

Monitoring Water Quality Around Key West: Progress Report

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3rd EPA Grant: Chemicals of Emerging Concern (CECs) in Areas of Concern (AOC)

Objectives

- 1. Continue water quality monitoring in the Key West harbor and ship channel using existing technology and infrastructure.**
- 2. Expand water quality monitoring to eight AOC around the islands of Key West using an Autonomous Underwater Vehicle equipped with sensors for dissolved oxygen, temperature, salinity, turbidity, and total algae.**
- 3. Expand water quality monitoring to beach AOC around the southern section of Key West for oxybenzone in the marine food chain.**
- 4. Expand water quality monitoring to seven AOC around the islands of Key West for sewage discharge indicators (i.e. ammonia and sucralose).**
- 5. Expand water quality monitoring to marine environment near Stock Island Landfill for toxic pollutants (i.e. hydrogen sulfide).**
- 6. Provide data and input for the City of Key West's Water Quality Improvement Plan.**



Key West Harbor & Ship Channel

Continue to Channel Marker G3

ADCP

Google Earth

Objective 1

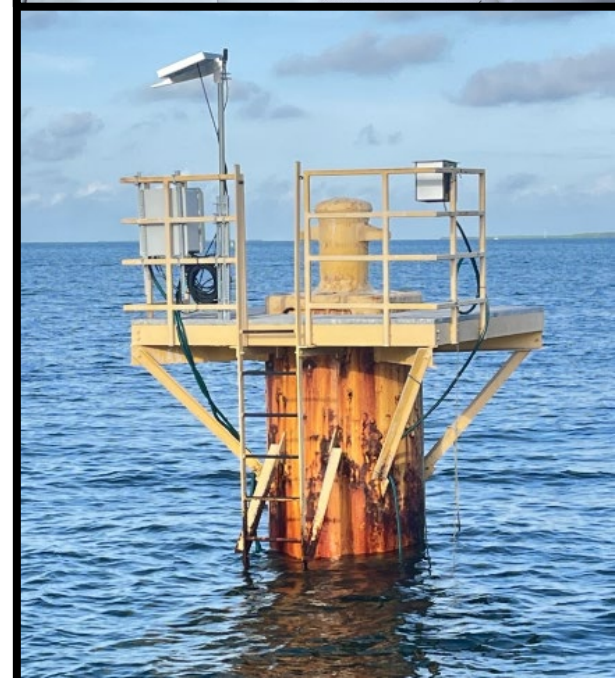
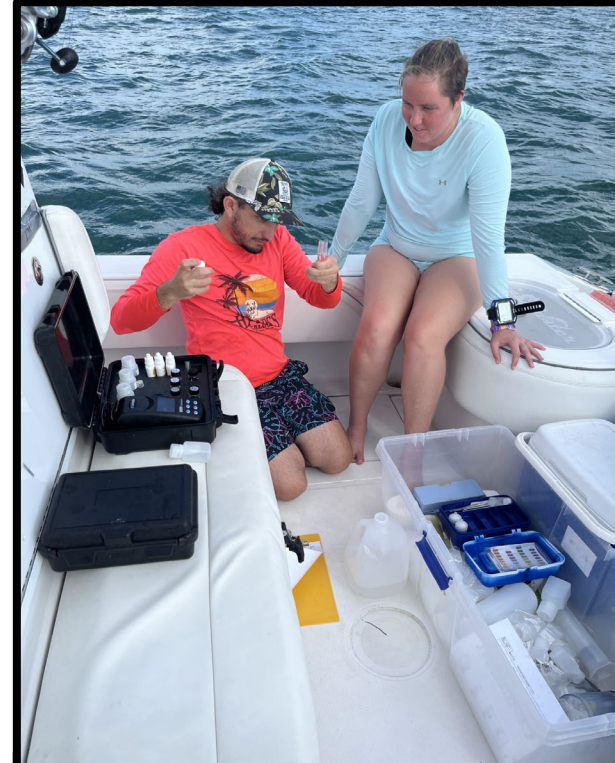
Continue water quality monitoring in the Key West harbor and ship channel using existing technology and infrastructure.



Objective 1

Successes:

- Over a year of water sample data collected from the Key West Harbor and Ship Channel
- Over a year of water sample data collected from Eastern Dry Rocks and Western Dry Rocks
- Over a year of data from the Mallory Square monitoring equipment (i.e. Turnkey System)



: Mallory Square

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[Chart View](#)

[Table View](#)

[Site Information](#)

[Alarms](#)

Exo1Data ▾

Parameters ▾

Studies ▾

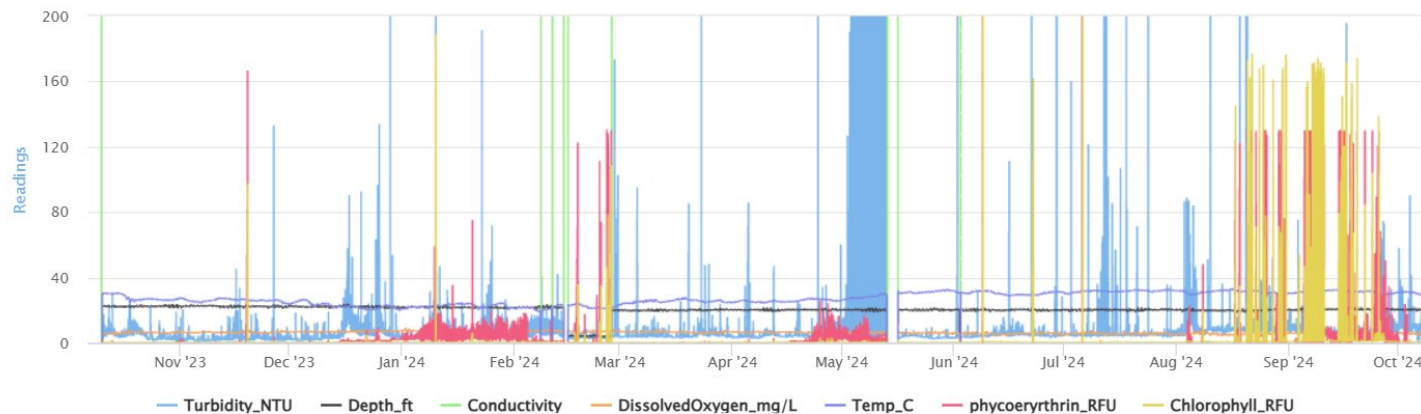
10/10/2023 - 10/10/2024

Y-axis scaling 0 200

Clear

Min

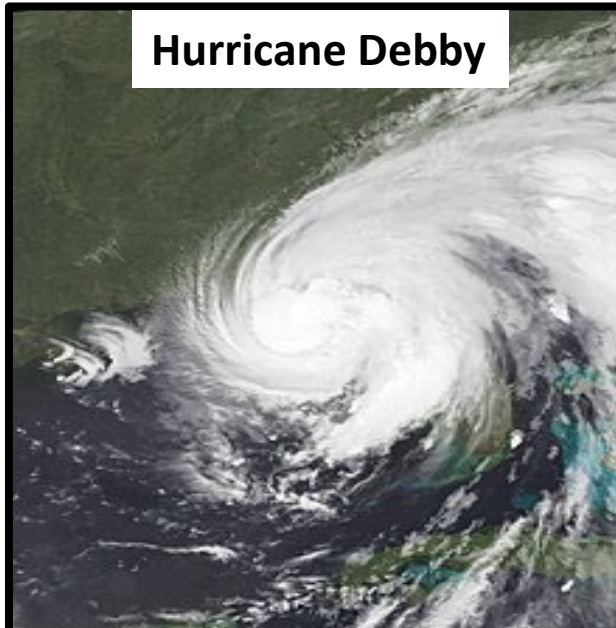
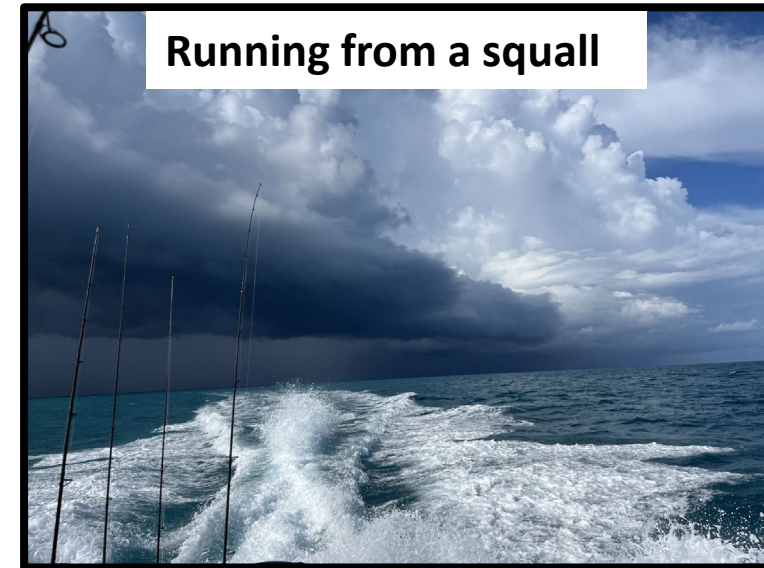
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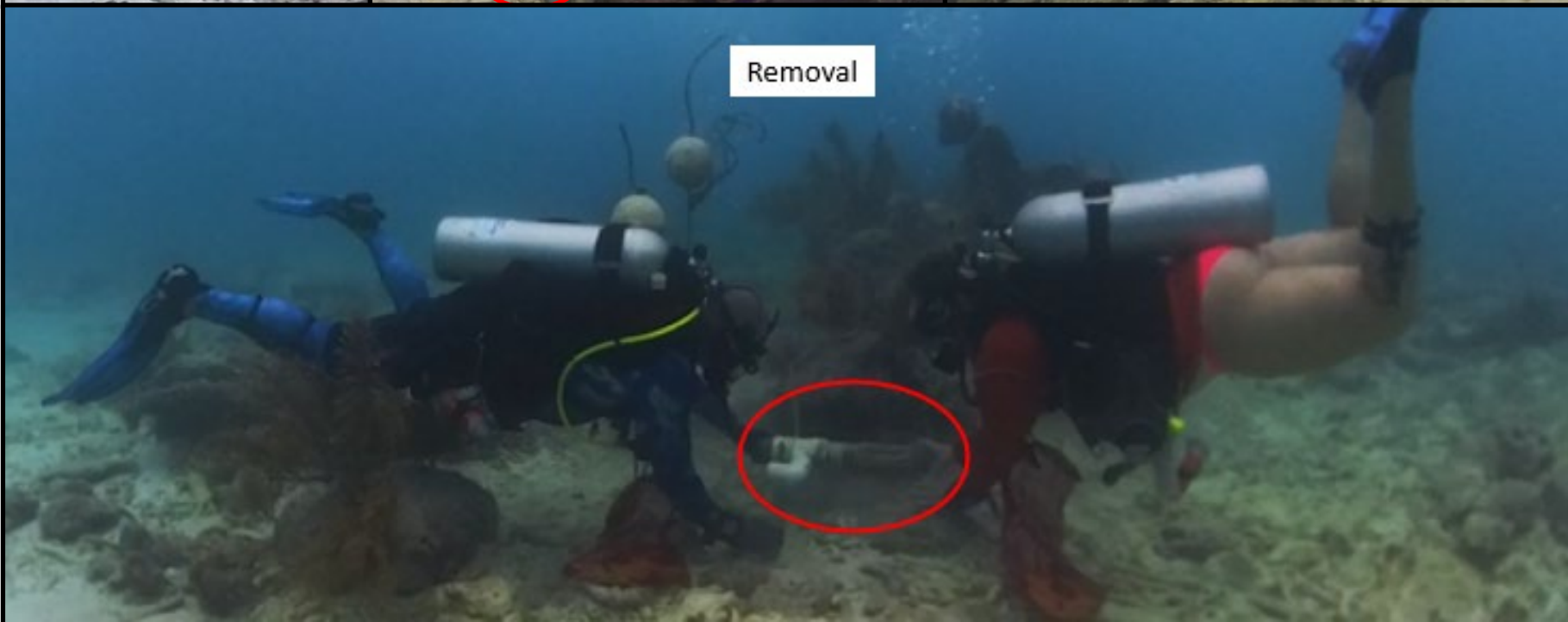
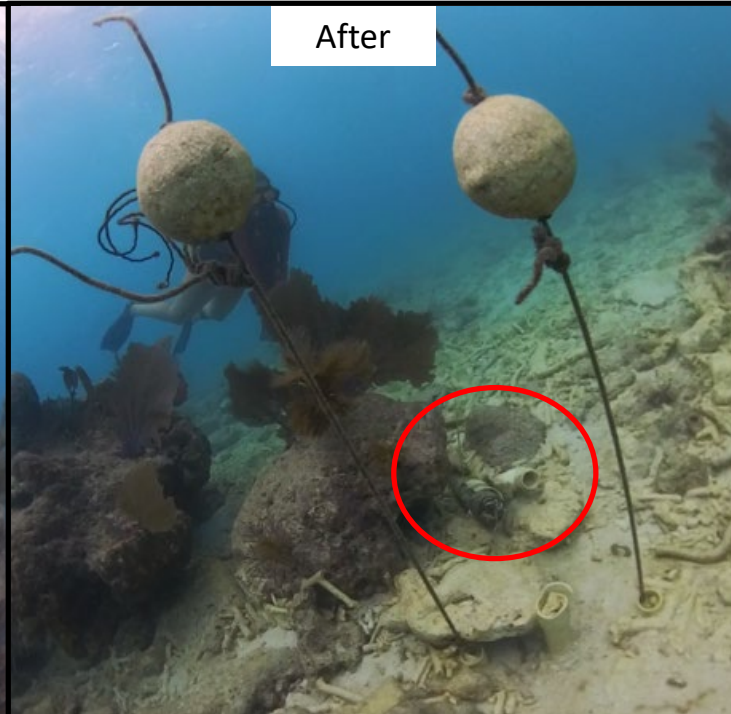
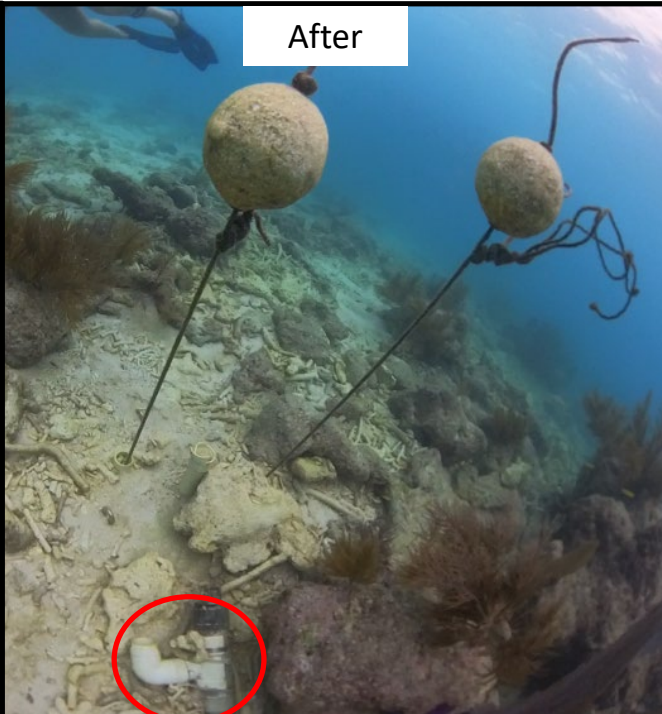


Objective 1

Challenges:

- Weather
 - Wind
 - Squalls
 - Tropical Storms and Hurricanes
- Equipment failures
- Research Assistant turnover





Cruise ship data in the Key West Harbor

- ❑ 244 ships have visited KW Harbor since Oct. 12, 2023 (the date the TK system was installed at Mallory Square)
 - ❑ Cruise ships range in size (i.e. capacity) from:
 - Smallest - Capacity = 49 passengers
 - Largest - Capacity = 3,646 passengers
 - ❑ Data collected on:
 - Capacity
 - Arrival/Departure time
 - Ambient water quality at arrival/departure
 - Tides
 - Wind direction
 - Wind speed
 - ❑ EPA standard not to exceed $\Delta \geq 29$ NTU beyond background turbidity (F.A.C. 62-302: Water Quality Standards)
- ❑ 32 turbidity events associated with cruise ships exceeded EPA standards (13.1% of total cruise ship visits)
 - ❑ The most substantial turbidity event was > 6.5 times beyond the EPA standards (i.e. $\Delta > 190$ NTU)



**Florida Administrative Code (F.A.C.)
CHAPTER 62-302.530 Table: Surface Water Quality Criteria
Effective May 19, 2015**

Criteria for Surface Water Quality Classifications							
Parameter	Units	Class I	Class II	Class III and Class III-Limited (see Note 4)		Class IV	Class V
				Predominantly Fresh Waters	Predominantly Marine Waters		
(69) Turbidity	Nephelometric Turbidity Units (NTU)	≤ 29 above natural background conditions	≤ 29 above natural background conditions	≤ 29 above natural background conditions	≤ 29 above natural background conditions	≤ 29 above natural background conditions	≤ 29 above natural background conditions

Double Turbidity Event

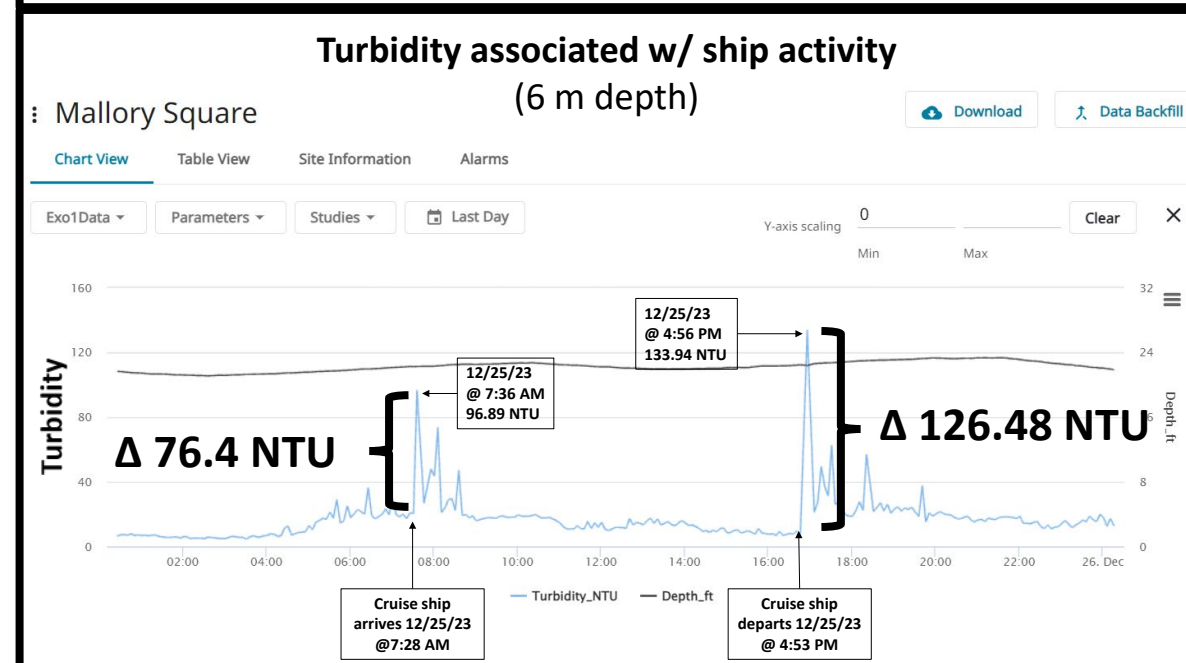
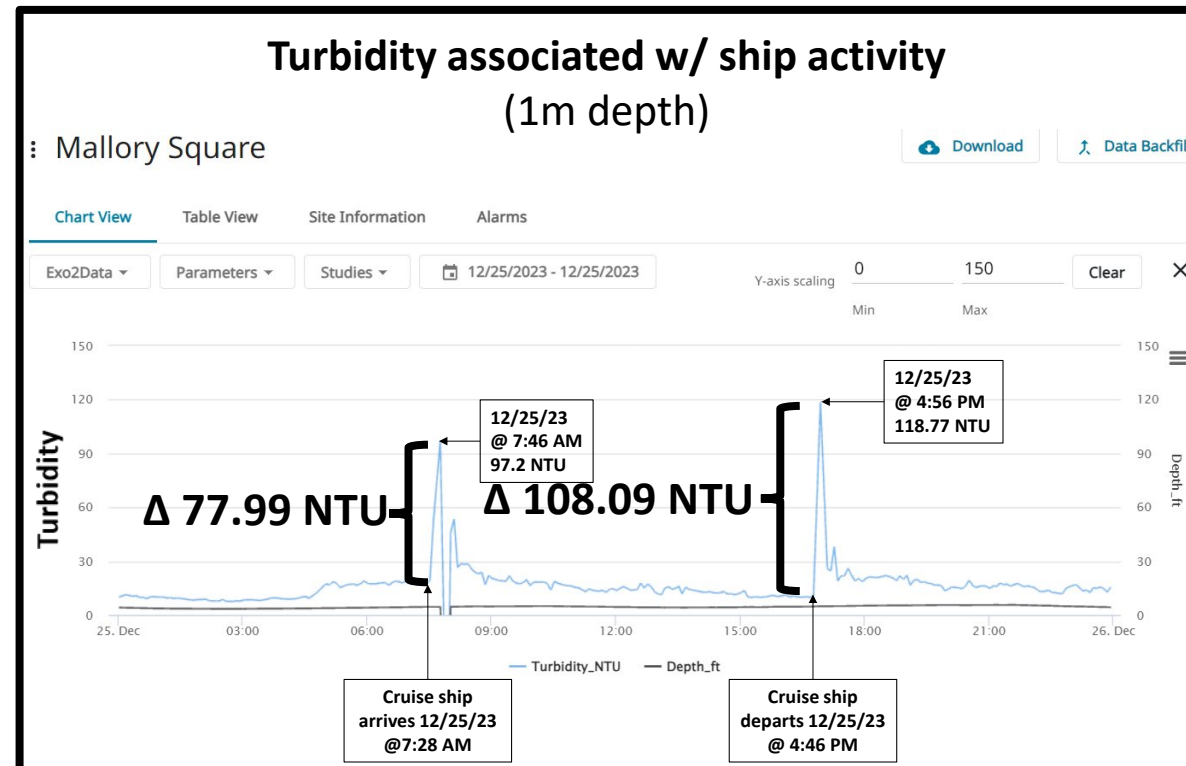
- Two turbidity events on 12/25/2023

Shallow sonde data:

- Arrival turbidity spike of $\Delta = 77.99$ NTU at 7:46 AM
- Departure turbidity spike of $\Delta = 108.09$ at 4:56 PM
- $\Delta = 3.7$ times EPA standard

Deep sonde data:

- Arrival turbidity spike of $\Delta = 76.4$ NTU at 7:46 AM
- Departure turbidity spike of $\Delta = 126.48$ at 4:56 PM
- $\Delta > 4$ times EPA standard

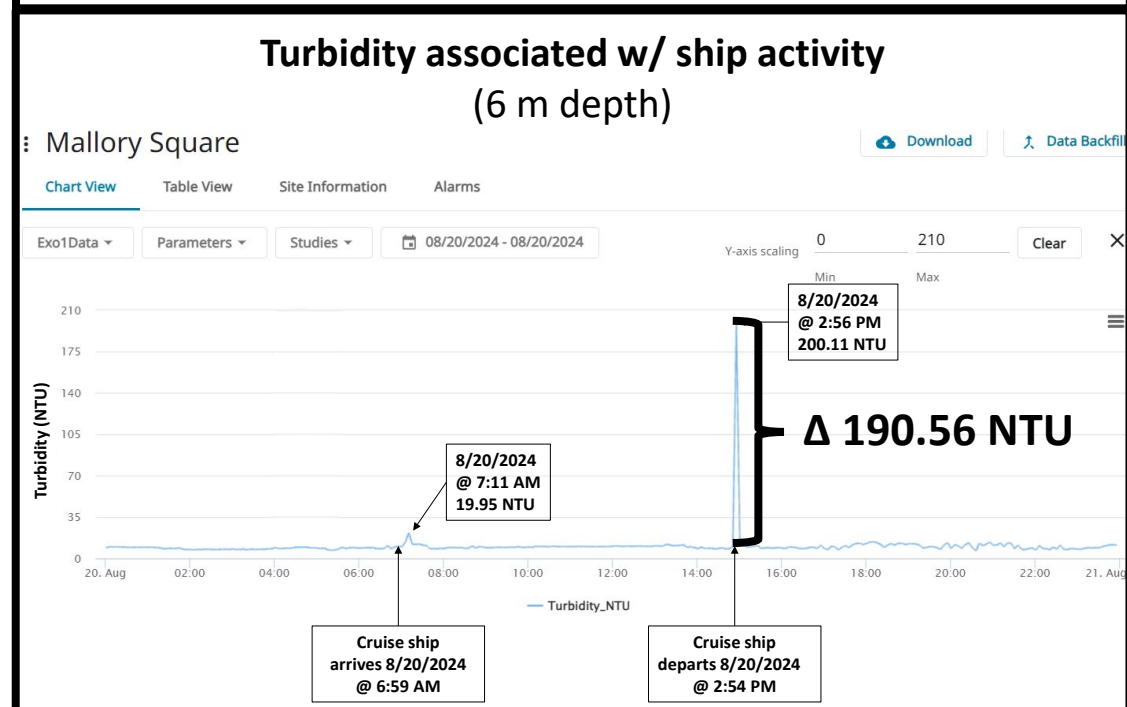
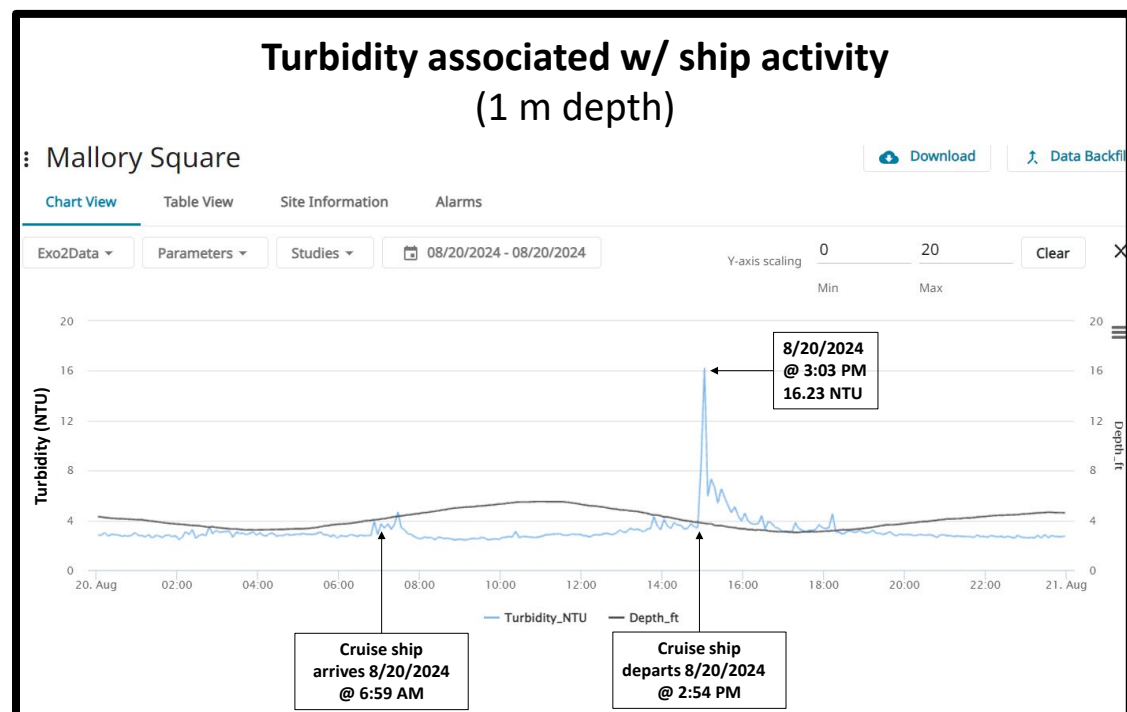


Most Severe Turbidity Event

- The most significant turbidity event of the year on 8/20/2024

Deep sonde data:

- Departure turbidity spike of $\Delta = 190.56$ NTU at 2:56 PM
- >6.5 times beyond EPA standard (not to exceed $\Delta \geq 29$ NTU)

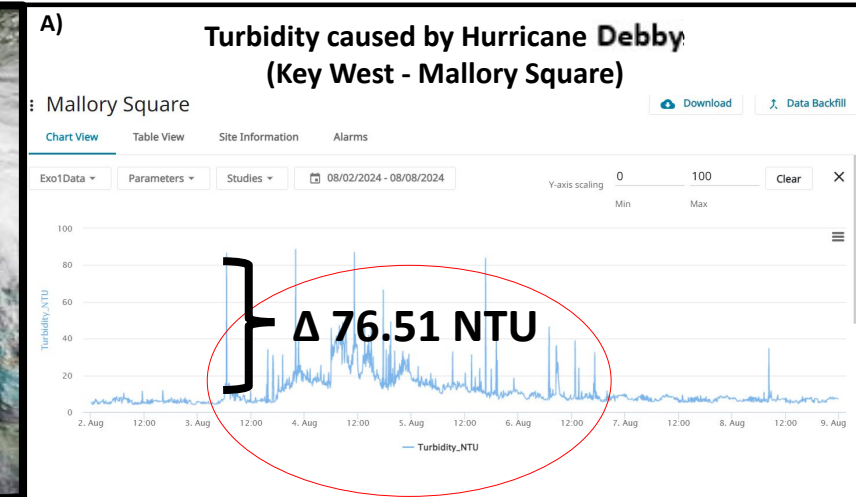


Turbidity Events Associated w/ Hurricanes

- Hurricane Debby (Aug. 3-6, 2024)
 - $\Delta > 76$ NTU
 - > 2 times EPA standard



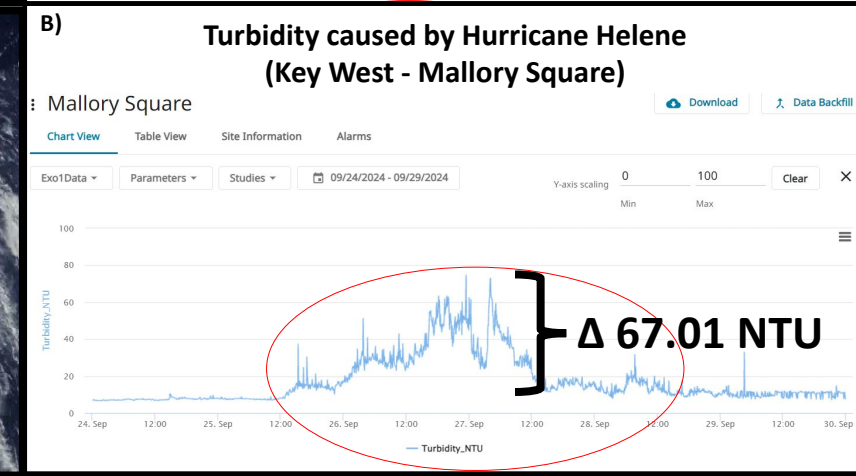
Hurricane Debby



- Hurricane Helene (Sept. 26-28, 2024)
 - $\Delta > 67$ NTU
 - > 2 times EPA standard



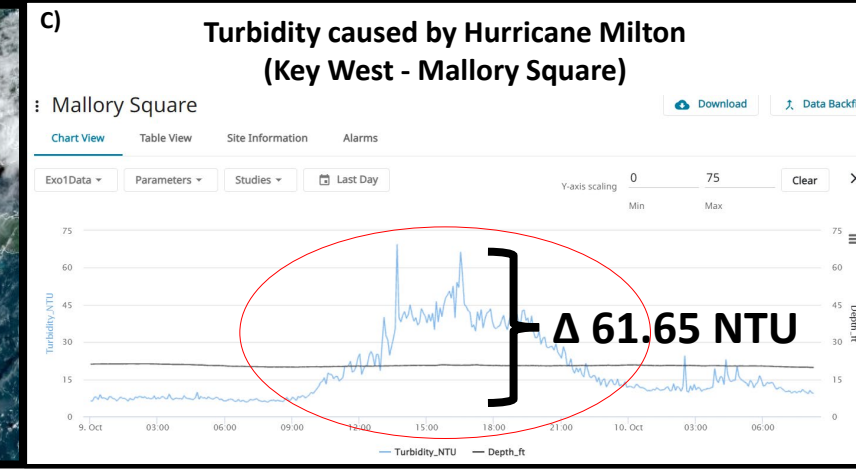
Hurricane Helene



- Hurricane Milton (Oct. 9-10, 2024)
 - $\Delta > 61$ NTU
 - > 2 times EPA standard



Hurricane Milton



Objective 2

Expand water quality monitoring to eight AOC around the islands of Key West using an Autonomous Underwater Vehicle equipped with sensors for dissolved oxygen, temperature, salinity, turbidity, and total algae.

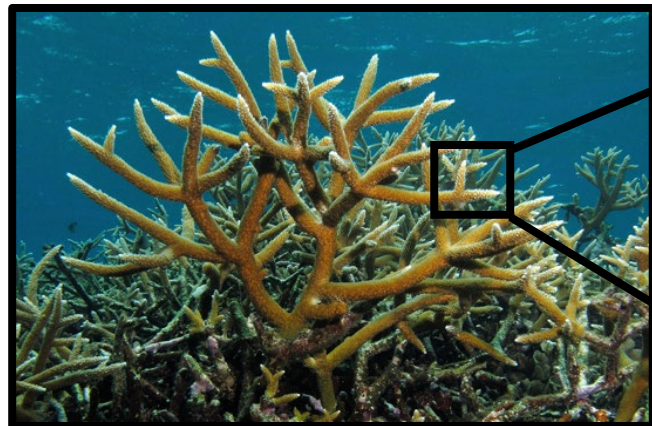
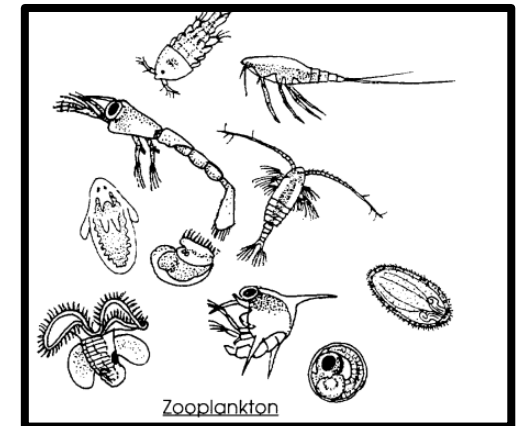
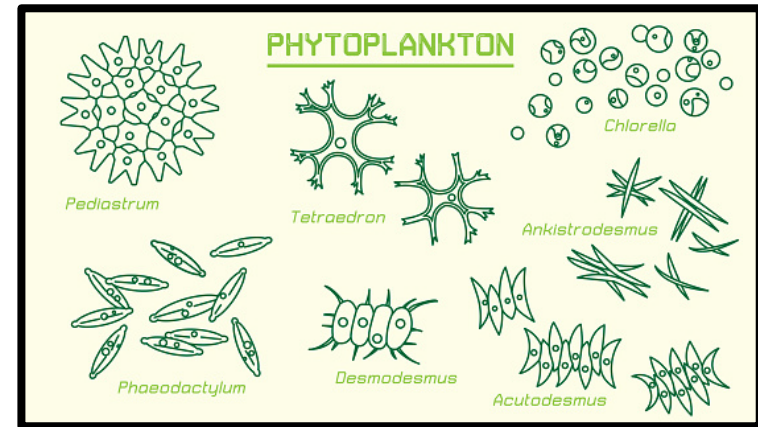


YSI i3XO EcoMapper Autonomous Underwater Vehicle (AUV)



Objective 3.

Expand water quality monitoring to beach AOC around the southern section of Key West for oxybenzone in the marine food chain



Sunscreen Pollution: Oxybenzone

Sources:

- Beach goers that enter the water with sunscreen products with oxybenzone
- Even beach goers that don't enter the water but use beach showers (Downs et al., 2022)
- This summer a new method for oxybenzone analysis (Magrin et al., 2024)
- Snorkelers with sunscreen

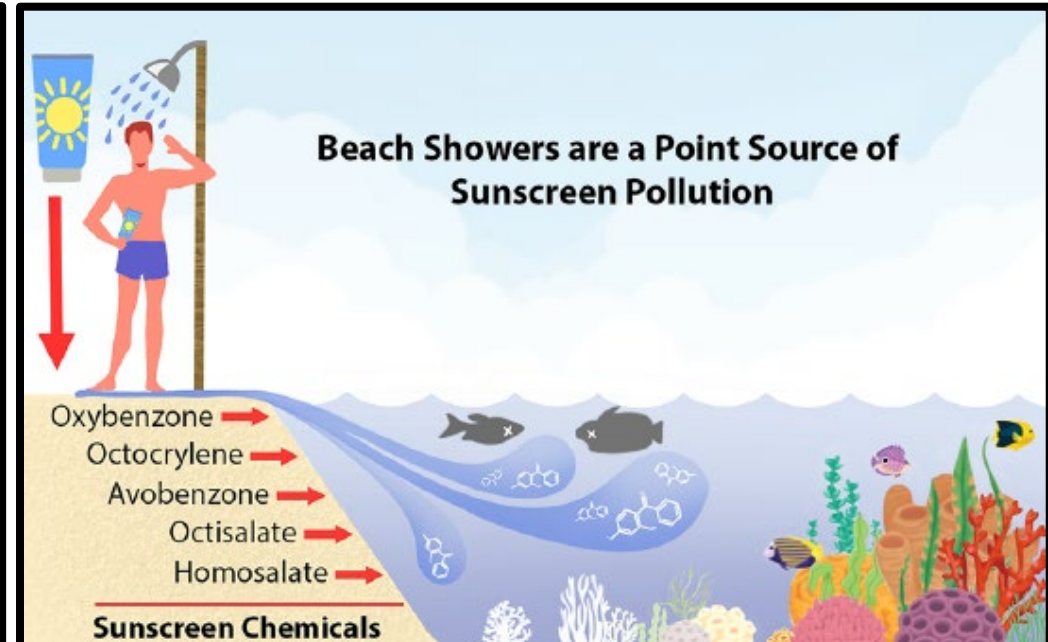
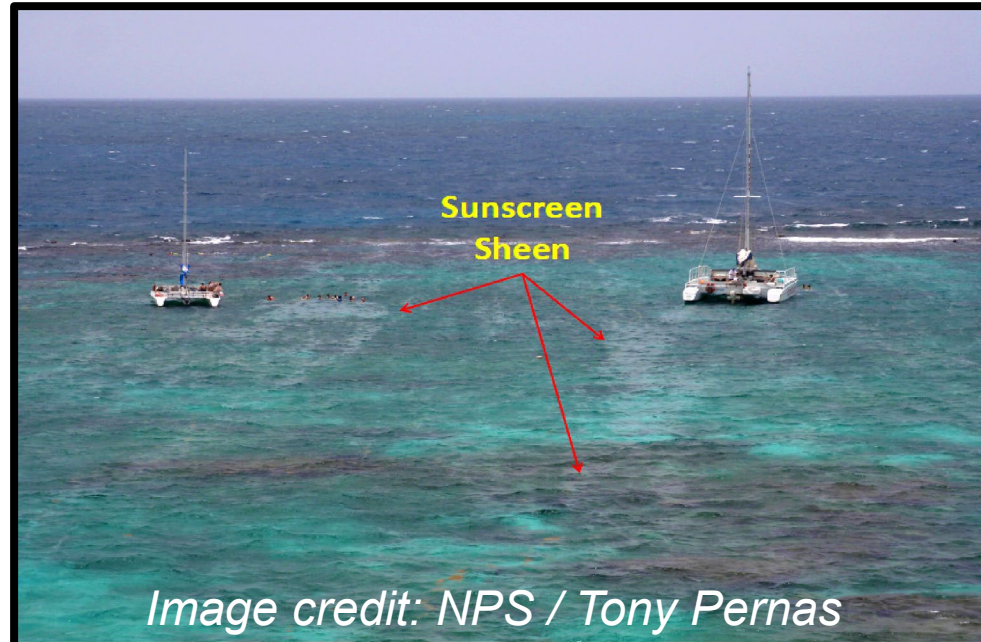
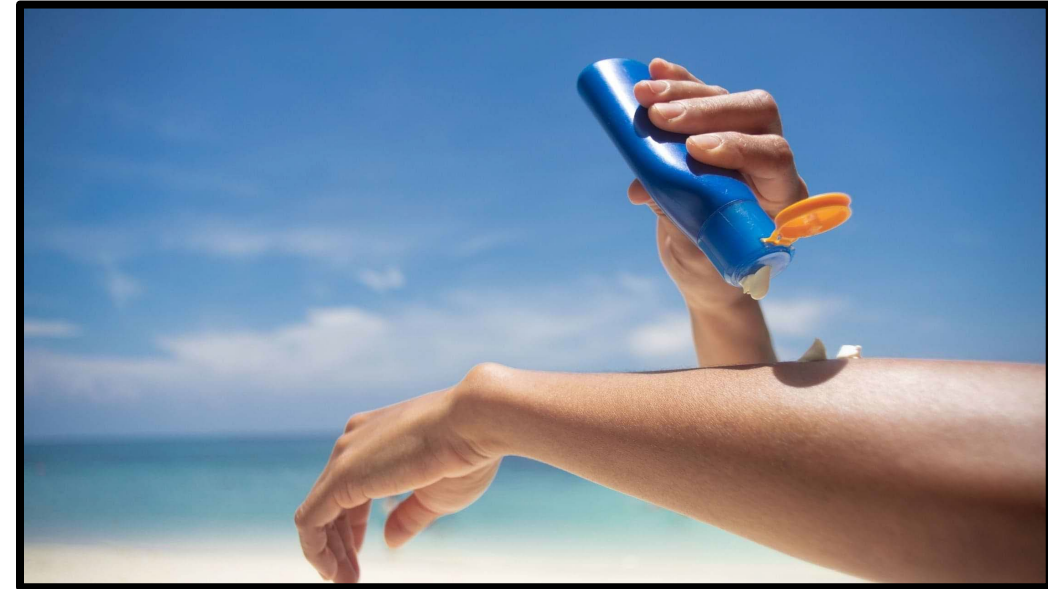


Image credit: Downs et al., 2022

Sunscreen Pollution on Key West Beaches: Oxybenzone

Preliminary Data:

Ft. Zachary Taylor

- March 2017 (unpublished data) sample indicates 8.115 $\mu\text{g/L}$

Higgs beach

- October 2021 (unpublished data) sample indicates 1.6 $\mu\text{g/L}$
- March 2021 (unpublished data) sample indicates 6.5 $\mu\text{g/L}$

Smathers Beach

- No preliminary data

Note:

$\geq 6.5 \mu\text{g/L}$ oxybenzone in light shown can cause deformity in coral planulae (Downs et al., 2016)

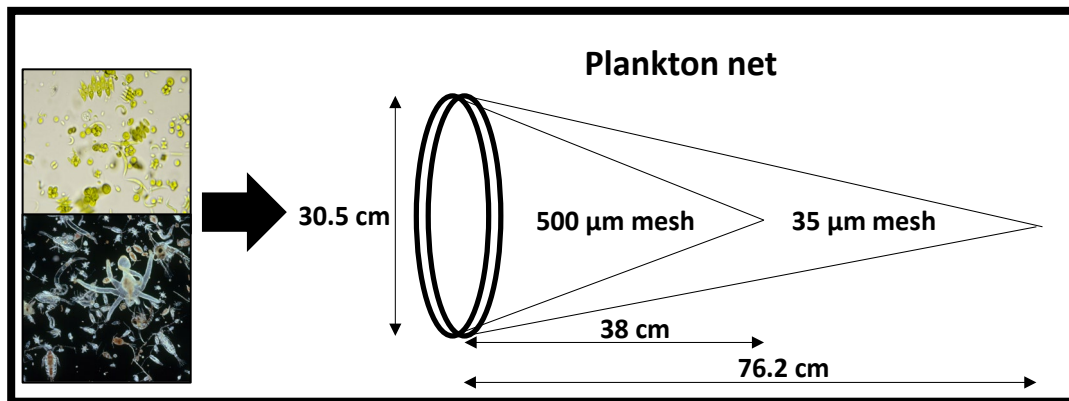
Literature Cited:

Downs, C.A., E. Kramarsky-Winter, R. Segal, J. Fauth, S. Knutson, O. Bronstein, F.R. Ciner, R. Jeger, Y. Lichtenfeld, C. Woodley., P. Pennington, K. Cadenas, A. Kushmaro, Y. Loya. 2016. Toxicopathological Effects of the Sunscreen UV Filter, Oxybenzone (Benzophenone-3), on Coral Planulae and Cultured Primary Cells and Its Environmental Contamination in Hawaii and the U.S. Virgin Islands. *Arch Environ Contam Toxicol* 70:265–288, doi:[10.1007/s00244-015-0227-7](https://doi.org/10.1007/s00244-015-0227-7)

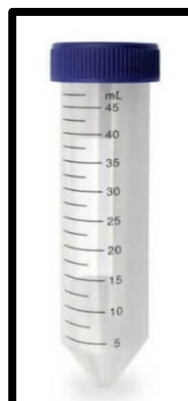
Ft. Zachary Taylor Historic State Park (March 18, 2017, 3:30 pm)



A) Plankton sample



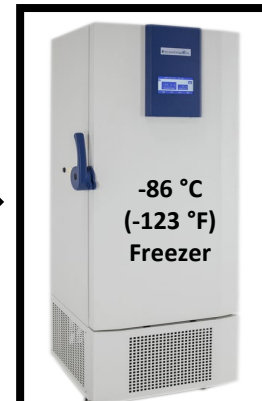
B) Centrifuge tube



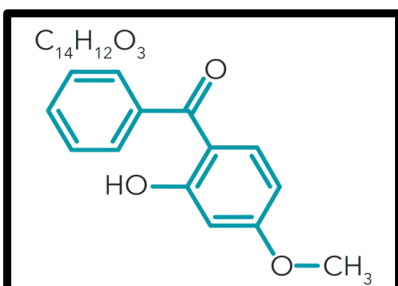
C) Liquid nitrogen



D) Ultra-low freezer



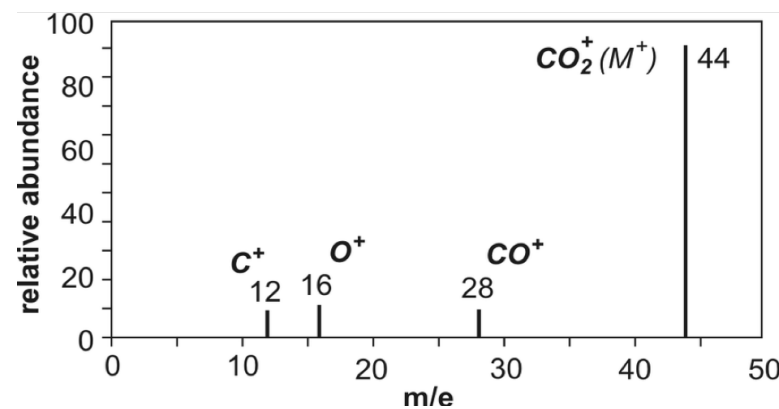
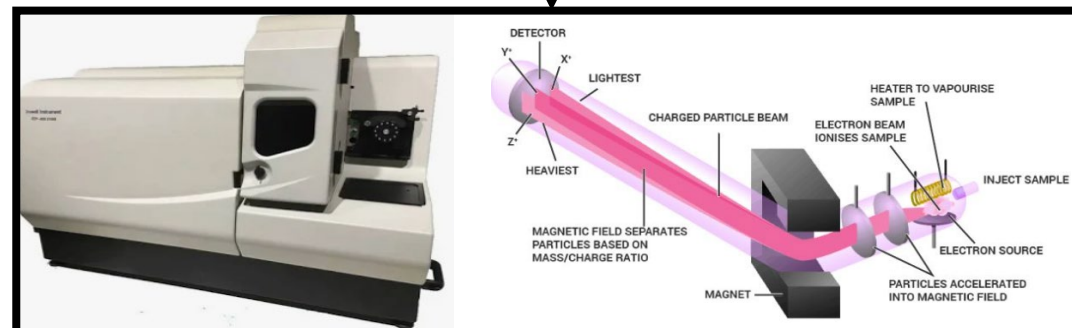
E) Oxybenzone



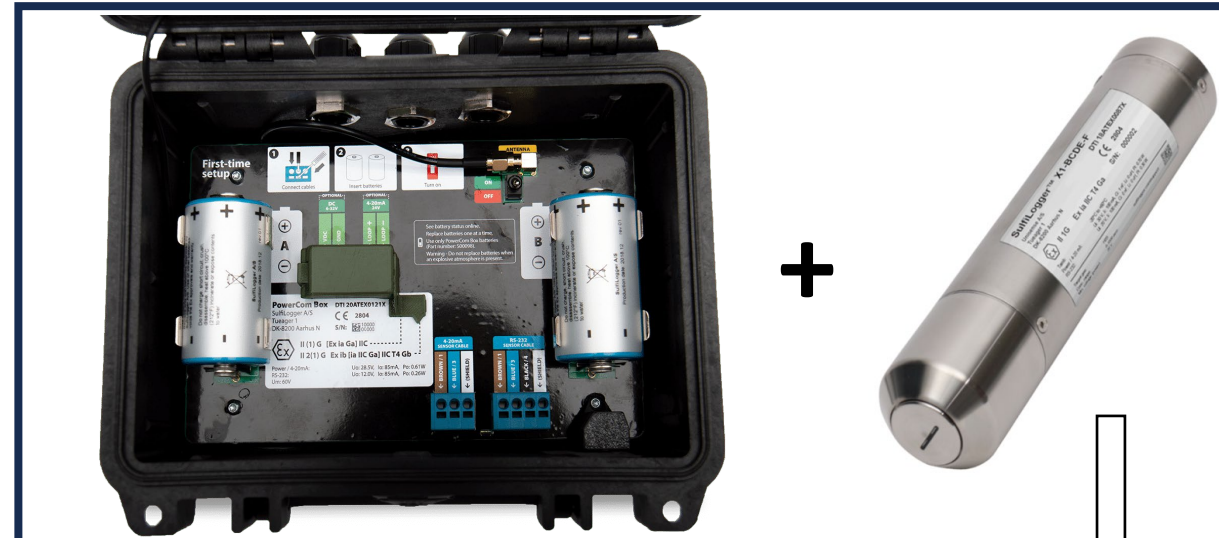
F) Algae culture



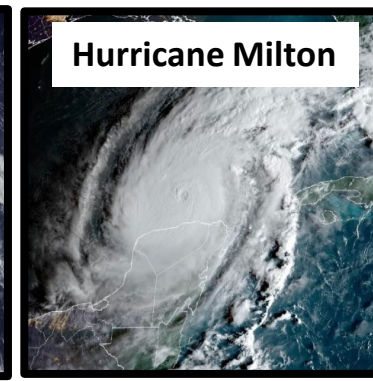
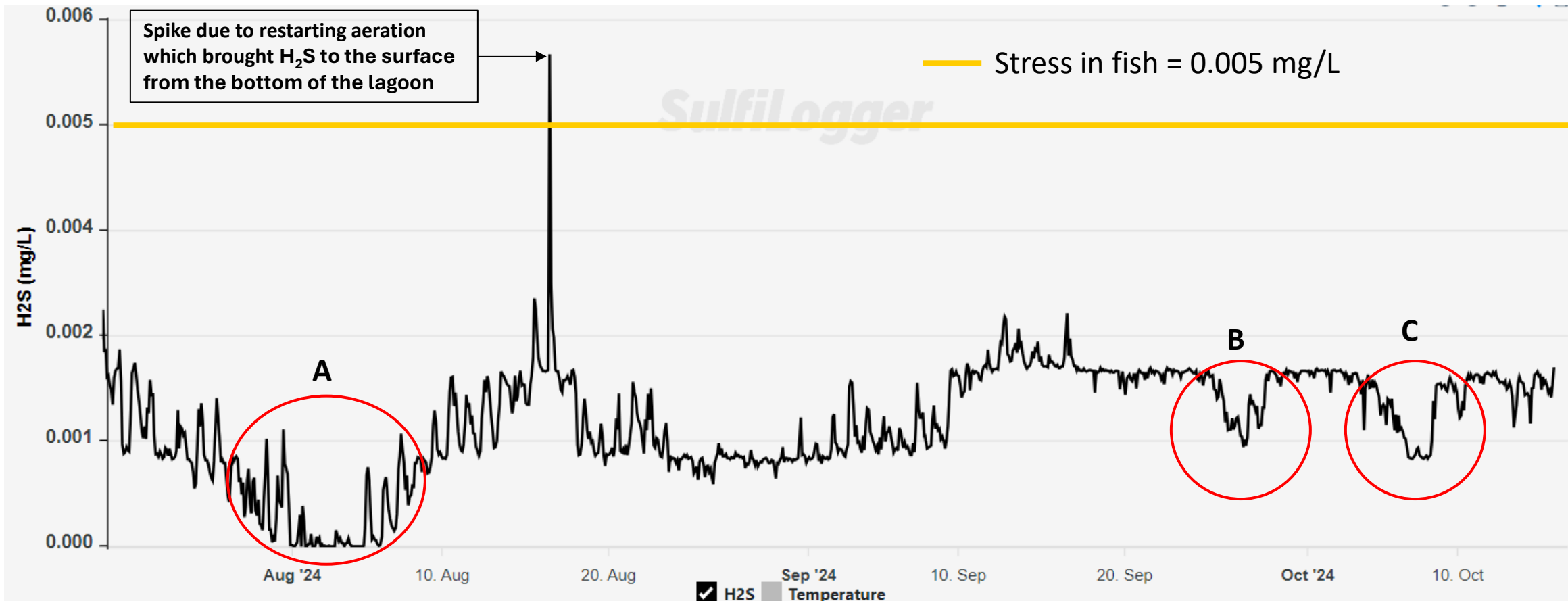
G) Mass spectrometer



Objectives 5 - Expand water quality monitoring to marine environment near Stock Island Landfill for toxic pollutants (i.e. hydrogen sulfide).



Hydrogen Sulfide in Surface Water of CFK Lagoon



Objective 6. Provide data and input for the City of Key West's Water Quality Improvement Plan

- Development of a GIS based water quality monitoring website
- Development of a Key West water quality monitoring consortium:
 - CFK
 - City of Key West
 - Florida Atlantic University
 - Reef Relief
 - Jacob's Laboratory (Key West, FL)
 - Florida Department of Environmental Protection
 - Florida Department of Health
 - Monroe County Sheriff's Office – Underwater Search and Recovery

Water Quality Monitoring Consortium



Key West Water Quality Improvement Plan

Questions?

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- CFK Marine Science Technicians, Research Assistants, and Scientific Dive Team
- Florida Department of Environmental Protection (FDEP)
- Florida International University (FIU)
- Environmental Protection Agency (EPA)
- City of Key West