



# National Science Foundation's Centers of Research Excellence in Science and Technology (CREST)

#### Goals:

- Integrate education and research
- Promote development of new knowledge
- Enhance faculty research productivity
- Increase diversity in STEM disciplines

#### **Success:**

- Promote faculty engagement in research activities at the highest level
- Engage undergraduate and graduate students in the process of discovery and innovation
- Provide students opportunities to become significant participants in the broader community of scholarship in their respective fields





### **FIU CREST CACHE**

A campus-wide integration of students and faculty from 14 departments, 4 colleges, 2 centers and the STEM Transformation Institute in fields from *environmental* chemistry to computer-intensive data analysis and visualization...working together to tackle one of the region's most complex challenges: *environmental* contamination.

We partner with the University of South Florida, Florida Atlantic University, University of Puerto Rico, Miami Dade College and the Florida Keys Community College, as well as a number of state and federal resource agencies.







### **Research Focus Areas**

**Detection and Identification** 

**Fate and Transport** 

**Impacts and Visualization** 



CREST research focuses on marine and coastal, as well as freshwater resources



**Everglades** 



Mangroves



**Shallow Marine Habitats** 

**Critical Ecosystems** 







### **CREST CACHE Research Focus Areas**

- 1. Advanced sensing of environmental exposure to anthropogenic contaminants, pollutants and other natural stressors.
- 2. Quantifying the fate and transport of contaminants across landscape gradient transects in South Florida.
- 3. Assessing the effects on South Florida's aquatic ecosystems through data analytics, interpretation and visualization to convey environmental impacts to policy- and decision-makers.



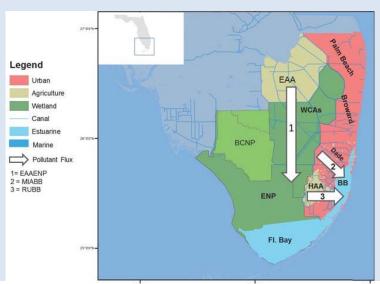


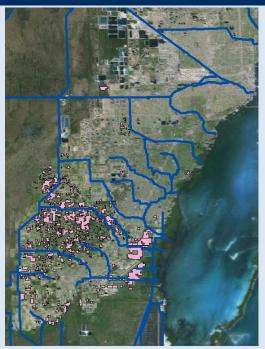


# Nutrient Transport Modeling from Agricultural Nurseries through Canals that Lead to Florida Bay



Dr. Colin Polsky, FAU, is on our advisory team and is an expert on fertilizer use and policy





Nutrient transport modeling from agricultural areas to the Everglades





# Age, Accumulation and Accretion

Accumulation =  $\underline{\text{mass}}$ time

Organic Matter Inorganic Matter Organic Carbon Carbonate etc.

~50 yrs old

Accretion =  $\frac{\text{depth}}{\text{time}}$ 

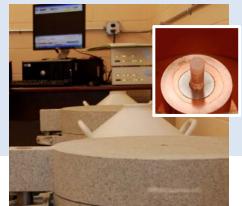
~100 yrs old











<sup>210</sup>Pb Dating Method

### **Preserving Florida's Seagrass Ecosystems**

Water chemistry, sediments and contaminants are measured to determine sea grass vulnerability and mitigation strategies









## **Understanding Red Tide Phenomena**

### Analysis of epigenetic mechanism responding to pollutants and contaminants

#### Epigenetic responses in corals

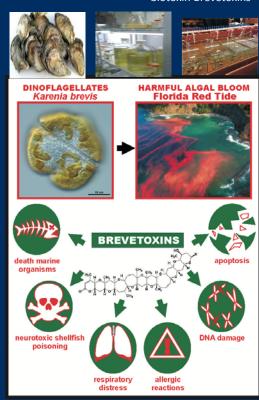
Climate change (temperature changes) pollution (nutrient loading)



Assess the impact of pollution on the health of these population/ ecosystems

Develop epigenetic biomarkers of stress (DNA methylation, histone variants and PTMs, and non-coding RNAs





# **Education**

#### Miami-Dade



### Florida Keys Community College







#### **University of Puerto Rico**

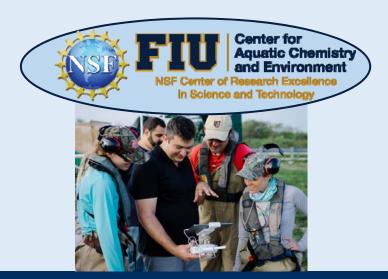


**Discovery-based Education** 

# **Education**

#### We have funded:

- 15 REUs
- 73 Discovery Learning I + 46 Discovery Learning II Undergrads
- 2 MS Fellows (Stipend + Tuition) including 1 USF student
- 26 PhD Fellows (Stipend + Tuition)



**Discovery-based Education** 

## **Technology Development and Transfer**

**Computer Science** 

**Analytic Chemistry** 

**Sensor Development** 

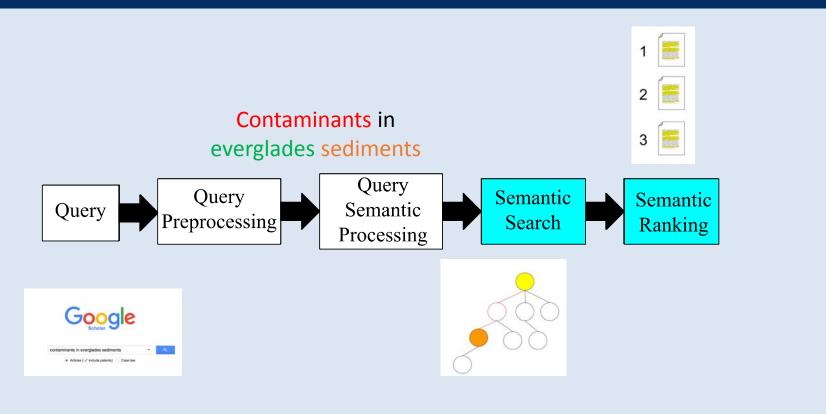








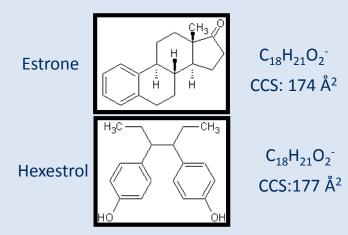
# **Building a New STEM Query Program—System Design**



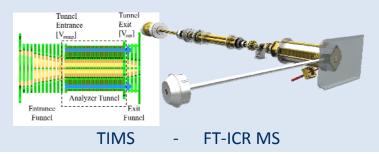


## **Developing Novel and Advanced Instrumentation**

- Trapped Ion Mobility Spectrometry-Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (TIMS-FT-ICR MS)
  - Separation based on
    - Size (Collision Cross Section [CCS])
    - Mass (Chemical Formula)
- Increases our ability to detect and identify molecules from complex mixtures, such as crude oil during oil spills.
- Can assign chemical formulas and chemical structures to the measured components.



#### Isomeric (same mass) endocrine disruptors





### CREST Scientists are Developing New Autonomous Surface Vessels, Sensors and Programs for Coastal Monitoring





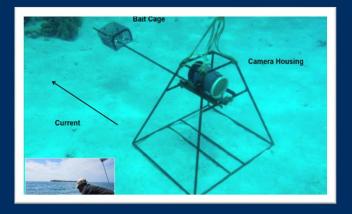
### **Supports:**

Fisheries Ecology

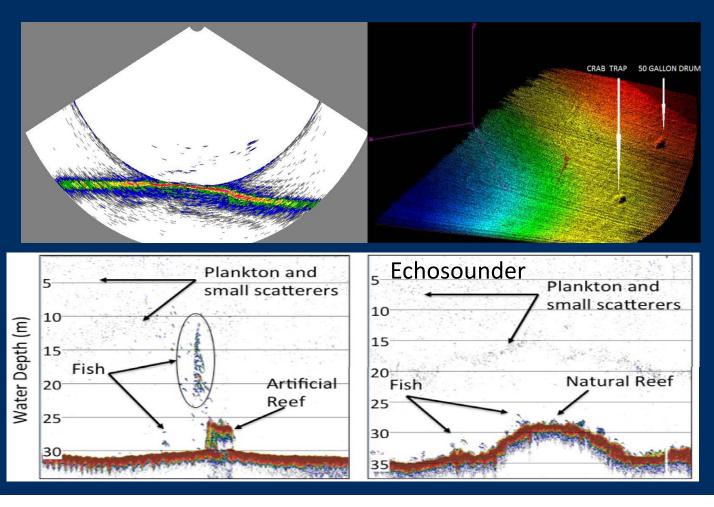
**Behavioral Studies** 

**Habitat Classification** 

Bathymetric profiles



# **Multifrequency/Wideband Acoustics**



# **FIU CREST Technological Transfer**





# Development of a Fecal Coliform Sensor and App for a Citizen Scientist Project to Quantify Bacterial Contamination

#### Tidal floodwaters may be contaminated



Sample flood waters



#### Dip plate in the water, cover it



Incubate at home in a warm place

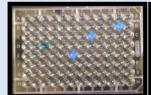




Miami Beach – King Tide event



- App will show result
- Data is uploaded to the FIU server



Blue= presence, fluorescence = *E-Coli*.



- Illuminate with UV flashlight
- Take **second** picture



# **Future Research**

### **Emerging Pollutants**

Pharmaceutical as Endocrine Disrupters



#### **Climate and Infectious Disease**

Vectors and Water-borne Disease Dynamics



# Aquatic Stressors and the Brain

Metals, Toxins and Human Disease





# **Partnerships and Collaborations**

- develop practical solutions to problems related to water quality in a natural-agricultural-urban setting, and
- create a modeling platform that will enable policy-makers and managers to make informed decisions

#### This partnership includes:

- South Florida Water Management District
- University of South Florida
- Environmental Protection Agency
- National Park Service
- Everglades National Park
- U.S. Geologic Survey

- Miami Dade College
- Florida Atlantic University
- Miccosukee Tribe of Indians
- Miami-Dade County Public Schools
- Florida Keys Community College
- Department of the Interior

























