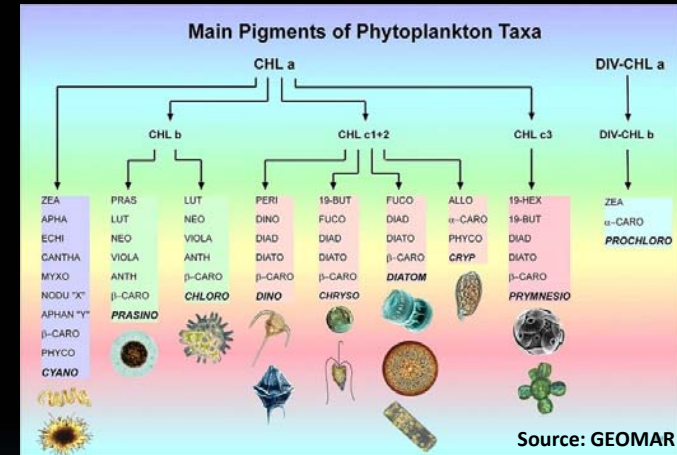
- 15 min interval temperature & salinity recordings

## Spatial & Temporal Water Quality Measurements



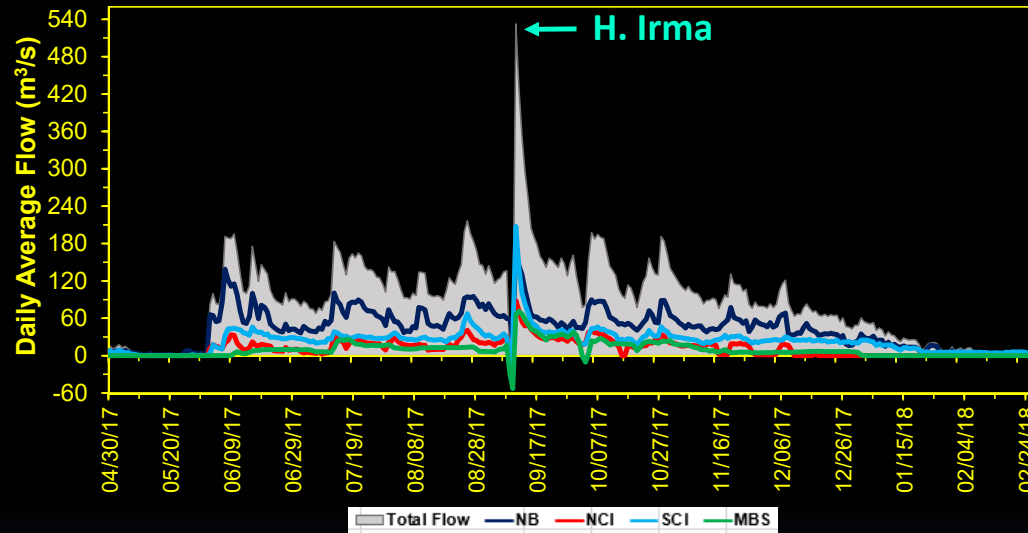
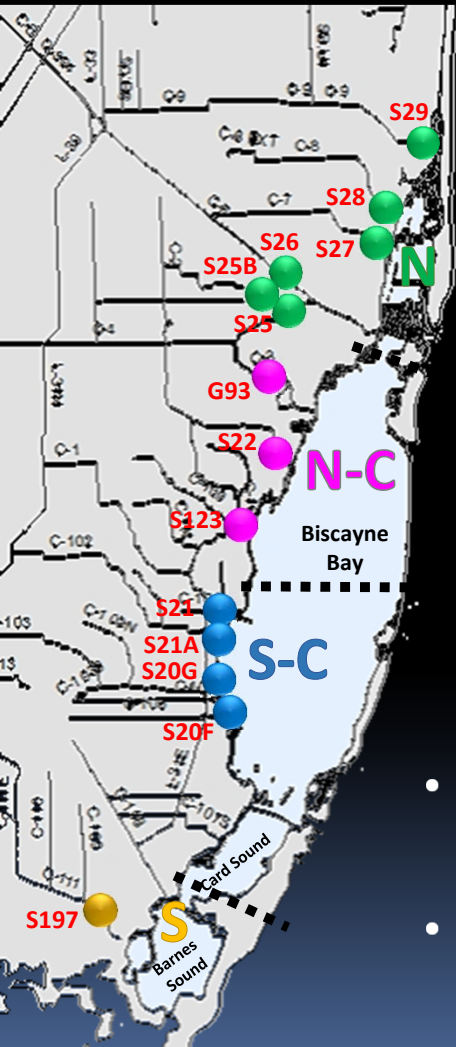
- Sampling in canals & near shore during outgoing tides
- Physical water parameters (temp., sal., turb., pH, DO)
- Inorganic nutrients

## Chemotaxonomy & Microscopy



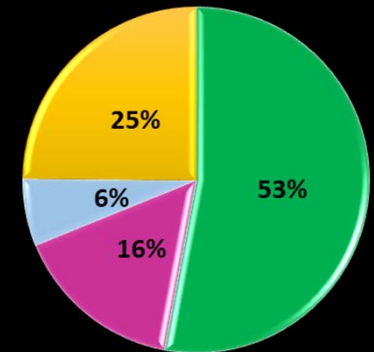
- Relative abundance of major phytoplankton classes
- Phytoplankton biomass (chl *a*)
- Identification of common taxa

# Canal Stages & Freshwater Inflow

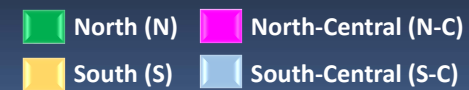
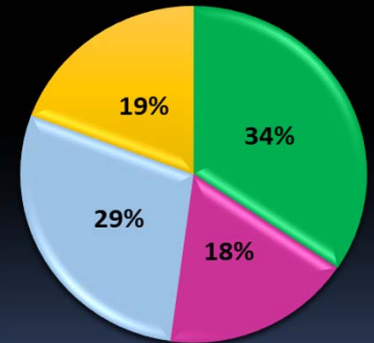


- Total aver. daily inflow increased by ~44 % in the 20-day period following the Hurricane
- The largest increase in total aver. daily inflow after the Hurricane occurred in the South-Central Bay (~224 % increase)

20 Days Prior to Hurricane  
(Total Aver. Inflow 204,873 acre-feet)

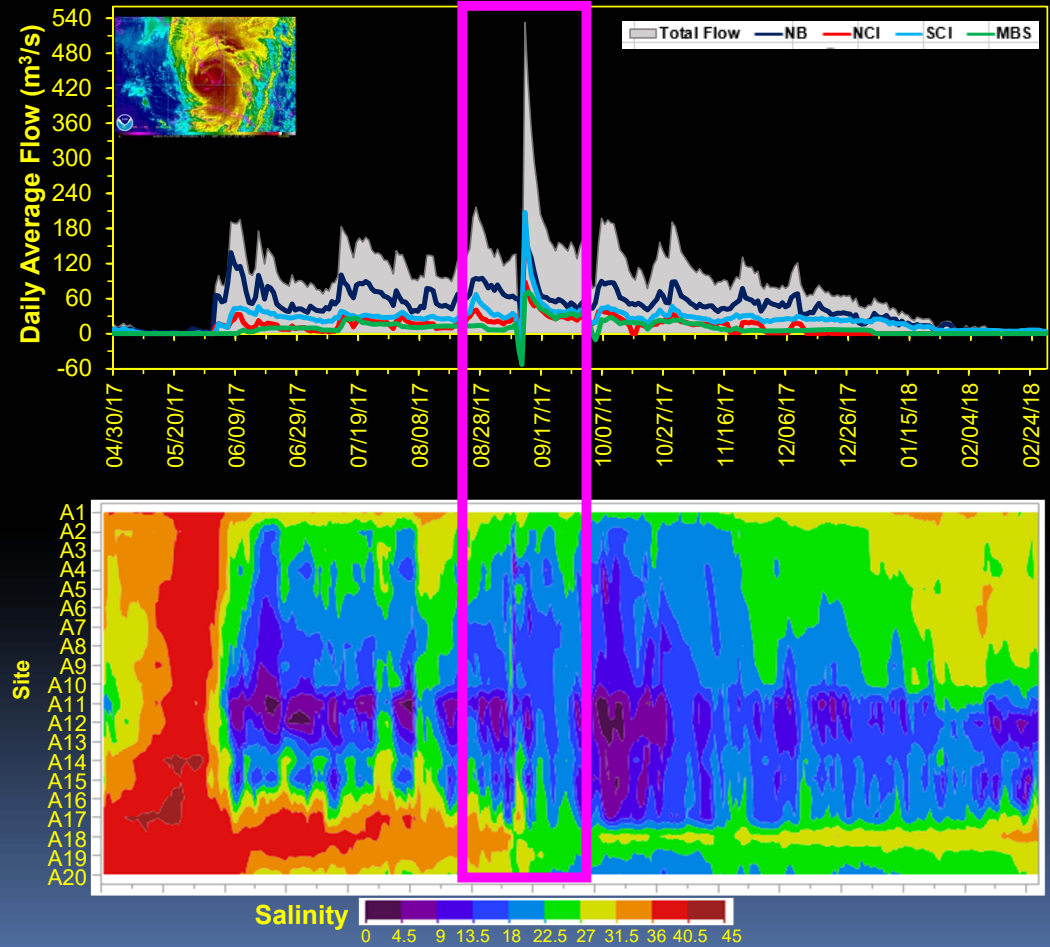
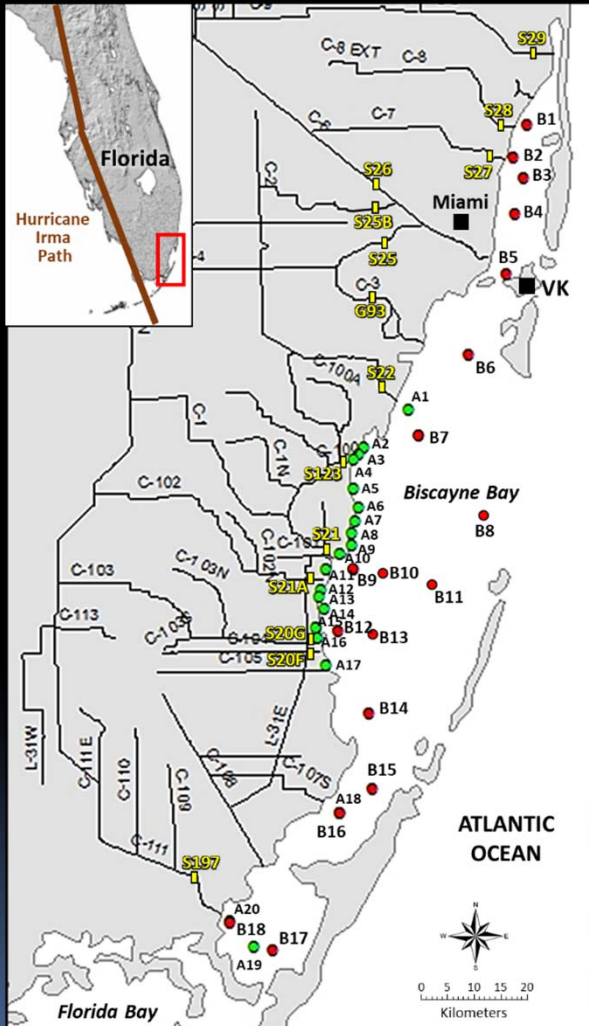


20 Days After Hurricane  
(Total Aver. Inflow 295,781 acre-feet)



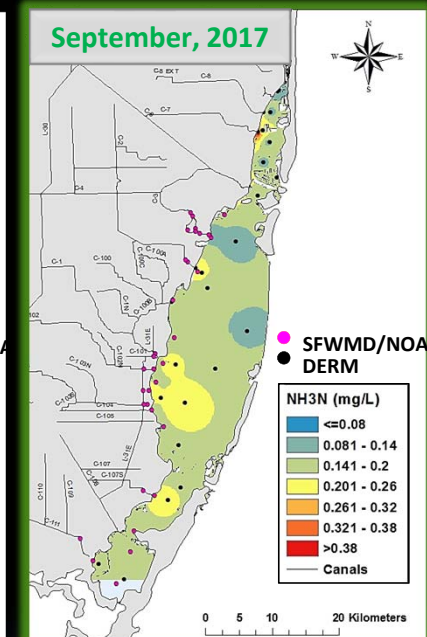
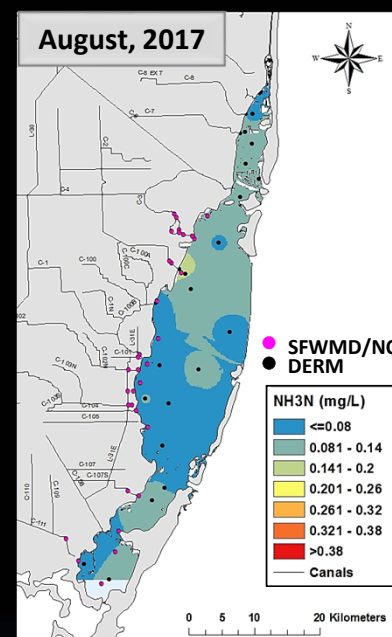
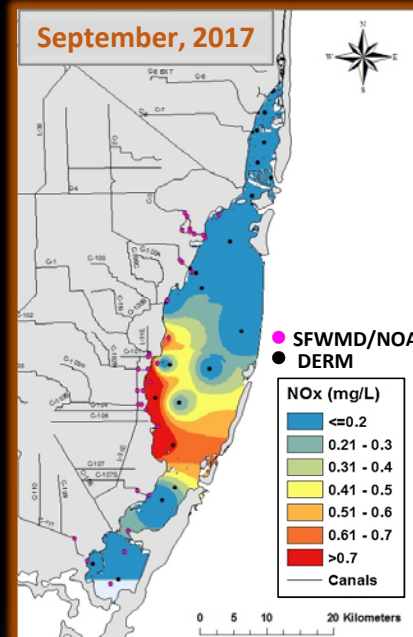
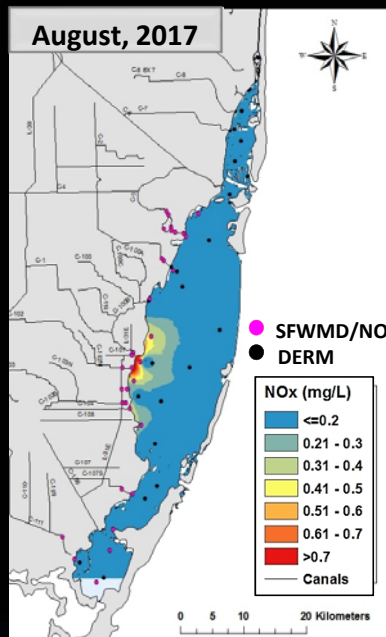


# Spatial & Temporal Changes in Inshore Salinity

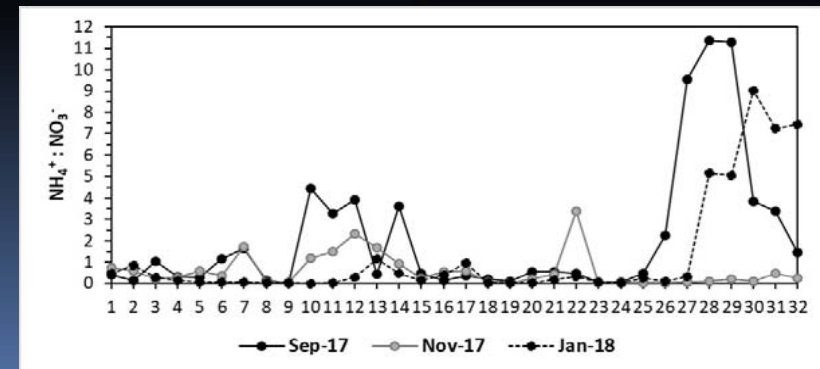




# Spatial & Temporal Changes in Nitrogen Concentration

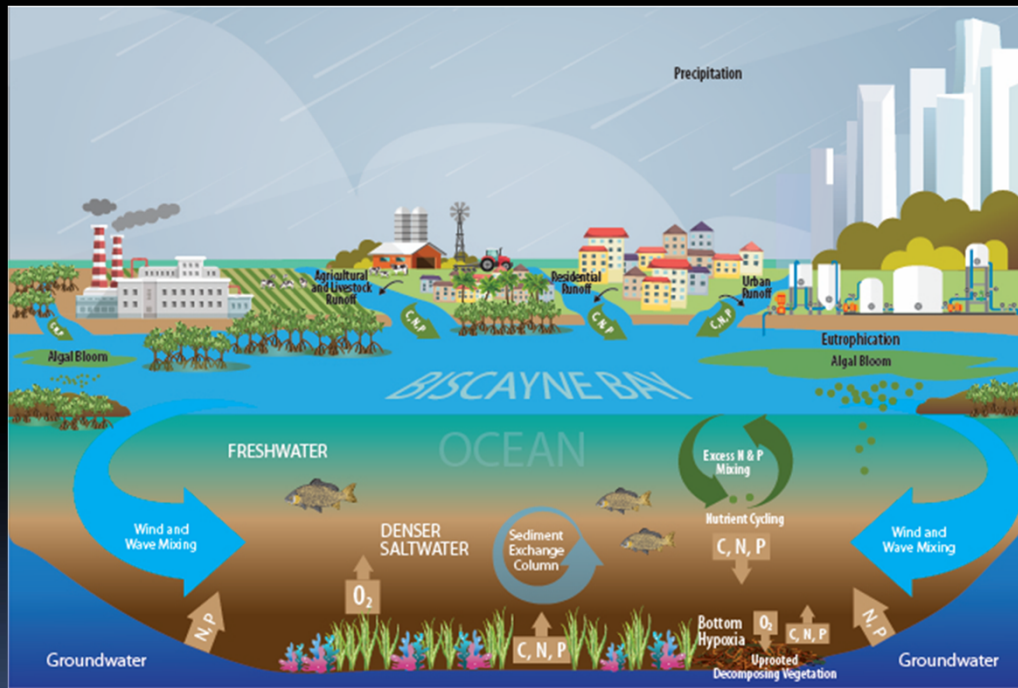


- Significant regional and intra-annual differences in water quality following Hurricane Irma



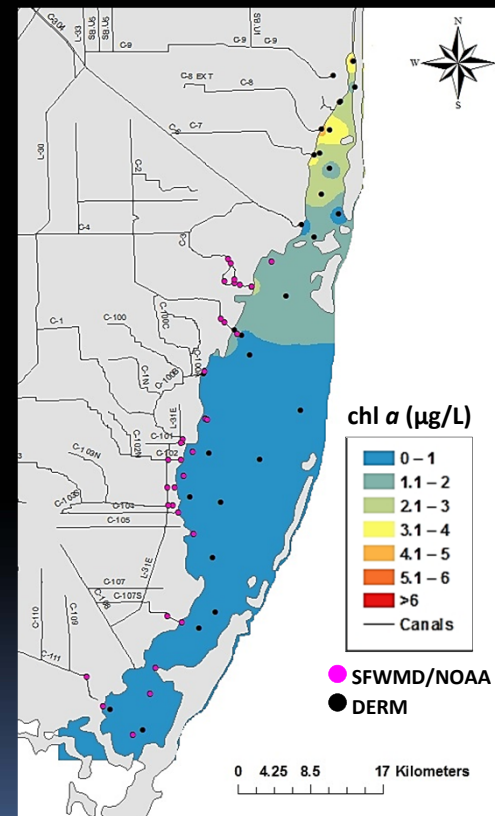
## 2. Post-Hurricane Eutrophication of Biscayne Bay

### Functional Linkages Between Hydrology, Nutrient Inputs & Phytoplankton Blooms After the Hurricane

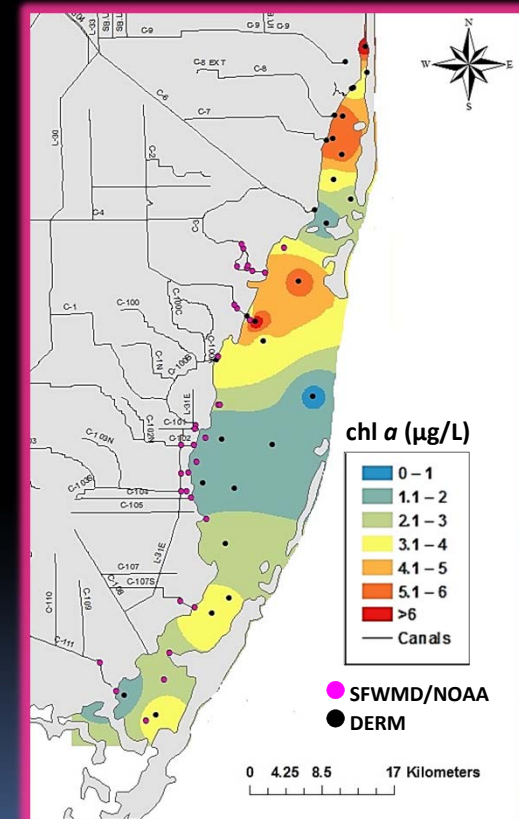


Wachnicka et al. (2019)

August 2017  
(3 weeks before Hurricane Irma)



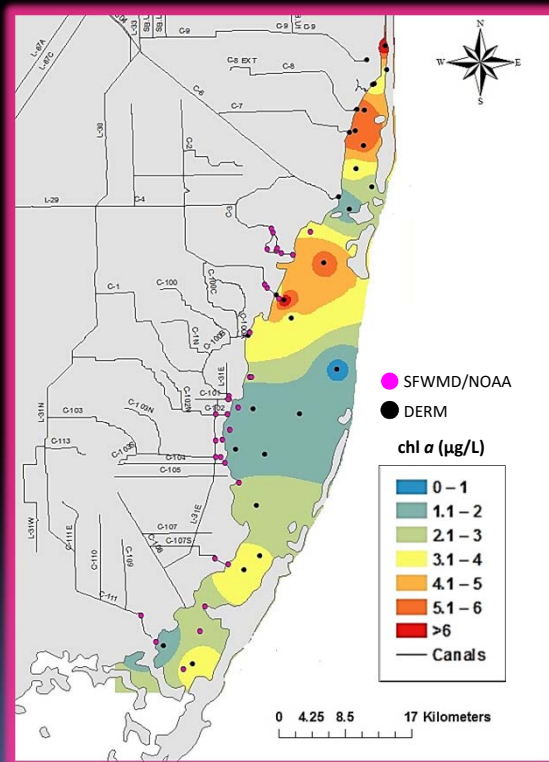
September 2017  
(2 weeks after Hurricane Irma)



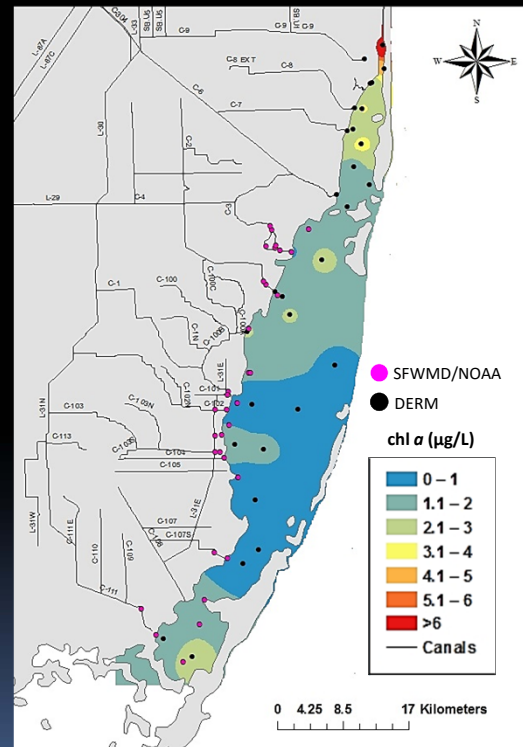
- Concentration of algal biomass in North & South Biscayne Bay was sig. higher than in other parts of the Bay (ANOVA;  $p < 0.05$ )

# Post-Irma Changes in Algal Biomass

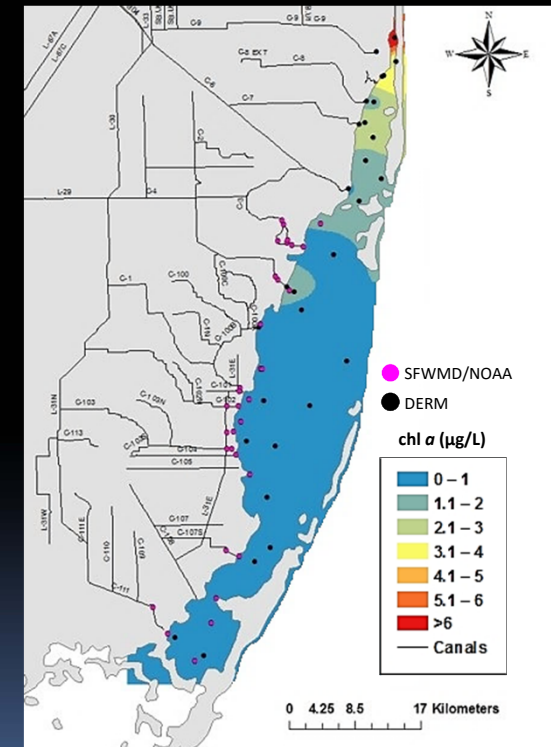
**September 2017**  
(2 weeks after Hurricane Irma)



**November 2017**  
(9 weeks after Hurricane Irma)

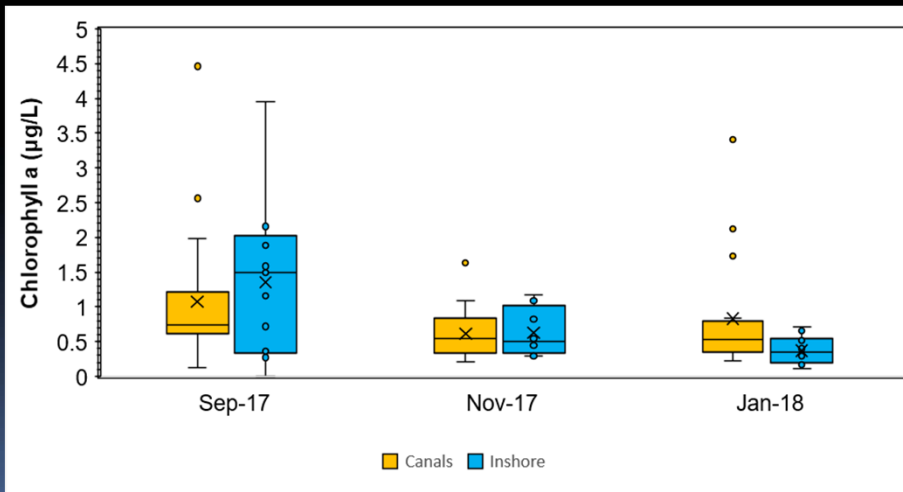
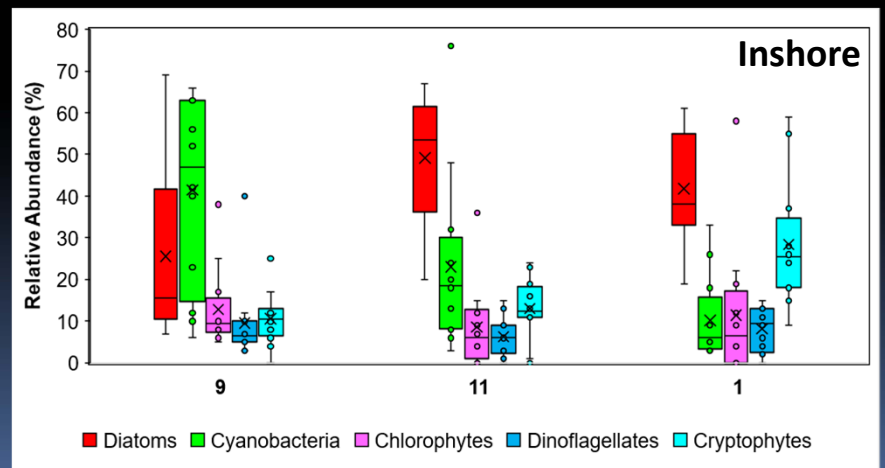
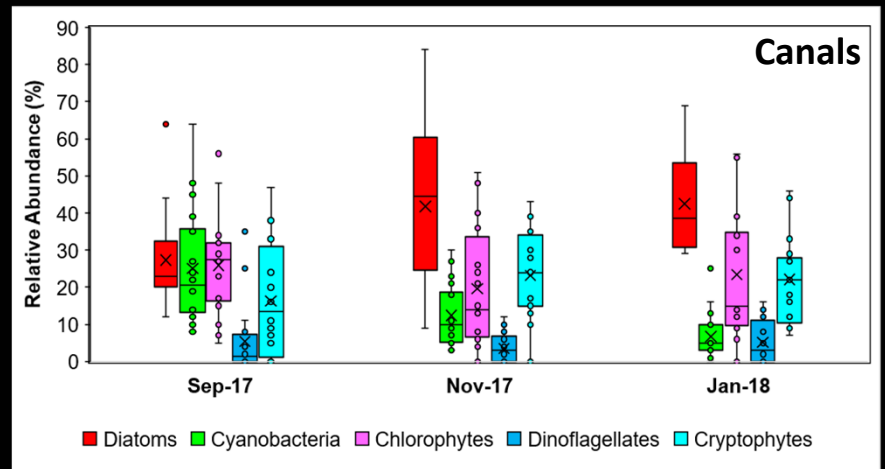


**January 2018**  
(18 weeks after Hurricane Irma)



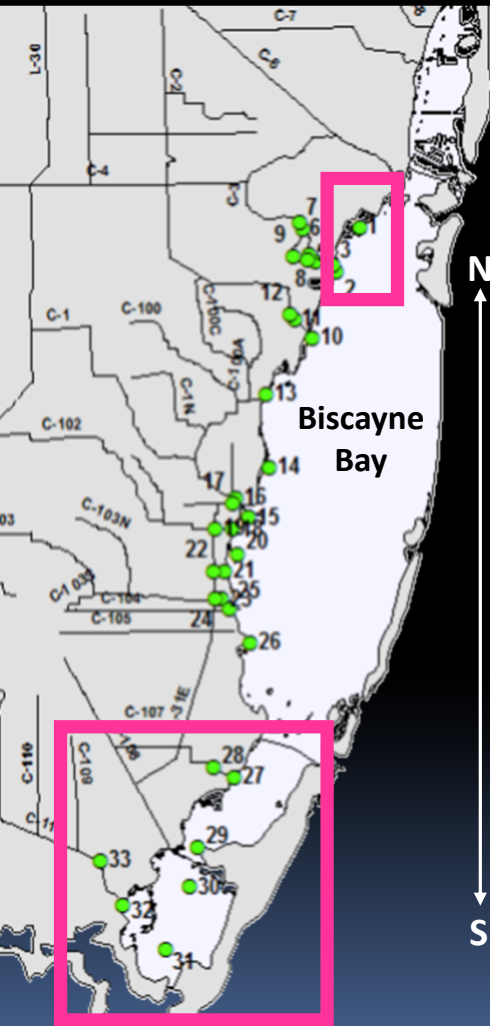
# Spatial & Temporal Changes in Algal Dynamics Near Shore

- Algal biomass was significantly higher in September than in November and January ( $p < 0.05$ )
- Temp.,  $\text{NO}_x$  and  $\text{PO}_4$  explained most of the variation in phytoplankton community structure
- Cyanobacteria were gradually outcompeted by diatoms





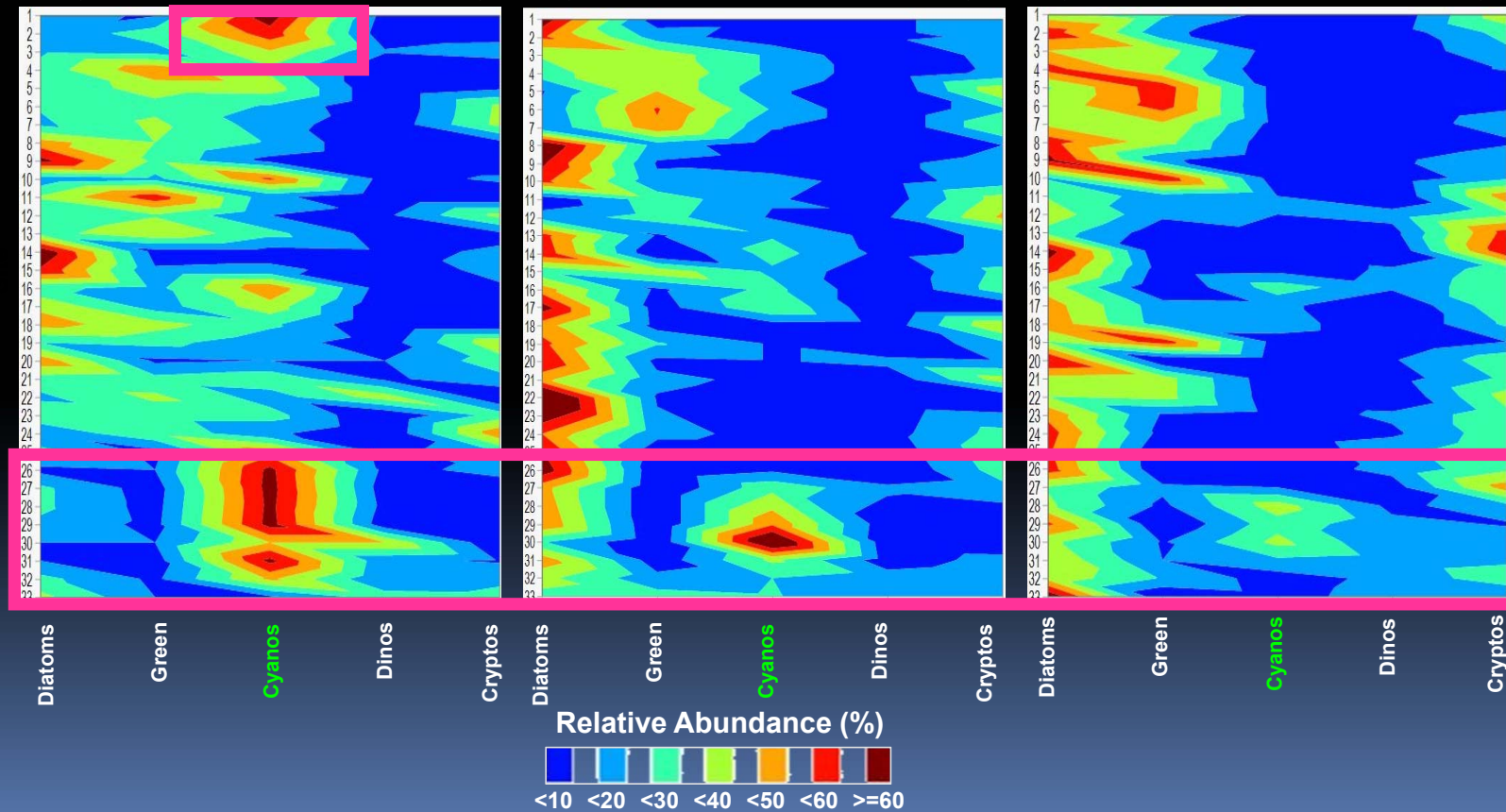
# Changes in Relative Abundance of Phytoplankton Classes in Canals & Near Shore



**September 2017**  
(2 weeks after Hurricane Irma)

**November 2017**  
(9 weeks after Hurricane Irma)

**January 2018**  
(18 weeks after Hurricane Irma)



## Conclusions

- **No evidence of a long-term water quality decline or hurricane-induced algal blooms was observed**
- **Biscayne Bay is resilient to pulse disturbances like hurricanes. Water quality and phytoplankton communities returned to the pre-disturbance conditions within < 6 months**

## ***Estuaries and Coasts Journal Special Issue:***

# ***“Impact of 2017 Hurricanes on Estuaries and Coasts in the Caribbean and the Gulf Coast States”***

***Coming Soon!!!***

**Lead Guest Editor:** *Anna Wachnicka (SFWMD)*

**Guest Co-Editors:** *Jim Fourqurean (FIU), Anna Armitage (TA&M),  
Ian Zink (UM/NOAA) & Joan Browder (NOAA)*

