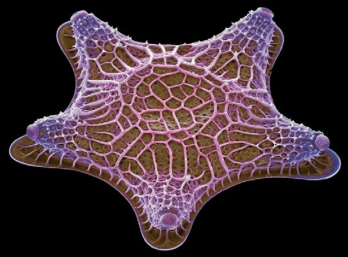
Greater Everglades Ecosystem Restoration
Coral Springs, Florida
April 22 - 25, 2019

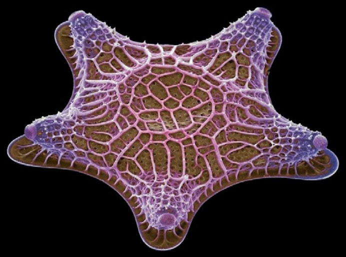
Spatiotemporal Shifts in Phytoplankton Biomass in St. Lucie River Estuary (Florida, USA)

Anna Wachnicka and Alexandra Serna

Coastal Ecosystems Section
South Florida Water Management District
West Palm Beach, FL 3301



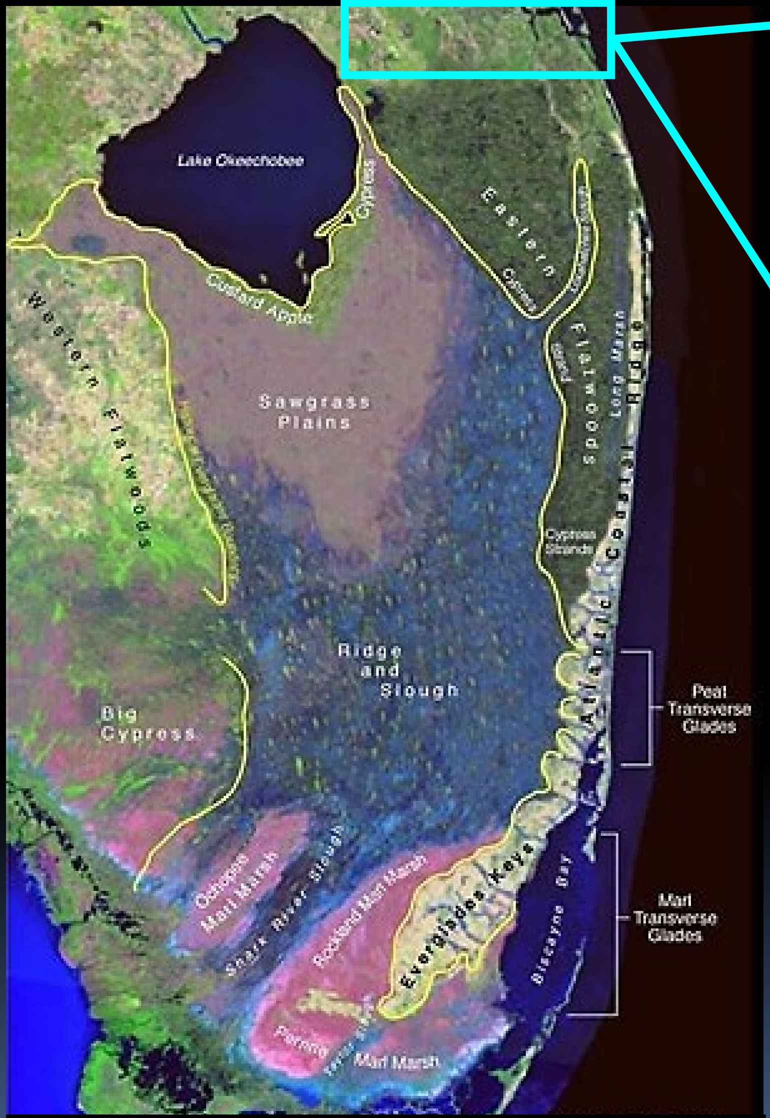
Importance of Phytoplankton and Phytoplankton Biomass Monitoring



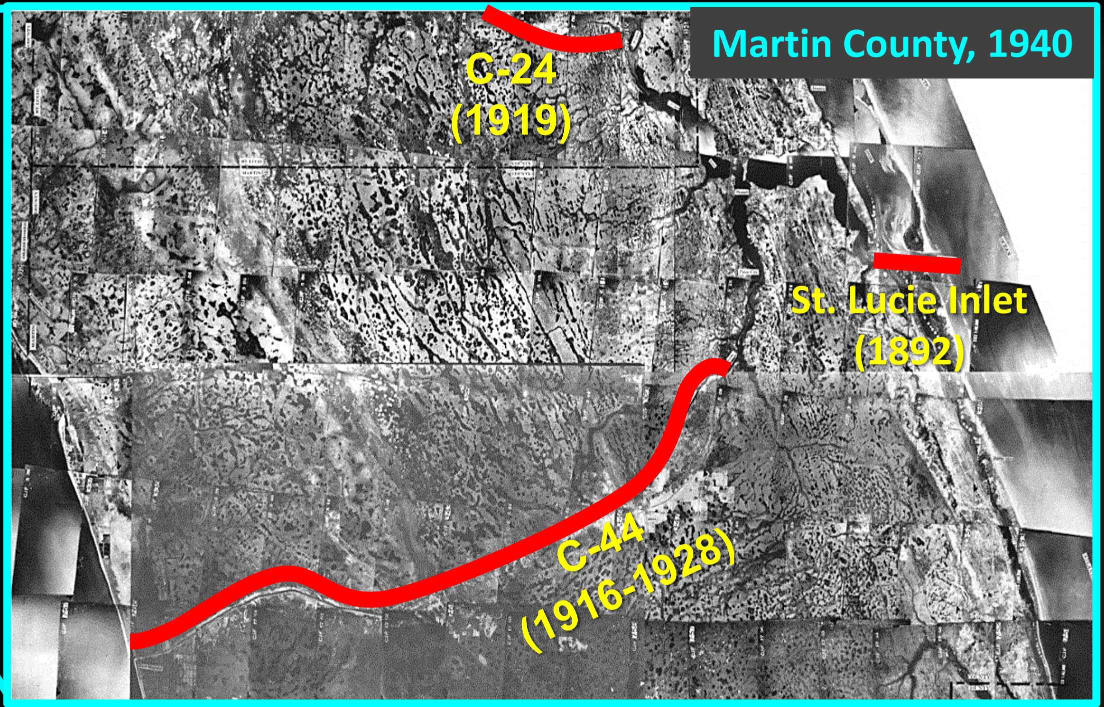
- **Phytoplankton are the foundation of aquatic food web and play crucial role in C and O_2 cycling**
- **Chl *a* is a proxy of phytoplankton biomass used for classifying trophic condition of waterbodies**
- **Time series of chl *a* helps us discover how patterns of phytoplankton biomass variability are shaped by:**
  - **Freshwater inflows**
  - **Nutrient enrichment**
  - **Vertical and horizontal water quality gradients**

Source: Univ. of New Hampshire

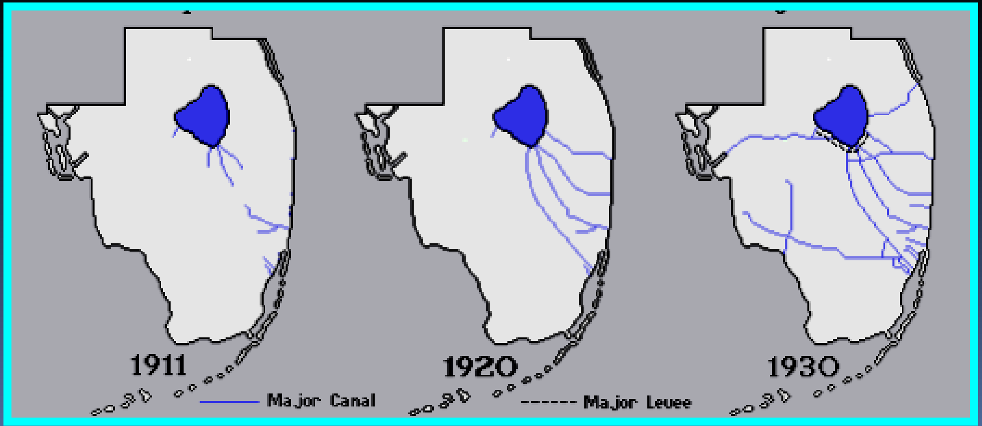
Historic Changes in Water Flow and Land Use: Pre-1948



Pre-Drainage System

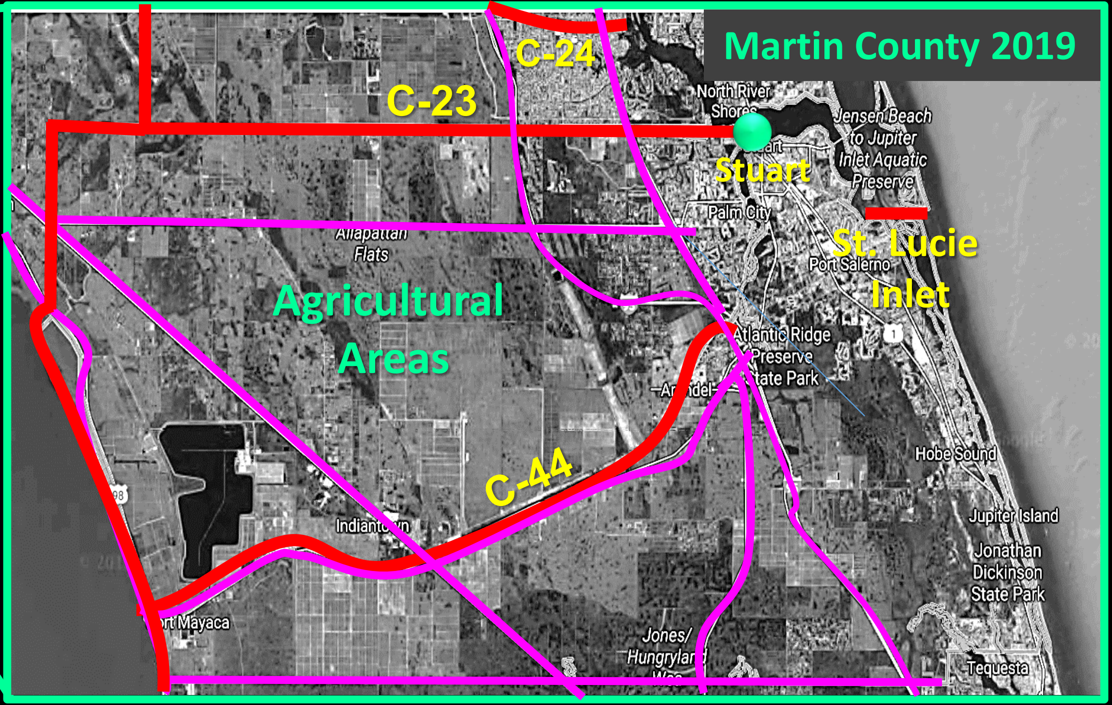


Pre-1948 Central &South Florida Drainage Projects

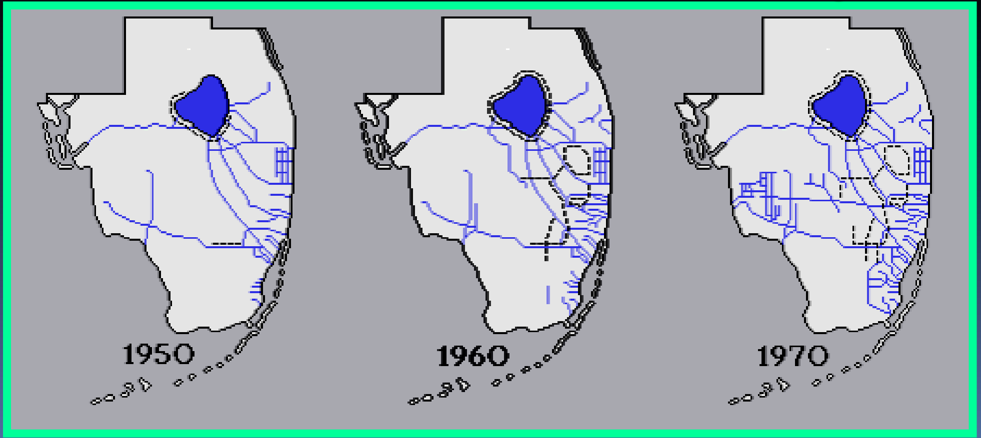


Historic Changes in Water Flow and Land Use: Post – 1948

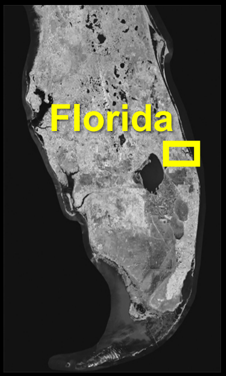
Managed System

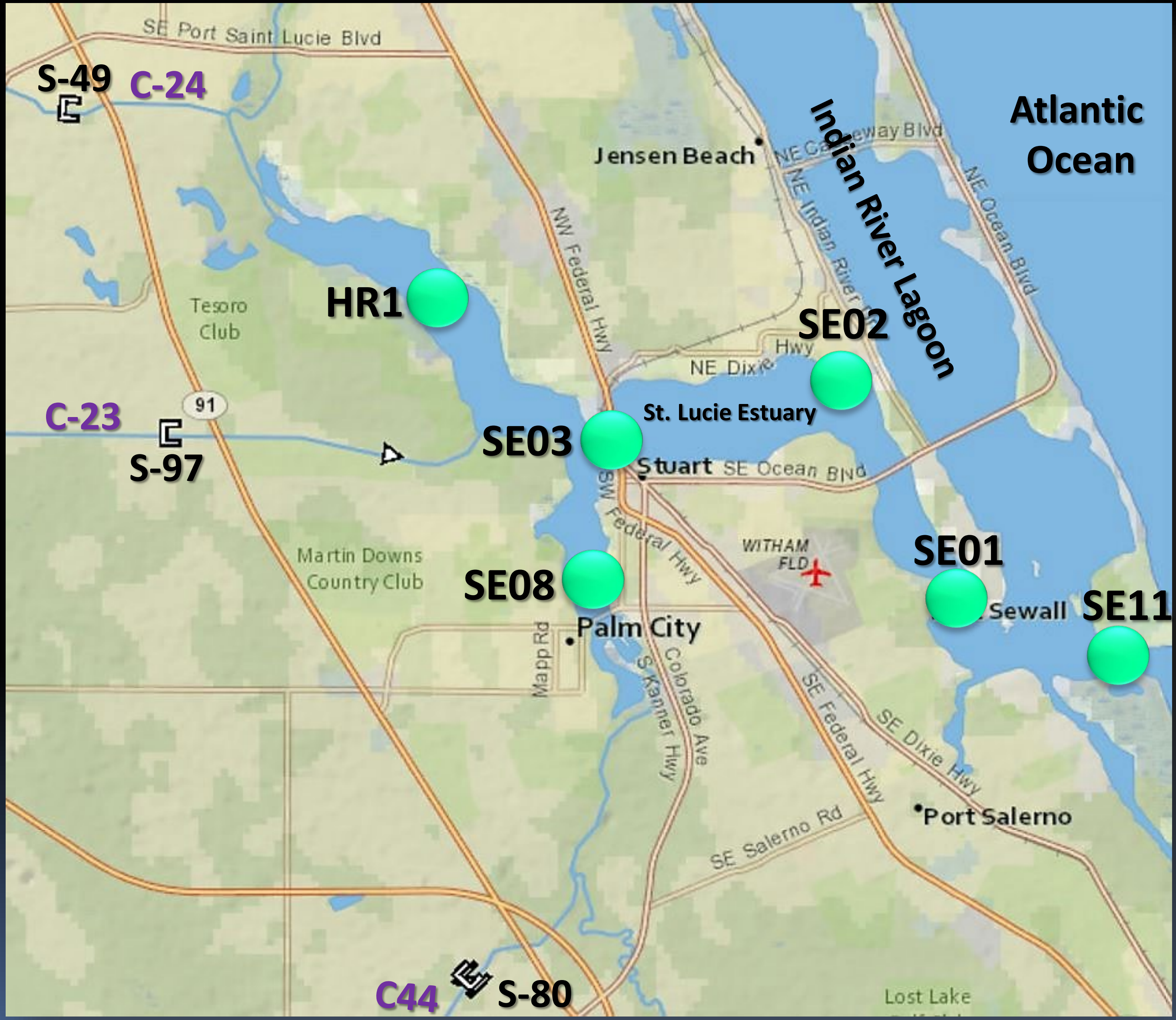


Post-1948 Central &South Florida Project

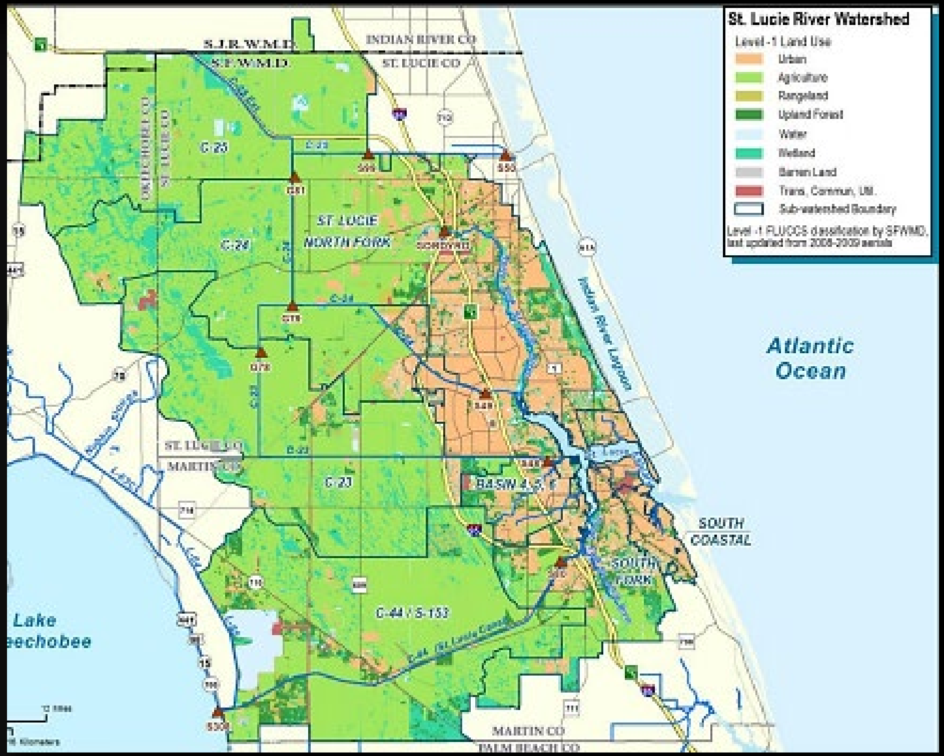


Study Locations





St. Lucie Estuary Watershed



SLE Watershed Area ~537,805 acres:

- 54 % agricultural land (289,635 acres)
- 19 % urbanized areas (102,717 acres)
- 27 % natural areas (145,453 acres)

SLE Area ~7,168 acres

Watershed/SLE =75:1

Source: SFWMD

Study Goal

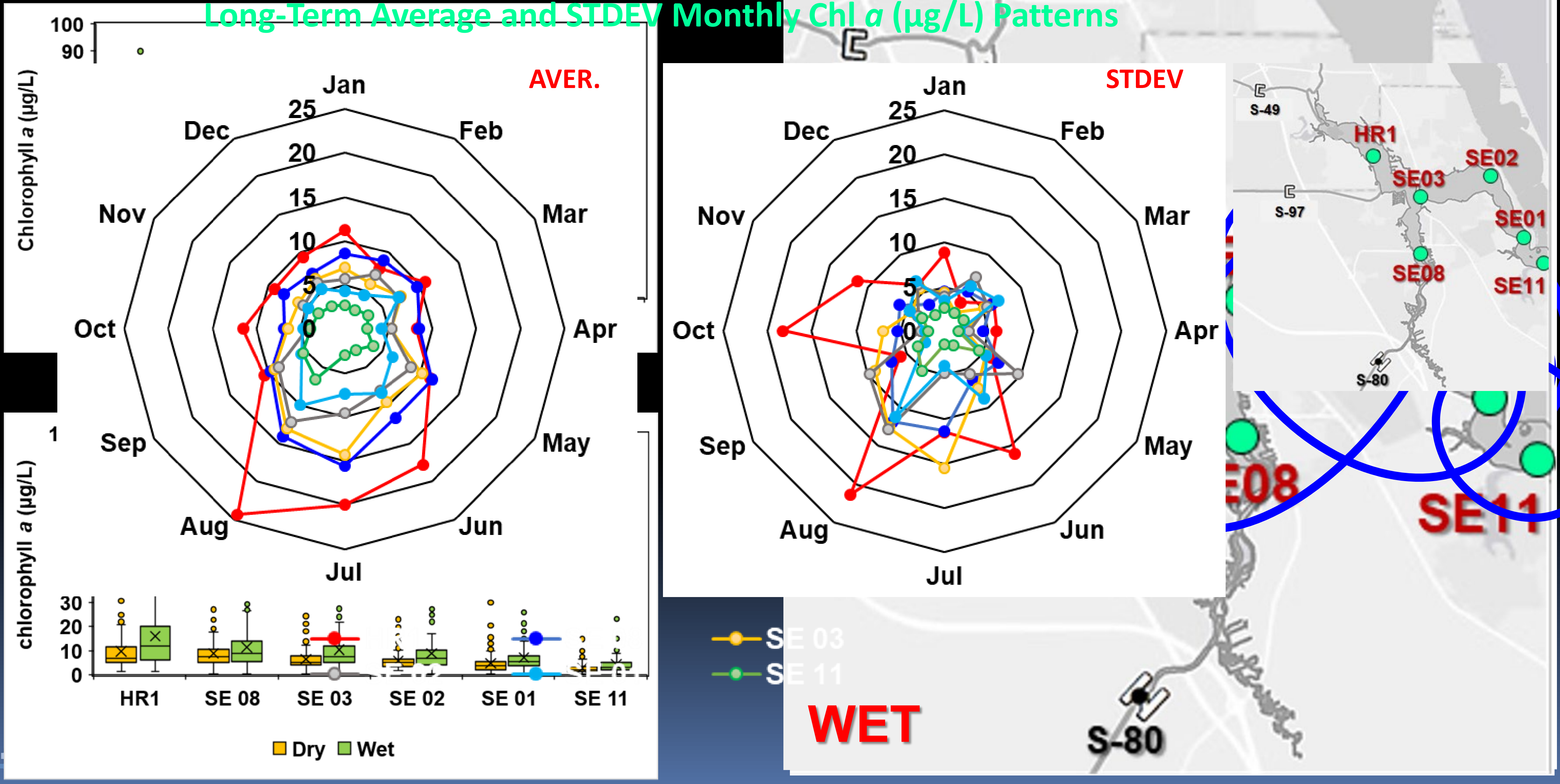
- *Identify long-term trends and patterns in phytoplankton biomass*
- *Identify predictor variables affecting phytoplankton biomass dynamics*

SOUTH FLORIDA WATER MANAGEMENT DISTRICT

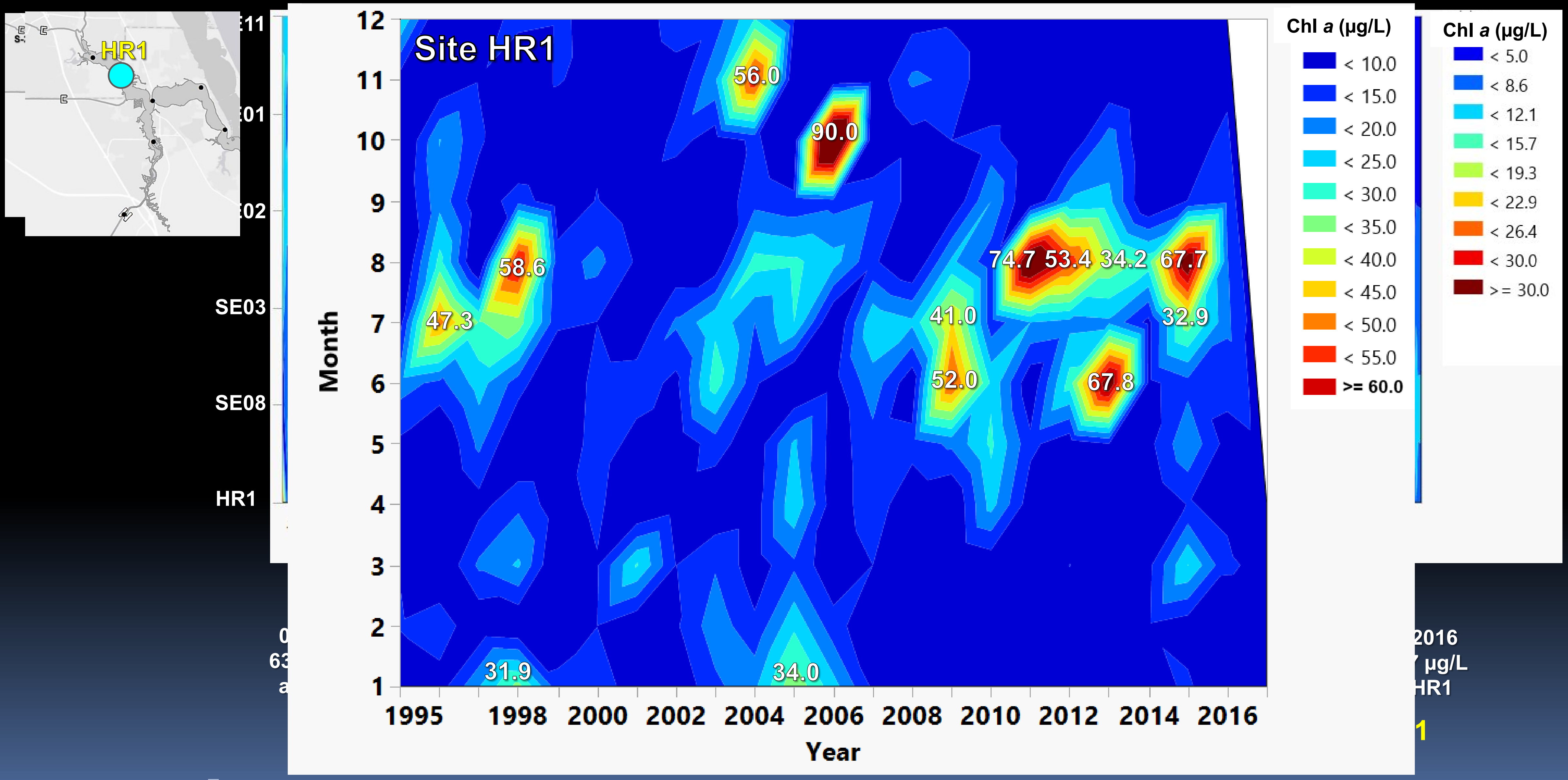
Long-Term Spatiotemporal Patterns in Chl *a* in St. Lucie River Estuary (POR 1996-2017)

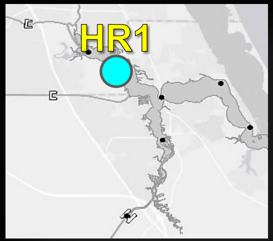
Spatial differences in Chl *a* (µg/L)

Long-Term Average and STDEV Monthly Chl *a* (µg/L) Patterns



Time Series of Chlorophyll *a* in St. Lucie River Estuary





Drivers of Algal Biomass Dynamics in North Fork (Site HR1)

Dry + Wet Combined

Variable Importance Table

X	VIP
NOx	0.8772
NH4	0.7116
PO4	0.7778
COLOR	0.7437
TURB	1.2438
SECCI	1.3755
SALIN	0.9565
TSS	0.7183
DO	0.4568
pH	0.9869
temp	1.5854

Dry Season

Variable Importance Table

X	VIP
NOx	0.3389
NH4	0.7645
PO4	0.3617
COLOR	0.4133
TURB	1.7285
SECCI	1.1036
SALIN	1.1594
TSS	0.5893
pH	1.7554
temp	0.1428

Wet Season

Variable Importance Table

X	VIP
NOx	1.2897
NH4	1.0026
PO4	0.8180
COLOR	0.8897
TURB	0.8268
SECCI	1.2615
SALIN	0.5399
TSS	0.5436
pH	1.0599
temp	1.3731

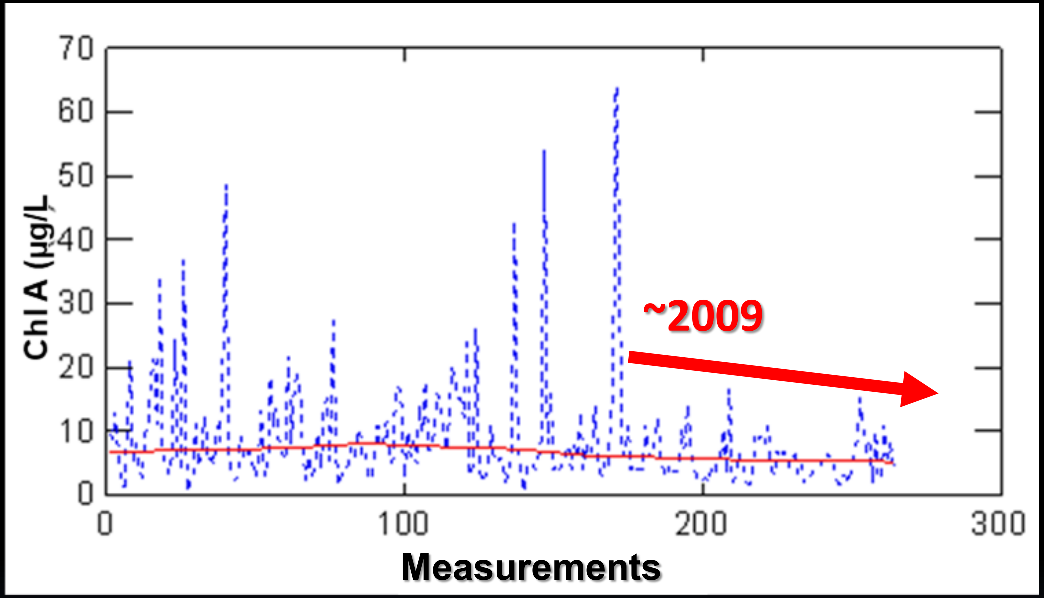
Correlation between Ch *a* & Water Quality Variables

	All	Dry	Wet
NOx	-.153*	-0.113	-.223*
NH4	-0.091	-.241**	-0.179
PO4	0.107	-0.131	-0.056
COLOR	0.033	0.032	-0.122
TURB	.230**	.427**	0.145
SECCI	-.261**	-.296**	-0.159
SALIN	-.162**	-.251**	0.024
TSS	0.057	0.156	0.037
pH	.141*	.476**	.181*
TEMP	.305**	0.051	.264**

- Partial Least Squares Regression Analysis showed that 27.1% (19.2% in Wet and 49.9% in Dry seasons) of variation in Chl *a* data could be explained by the variables
- Significant negative correlation between inflows from S-49/C-24 and chl *a* only ($r = -0.117$, $p < 0.05$) during wet season

Long-Term Trends in Chlorophyll *a* in St. Lucie River Estuary

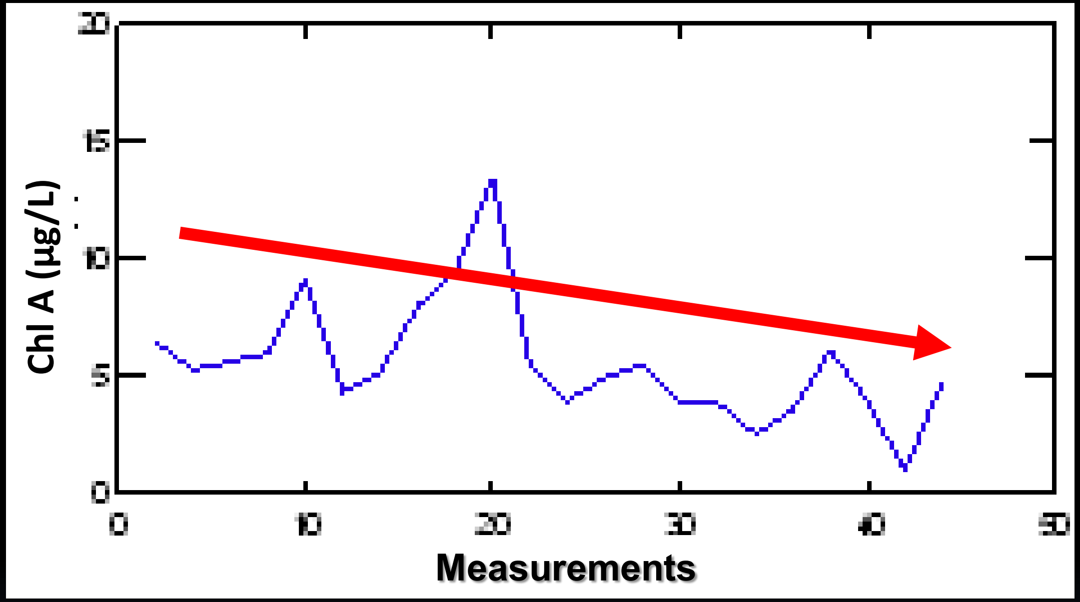
Mann-Kendall Test: Smoothed Time Series of Chl *a*



1) H_0: NO trend vs. H_1: Downward Trend
2) H_0: No trend vs. H_1: Upward Trend

- 1) H_0 REJECTED: Downward test detected (p = 0.000)
- 2) H_0 ACCEPTED: No Upward Trend detected (p = 1.000)

Seasonal Kendall Test: DRY Season



1) H_0: NO trend vs. H_1: Downward Trend
2) H_0: NO trend vs. H_1: Upward Trend

- 1) H_0 REJECTED: Downward test detected (p = 0.004)
- 2) H_0 ACCEPTED: No Upward Trend detected (p = 0.996)

CHANGING INFLOWS/FLUSHING RATES/PRECIPITATION???

Conclusions

- Concentrations decrease with increasing distance from the Forks, which receive most of freshwater inflows/nutrient input from surrounding watershed
- Temperature, NO_x and light were the most important variables influencing chl *a* concentrations in the North Fork during wet seasons, while pH, turbidity and salinity during dry seasons
- Chl a concentration decreased over time in central part of St. Lucie Estuary

Acknowledgements

Kathy Haunert

Zhi, Chen

All scientists from the Water Quality Monitoring Bureau at SFWMD who collect the data across the Greater Everglades System