Florida’s Coral Reef unified water quality monitoring database: data aggregation and analysis

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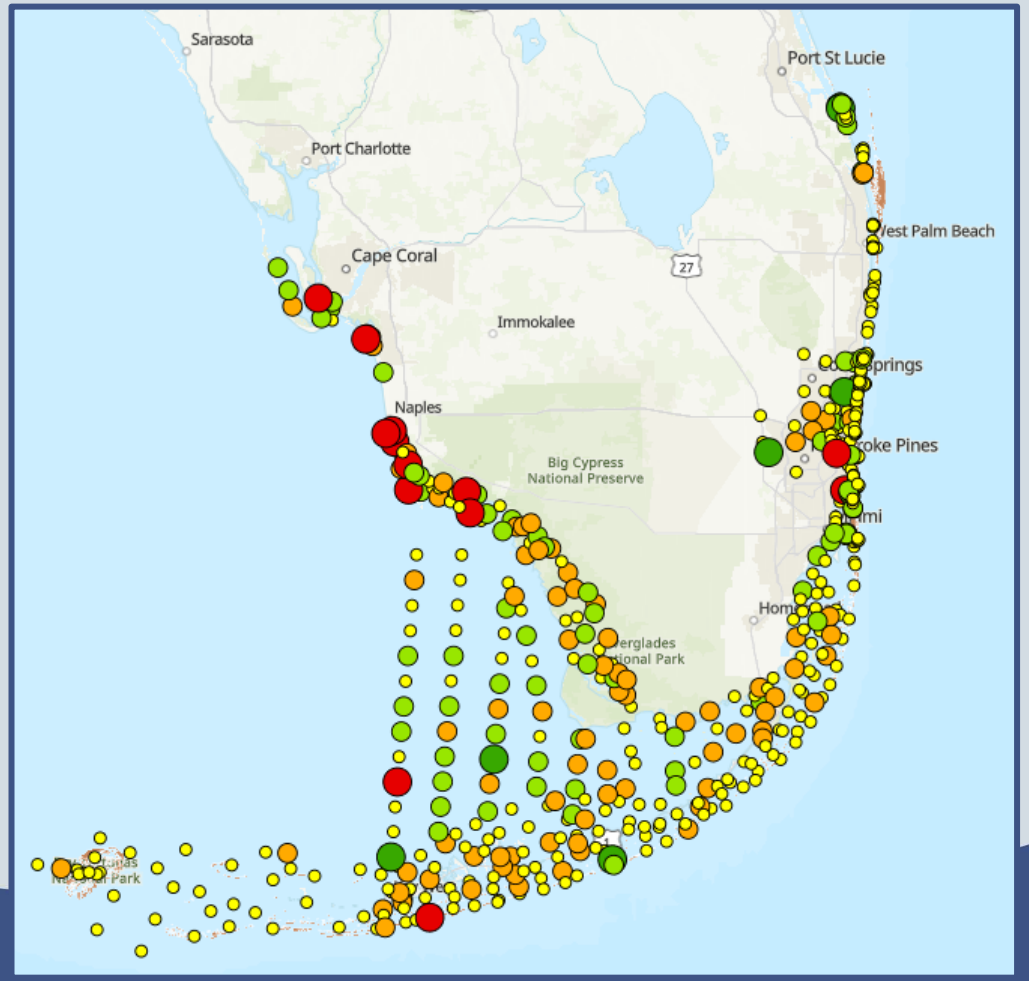

Project team and funding

Funding provided by **Florida Department of Environmental Protection**

- **David Kochan**, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
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- **Lucas McEachron,** Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute
- **Frank Muller-Karger,** University of South Florida
- **Tylar Murray,** University of South Florida
- **Dan Otis,** University of South Florida
- **Carolina Peraltova,** University of South Florida
- **Tina Udouj**, Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute

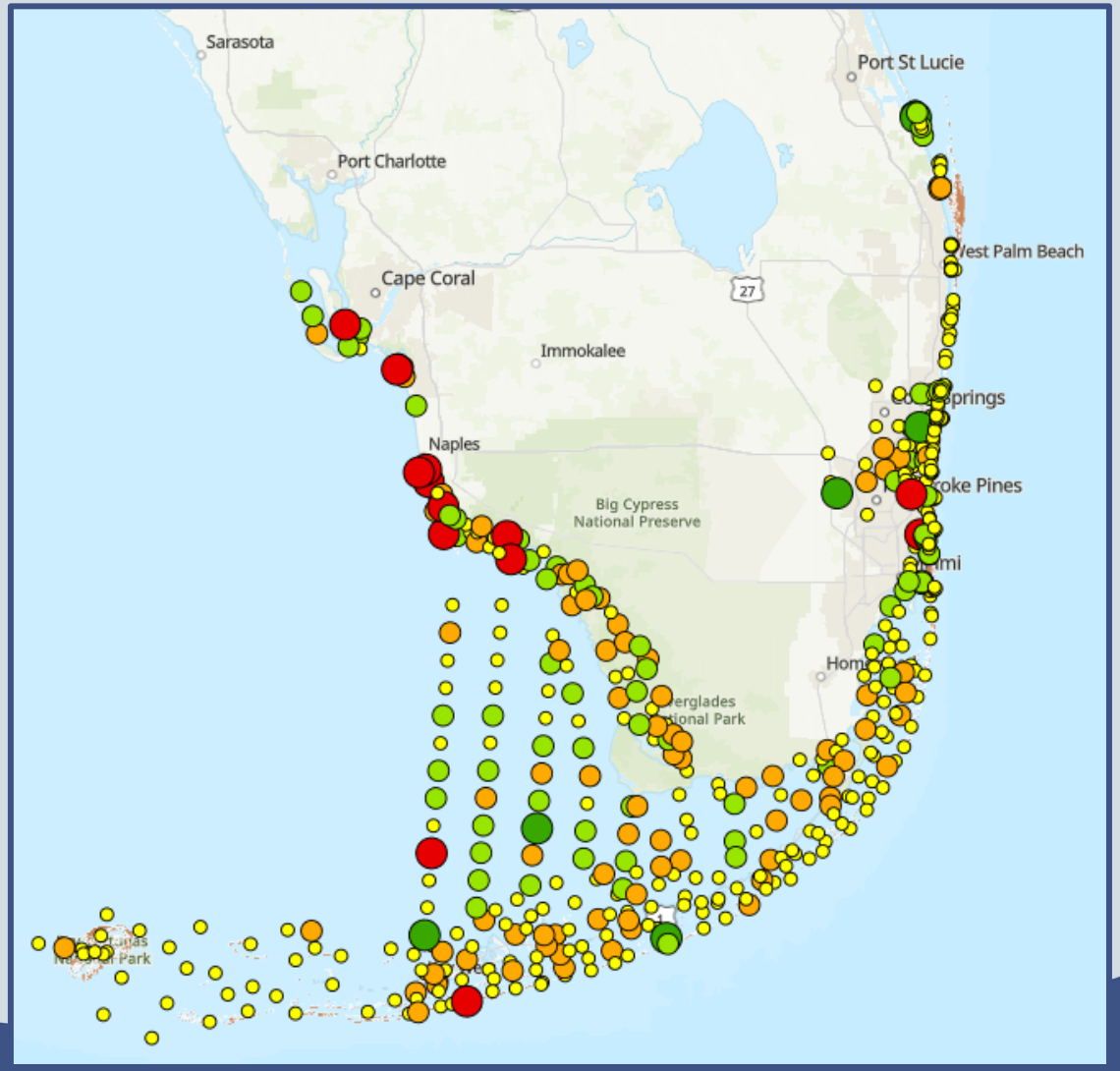
Project goals

Year 1-4 Goals:

- Create a **unified** water quality monitoring dataset across Florida's Coral Reef
- Identify long-term trends and monitoring gaps
- Focused on **nutrients** and **water clarity**

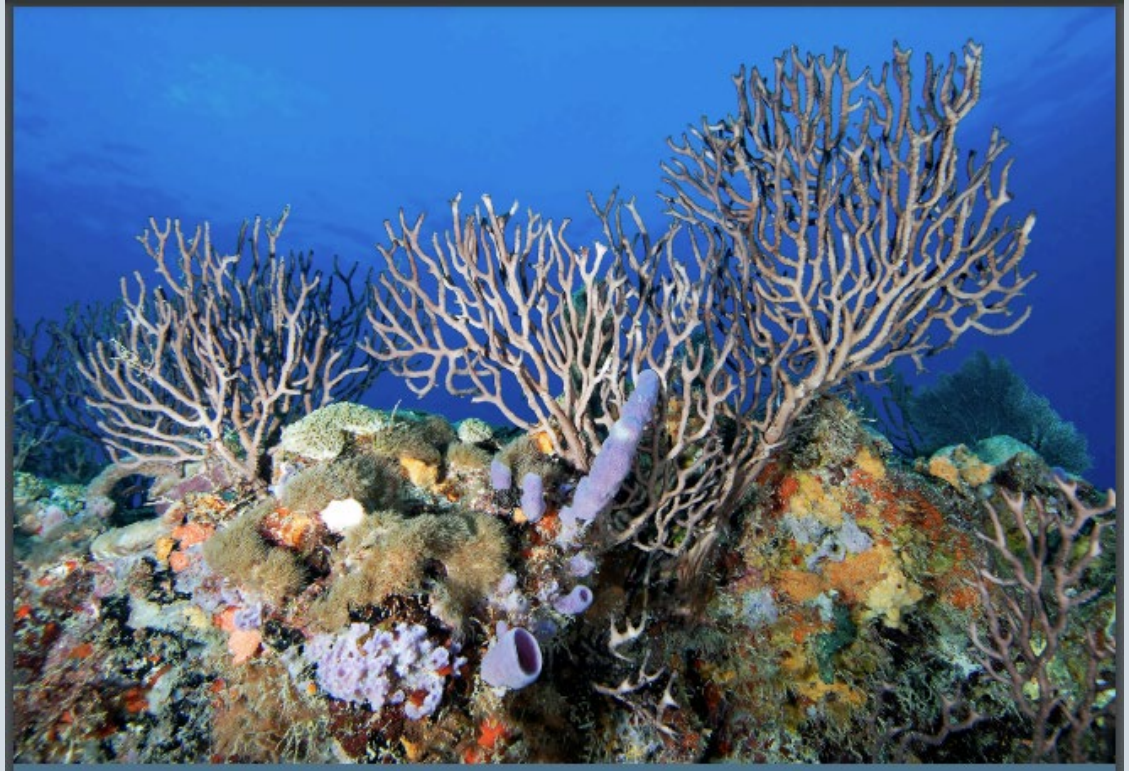
Year 4-6 Goals:

- Contribute to **FCRCT** integrated framework to answer question: **Can we detect change from management and restoration efforts?**
- Inventory of **"abiotic"** water quality and **biological and ecological** monitoring programs



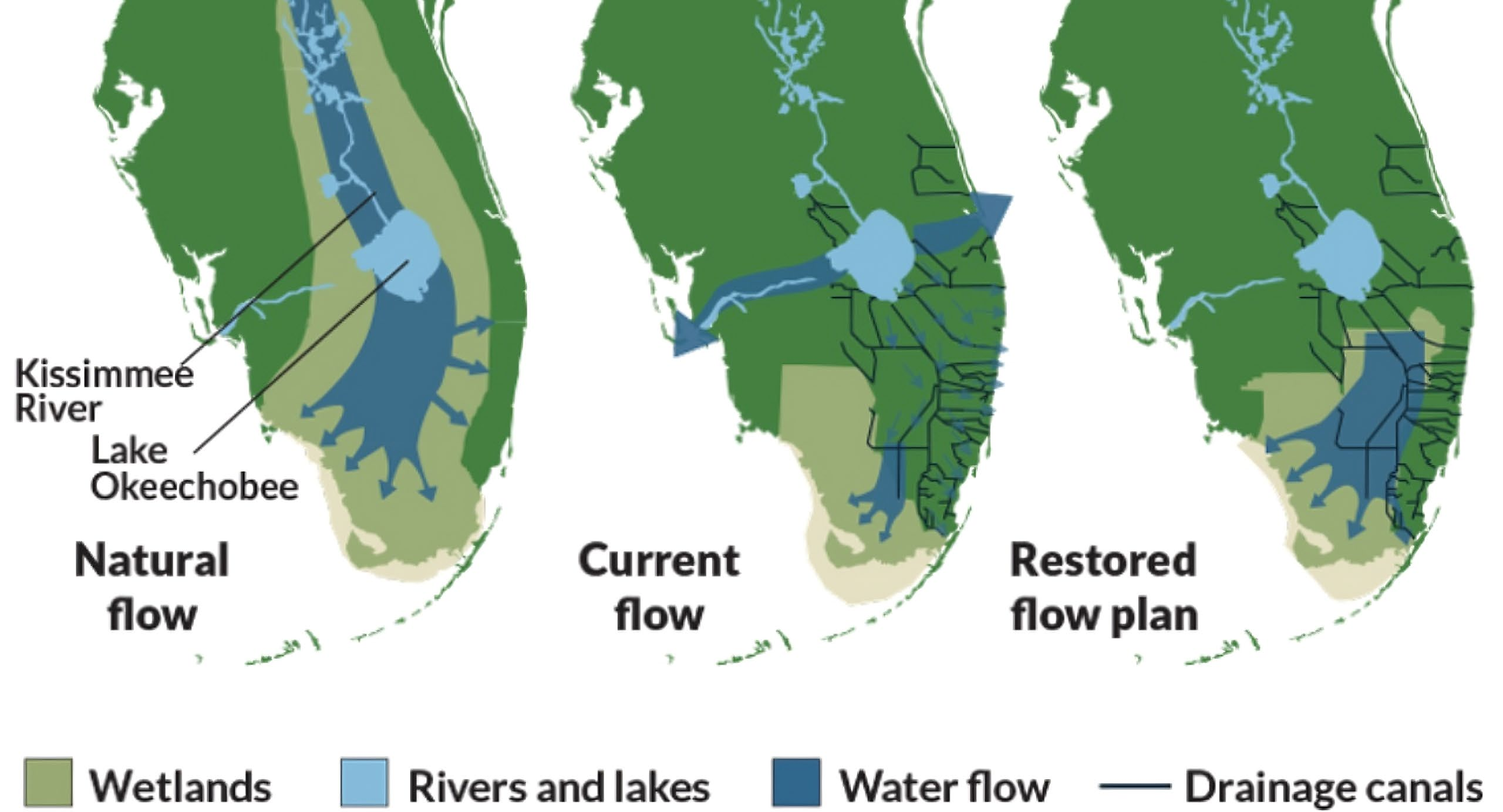
FLORIDA'S CORAL REEF Coordination Team

- Can we detect changes in nearshore water quality across time and space as a result of Everglades restoration's anticipated hydrological improvements?
- If so, how do those changes affect Florida's Coral Reef and associated resources within the South Florida ecosystem?
- Ultimately, do subsequent ecosystem responses manifest in measurable benefits for neighboring human communities?

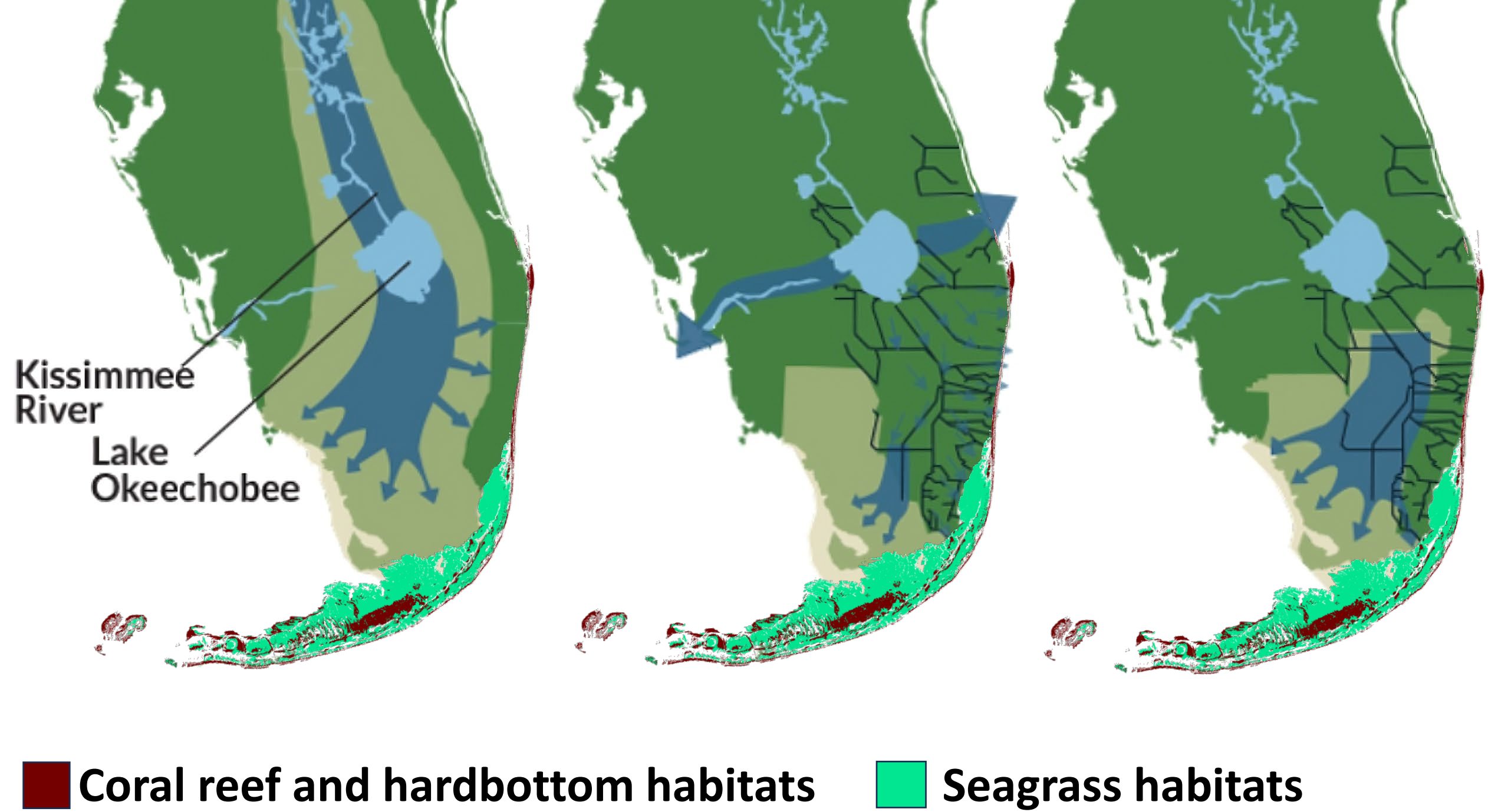


UNIFIED MONITORING FRAMEWORK FOR FLORIDA'S CORAL REEF

ADOPTED: November 9, 2023



Source: U.S. Army Corps of Engineers, Jacksonville District



Coral reef and hardbottom habitats **Seagrass habitats**

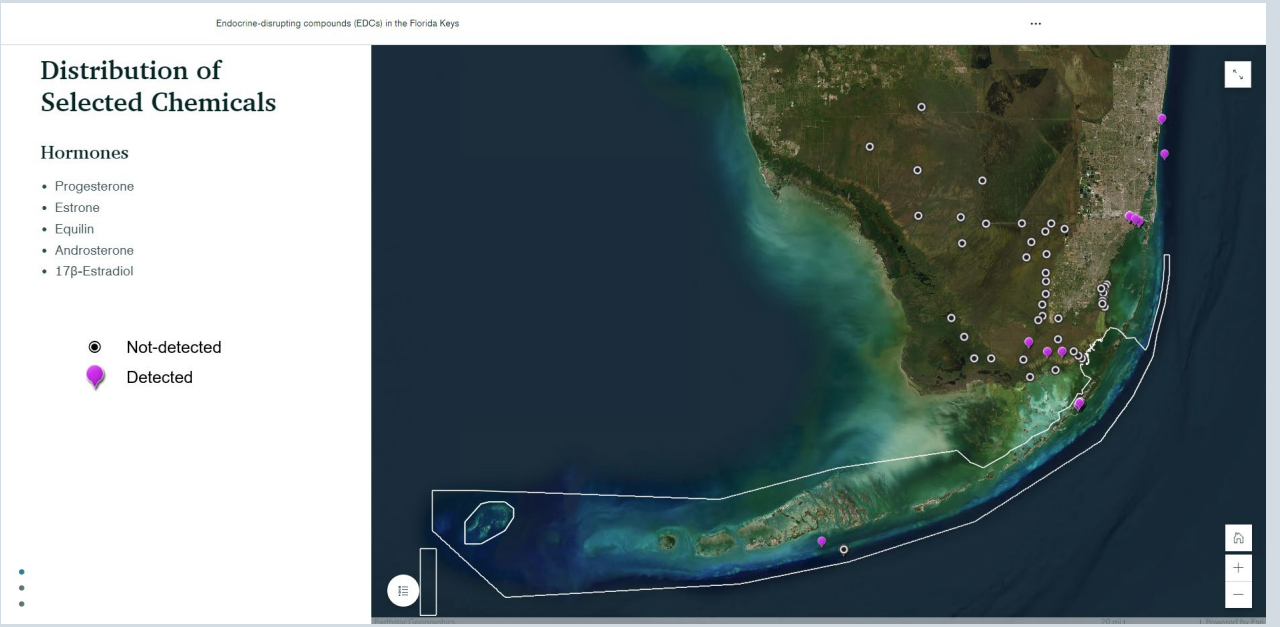
Adapted from U.S. Army Corps of Engineers, Jacksonville District and FWC URM

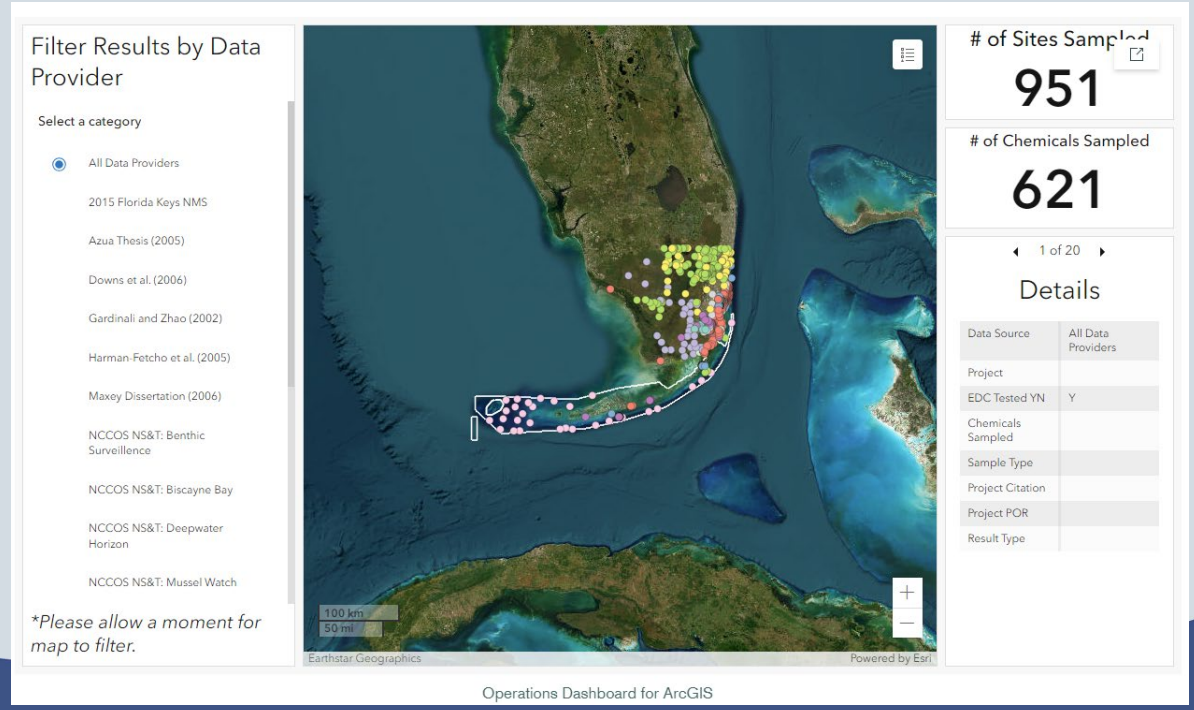
Florida Unified Reef Map

- Initiative to integrate maps and monitoring from a network of sources
- Expanded in 2024
- Expect to update with new FSMI data in 2026/2027
- Link to URM:

Endocrine Disrupting Compounds

- FDEP-funded project to summarize type, concentrations, sampling gaps, and distribution of EDCs
- Outreach, Geodatabase, Mapping
- Completed in 2021
- StoryMap Link:



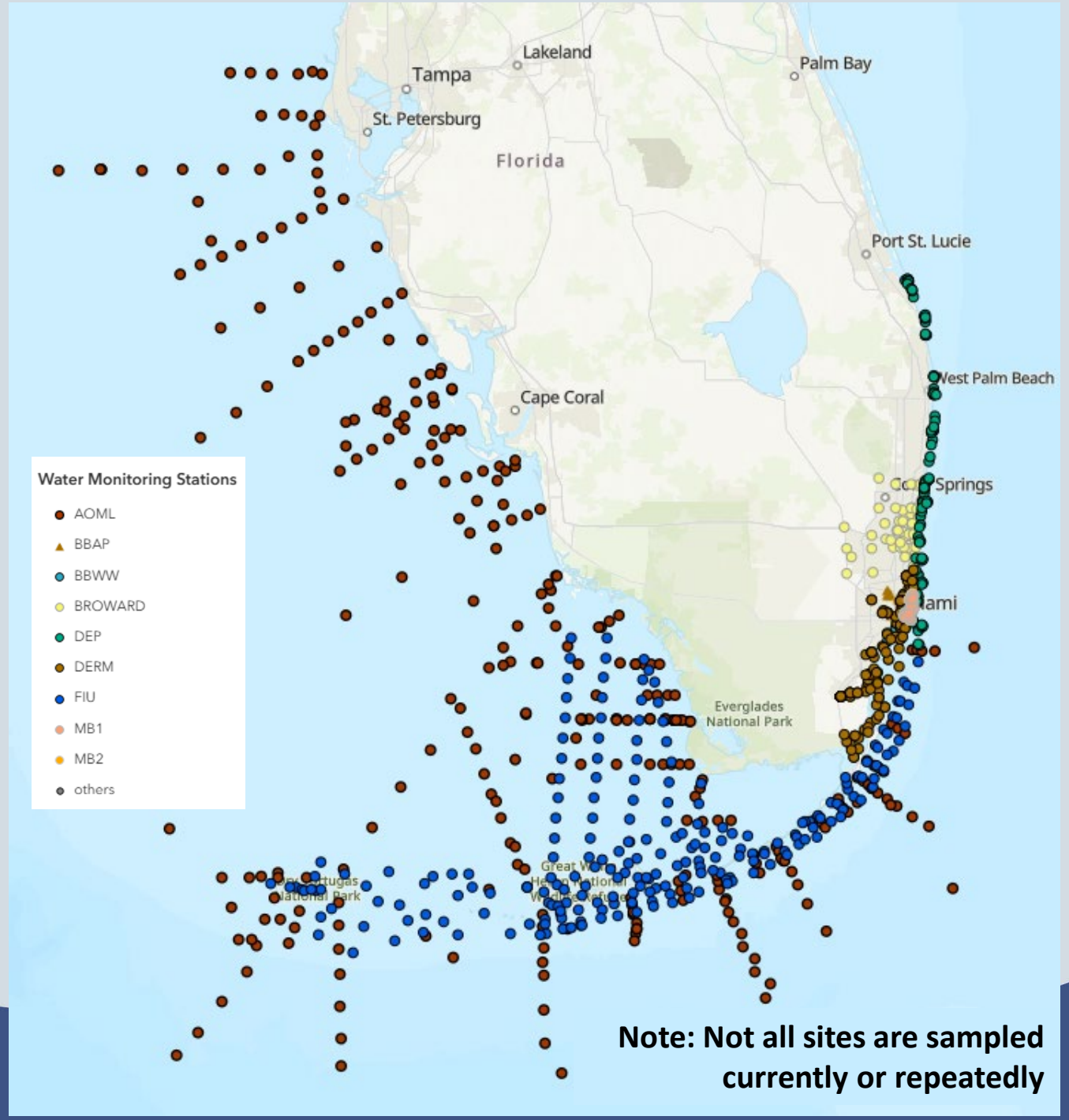


Nutrient Monitoring Data Aggregation

- Eight programs included

- AOML, Biscayne Bay Aquatic Preserve/Water Watch, Broward County, DEP ECA, Miami DERM, FIU/SERC, City of Miami Beach, Palm Beach County (not shown)

- Sampling nitrogen, phosphorus, chlorophyll, or water clarity parameters
- >5 years of data
- At least annual samples
- Link to web map:



Water quality parameters

Nitrogen

- Total Nitrogen
- NO2
- NO3
- Ammonium
- TKN

Phosphorus

- Total Phosphorus
- Ortho-phosphates (OPO4)

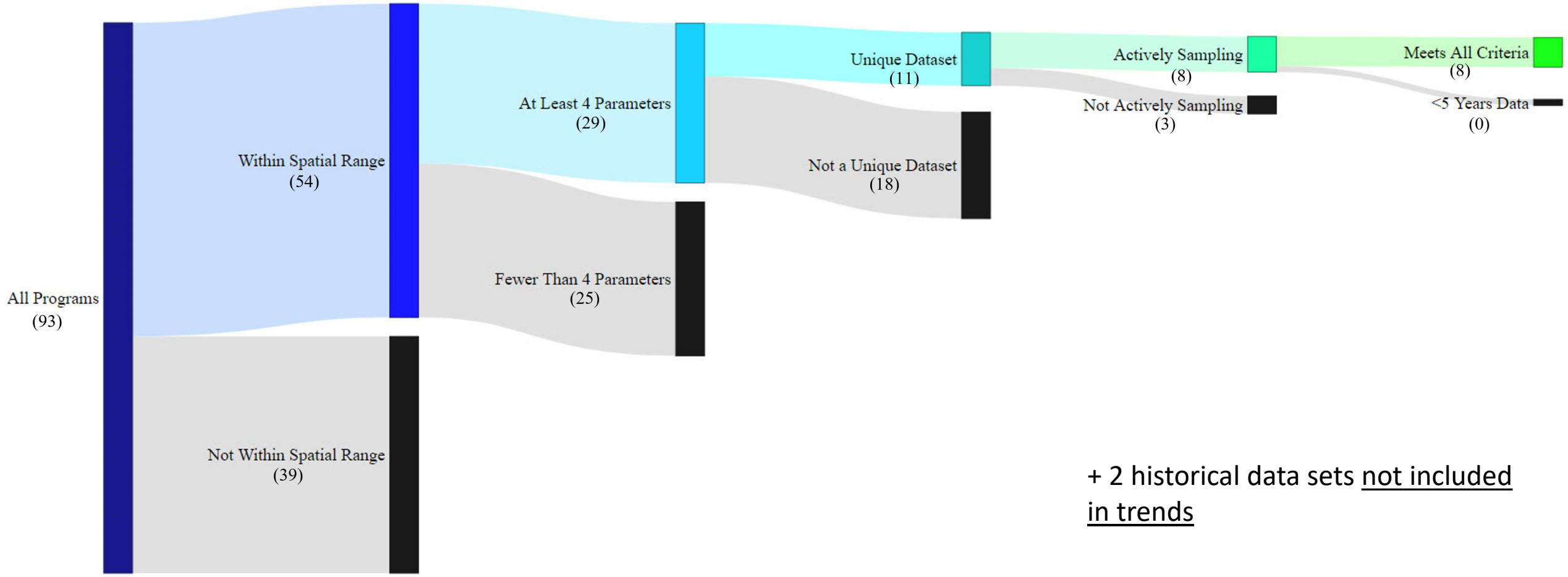
Water Clarity

- Chlorophyll-a
- Turbidity
- Silicates

"Abiotic"

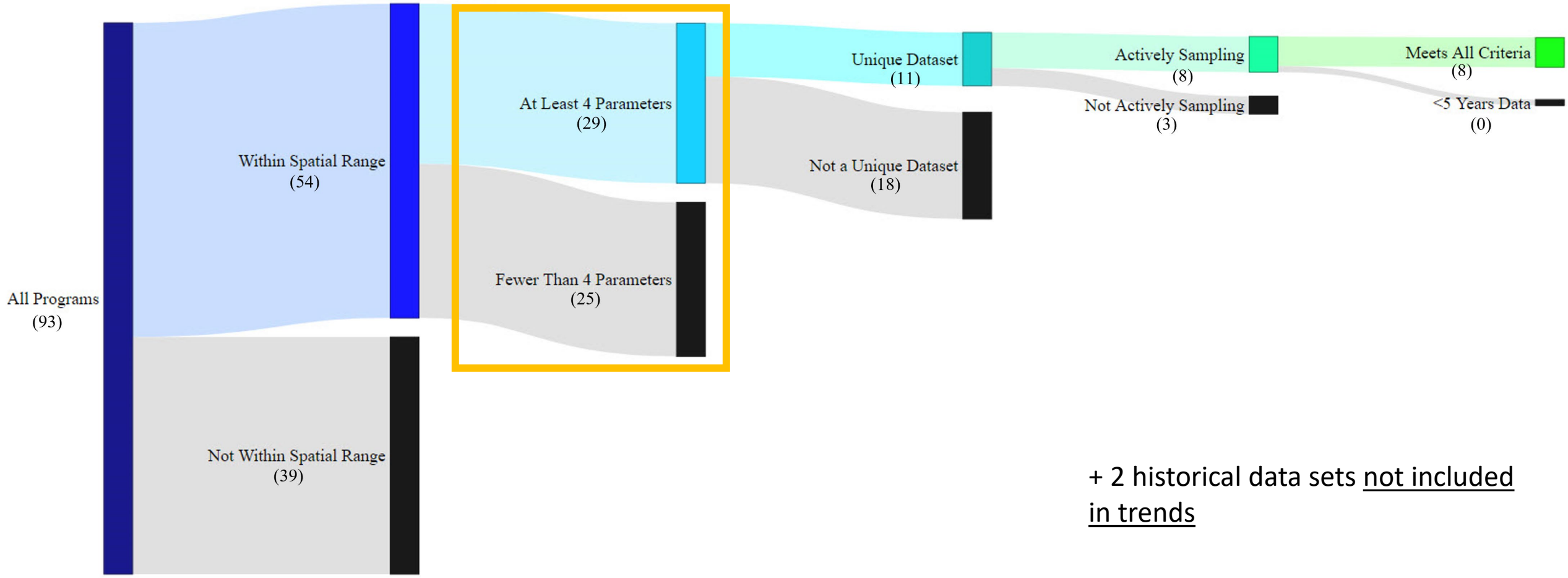
- Temperature
- Salinity
- pH
- Dissolved oxygen

Data inclusion



+ 2 historical data sets <u>not included in trends</u>

Data inclusion



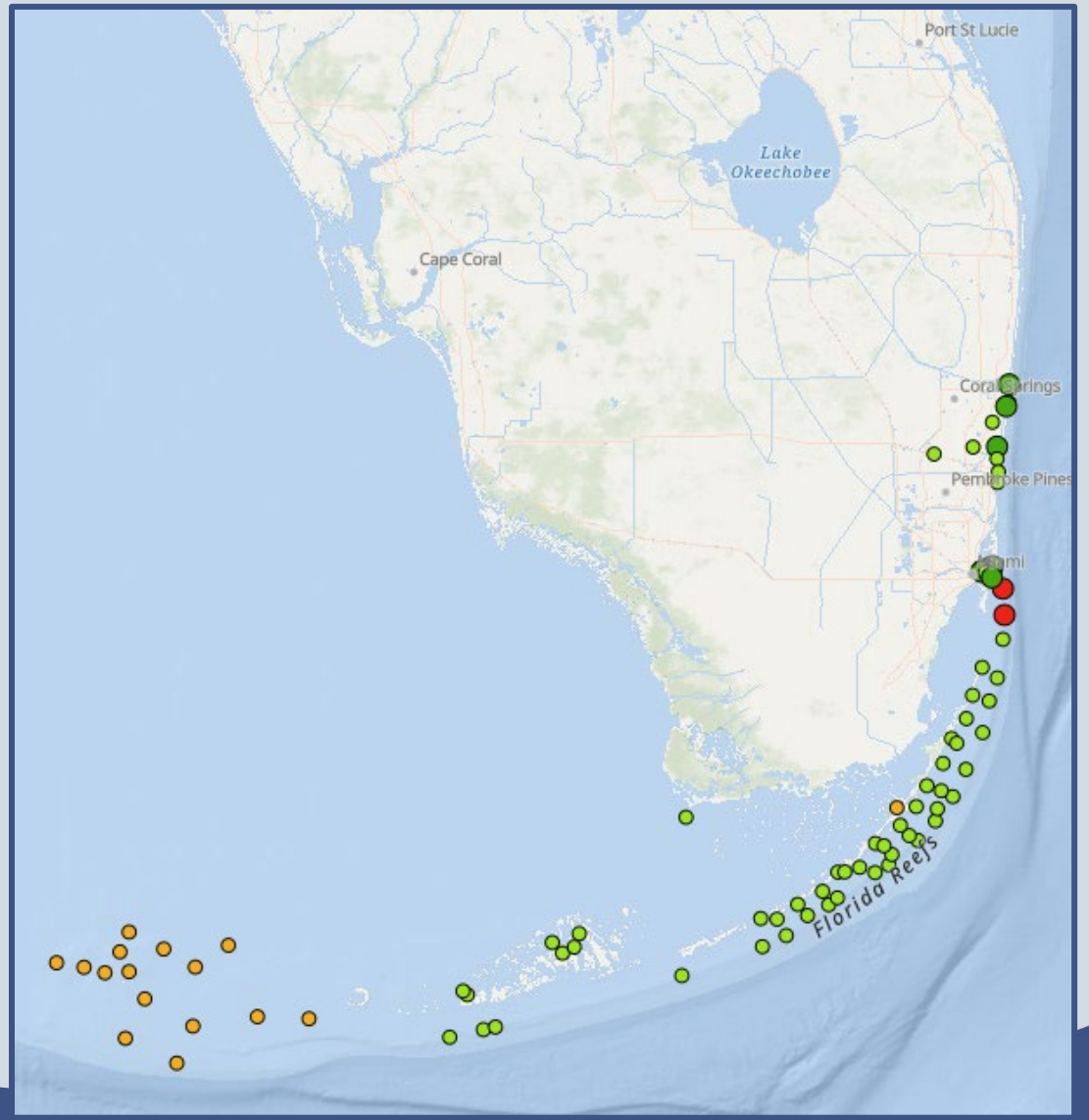
+ 2 historical data sets <u>not included in trends</u>

Trend analysis

- Basis for comparing data across Florida's Coral Reef
  - Even if raw values not directly comparable, the same trends should be captured
- Long-term analysis
- Identify hotspots and gaps

Map shows Total Nitrogen through 2023

- Only significant trends
- Lots of decreasing TN, 2 hotspots of increasing TN

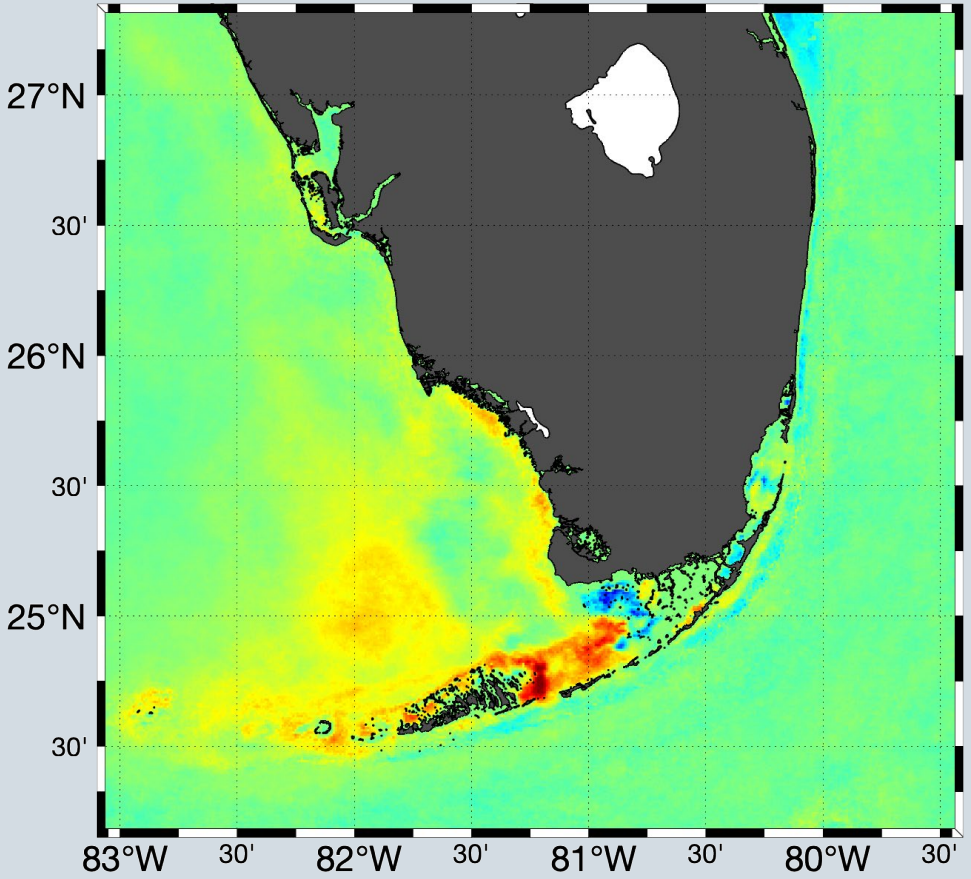


Satellite-based estimates of Sen's slope

Data from MODIS satellite (1-km pixel, 2003-present)

Products:

- Chlorophyll-a (proxy for phytoplankton biomass)
- Rrs_667 (red reflectance; proxy for suspended sediments)
- Kd_490 (proxy for water clarity in the blue-green region of the spectrum)
- adg_443 (absorption at 443 nm by CDOM)
- SST (sea surface temperature)



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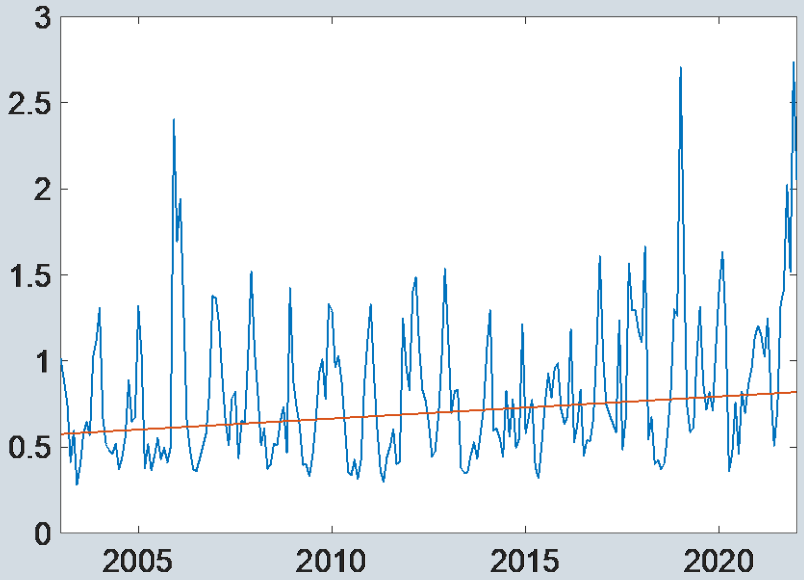
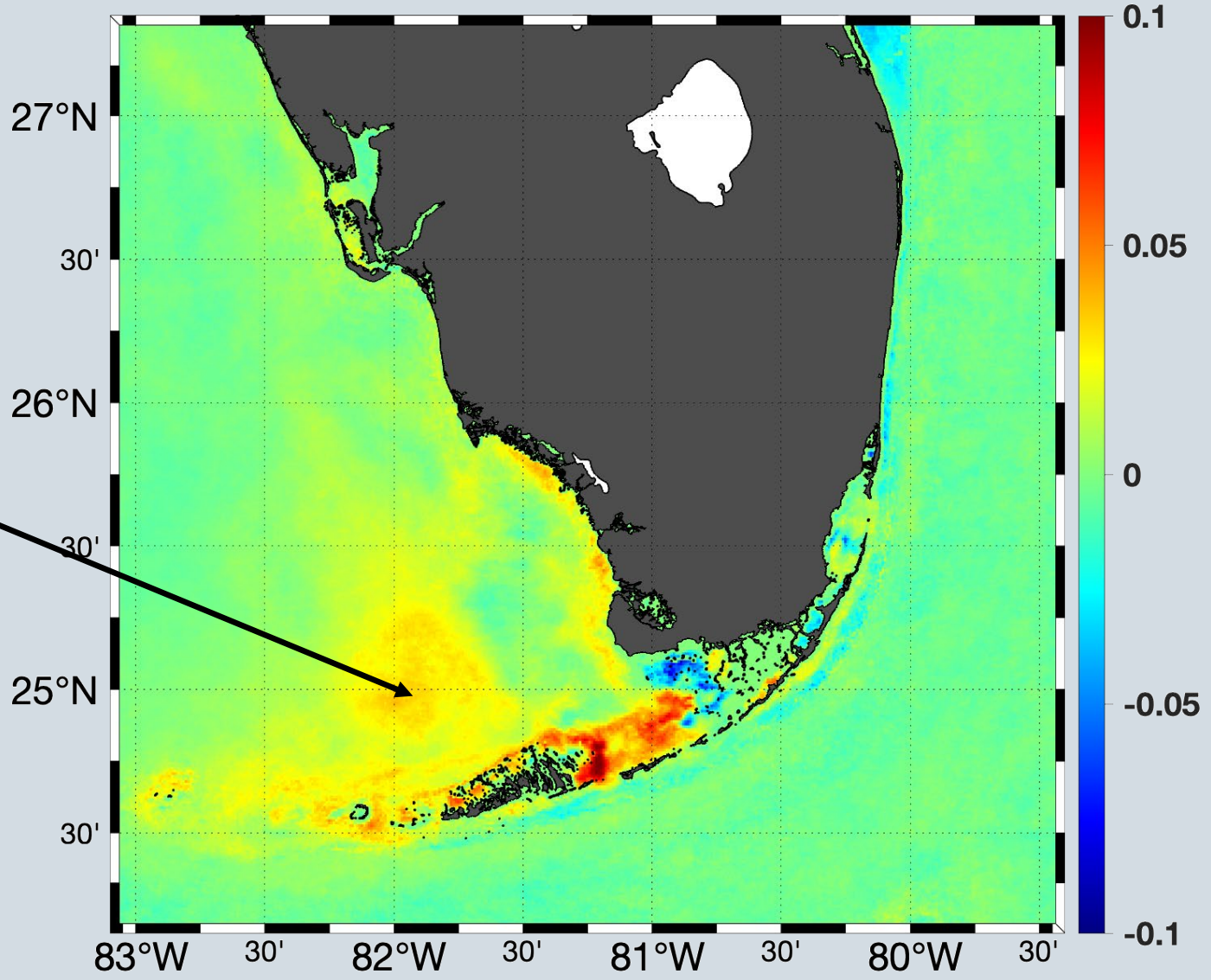
Chlorophyll-a (2003-2021)

Red colors indicate positive slopes



Slope = 0.013 mg/m^3/yr



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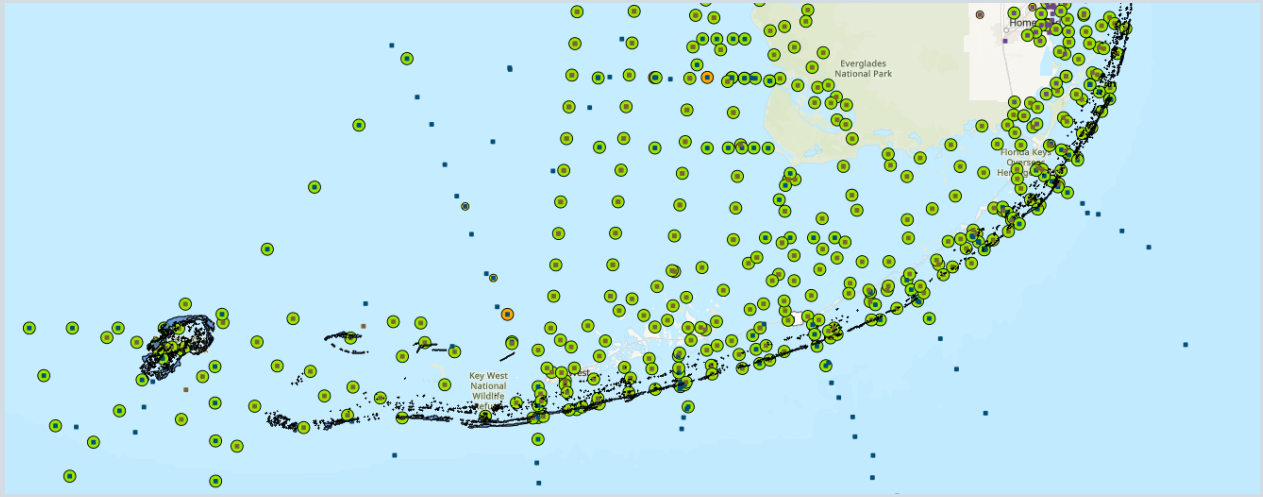
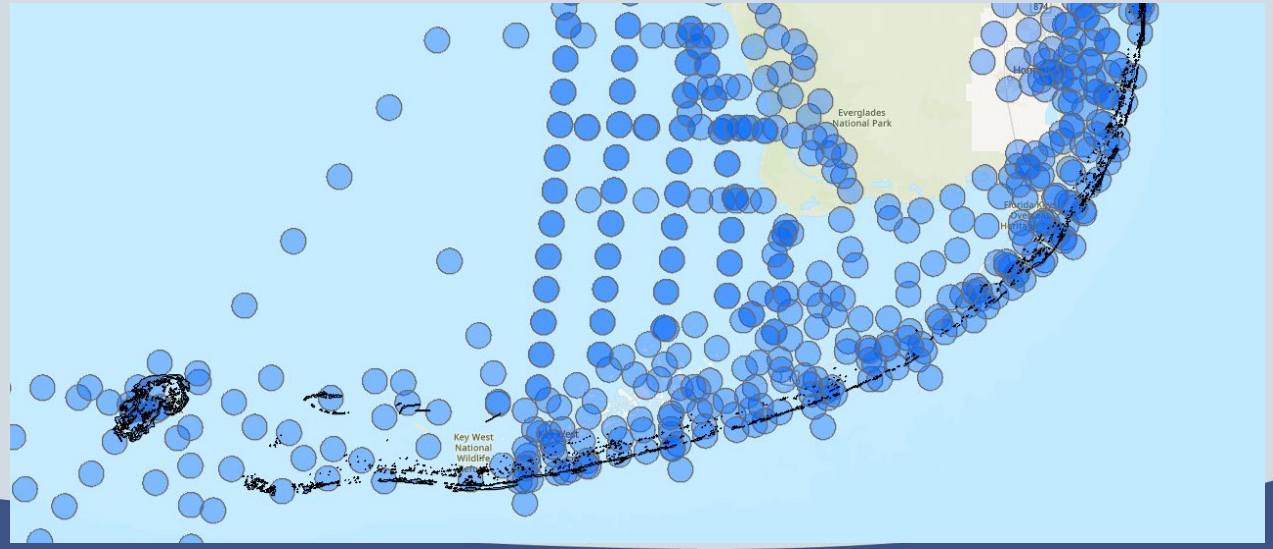
Gap Analysis

- Semivariograms show spatial correlation – how far apart does sampling still show the same trend
- Buffer zones vary by analytes from 1.7 – 7+ km
- Nitrogen analytes have no buffer due to inshore-offshore gradient

Total Phosphorus – 1.7 km buffer

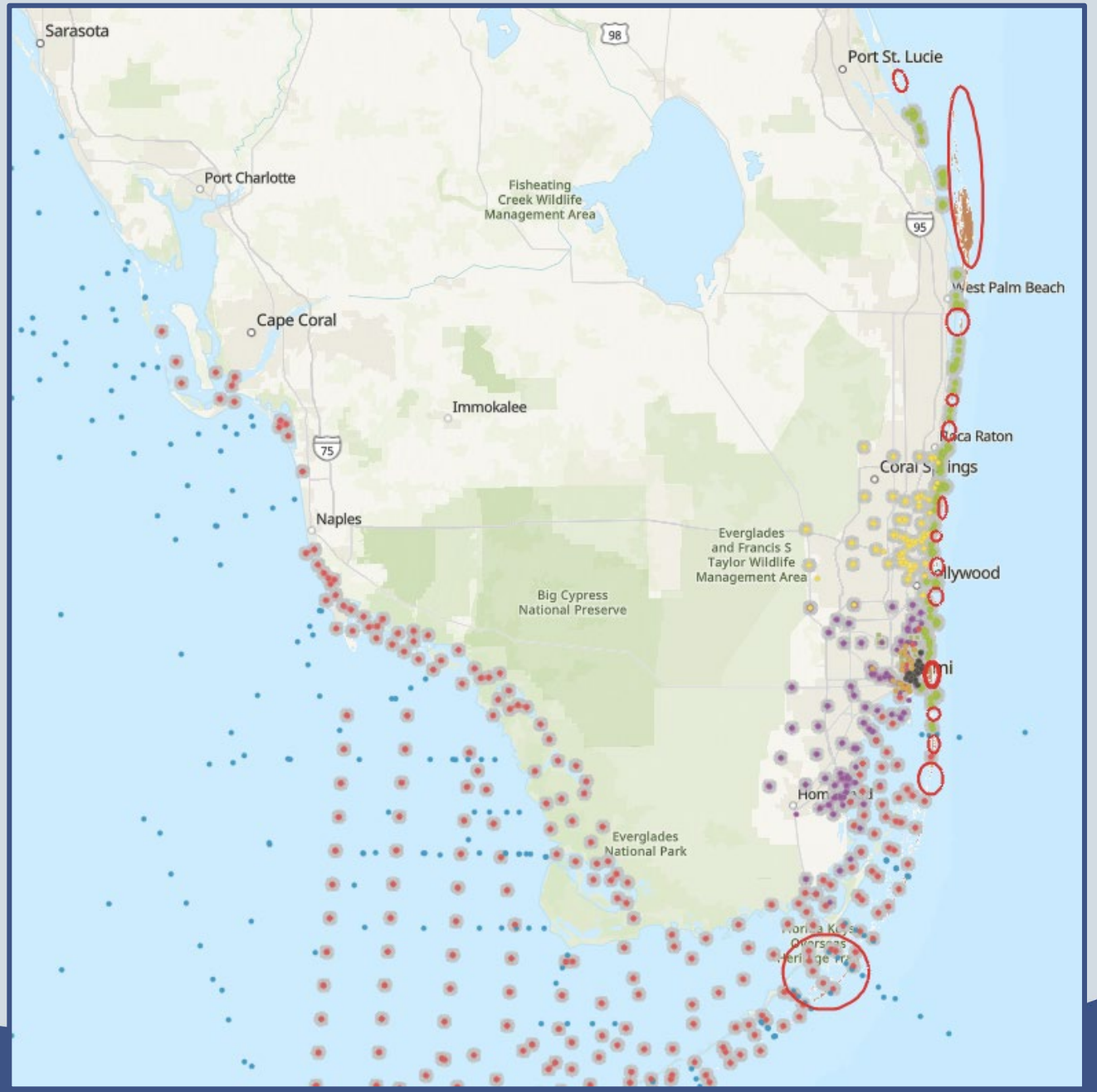


Orthophosphates – 3.5 km buffer



Gap Analysis

- Most restrictive gap results overlaid with coral reef map identified several gaps
- Some gaps filled by addition of programs like City of Miami Beach
- Identified suggested changes or additions to sampling programs to fill gaps



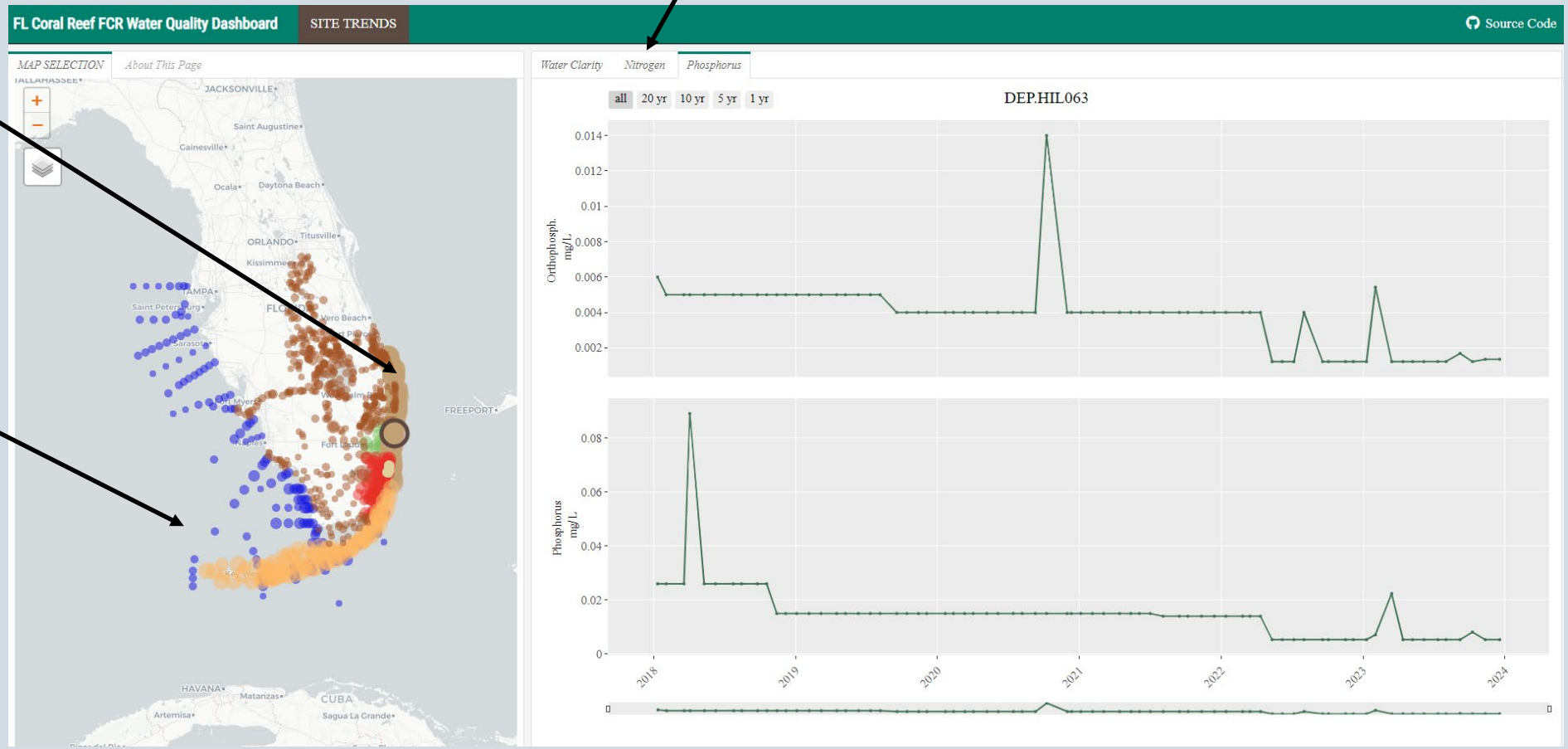
Data Visualization Tool

Sampling program (icon color)

Switch between Water Clarity/Nitrogen/Phosphorous

Number of observations (icon size)

Filters:
Actively sampled?
Time period
Program
Number of obs.



Time series of WQ parameters

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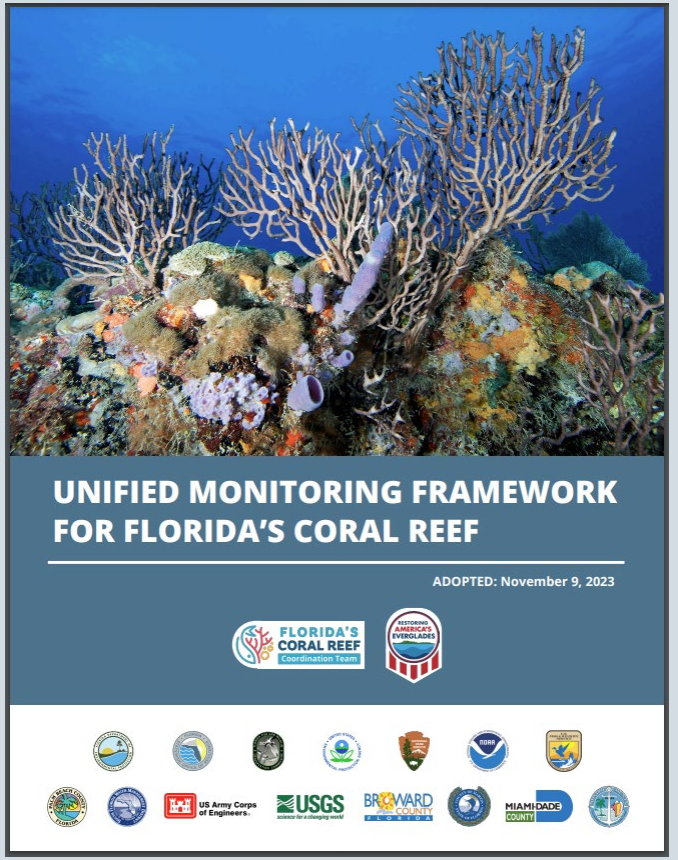
Unified Monitoring Framework for Florida's Coral Reef

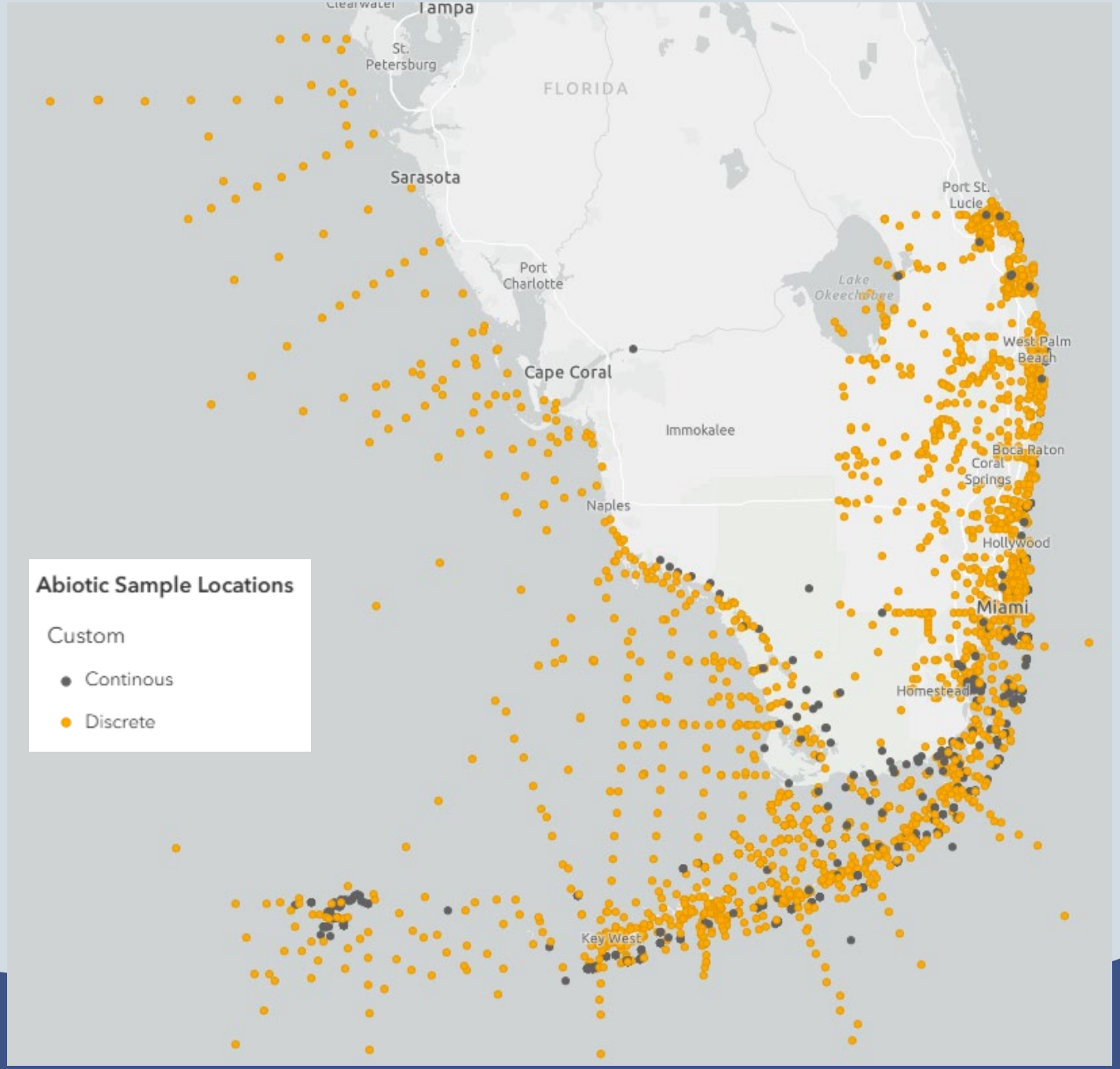
PRIORITY FOCUS: INVENTORY EXISTING MONITORING PROGRAMS

- ACTION 1: Inventory existing **water quality monitoring programs** along FCR and nearshore coastal waters of South Florida.
- ACTION 2: Inventory existing **biological or ecological monitoring programs** related to FCR and associated resources within the South Florida ecosystem.



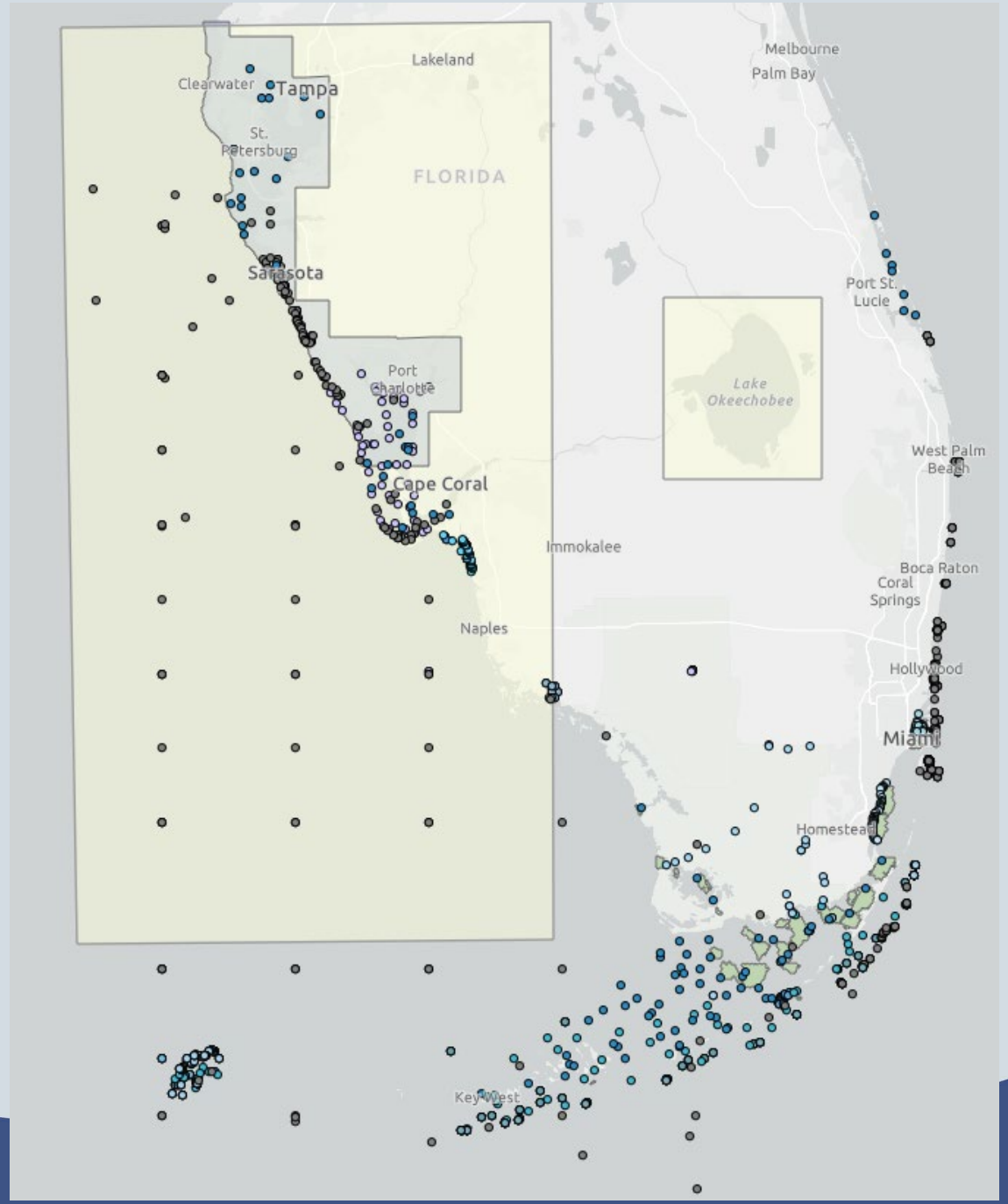
“Abiotic” Sampling Program Inventory

- 59 programs
- 108 continuous monitoring locations (current or historic)
- Where are abiotic factors being sampled and how?
  - Parameters
  - Frequency (continuous/discrete)
  - Depth
- Cheaper/faster to sample
  - Fill gaps and track water movement



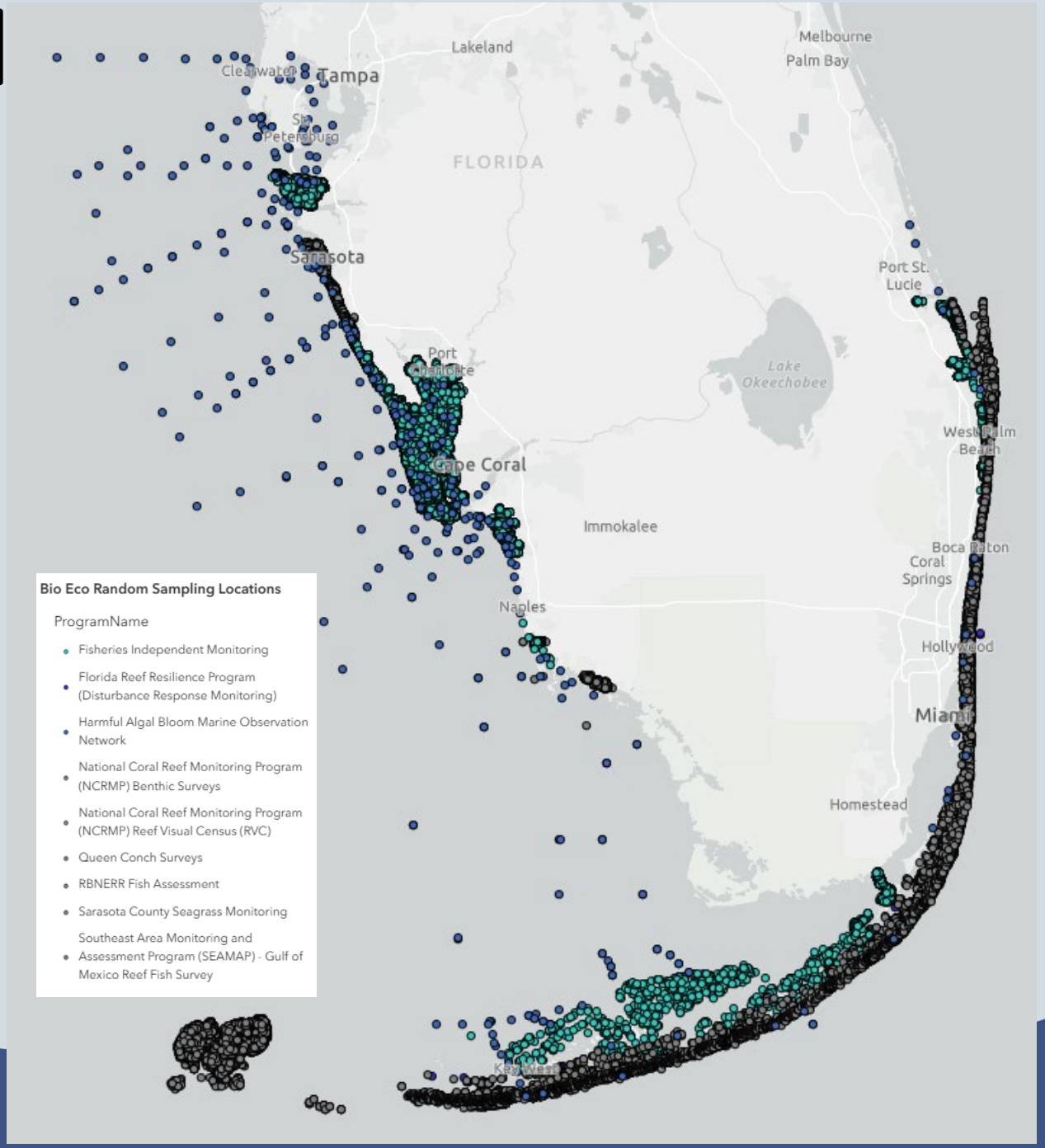
Biological and Ecological Monitoring Program Inventory

- 33 programs
- Included coral/benthic inverts, fish, red tide, seagrass, mangroves, pelagic plankton
- Survey locations could be fixed, random, or within regions



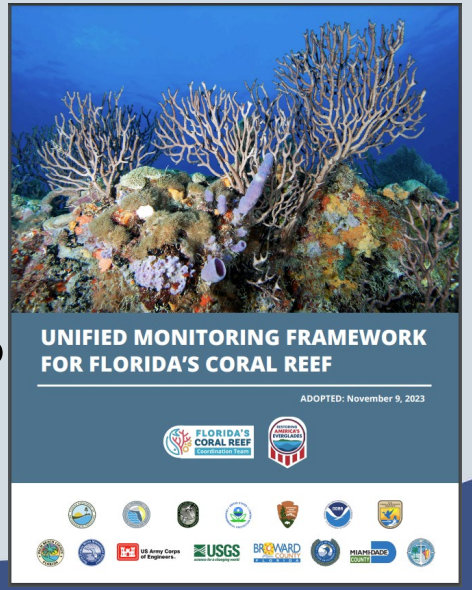
Biological and Ecological Monitoring Program Inventory

- Programs that did not repeat the survey locations each year



Unified Monitoring Framework for Florida's Coral Reef

- Can we detect changes in nearshore water quality across time and space as a result of Everglades restoration…
  - **Are we sampling enough, in the right places, and at the right times?**
- If so, how do those changes affect Florida's Coral Reef and associated resources…?
  - **Are we sampling in an ecologically relevant way?**
- Ultimately, do subsequent ecosystem responses manifest in measurable benefits for neighboring human communities?
  - **Can we link water quality, ecosystem health, and ecosystem services?**



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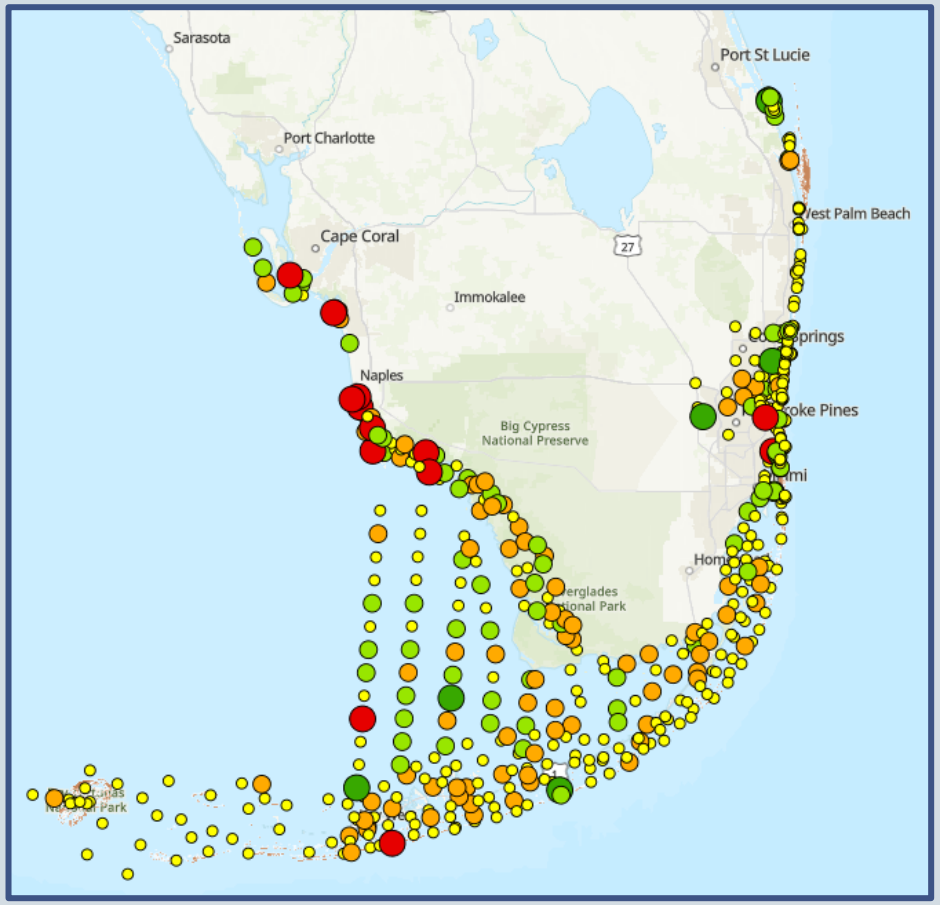

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Links to resources available on our SEACAR project page:
https://data.florida-seacar.org/programs/details/10006