Image-based Zooplankton and Phytoplankton Essential Ocean Variables in South Florida Waters Contributed by the U.S. Marine Biodiversity Observation Network Program

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[3]Oregon State U., Oregon, USA
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MBON
Marine Biodiversity Observation Network

ROSENSTIEL SCHOOL
COOPERATIVE INSTITUTE for MARINE & ATMOSPHERIC STUDIES
MIAMI

MarineGEO
THE TENNENBAUM MARINE OBSERVATORIES NETWORK

NATIONAL MARINE SANCTUARIES

GEO BON

NOAA

NASA

NOPP

Office of Naval Research ONR Science & Technology

BOEM
BUREAU OF OCEAN ENERGY MANAGEMENT

OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM

GOOS
Biology and Ecosystems Panel

IOOS
Integrated Ocean Observing System

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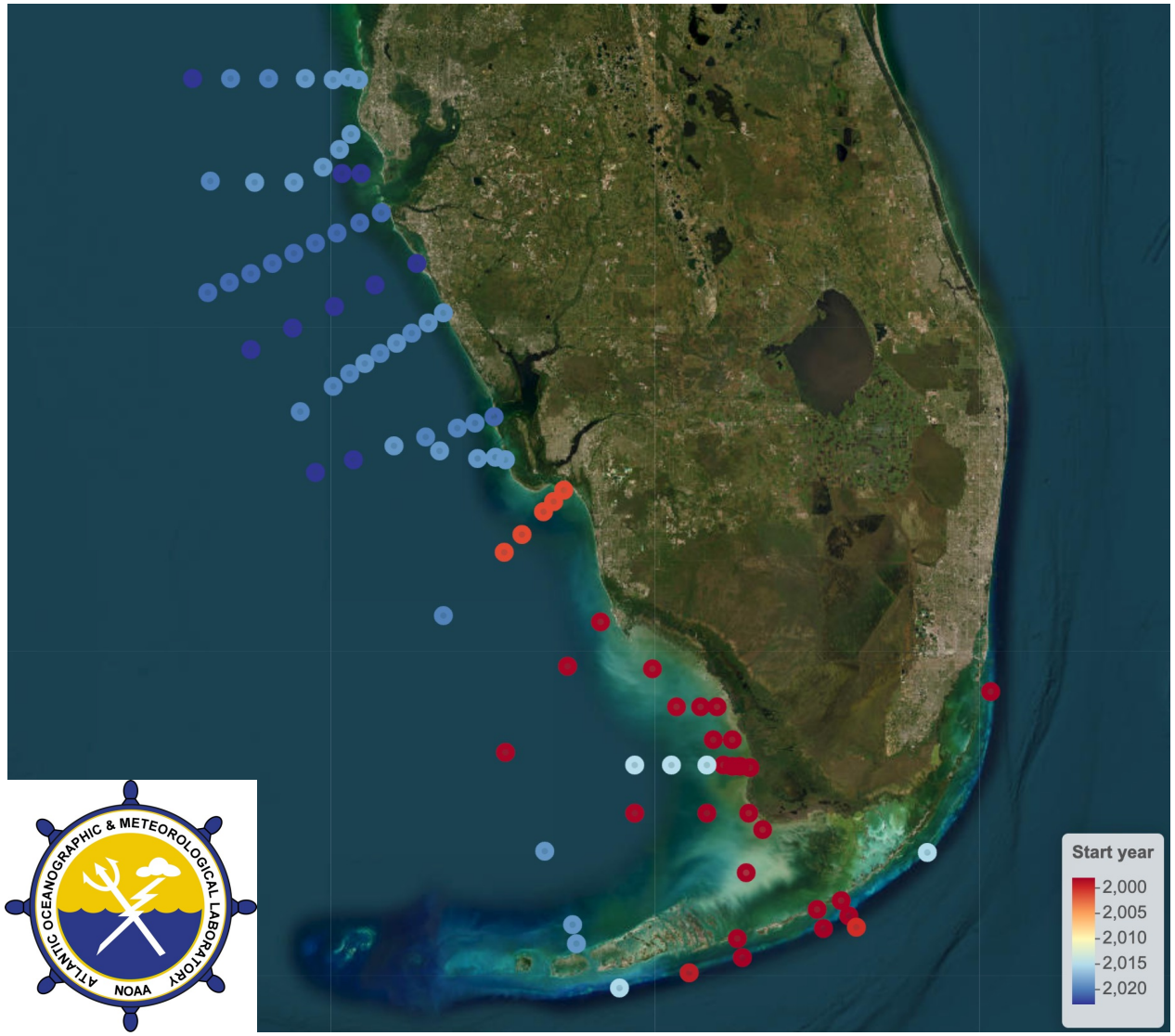
Atlantic Oceanographic and Meteorological Laboratory - AOML
National Oceanic and Atmospheric Administration - NOAA

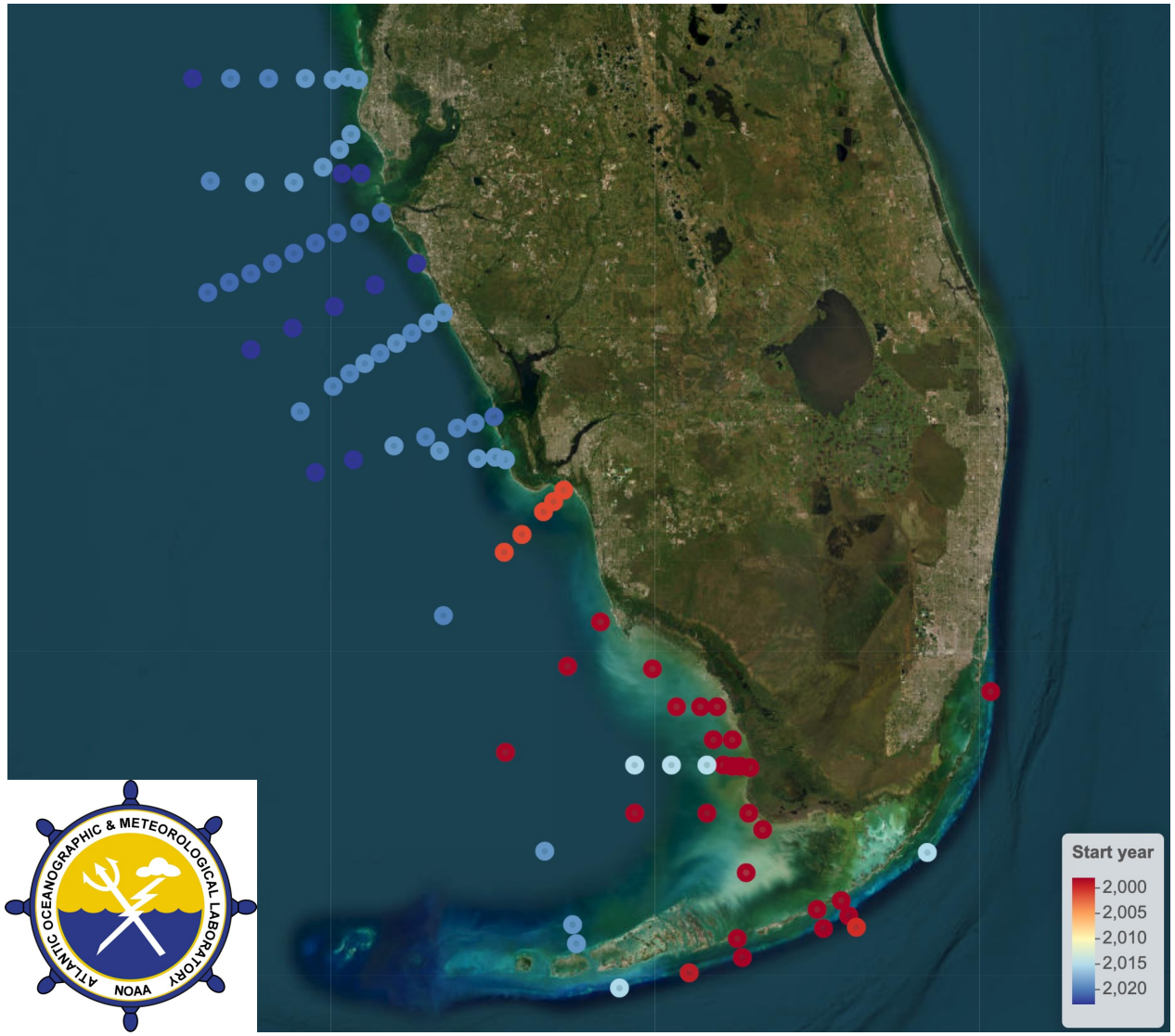
South Florida Ecosystem Restoration (SFER) and SE Marine Biodiversity Observation Network (SE MBON)



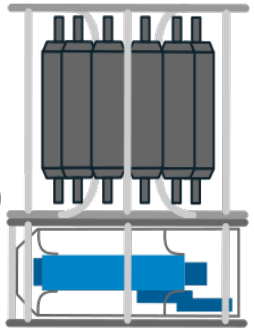
- SFER collects hydrographic, water quality and biological observations since mid-1990's
- SE MBON contributes marine life observations since 2015
- **Focus: evaluate responses of sea life and ecosystem to environmental change for EBM**

Oceanographic surveys every ~ 6 weeks

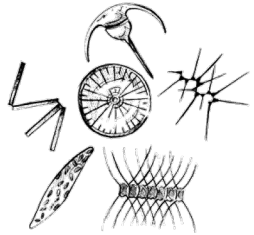
South Florida Ecosystem Restoration (SFER) – SE MBON



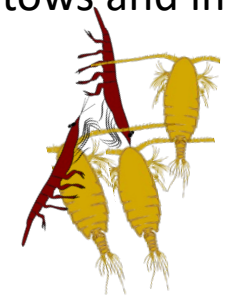
Hydrography
trace metals
carbonate system
NCP (24 hr incub.)



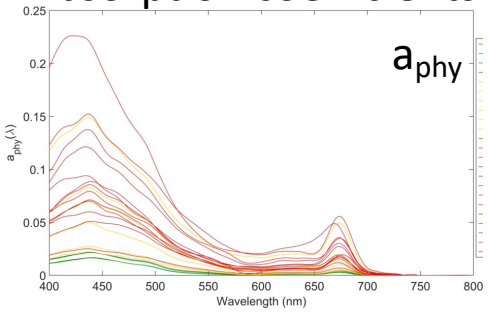
Phytoplankton pigments
morpho-taxonomy
IFCB



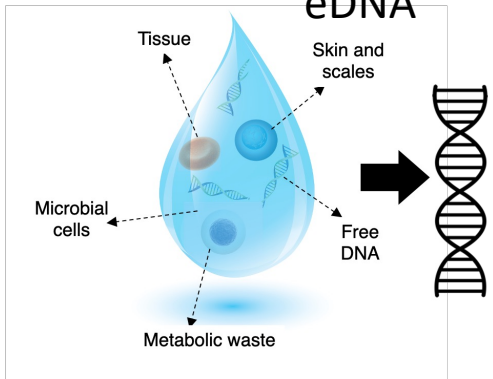
Zooplankton
Net tows and imaging

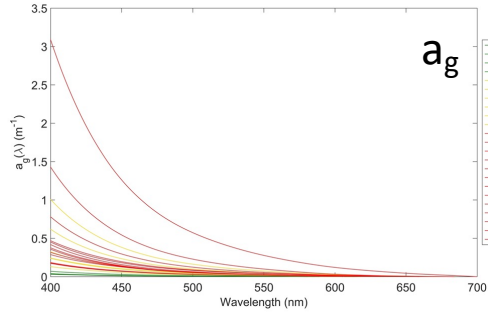


Absorption coefficients



eDNA





MBON Partnerships

MBON
Marine Biodiversity Observation Network

MARCO-BOLO
STRENGTHENING BIODIVERSITY OBSERVATION IN SUPPORT OF DECISION MAKING

LifeWatch ERIC

SCAR
INTERNATIONAL SCIENCE COUNCIL
SCIENTIFIC COMMITTEE ON ANTARCTIC RESEARCH

BIODIVERSITY.AQ

protectedseas

GEO BON
Group on Earth Observations
Biodiversity Observation Network

GEO GROUP ON EARTH OBSERVATIONS

Intergovernmental Oceanographic Commission
GOOS
OBIS
OCEAN BIODIVERSITY INFORMATION SYSTEM
Intergovernmental Oceanographic Commission
IOC-UNESCO

AP MBON

IOOS
Integrated Ocean Observing System

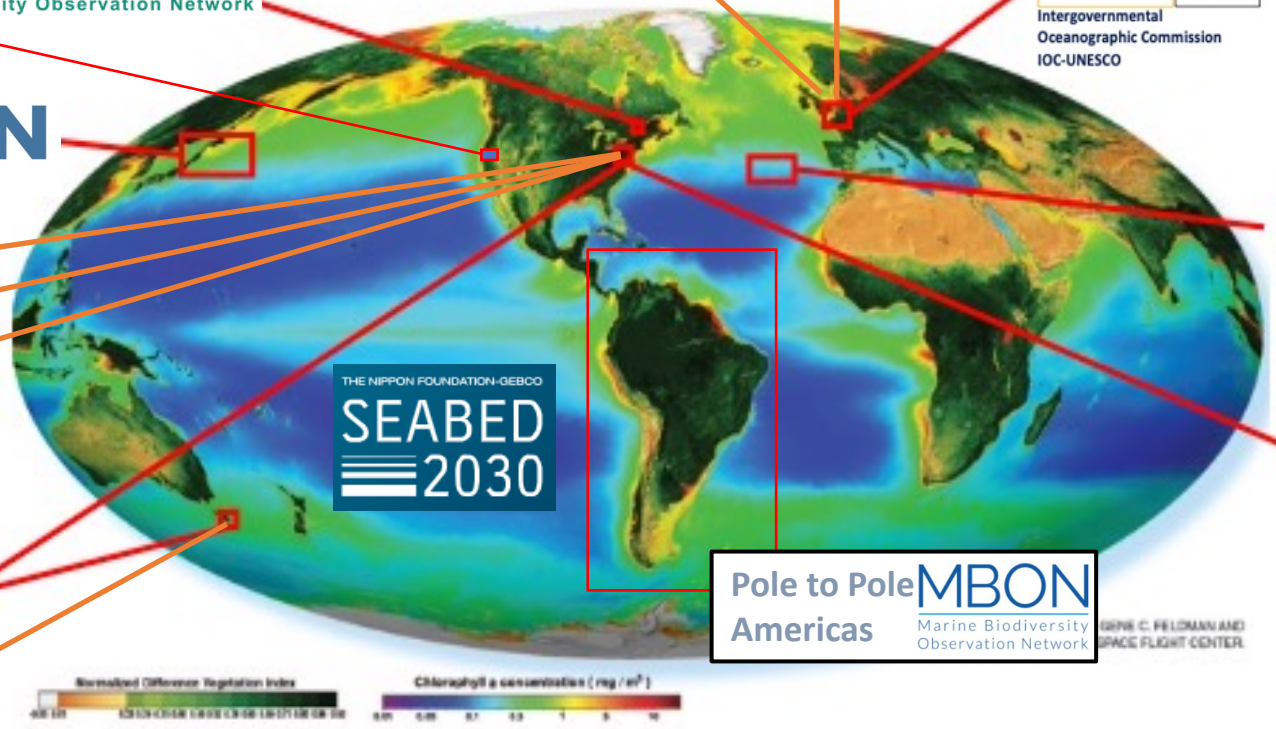
MBON Secretariat
AIR CENTRE
Joana Soares / Alice Soccod
AIR Centre – Azores / Portu

MarineGEO
THE TENNENBAUM MARINE OBSERVATORIES NETWORK

ATN
ANIMAL TELEMETRY NETWORK

THE NIPPON FOUNDATION-GEBCO
SEABED 2030

Amer GEOSS
BLUE PLANET
Oceans and Society



GOOS Bio-Eco
USA / Australia

GCRMN
GLOBAL CORAL REEF MONITORING NETWORK

http://marinebon.org

Marine Life 2030

2021 2030 United Nations Decade of Ocean Science for Sustainable Development

AIR CENTRE

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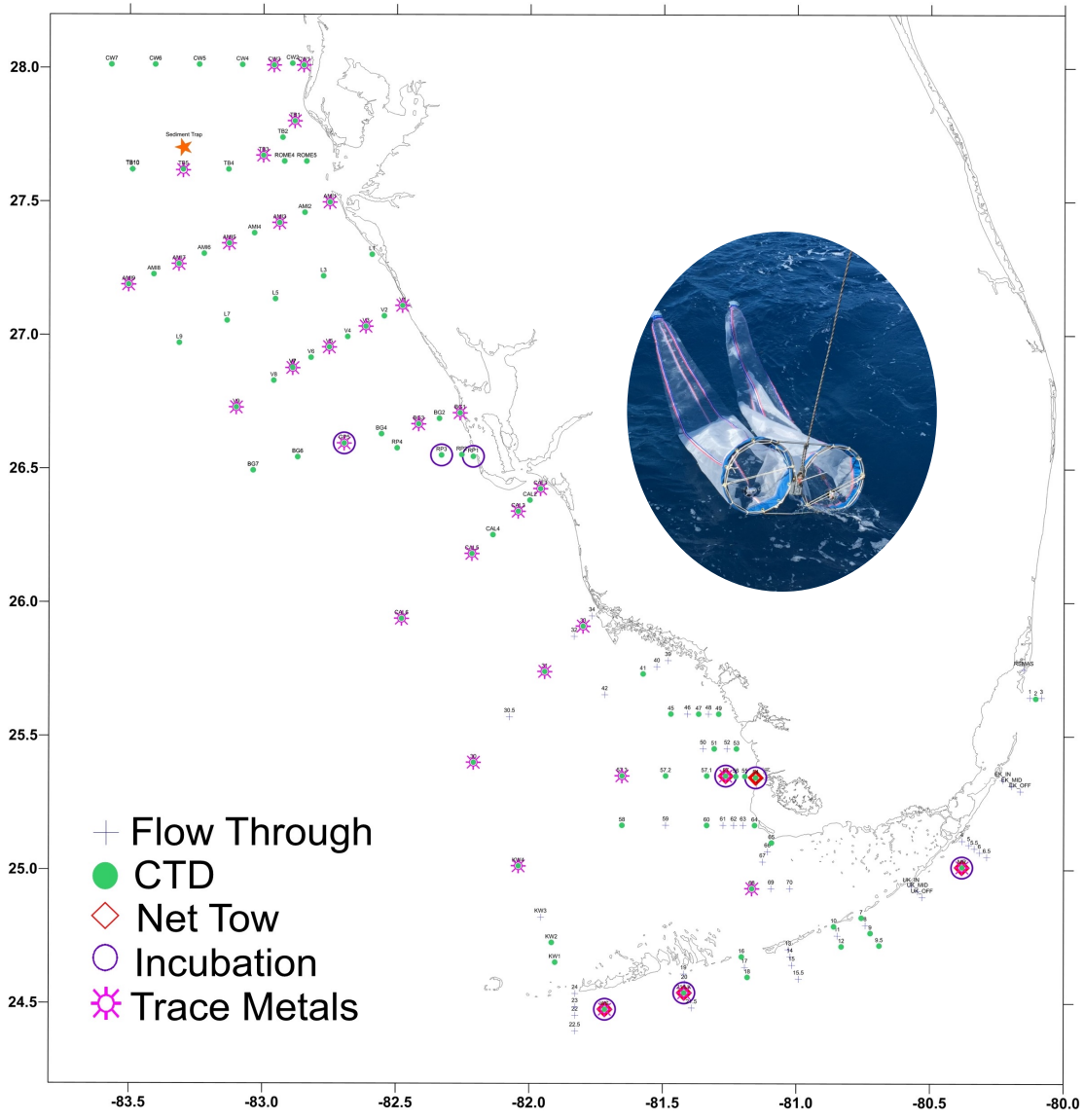
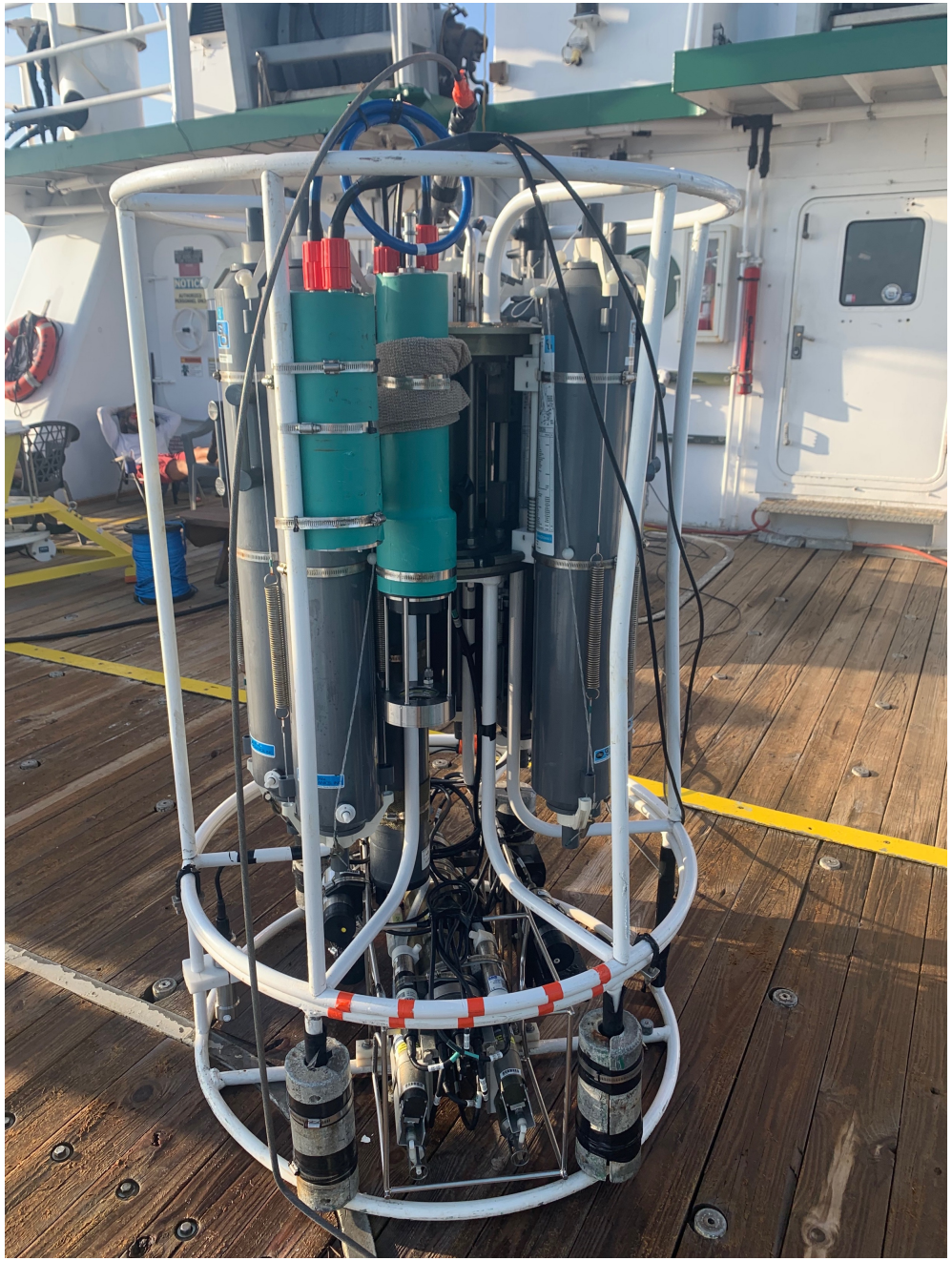
What are the spatiotemporal distributions of large phytoplankton and meso-zooplankton taxa?

How do plankton assemblages respond to episodic disturbances and climate-driven processes?

Can satellite seascapes help us to better understand biogeographic and phenological distributions of observed plankton groups?

Plankton imaging



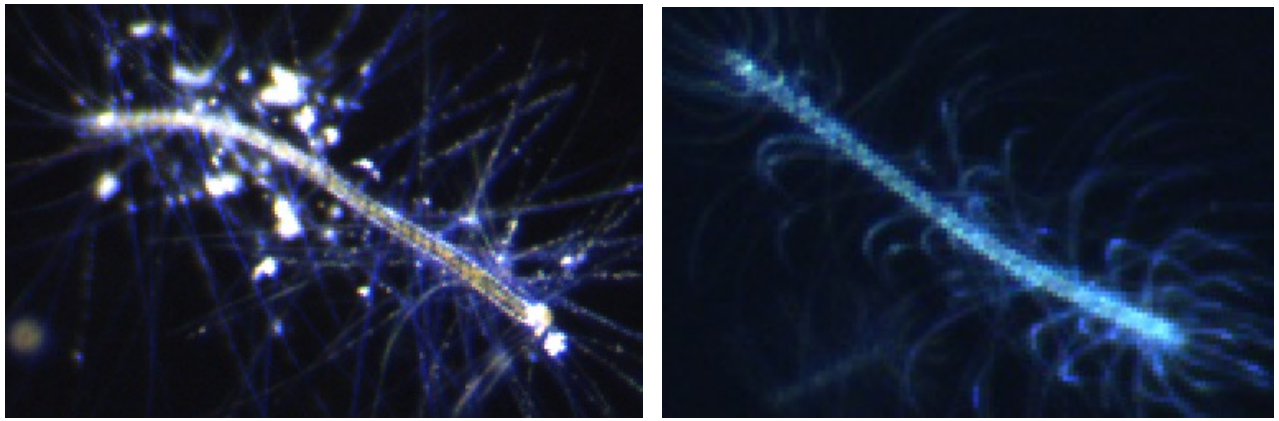


Continuous Particle Imaging and Classification System (CPICS)

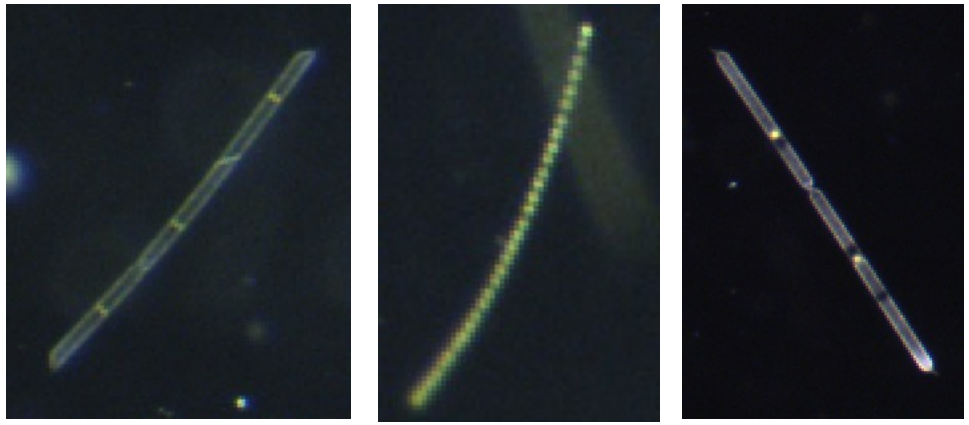
Coastal Ocean Vision

Phytoplankton groups analyzed

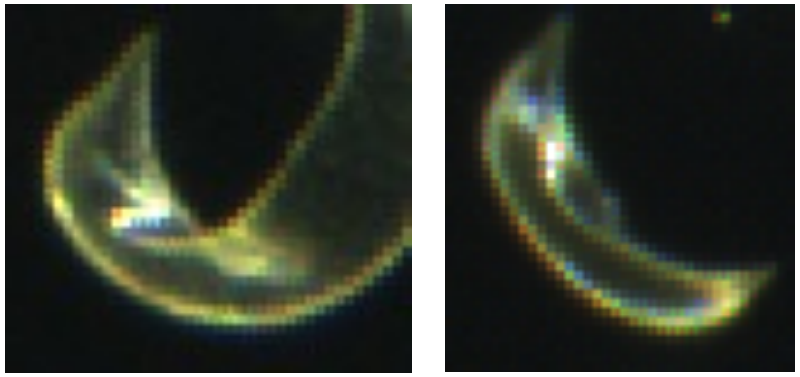
Chaetoceros spp



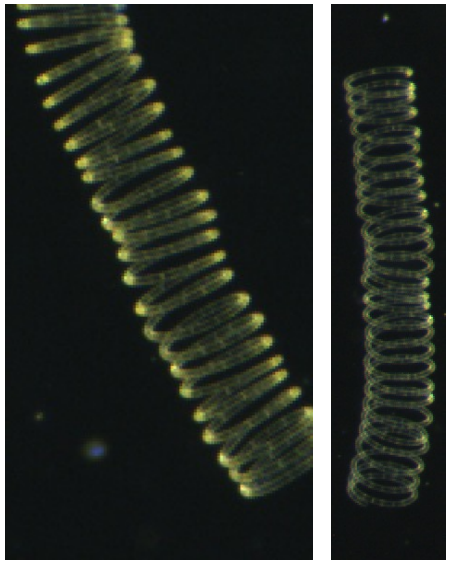
Chain diatoms
e.g. *P. alata, Skeletonema spp., Pseudosolenia* spp,



Neocalyptrella spp

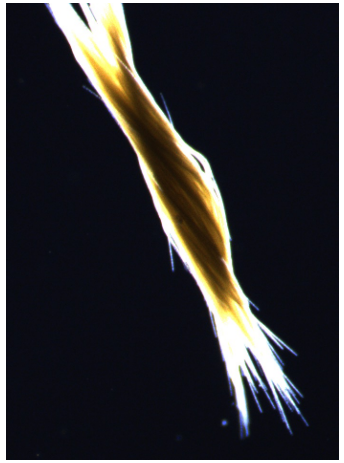


Guinardia striata



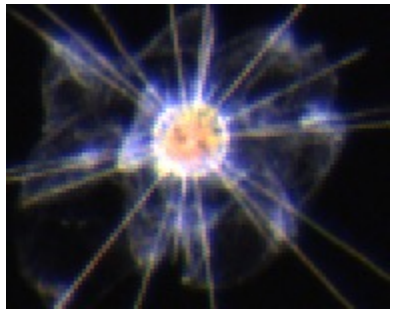
Trichodesmium thiebautii

Trichodesmium erythraeum

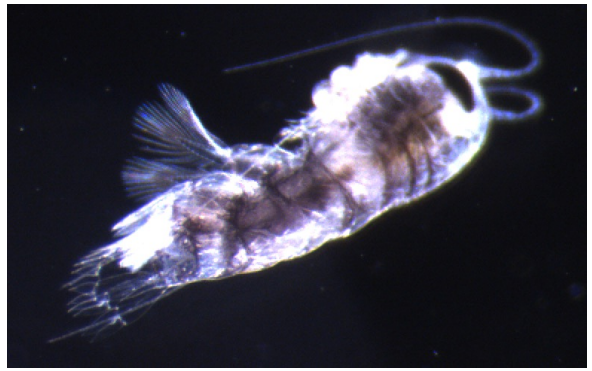


Zooplankton groups analyzed

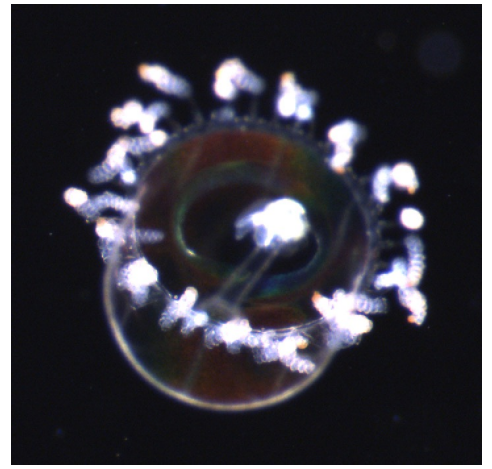
Acantharea spp



Copepods

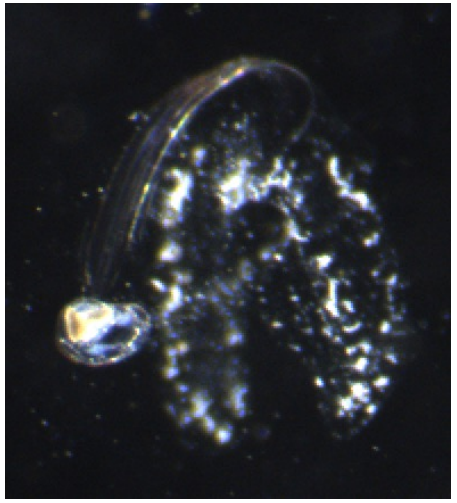


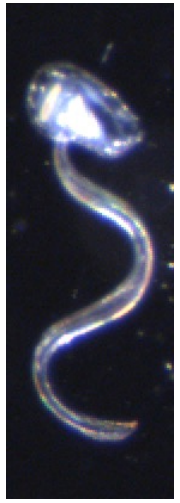
Gelatinuos



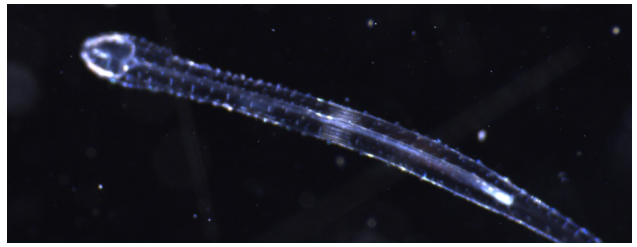
Echinoderm larvae

Appendicularians





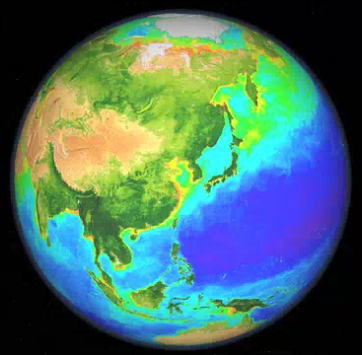
Chaetognaths



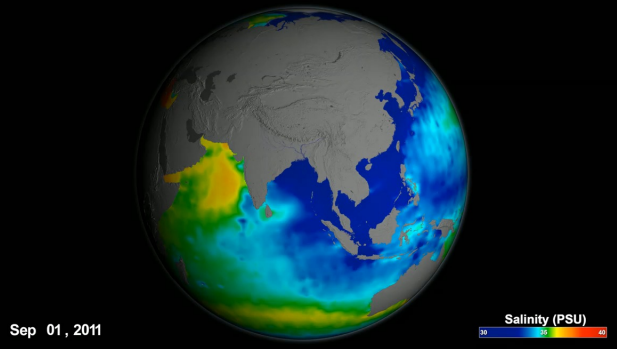
Polychaete larvae

Dynamic pelagic satellite seascapes

Multiple NASA assets

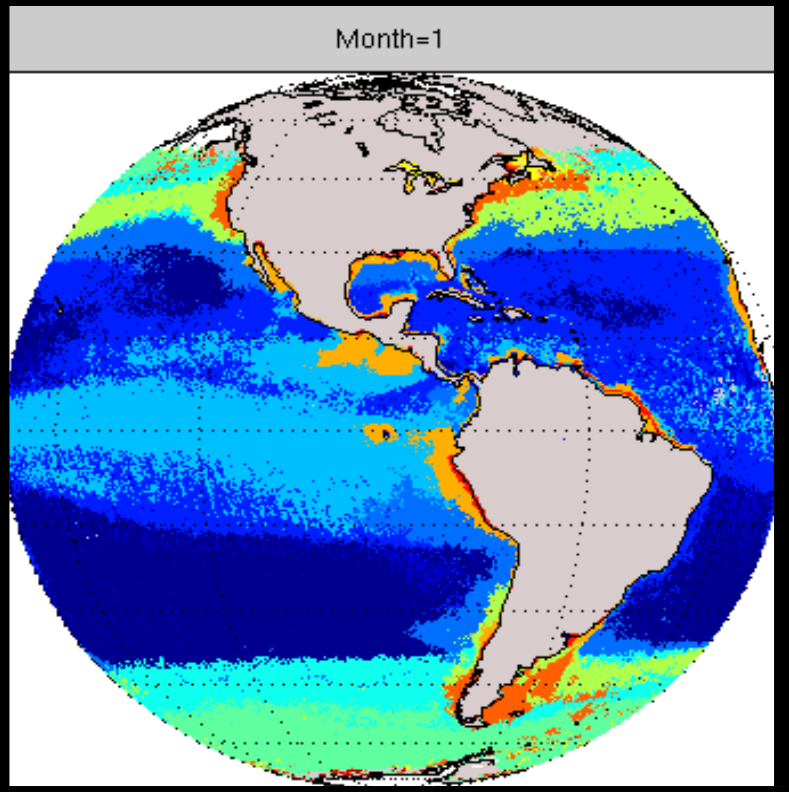


Biology: Ocean Color



Physics: e.g.
SSS, SST, winds, SSHa

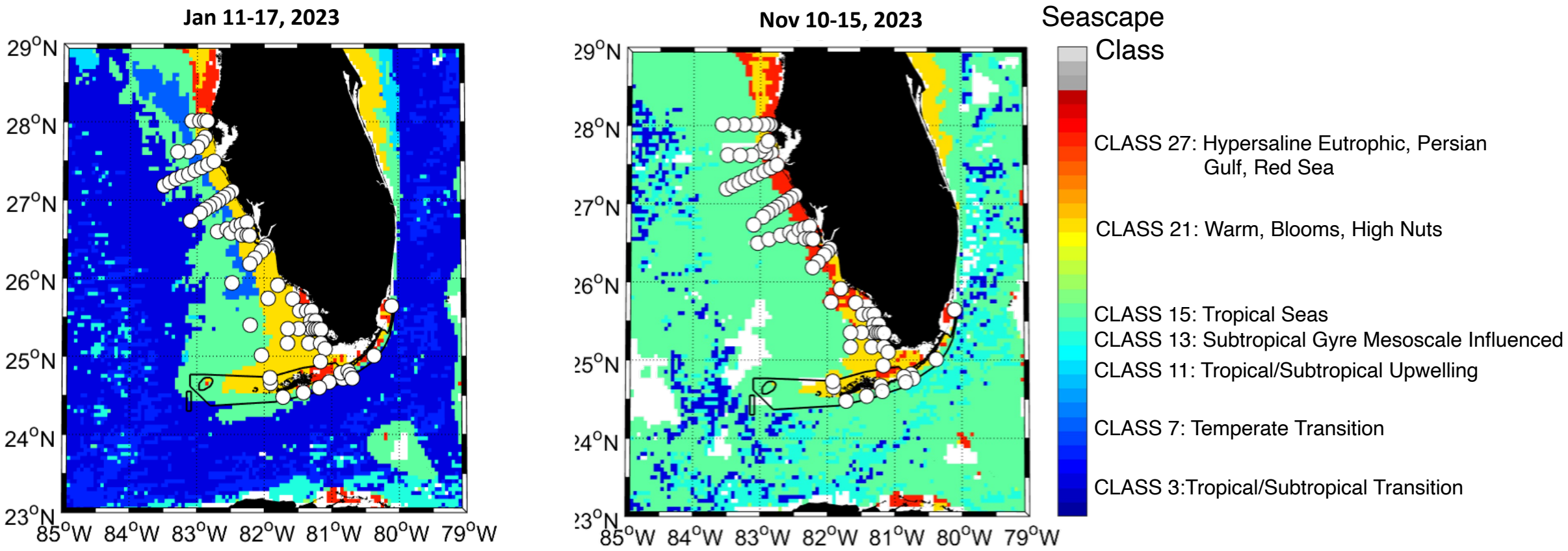
Global dynamic classification



- Globally relevant variables:
  - SST, Chl-a, nFLH, ADT, SSS, CDOM, ice cover
- 8-day and monthly composites
- 5 km pixel resolution
- N= 33 (including sea ice)

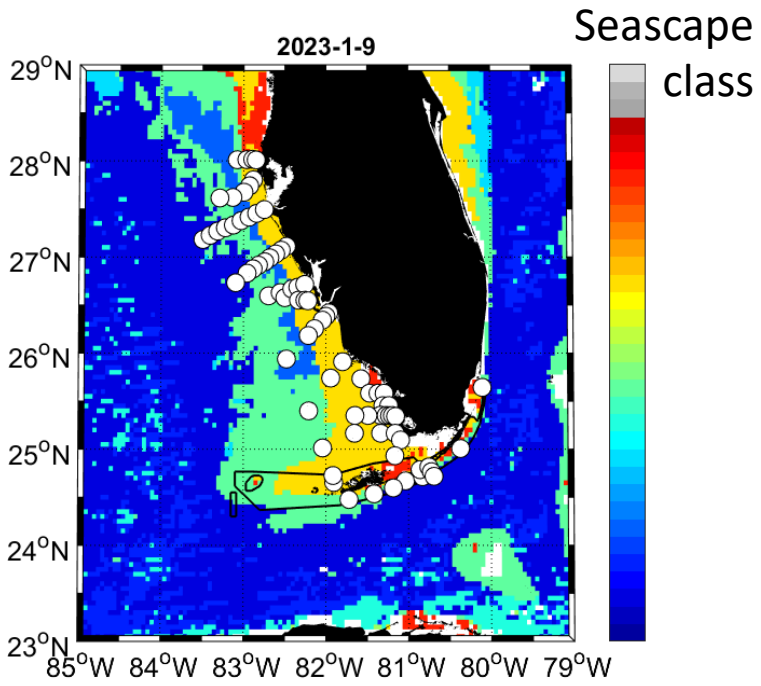
See Kavanaugh et al. 2016
ICES J. Mar. Sci.: 10.1093/icesjms/fsw086

Integrating field plankton and satellite seascapes observations

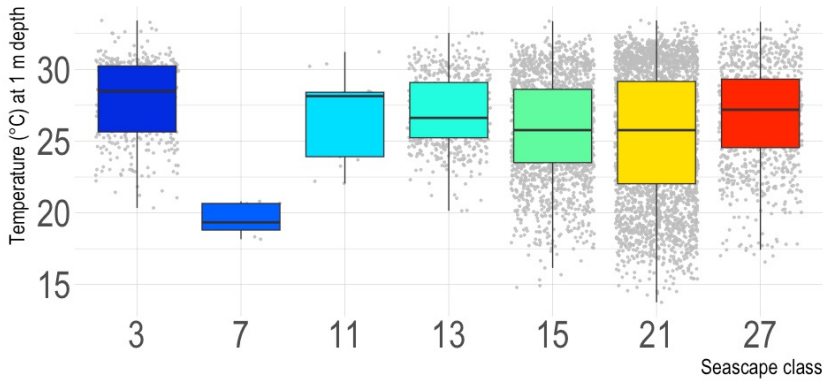


- 7 surveys every 6 weeks between Dec 2022 and Nov 2023
- 5 dominant seascape classes occupied
- 1,723 zooplankton records
- 7,093 phytoplankton records

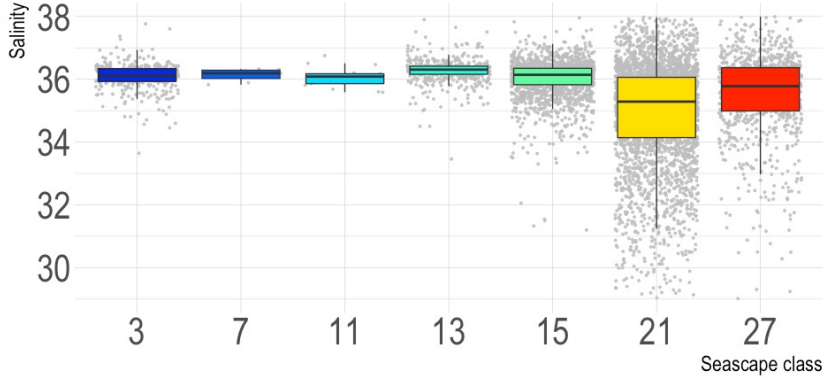
Physical / biogeochemical makeup of seascapes – *in situ* (2003-present)



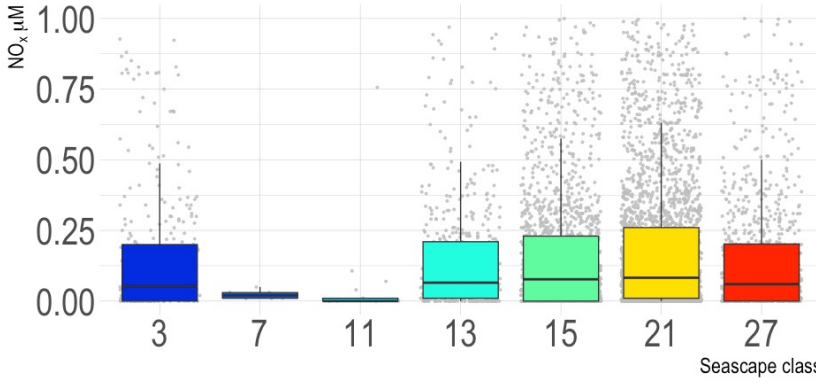
Temperature



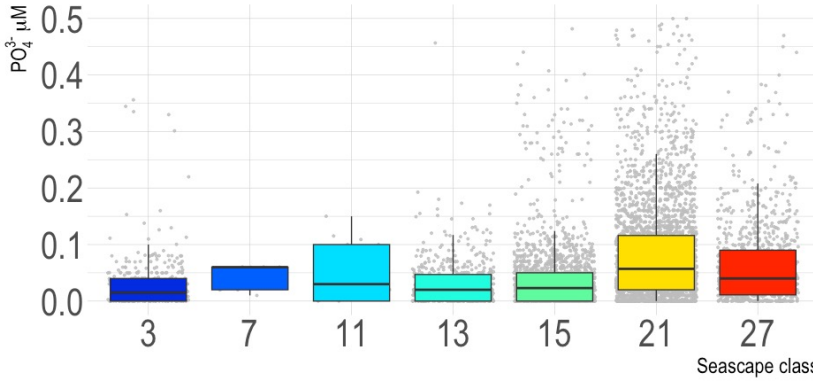
Salinity



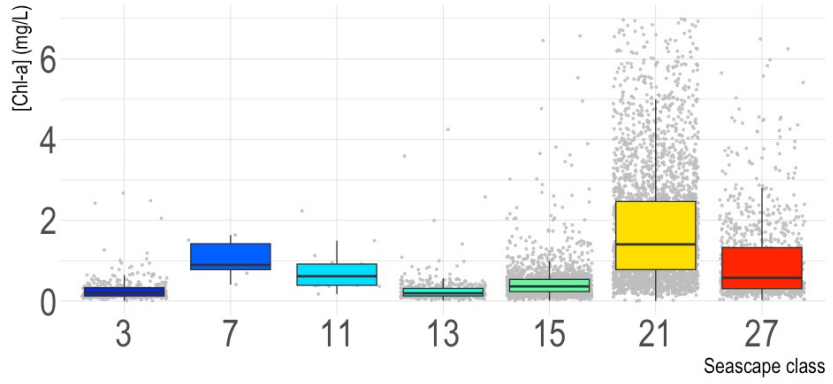
$NO_3 + NO_2$



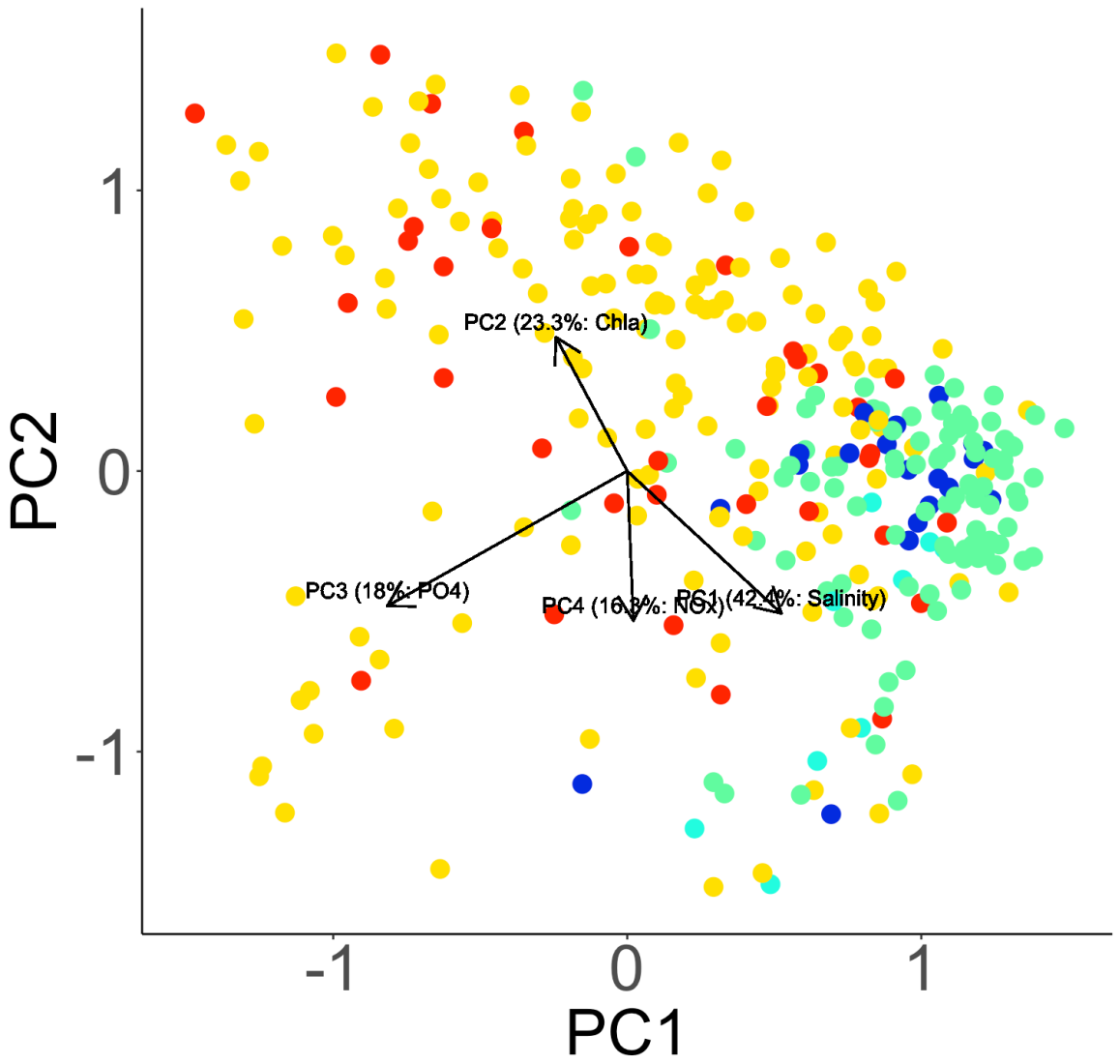
PO_4^{3-}



Chlorophyll *a*

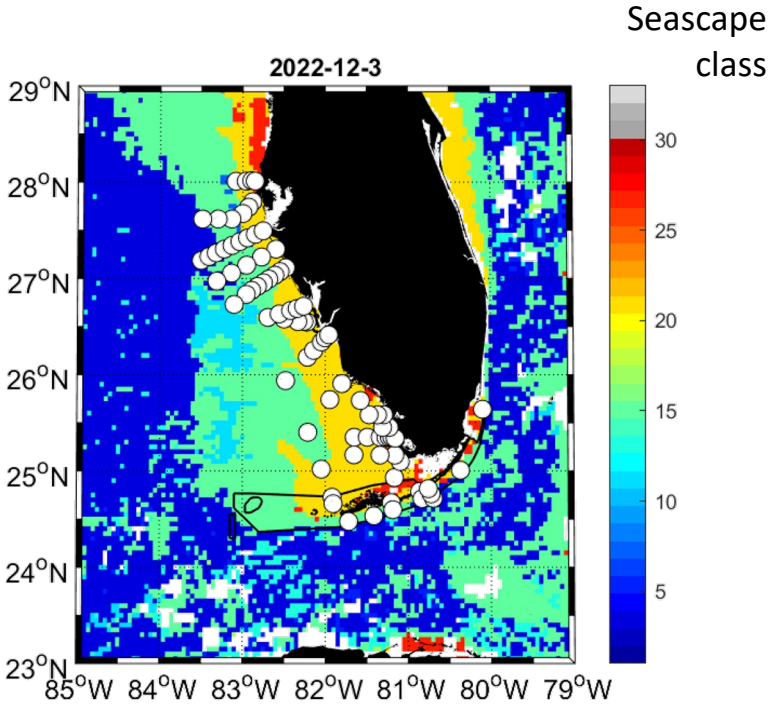


Physical / biogeochemical makeup of seascapes – *in situ*

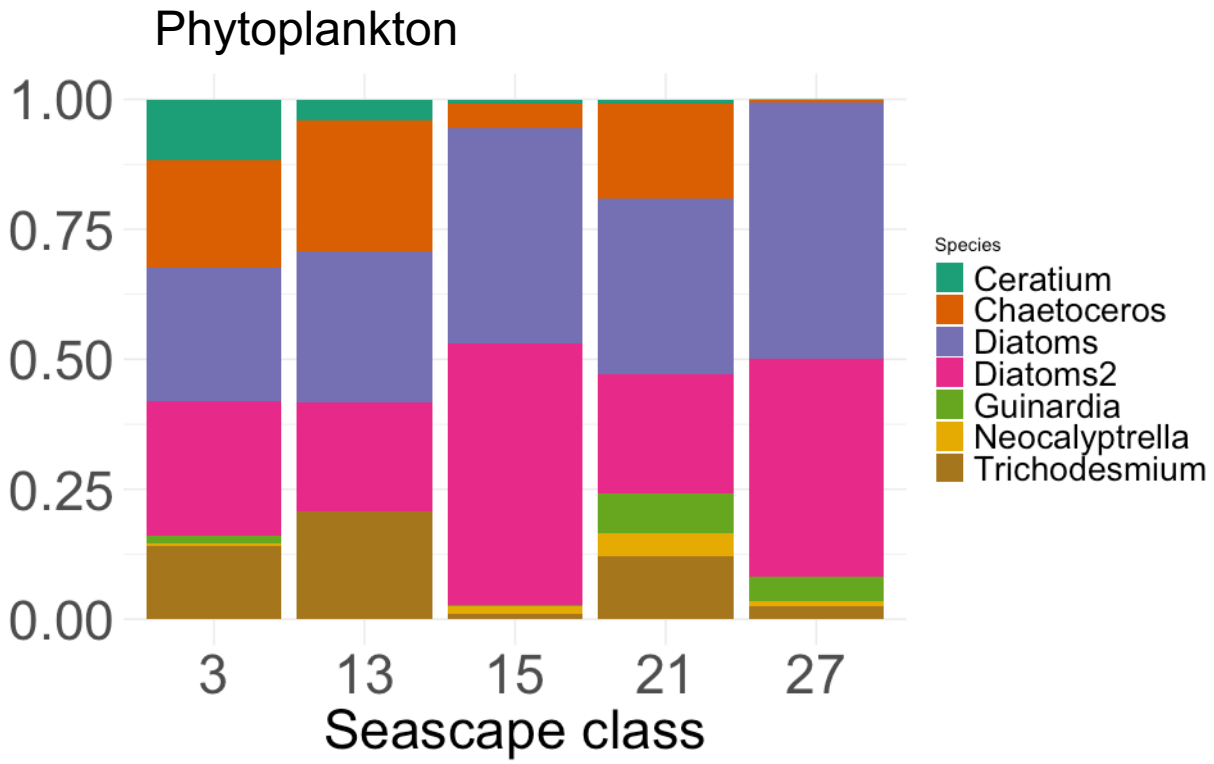


seascape

- 3 Tropical/Subtropical Transition
- 13 Subtropical Gyre Mesoscale Influenced
- 15 Tropical Seas
- 21 Warm, Blooms, High Nuts
- 27 Hypersaline Eutrophic, Persian Gulf, Red Sea

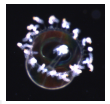


Plankton relative abundance per sampled seascape class

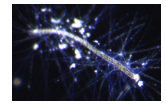


Plankton affinities to seascapes

Copepods

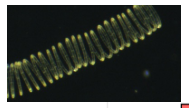


Gelatinous

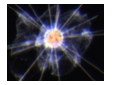


Chaetoceros

Echinoderms



Guinardia striata



Acantharea

Counts / seascape frequency * 1000

Seascape Class

Seascape Class

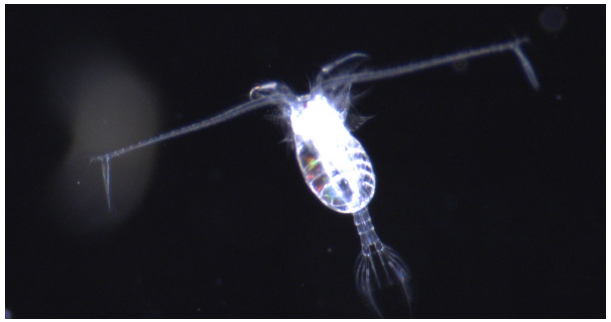
Seascape Class

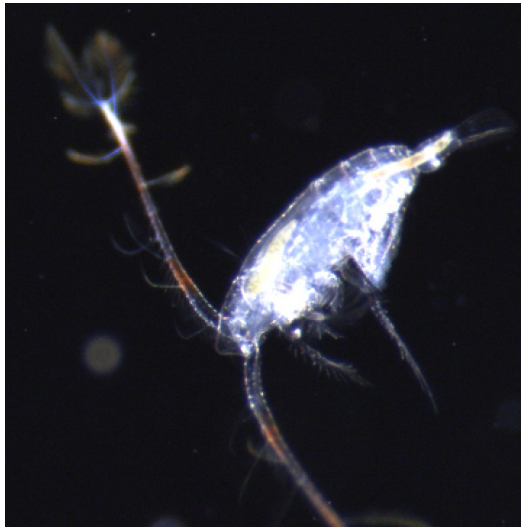
Seascape Class

Seascape Class

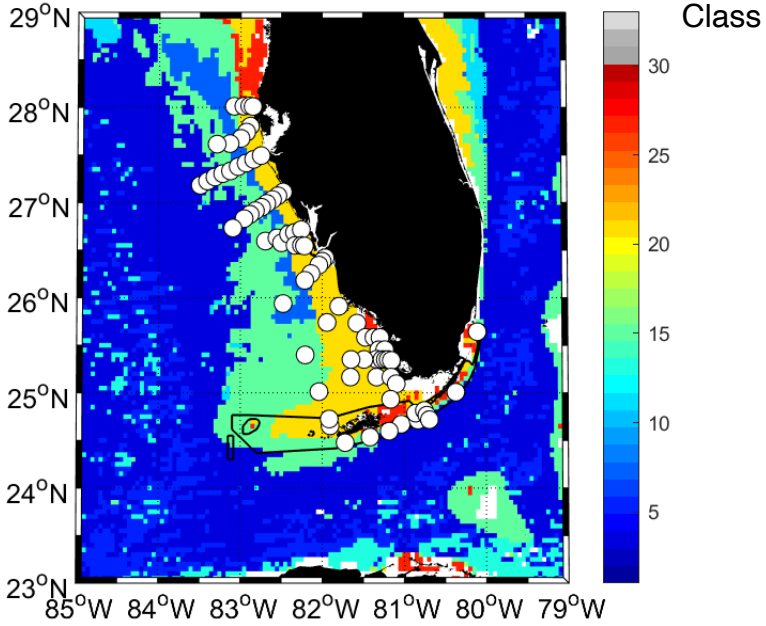
Seascape Class

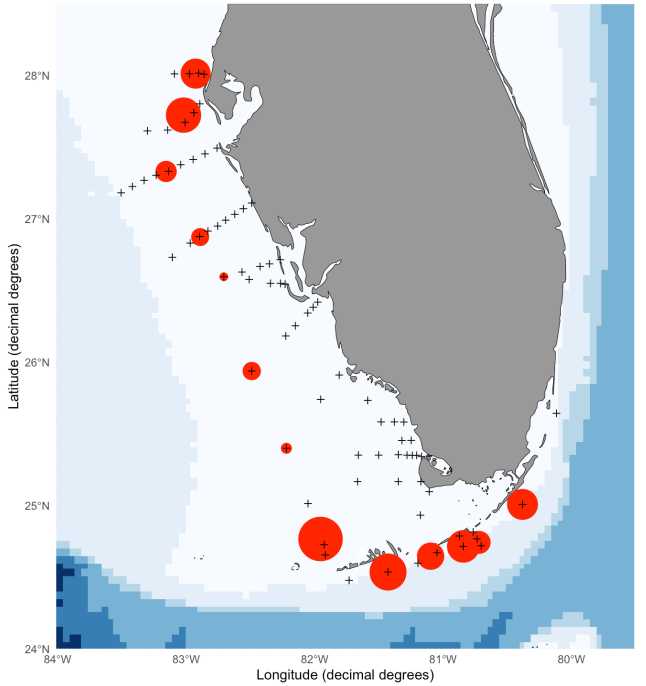
Copepods:
e.g. Calanoida, Cyclopoida, Harpacticoida

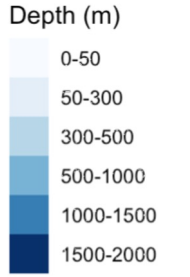




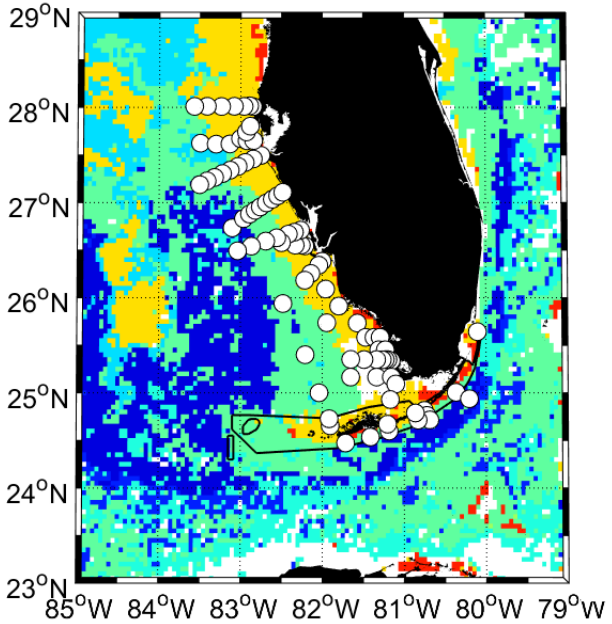
January 1-9, 2023

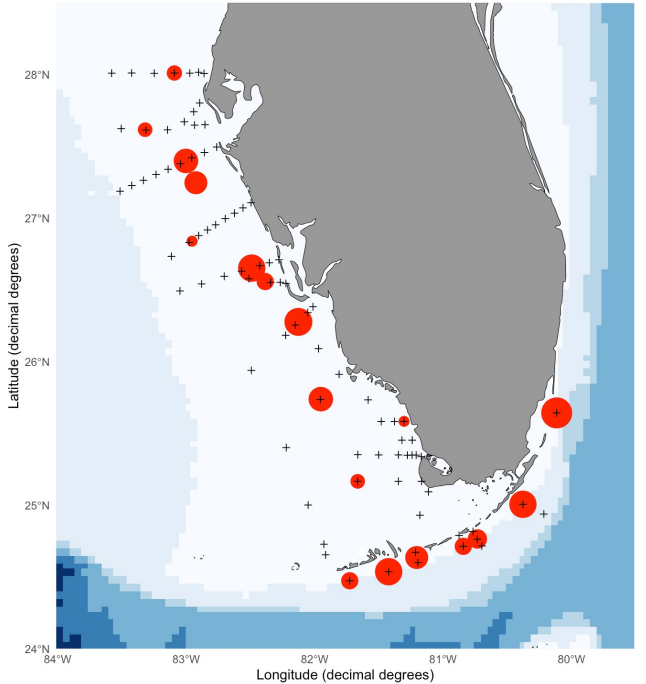




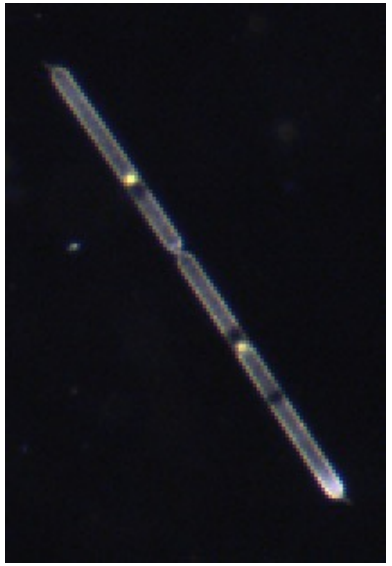


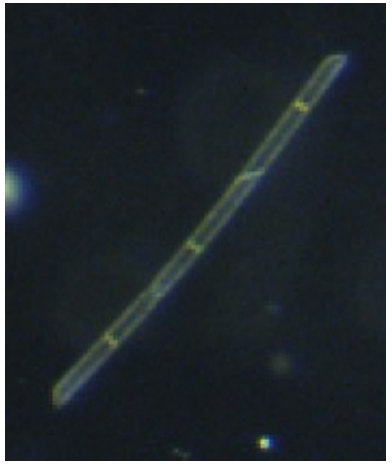
September 16-22, 2023



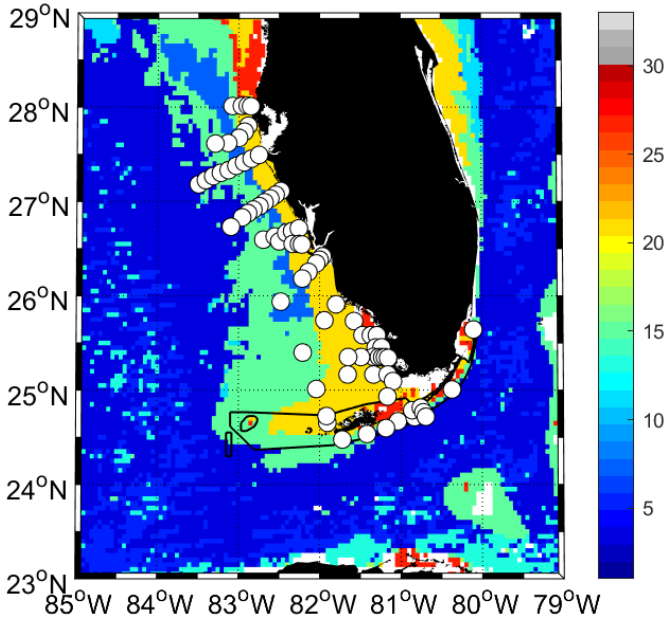


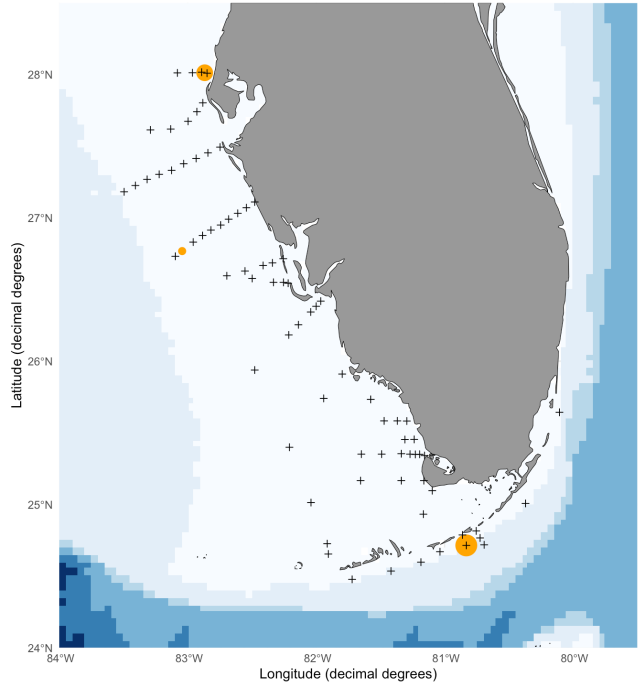
Chain diatoms:
e.g. *Proboscia alata.*
Pseudosolenia spp.

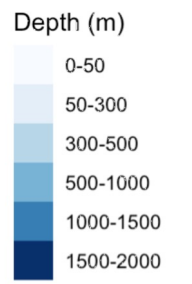


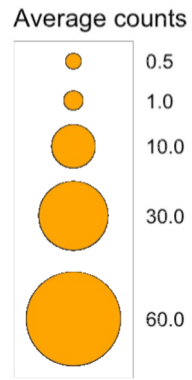


January 1-9, 2023

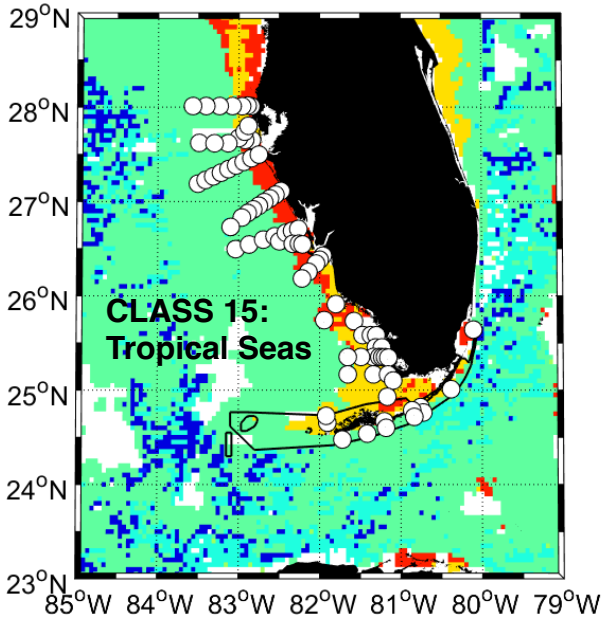


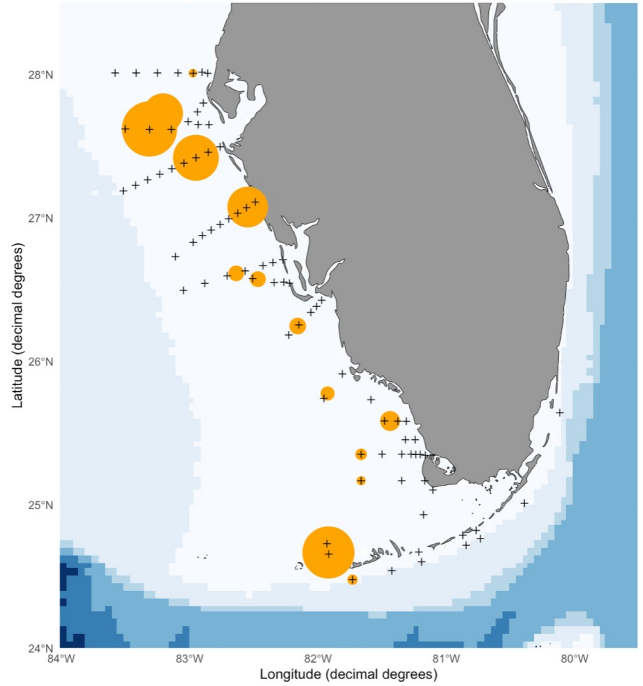




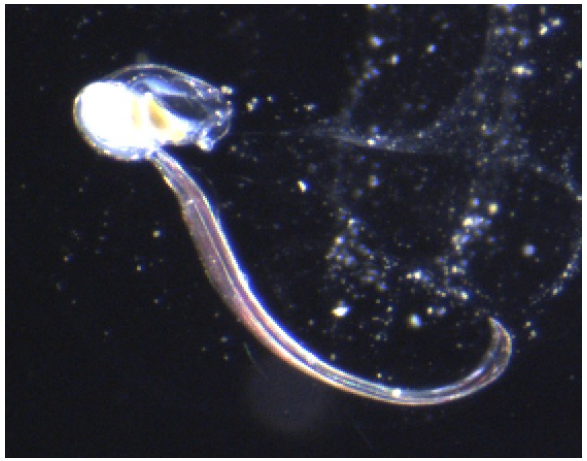


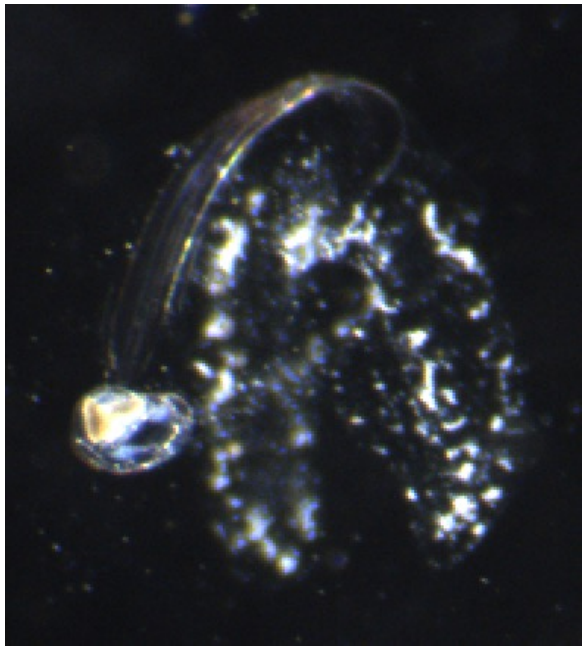
November 10-15, 2023

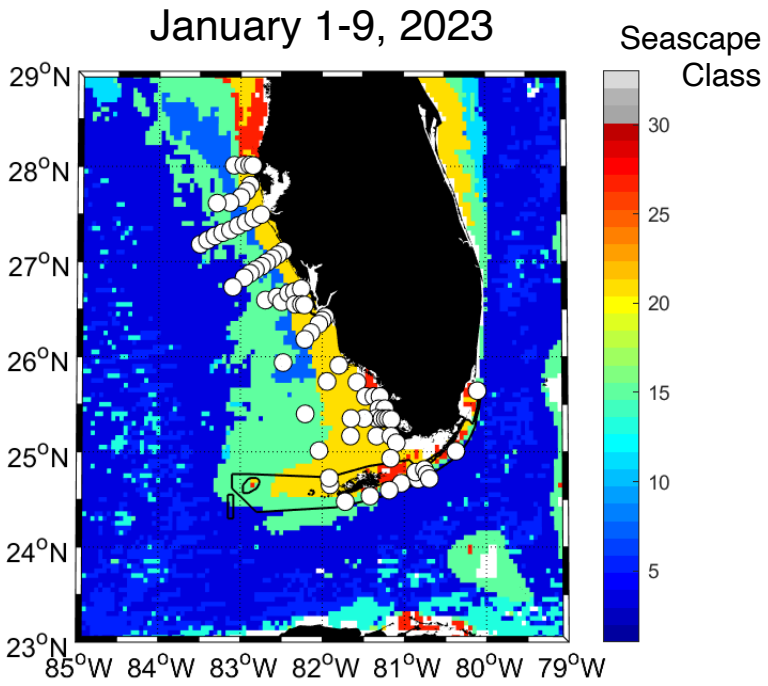


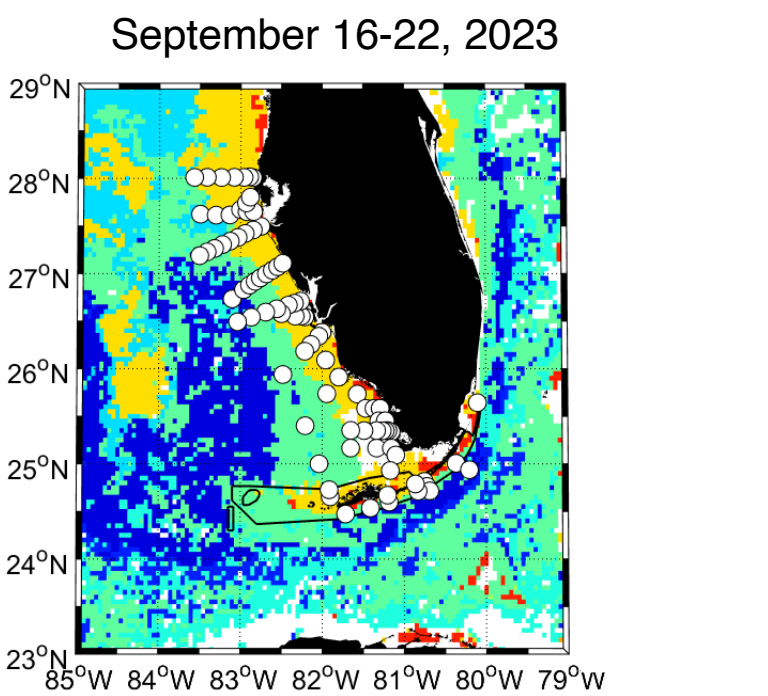


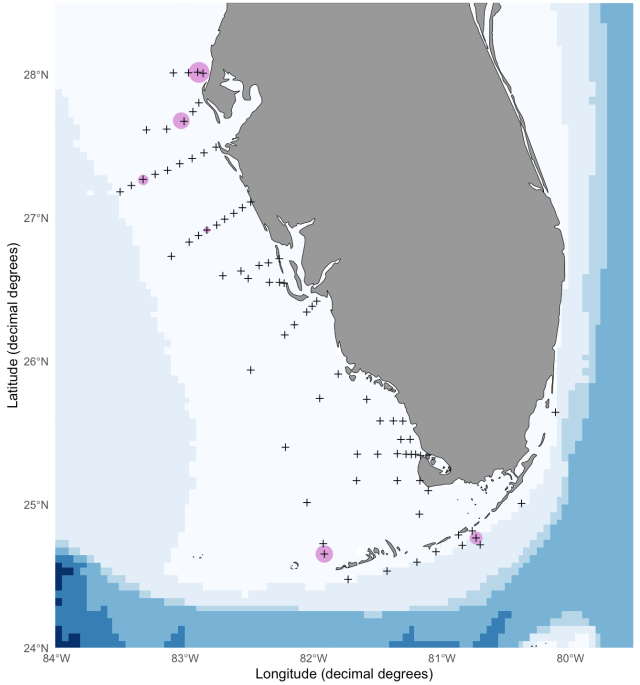
Appendicularia:

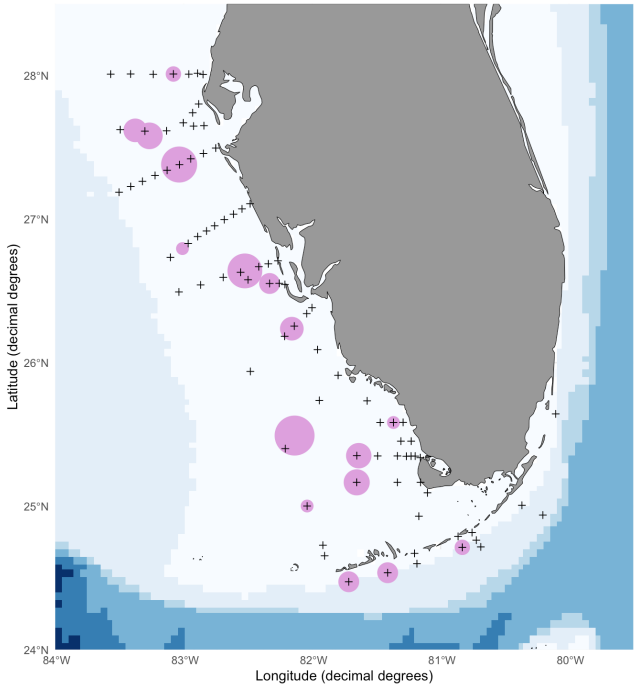


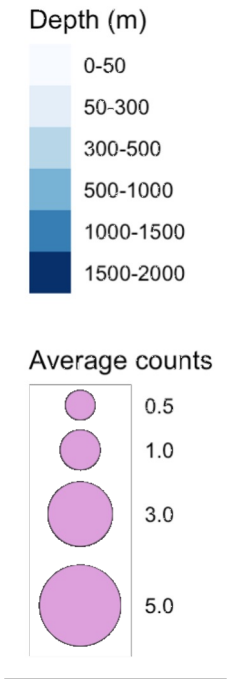












Conclusions

- Satellite seascape carry distinct physical and biogeochemical properties
- Chain diatoms and appendicularians showed high preference for nutrient-rich, coastal seascapes
- *Acantharea spp* and echinoderm larvae had strong affinity to low-nutrient seascapes
- Challenges:
  - Taxonomic identification
  - Resolving taxonomy to species level
  - Imagery metadata standards not readily available
  - No common approaches for automated classifications
  - In situ imaging very limited in turbid waters

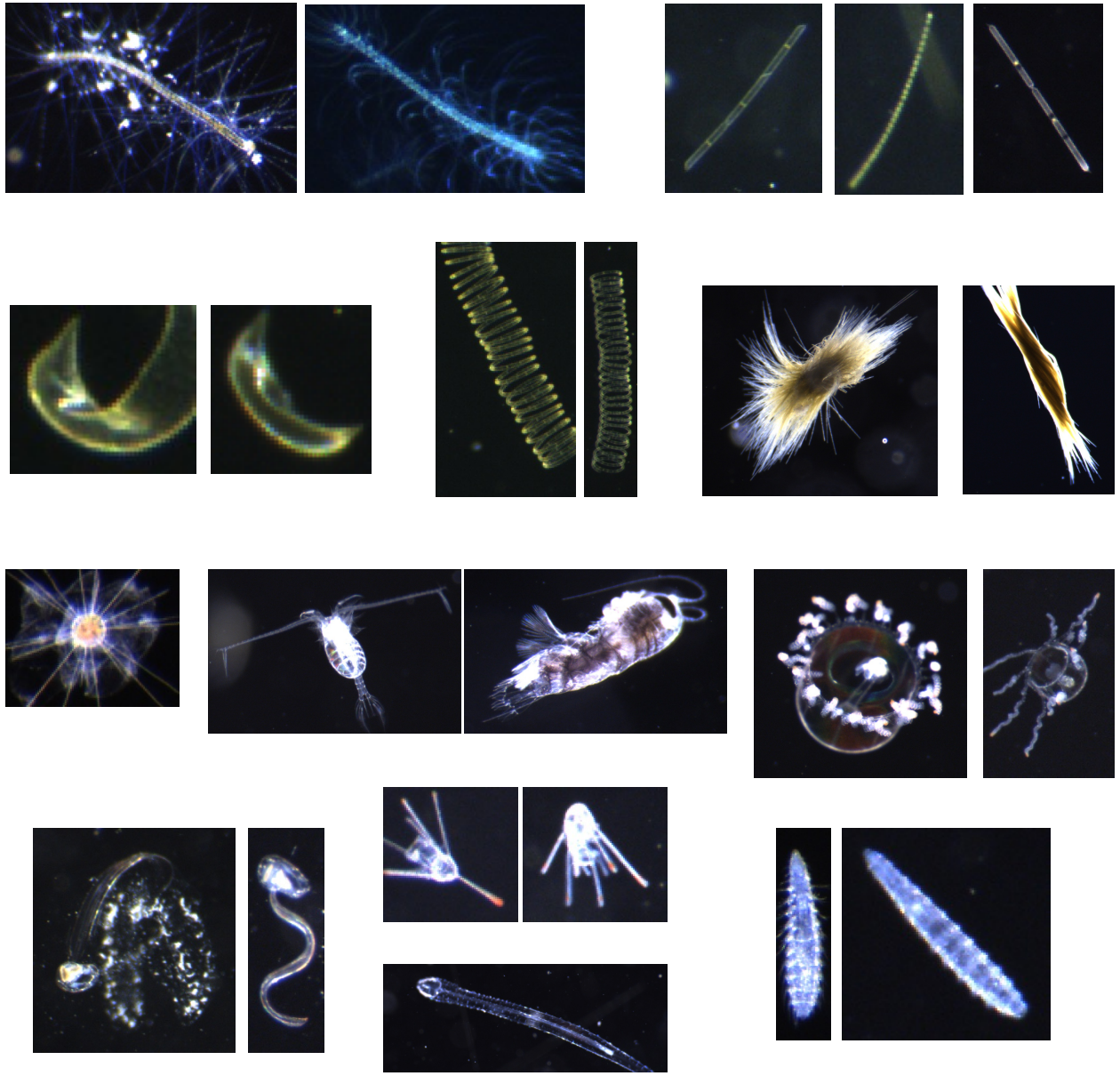


Image-based Zooplankton and Phytoplankton Essential Ocean Variables in South Florida Waters Contributed by the U.S. Marine Biodiversity Observation Network Program.

NASA

NOPP

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Thank you!