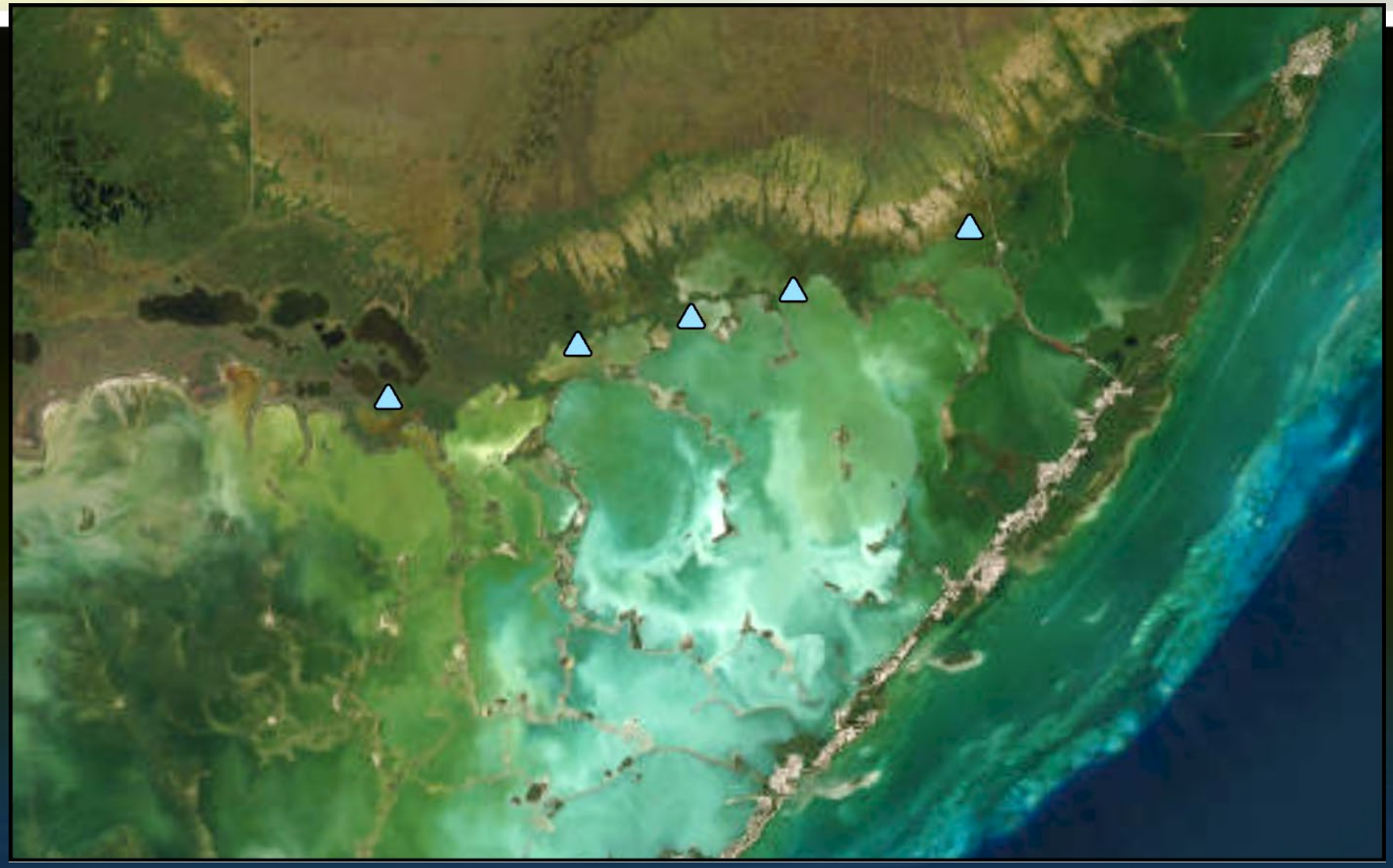
Environmental Trends and Ecological Responses to Water Management, Restoration, and Extreme Events in Florida Bay

Theresa Strazisar, Christopher Madden, Joshua Linenfelser, Kira Allen, Michelle Blaha, Mark Cook, Fabiola Santamaria

South Florida Water Management District

GEER, April 24, 2025

Florida Bay Inflows (Creek Flow)

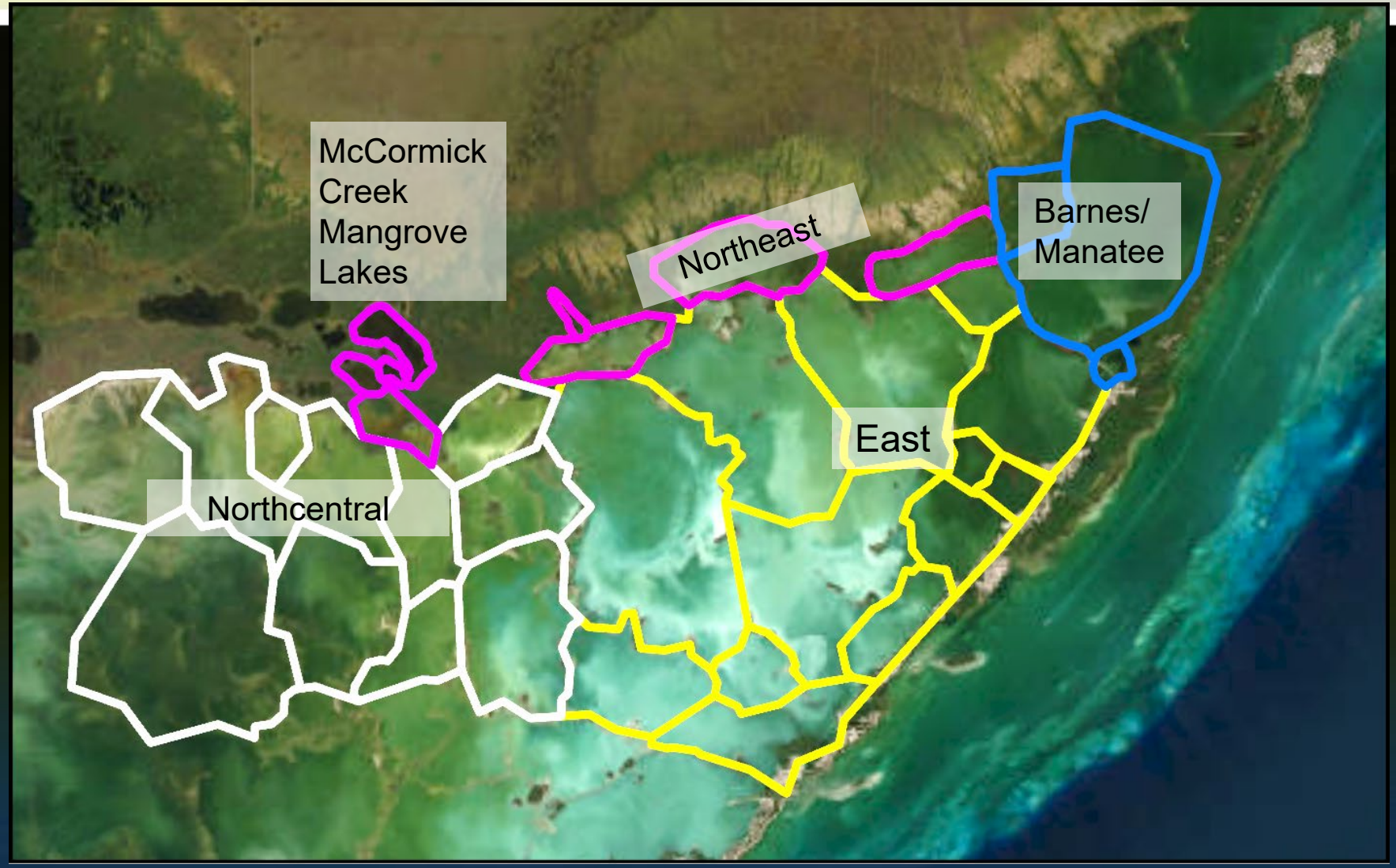


▲ Creek inflow

- 5 major creeks
- P gradient ↑ West to ↓ East

Florida Bay Basin Compartmentalization

Nuttle et al., 2000; Briceño et al. 2013 modified



— Basin delineations

- Regional and smaller-scale basin-level organization

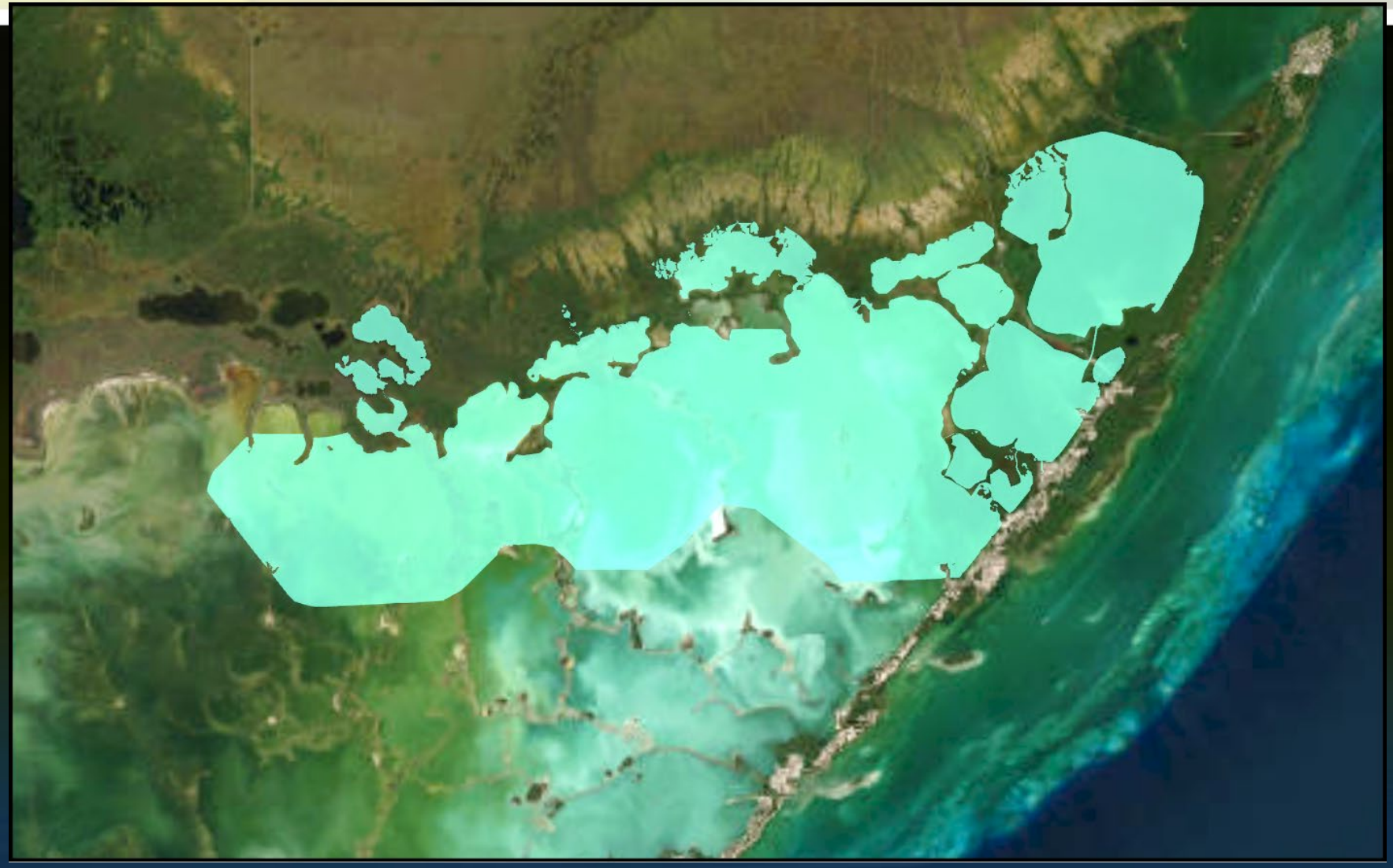
Florida Bay Dataflow Mapping (1998-present)

Madden and Day, 1992

— "Dataflow" track

- South of 5 creeks
- Flow-through geo-referenced measurements every 5s
- Salinity, temperature, photosynthetic pigments, CDOM, turbidity, O_2, pH

High-Resolution Dataflow Map Interpolations (1998-present)



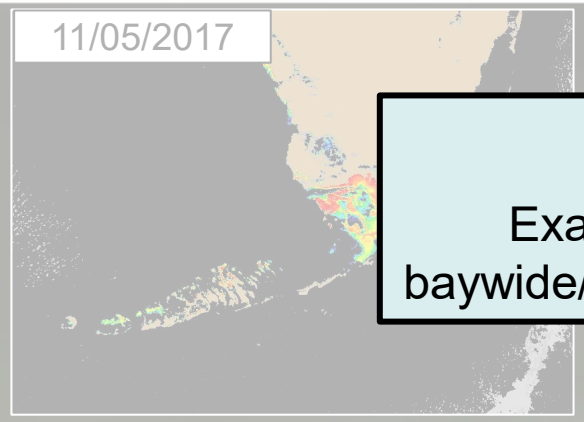
Dataflow interpolation area

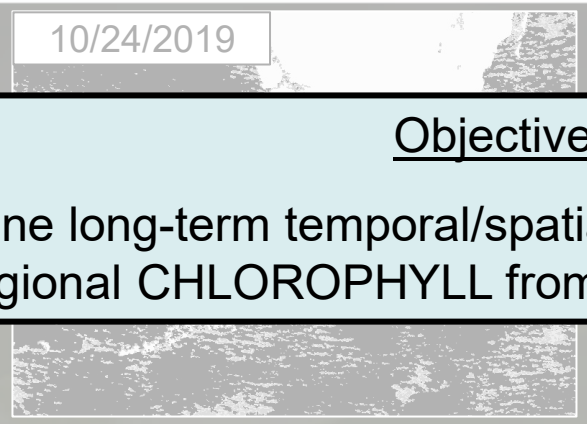
- inverse path distance weighted honors barriers
  (Stachelek and Madden, 2015 *modified*)
- High spatial resolution (60x60m) identifies/ tracks gradients, changes

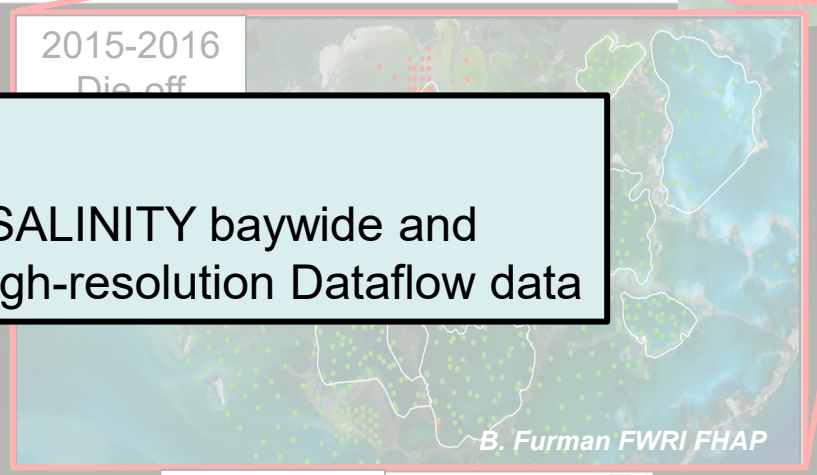
Florida Bay Event Timeline (1998-2024)

- Periodic disturbances: hurricanes, El Niño/La Niña, drought, cold events, 2023 MHW
- Multi-year disturbances: **seagrass die-off 2015-2016, recurring algal blooms**
- **Water management**

Seagrass Die-off Spatial Extent and Subsequent Algal Blooms

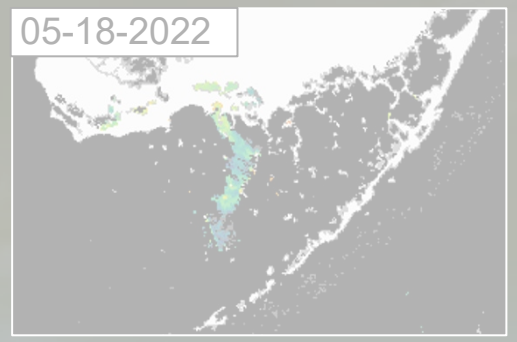


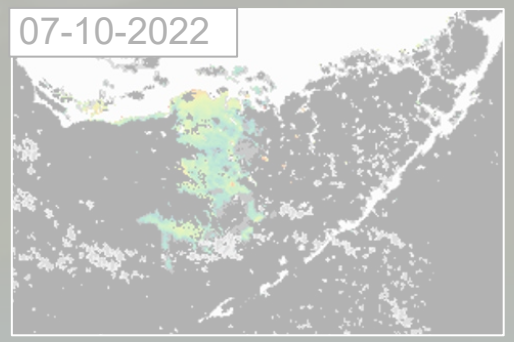


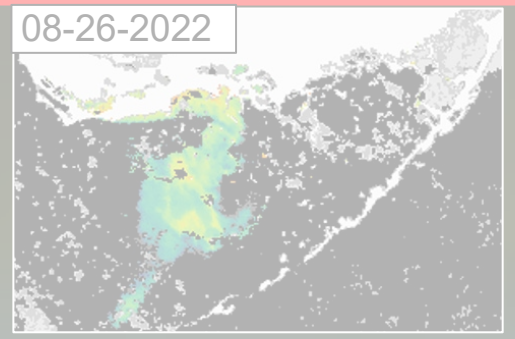


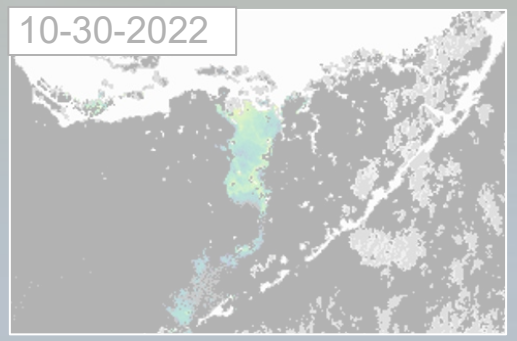
Objective:

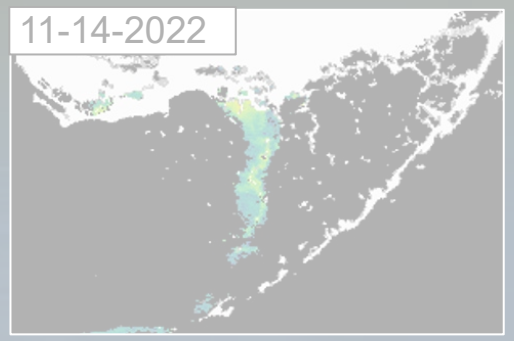
Examine long-term temporal/spatial SALINITY baywide and baywide/regional CHLOROPHYLL from high-resolution Dataflow data

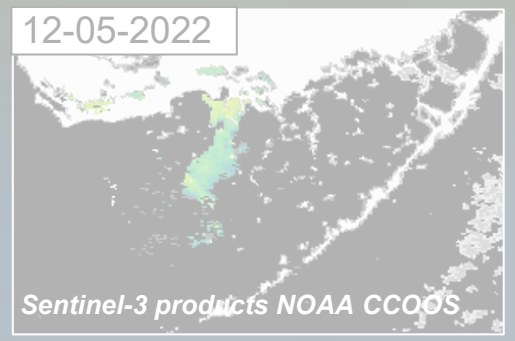




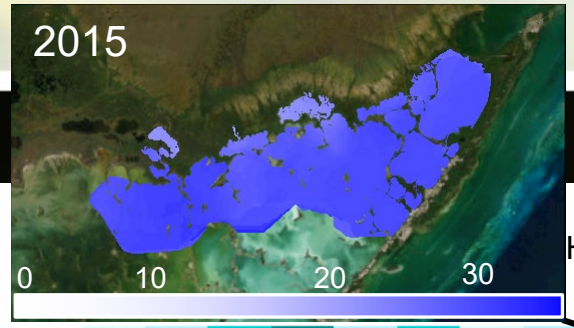


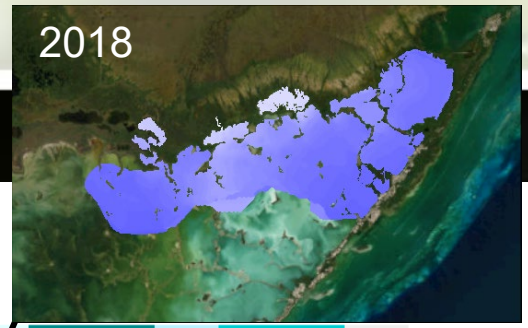


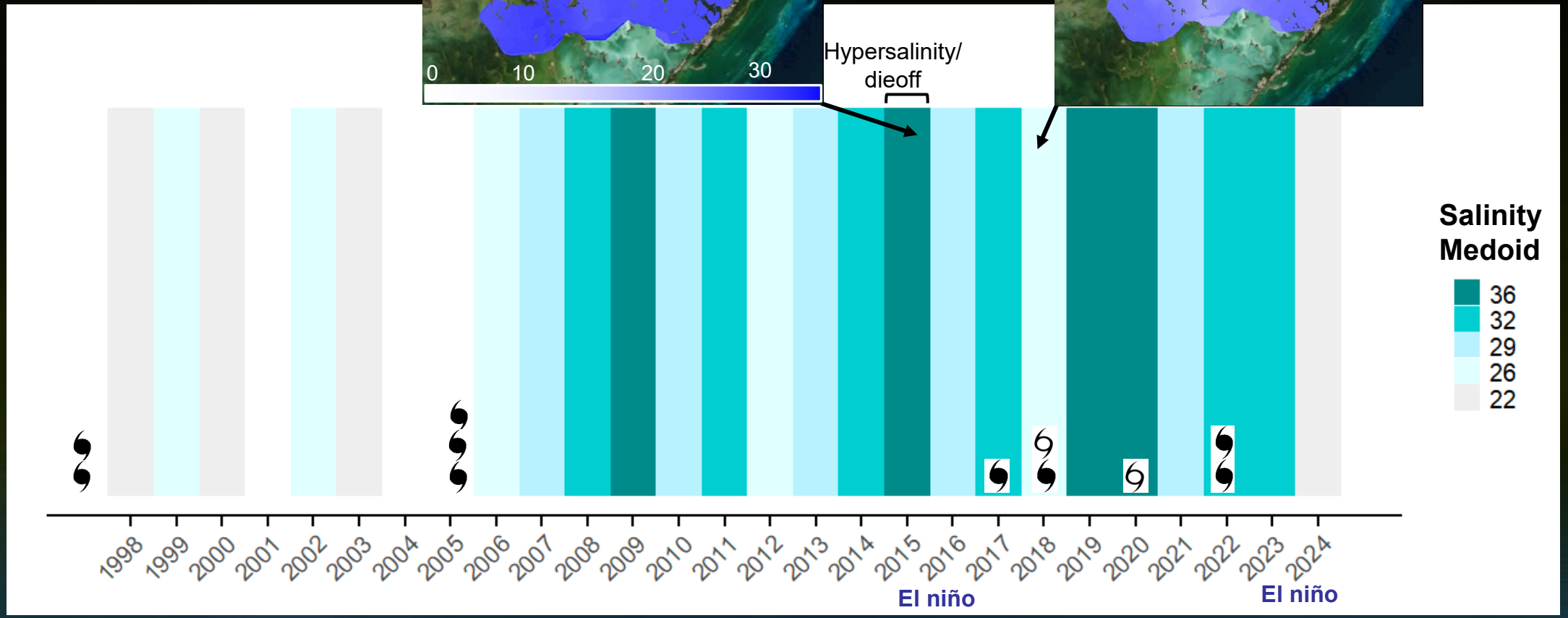




High-resolution Baywide Salinity over Time 1998-2024

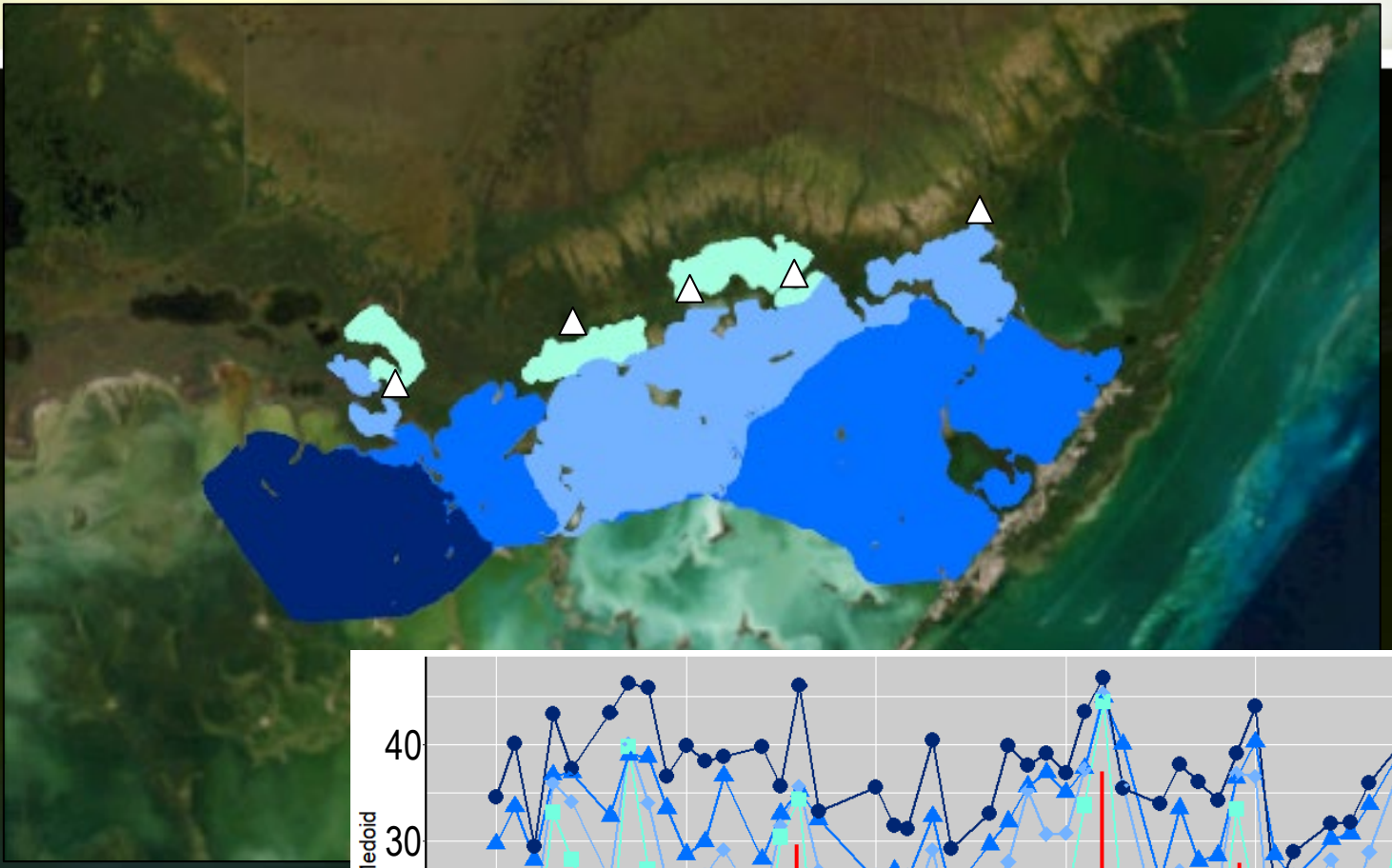




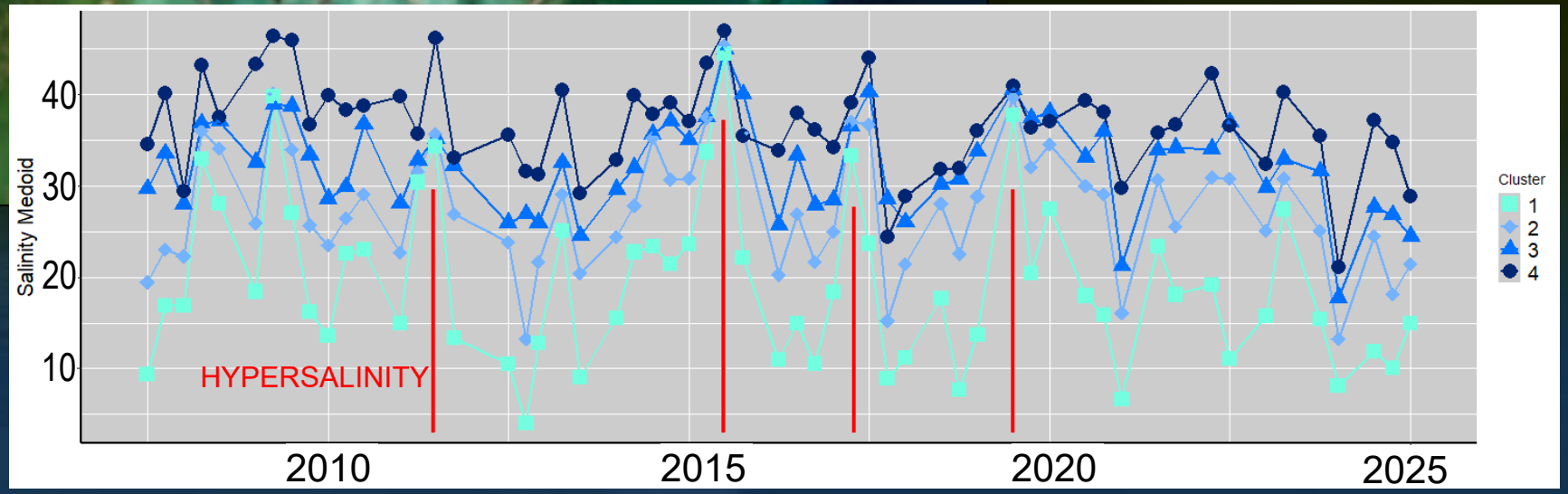


- Lower salinities follow storms/ El niño
- High salinity years seen baywide
- 2007-present higher salinities

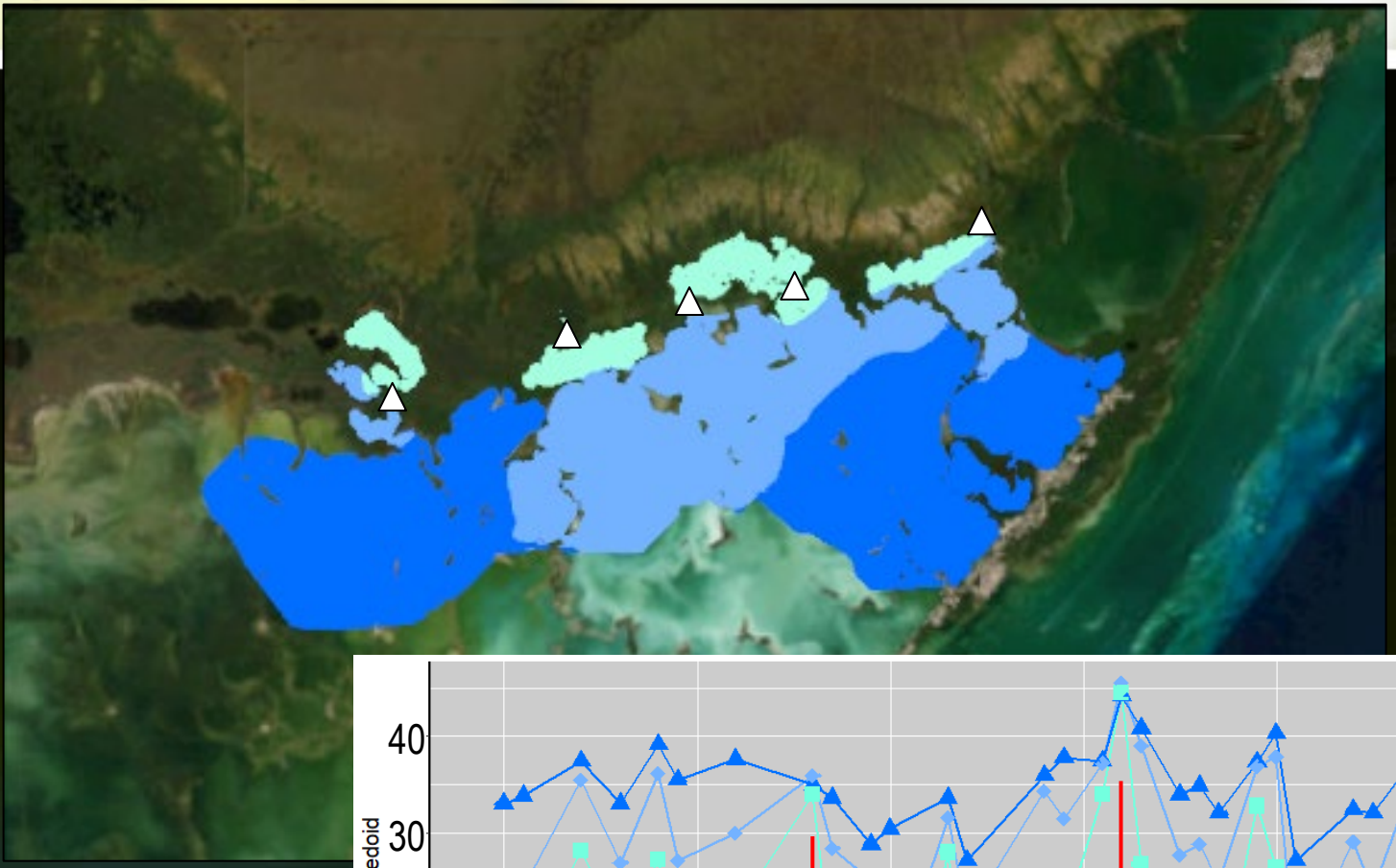
Salinity Spatial Clusters 2007-2024



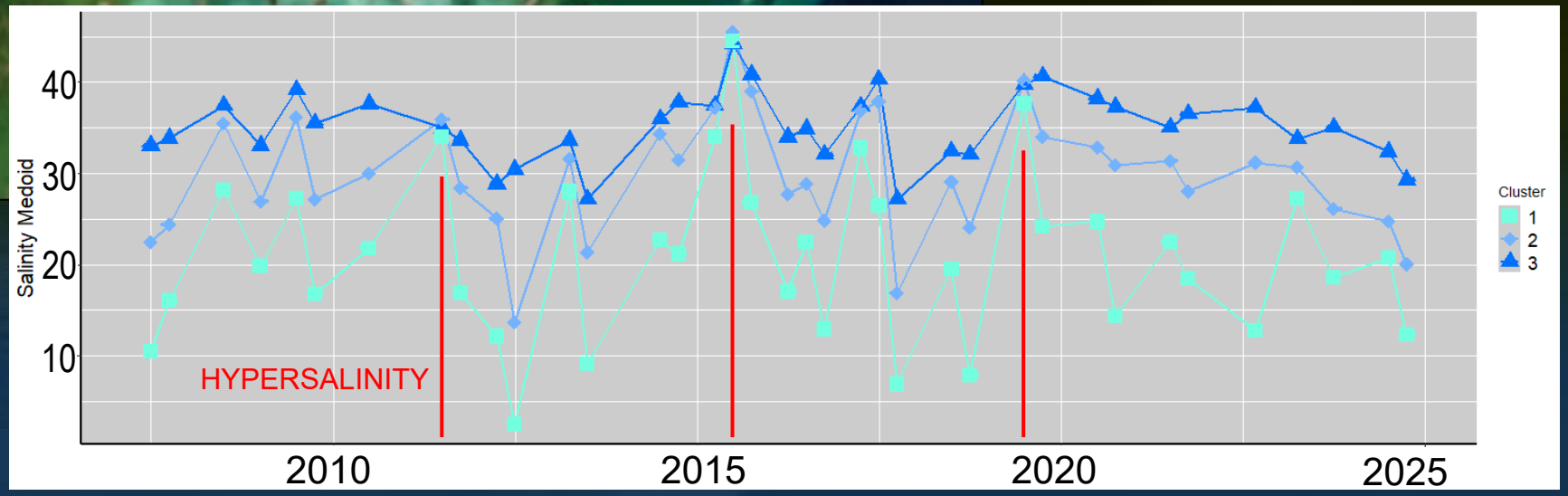
- Not unexpected
- Cluster based on proximity to inflows
- Highest in northcentral Bay (reaches hypersalinity)
- Dry years - hypersalinity all clusters



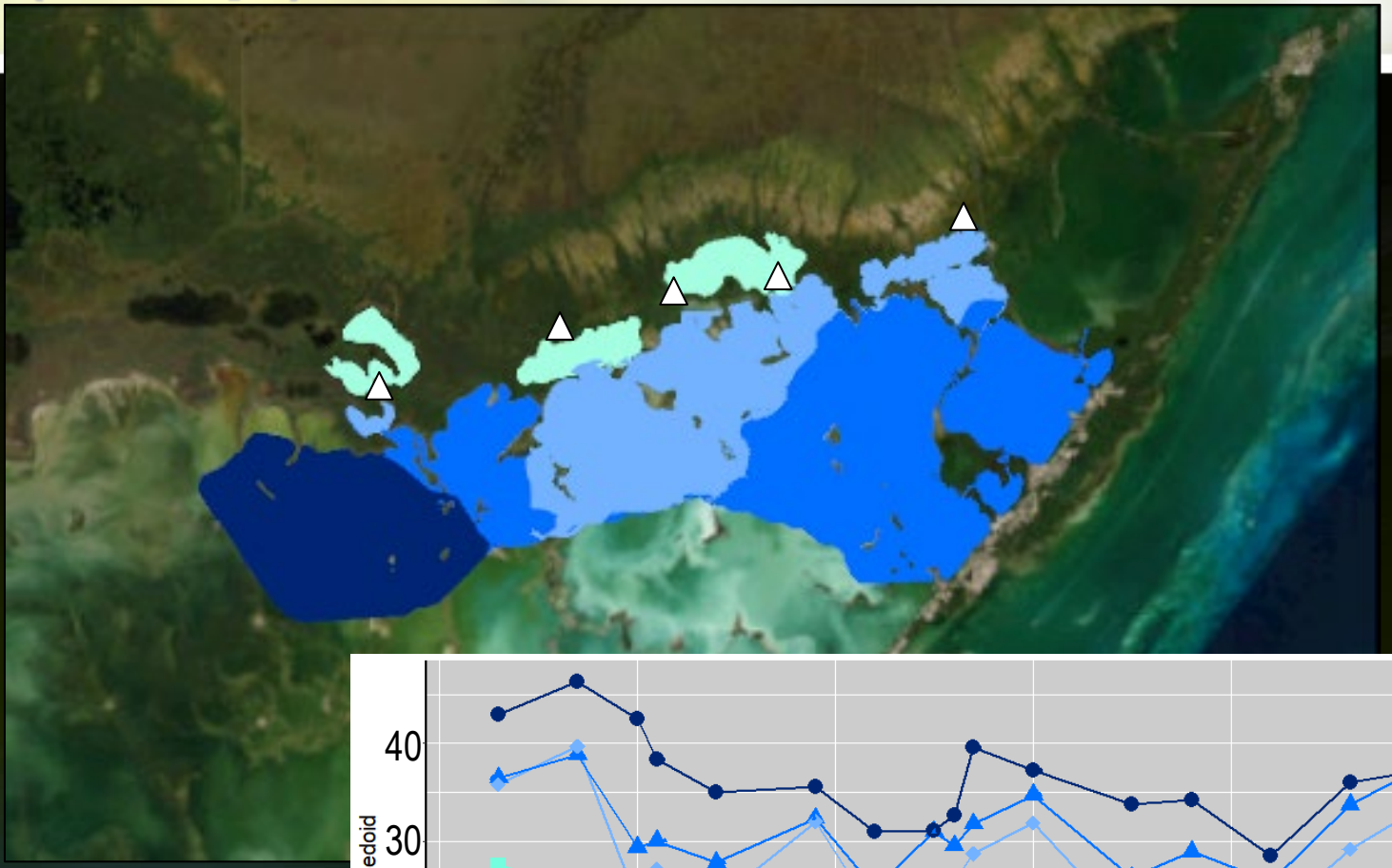
Wet Season Salinity Spatial Clusters 2007-2024
(May-Oct)



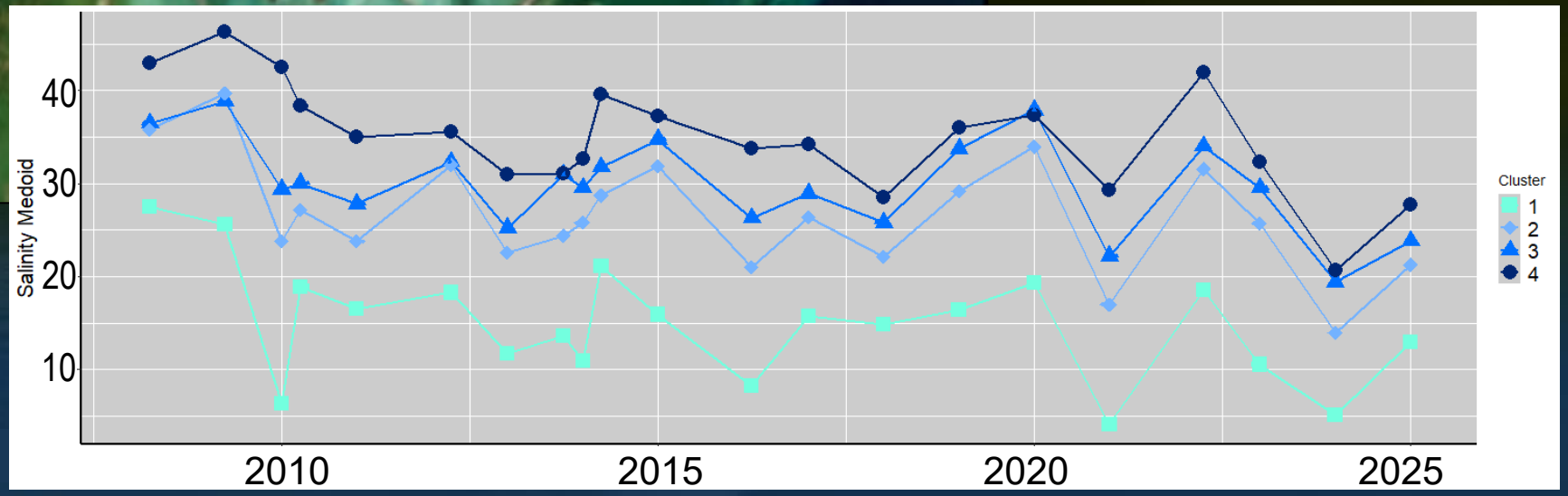
- Cluster based on proximity to inflows
- No distinct northcentral cluster
- Dry years, see shift in nearshore cluster to high salinity = “dry” wet season



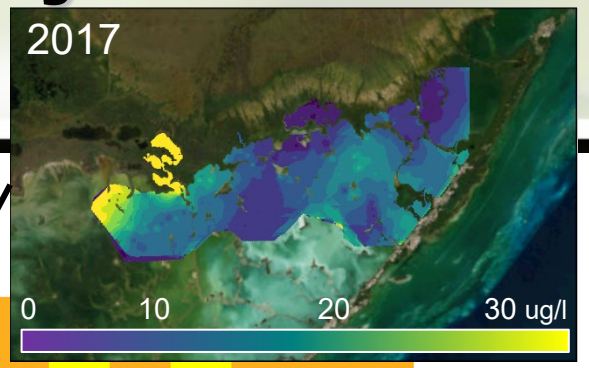
Dry Season Salinity Spatial Clusters 2007-2024
(Nov-Apr)



- Cluster based on proximity to inflows – retracts
- Transition zone cluster consistently lower
- Northcentral cluster drives overall pattern

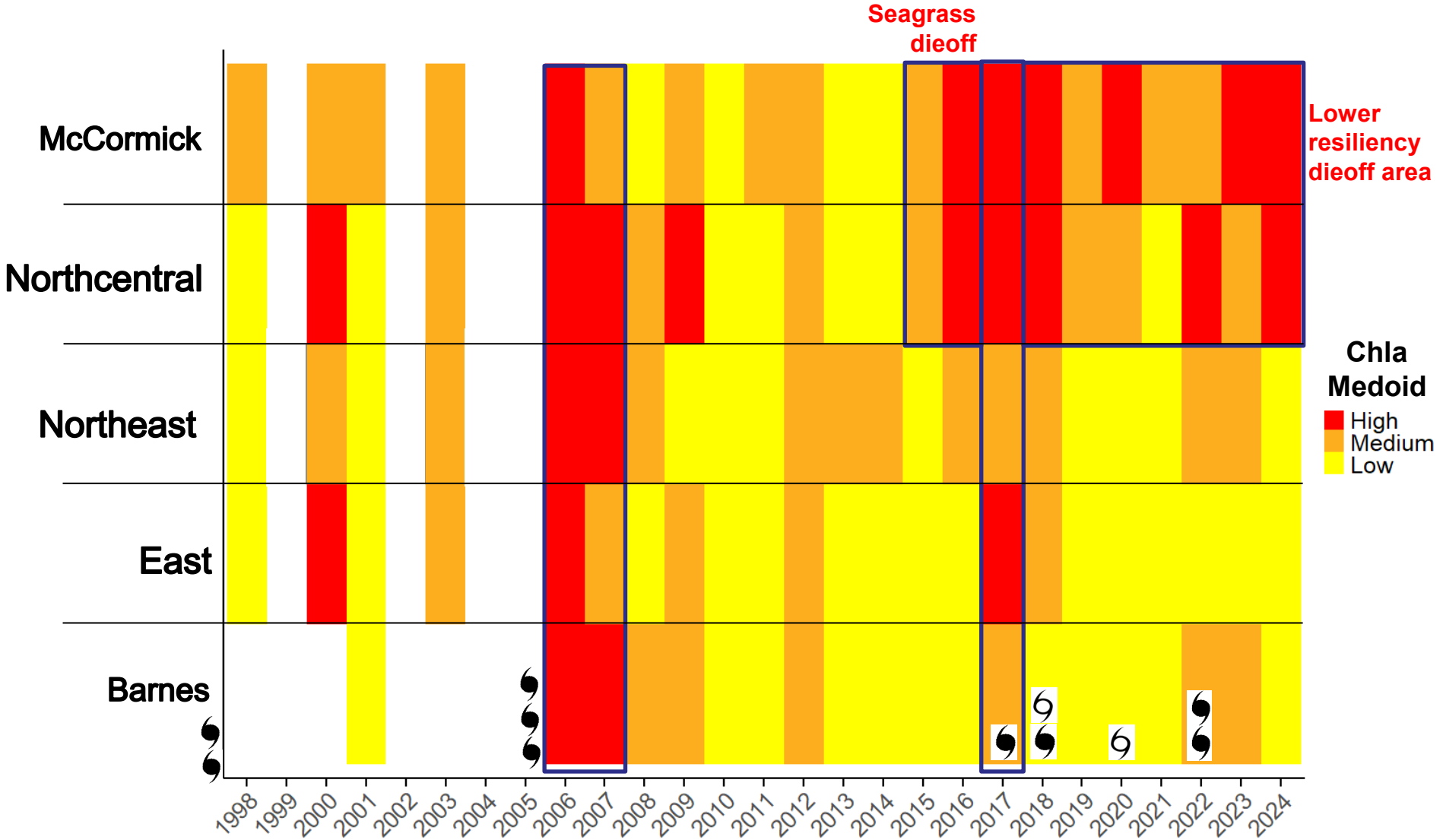


High-Resolution Baywide Chlorophyll Over Time 1998-2024

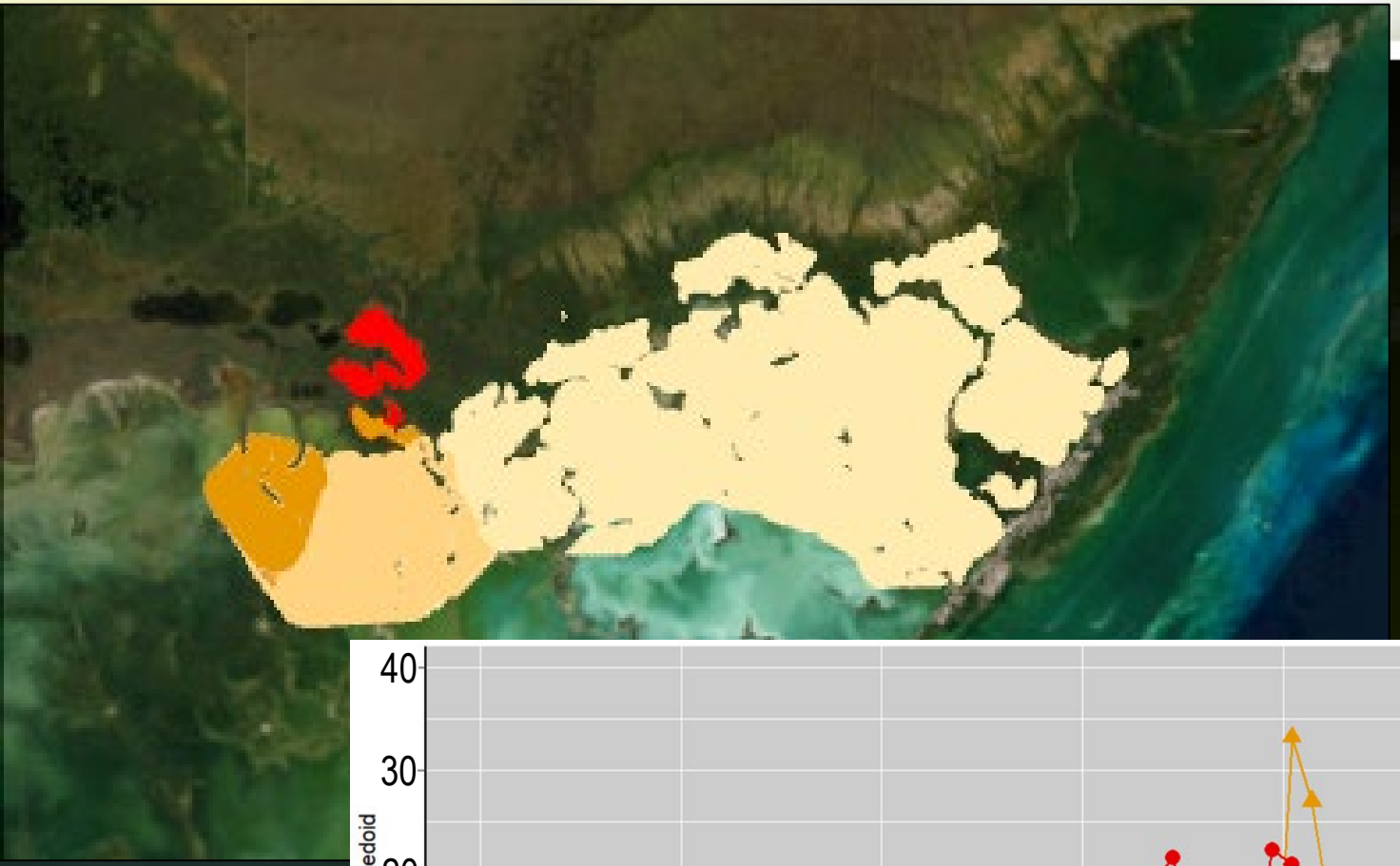


- Higher Chla after disturbances
- 2017 followed sequence of events
- Regional differences

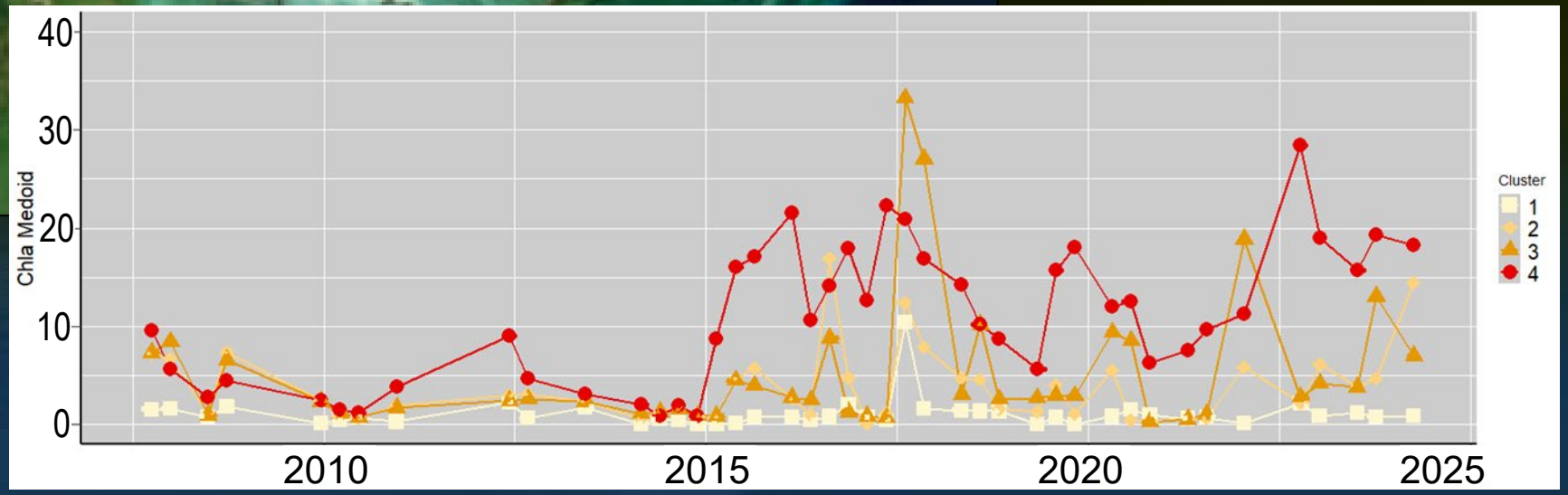
Regional Chlorophyll Over Time 1998-2024



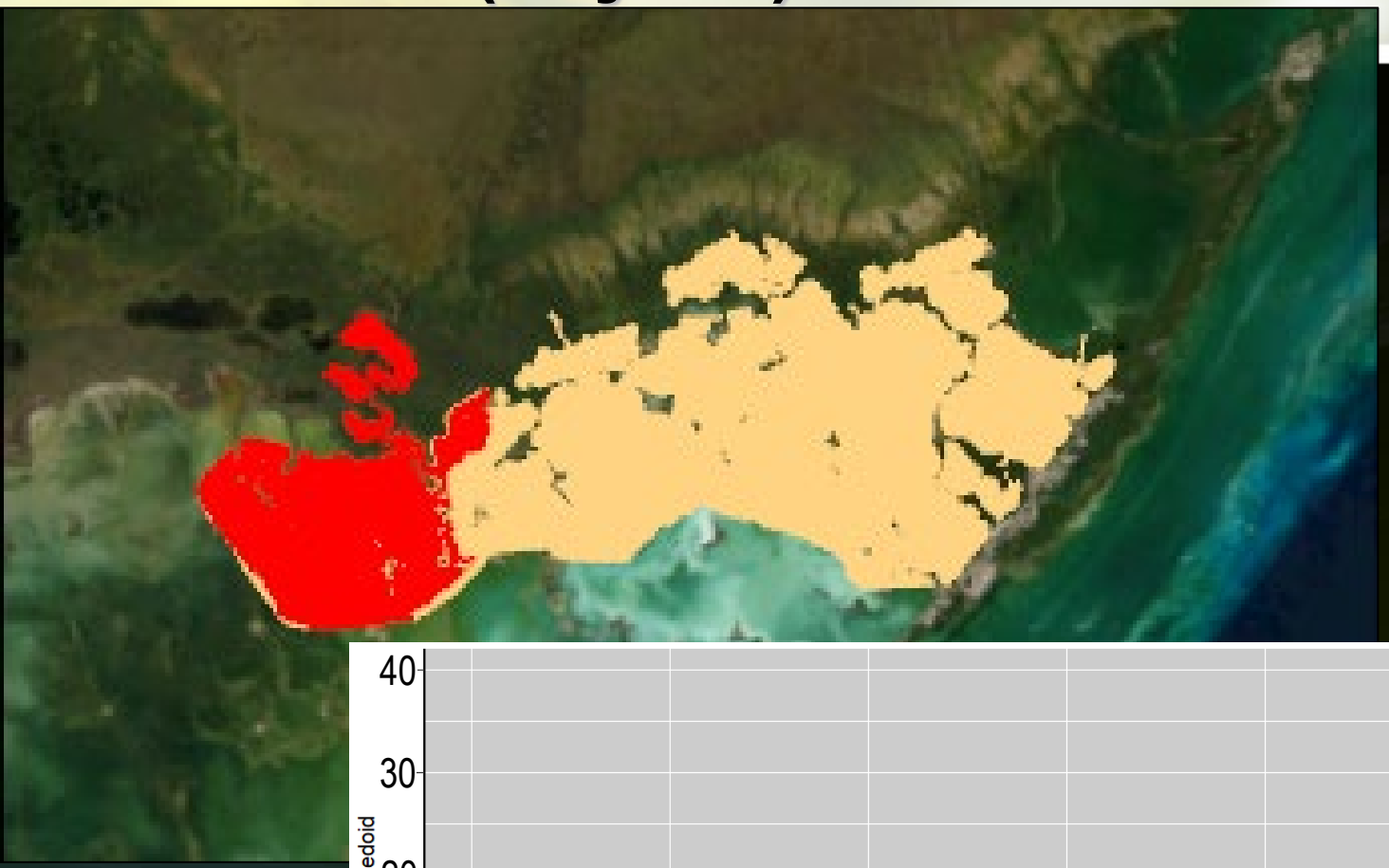
Chlorophyll Spatial Clustering 2007-2024



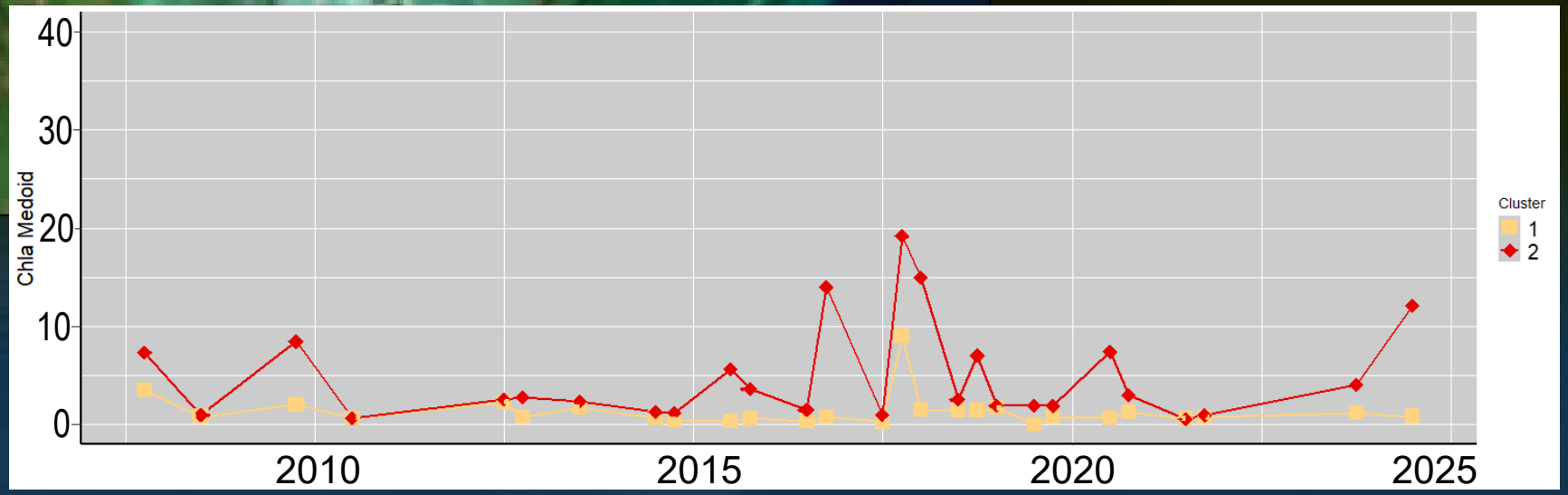
- Highest in mangrove lakes/northcentral bay
- Cluster in die-off area
- Decreases as move East (P-gradient)
- Increase after 2015



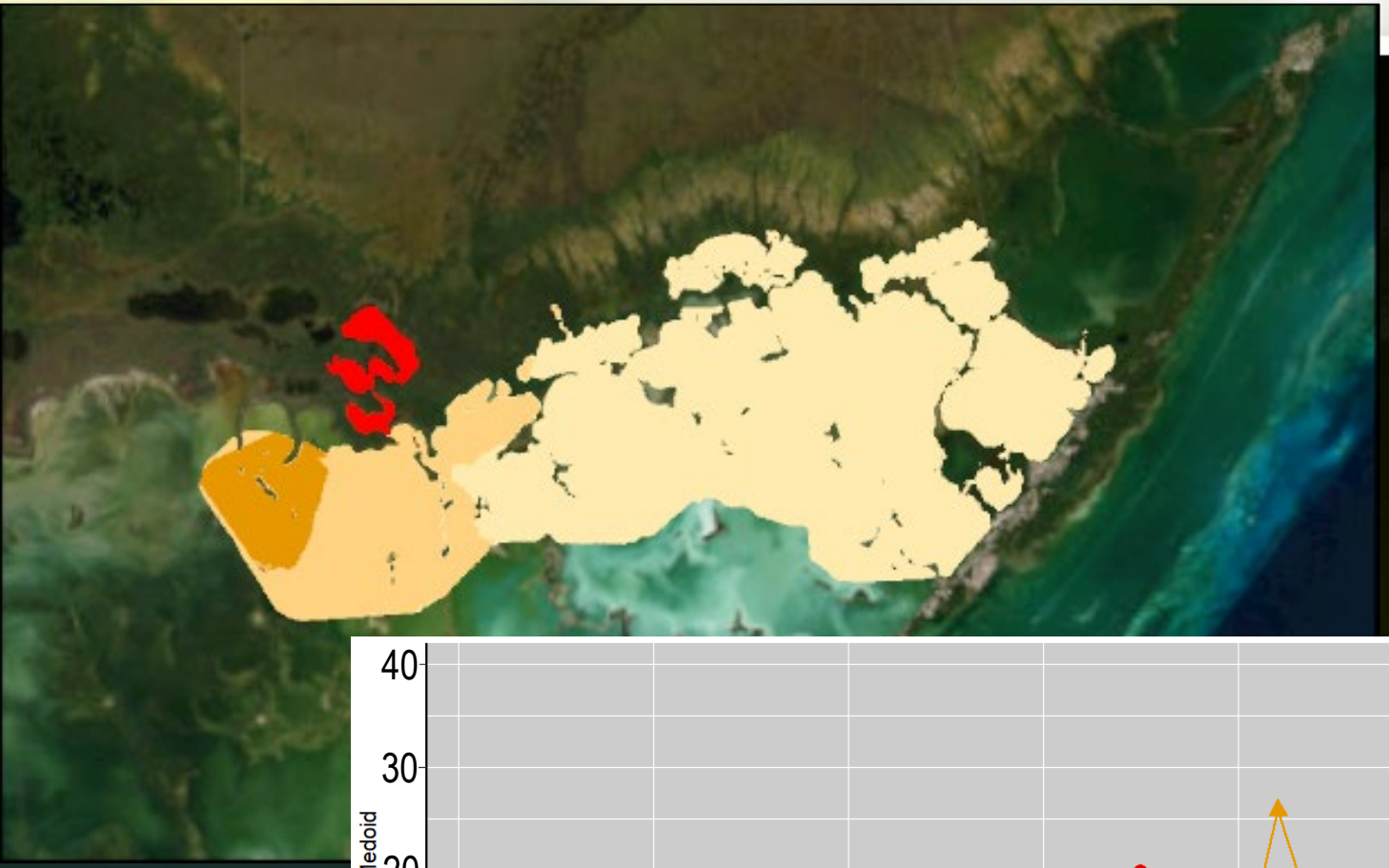
Chlorophyll Spatial Clustering Wet Season 2007-2024 (May-Oct)



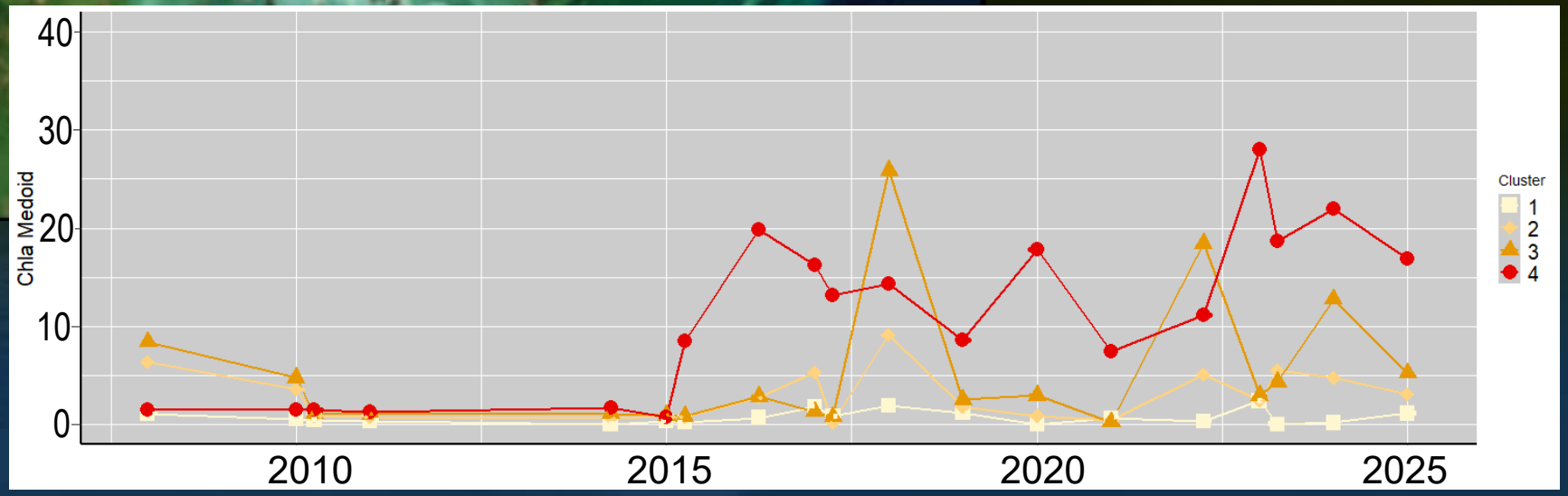
- Highest in mangrove lakes/ northcentral bay
- Less variability
- Differences mainly after 2015



Chlorophyll Spatial Clustering Dry Season 2007-2024 (Nov-Apr)



- Highest in mangrove lakes/northcentral bay
- Distinct cluster in die-off area
- Decreases as move East
- Increase after 2015



Takeaways

1) Salinity is lowest closest to inflows and after storm/climate events

2) “Dry” wet seasons

3) Phytoplankton is highest in mangrove lakes and dieoff area, follows P-gradient

4) Seagrass dieoff critical event – lowered resilience and recurrent algae blooms

Contact Information:

Theresa Strazisar tstrazis@sfwmd.gov
Christopher Madden cmadden@sfwmd.gov

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- Madden, C. and J.W. Day. 1992. An instrument system for high-speed mapping of chlorophyll a and physico-chemical variables in surface waters. *Estuaries*. DOI:10.2307/1352789.
- NOAA Centers for Coastal Ocean Science. HAB Data Explorer
- Stachelek, J. and C. Madden. 2015. Application of Inverse Path Distance Weighting for high-density spatial mapping of coastal water quality patterns. *Int. J. Geographical Information Science*. DOI:10.1080/13658816.2015.1018833.
- Dataflow interpolation documentation available at https://github.com/jstachelek/onboard-dataflow-processing

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