



OCEAN
OBSERVATORIES
INITIATIVE

The Pioneer NES Array

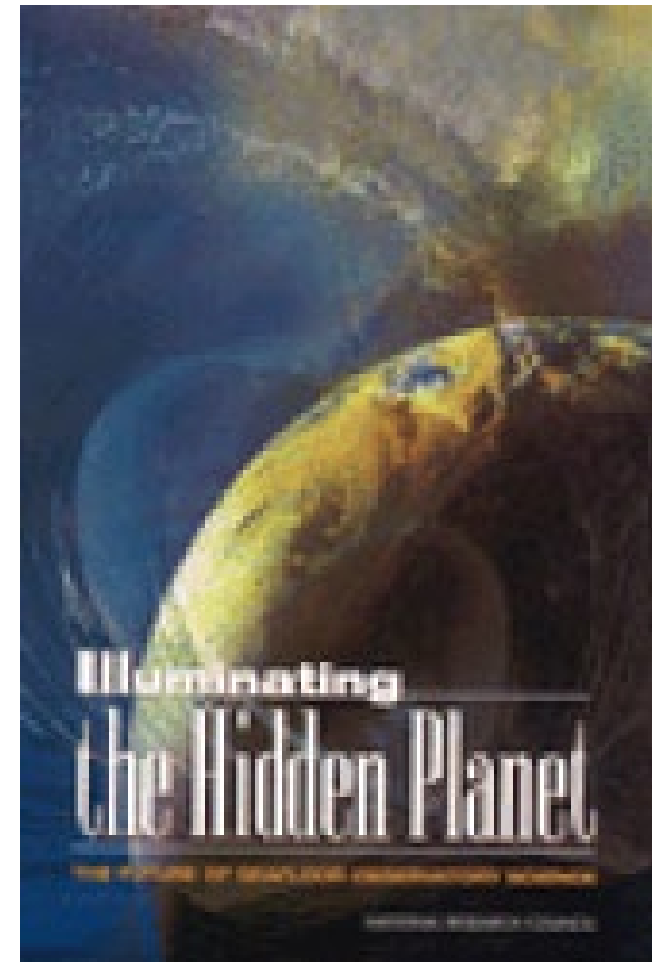
Al Plueddemann and the CGSN Team

OOIFB MAB Workshop
10-12 Sep 2024

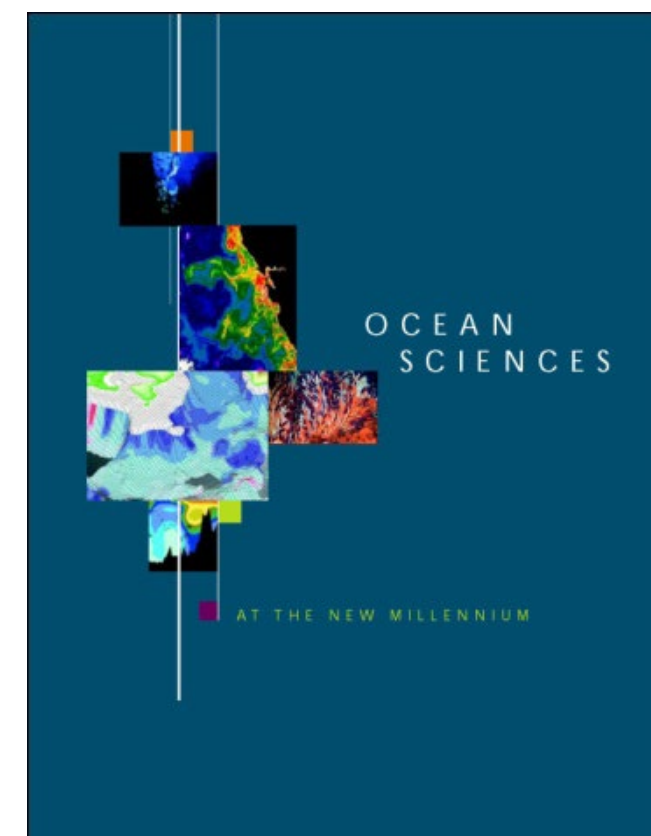


The Ocean Observatories Initiative (OOI)

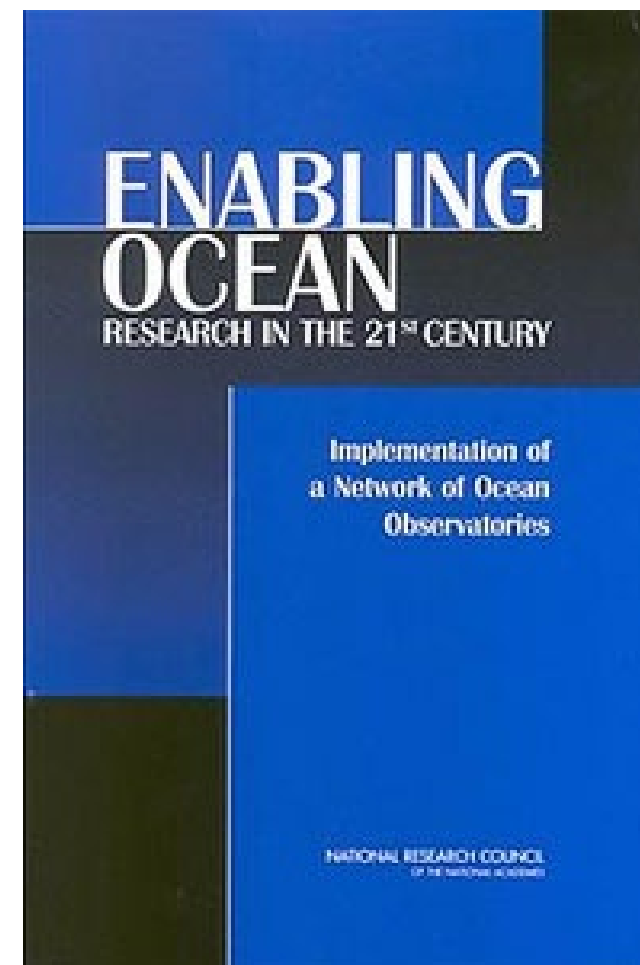
NSF developed the OOI based on years of community-wide scientific planning efforts, both nationally and internationally



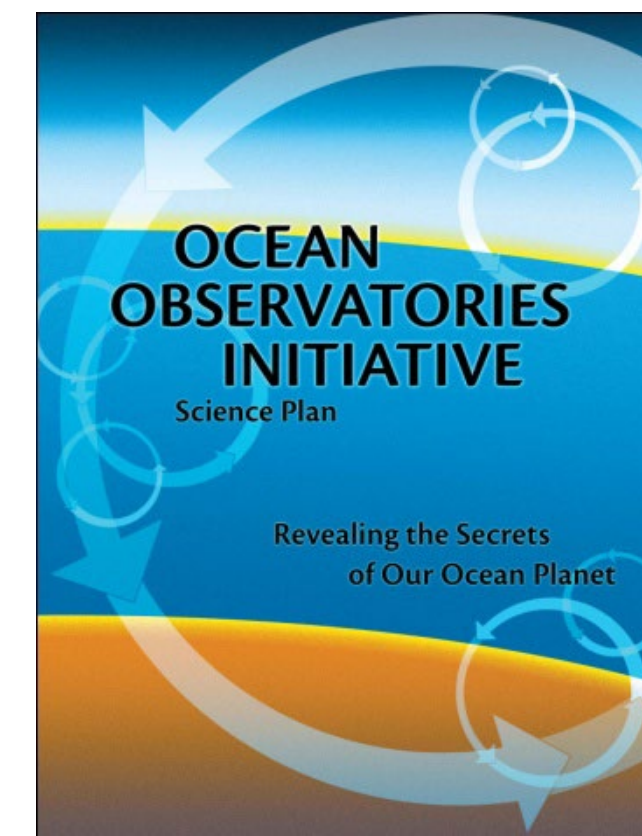
2000



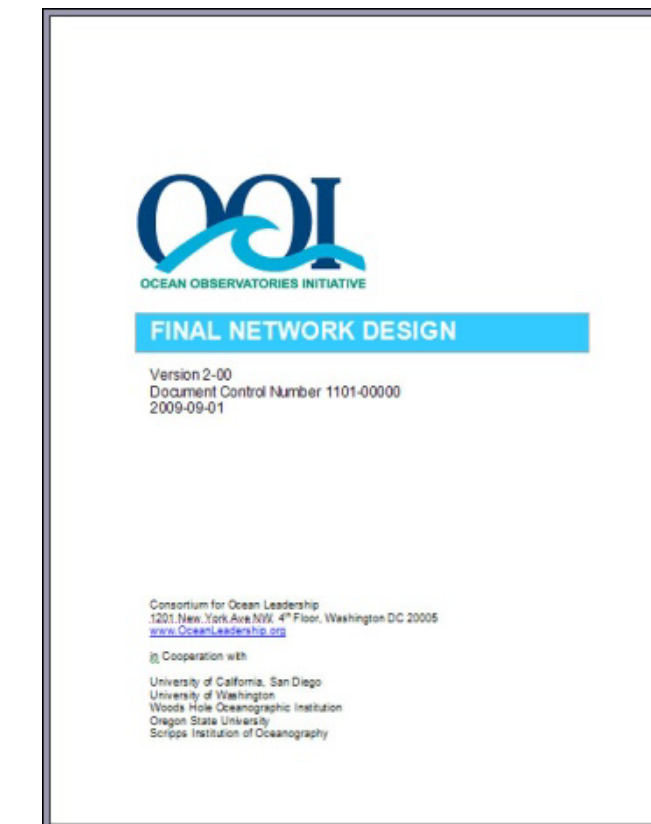
2001



2003



2005



2009



NSF Request for Assistance (RFA)

Proposals

- Prepared 2004, reviewed 2005

Award

- No funds would be awarded!
- Results folded into OOI design process

New England Shelf (NES) Pioneer Array was among the highly ranked proposals

REQUEST FOR ASSISTANCE



Ocean Research Interactive Observatory Networks:

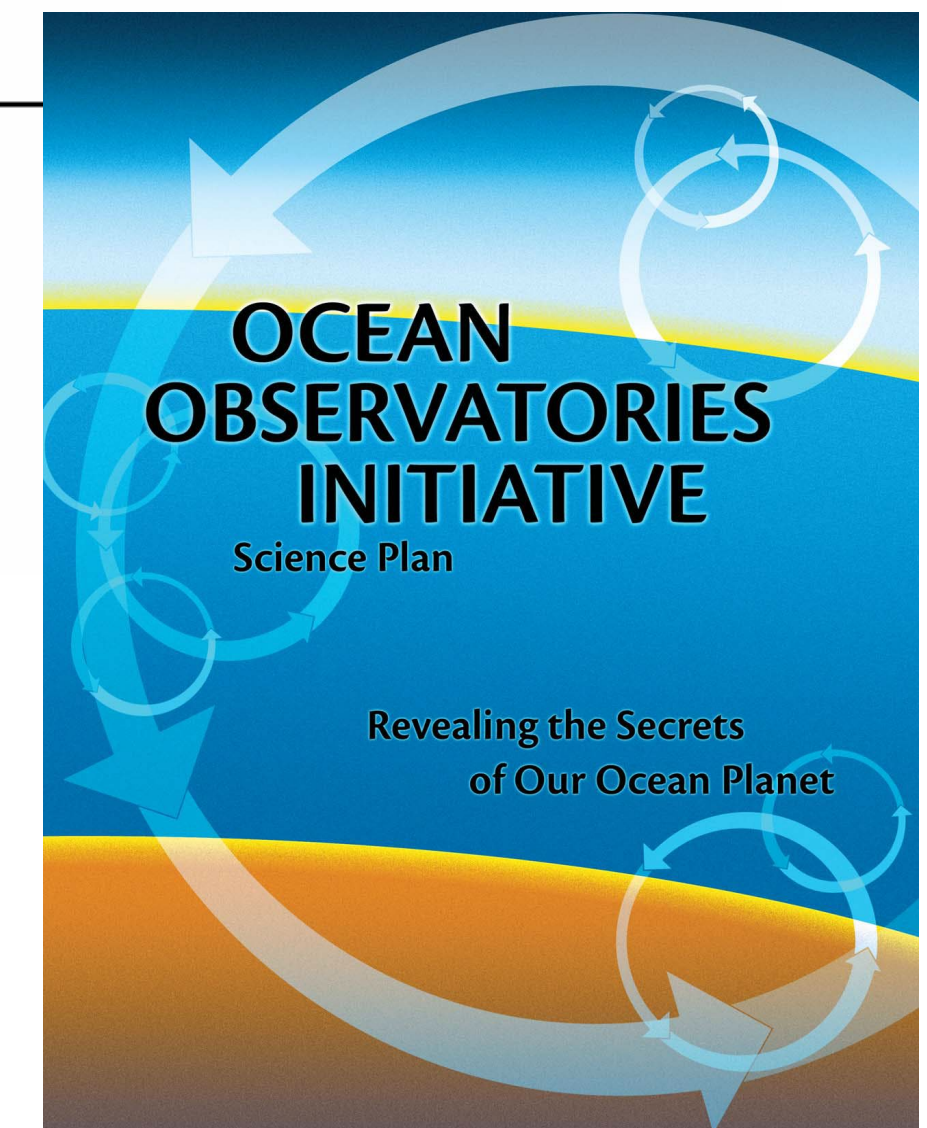
Conceptual Science Experiments for the Establishment of the Ocean Observatories Initiative Infrastructure

CONTACTS

Programmatic: Dr. Peter Milne (pmilne@joiscience.org)
Administrative: Ms. Emily Griffin (egriffin@joiscience.org)

TARGET DATES:

Letters of Intent (optional): March 14th 2005
Full Proposals: May 23rd 2005



The Pioneer NES Array

Overarching Theme:

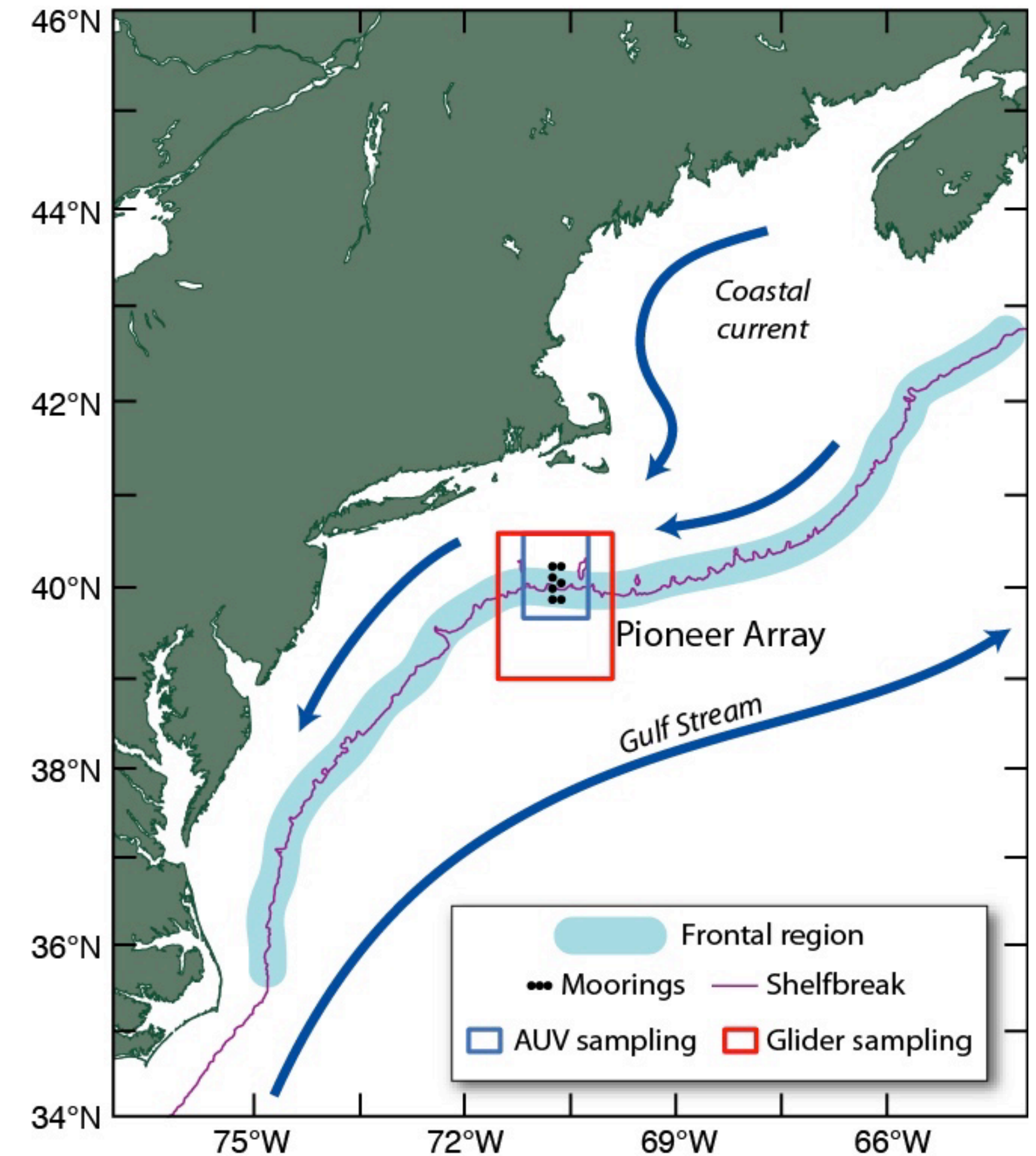
- Coastal Ocean Dynamics and Ecosystems

Key Question:

- How do shelf/slope exchange processes structure the physics, chemistry, and biology of continental shelves?

Site Characteristics:

- Northern MAB Shelf/Slope
- Prototypical shelfbreak system
- Well defined frontal zone



Pioneer and OOI Science Themes

Pioneer science maps onto four of the six OOI science themes:

- Coastal dynamics and ecosystems
- Ocean-atmosphere exchange
- Climate, circulation, and ecosystems
- Mixing and bio-physical interactions



2005



2007

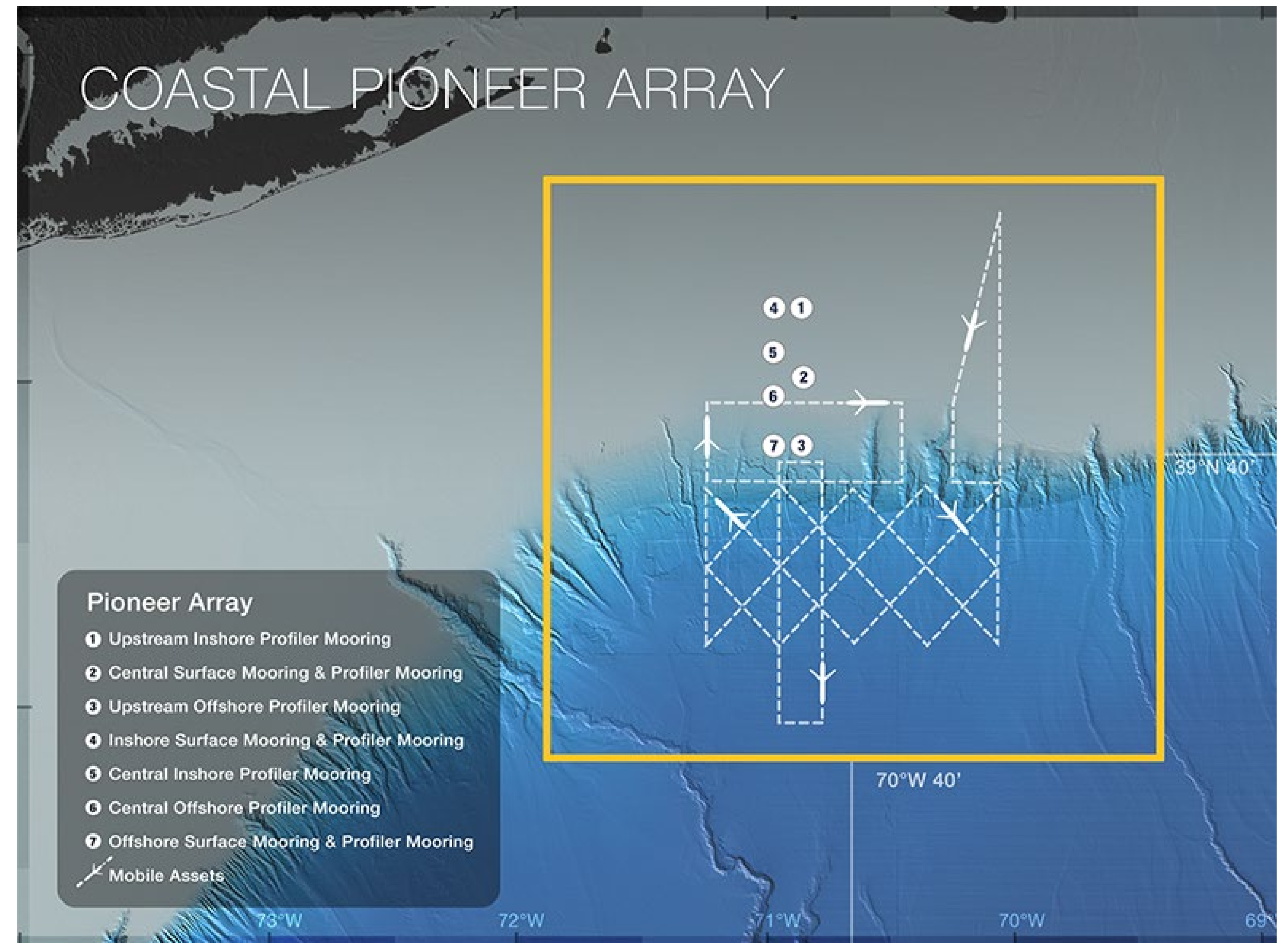


2021



Pioneer NES Observing Approach

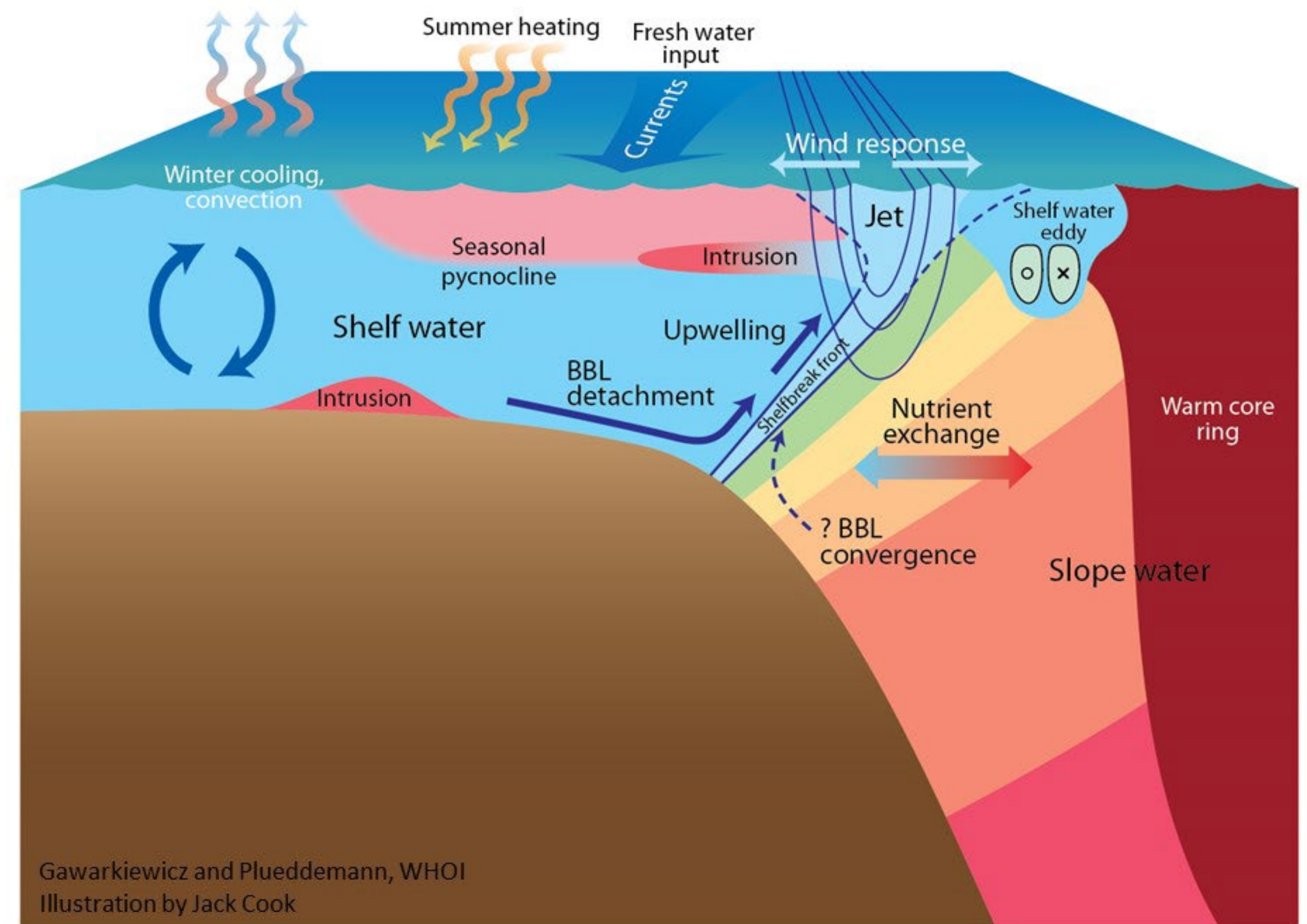
- Multi-platform, multi-scale
- 10 moorings at 7 sites
 - Mooring pairs at 3 sites
 - Array spans the shelfbreak
- 5 gliders on 4 track lines
 - Upstream and slope sea
- 2 AUVs
 - Transects around moorings
- ~7 years of operation
 - Spring 2016 - Fall 2022



Shelf Break Processes

- Winter storms
- Summer heating
- Fresh water input
- Salinity intrusions
- Convergence zone
- Frontal instabilities
- Shelf-water eddies
- Warm-core rings

- Others?



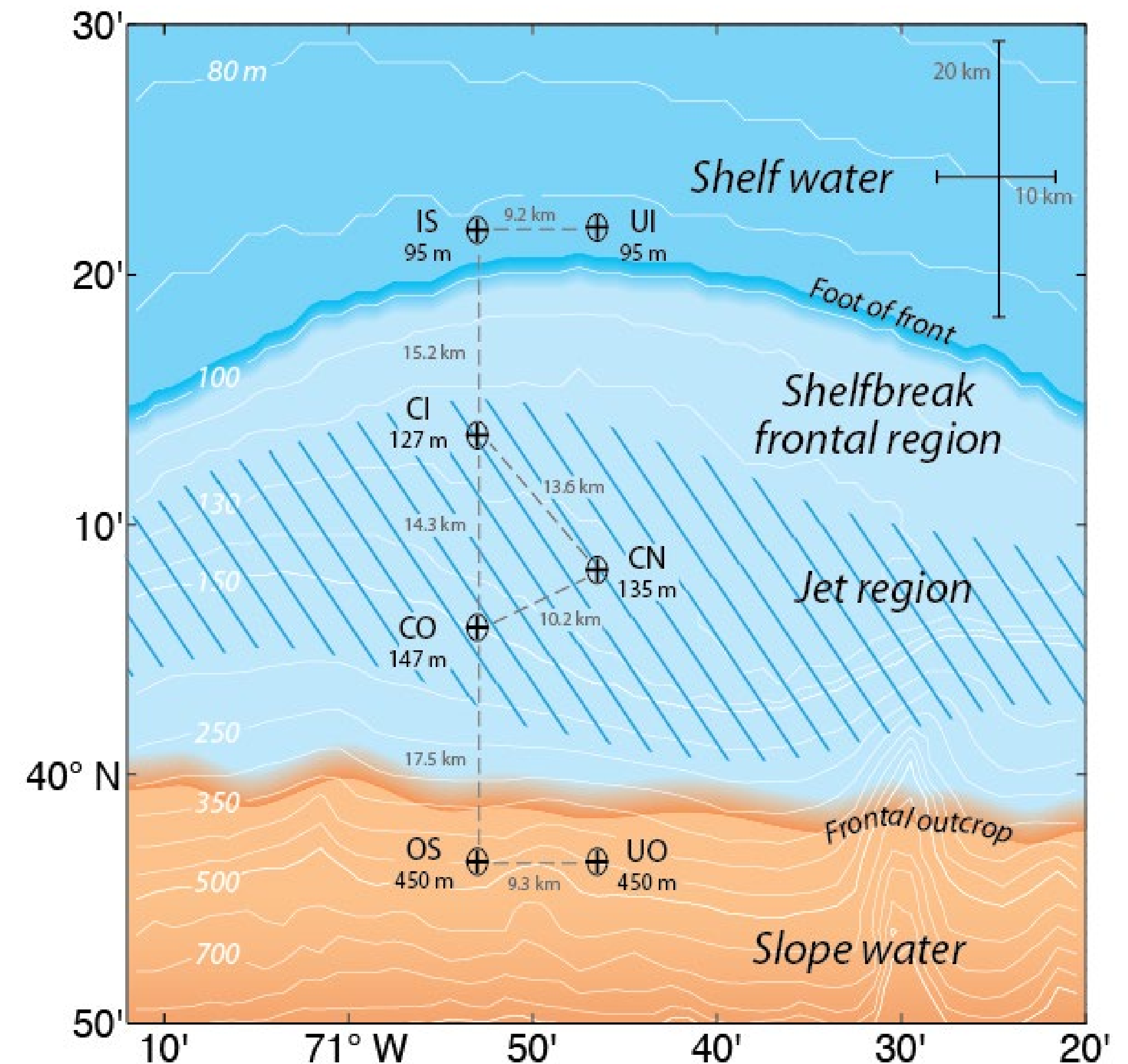
Gawarkiewicz and Plueddemann, 2020



Pioneer NES Moored Array

- Inshore moorings: Shelf water
- Central triangle: Jet region
- Offshore moorings: Slope water

- Array extent matches typical frontal extent
- Array spacing matches expected correlation scales

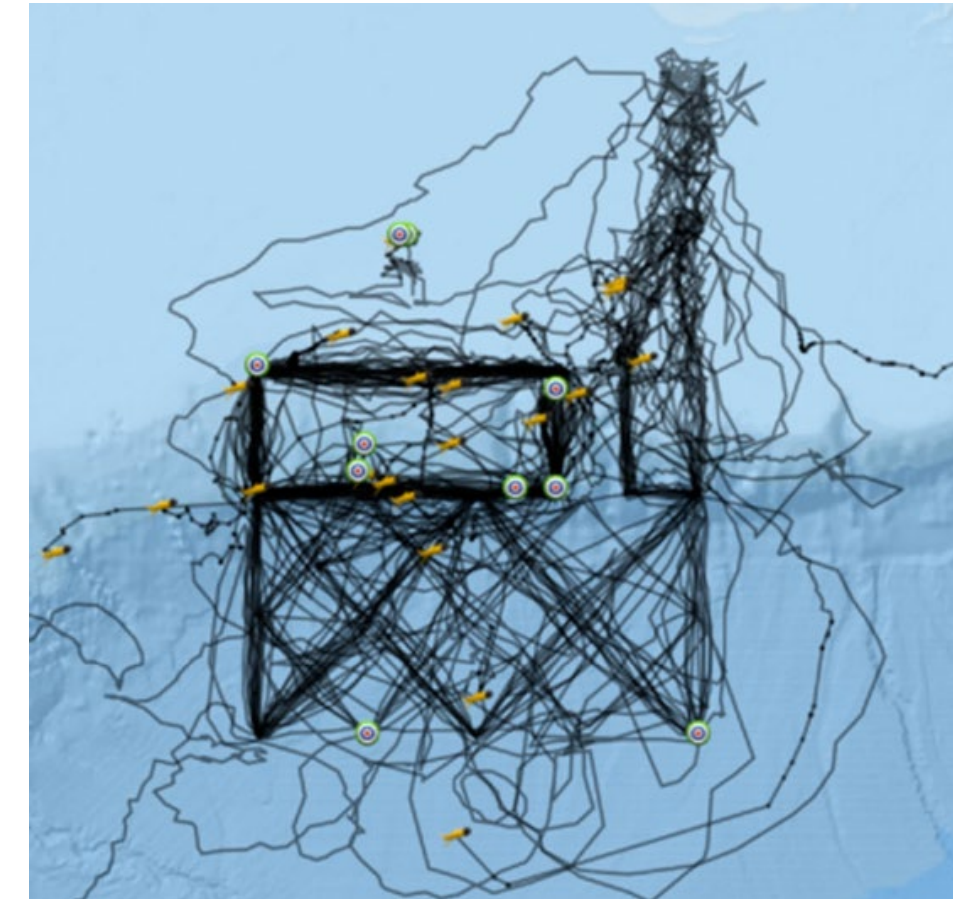


Gawarkiewicz and Plueddemann, 2020

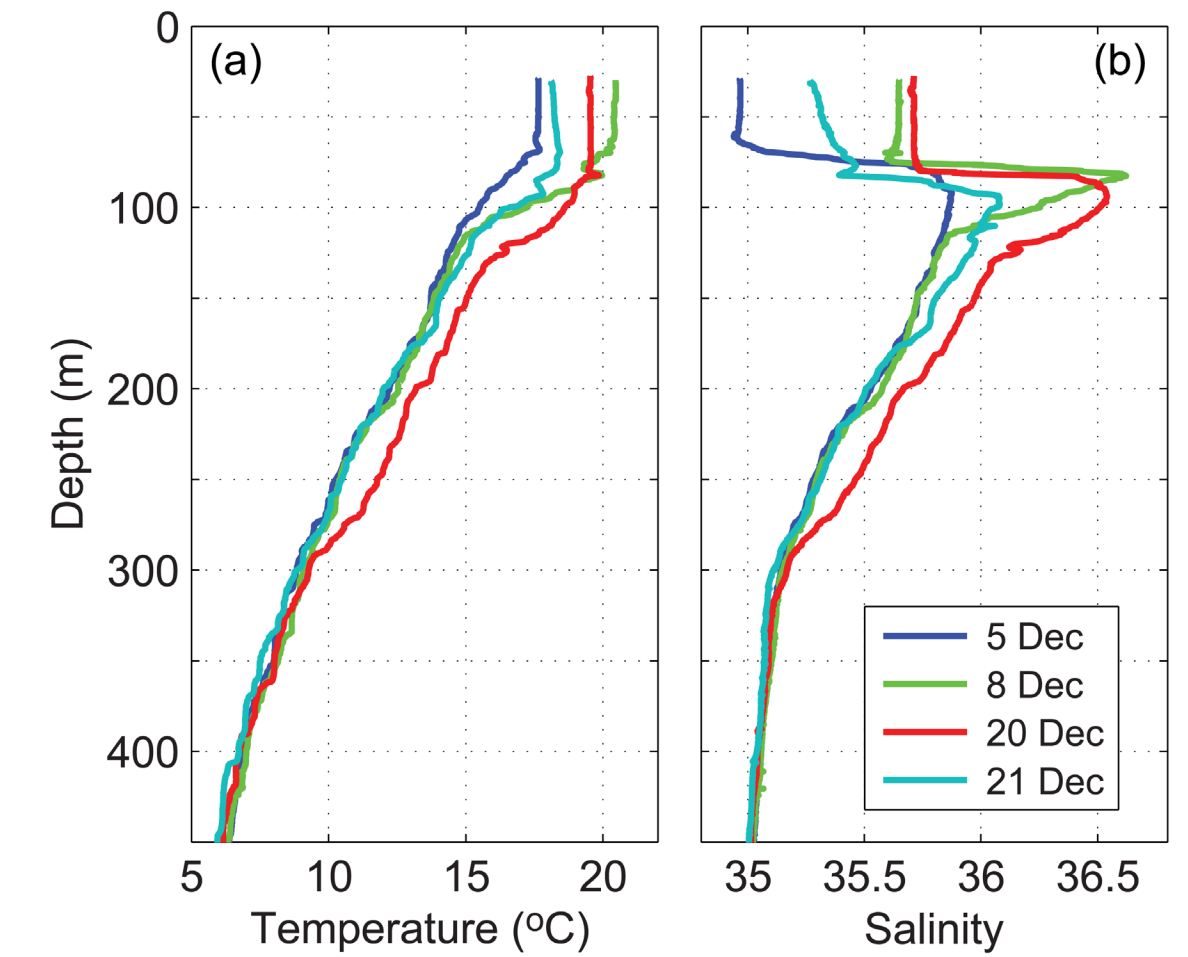


Early Returns

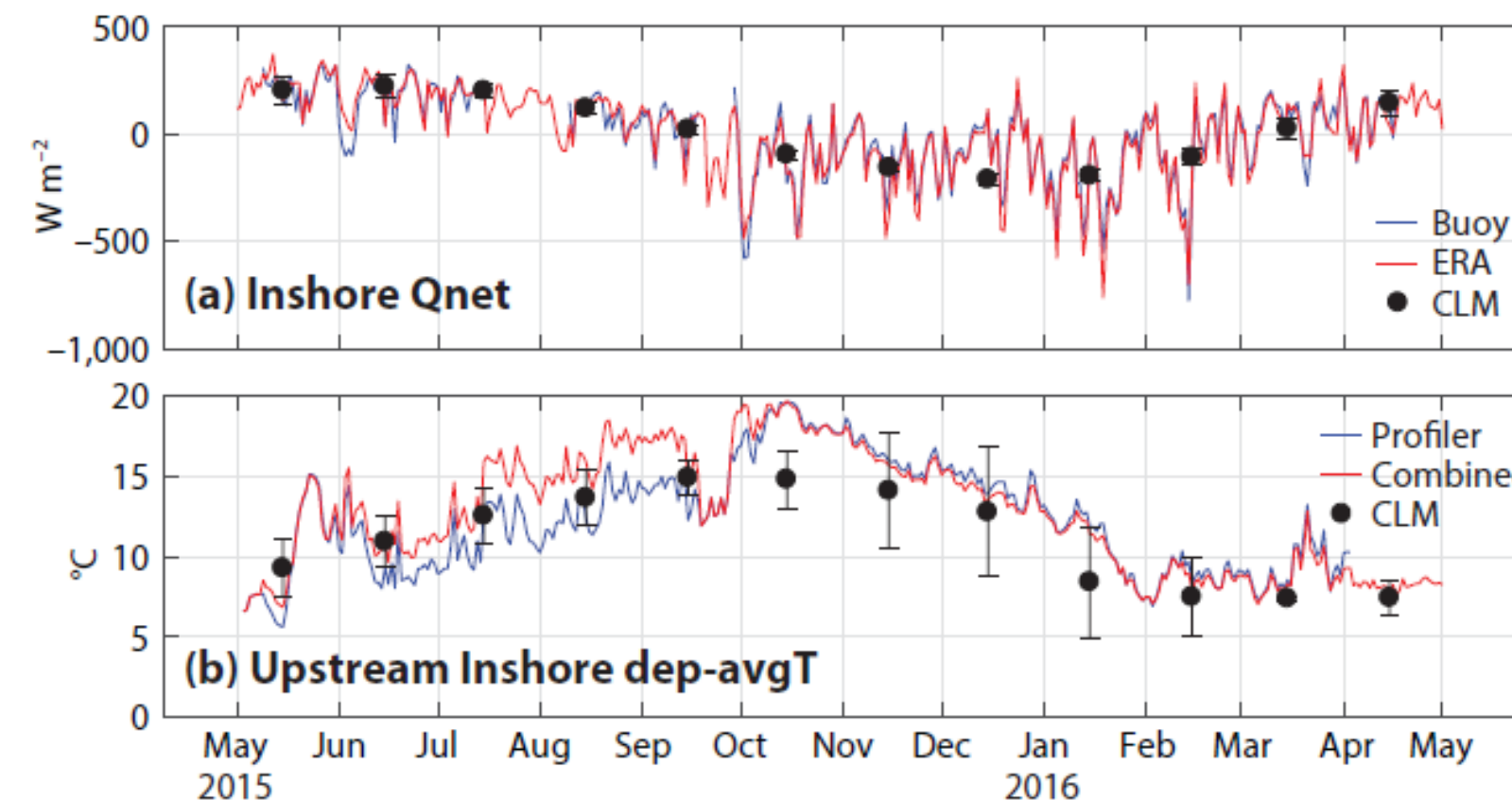
- Air-sea fluxes from buoys
- Subsurface variability from profilers
- Eddies and streamers from gliders
- Snap-shots of frontal structure from AUVs
- Multi-disciplinary variables from NSIF and MFN



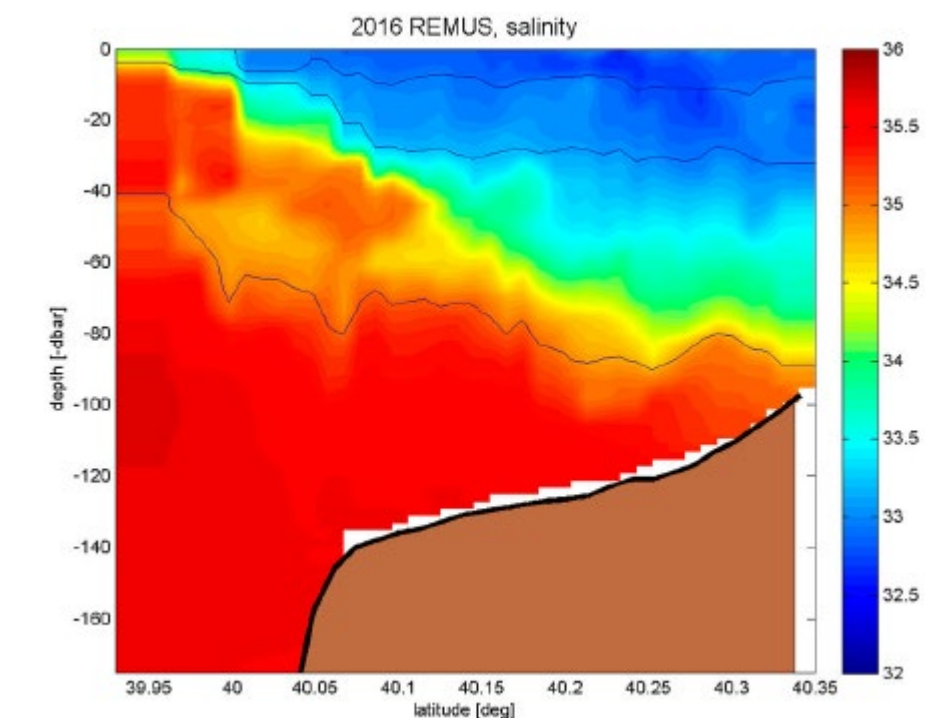
Gawarkiewicz and Plueddemann 2020



Gawarkiewicz et al., 2012



Chen et al., 2018

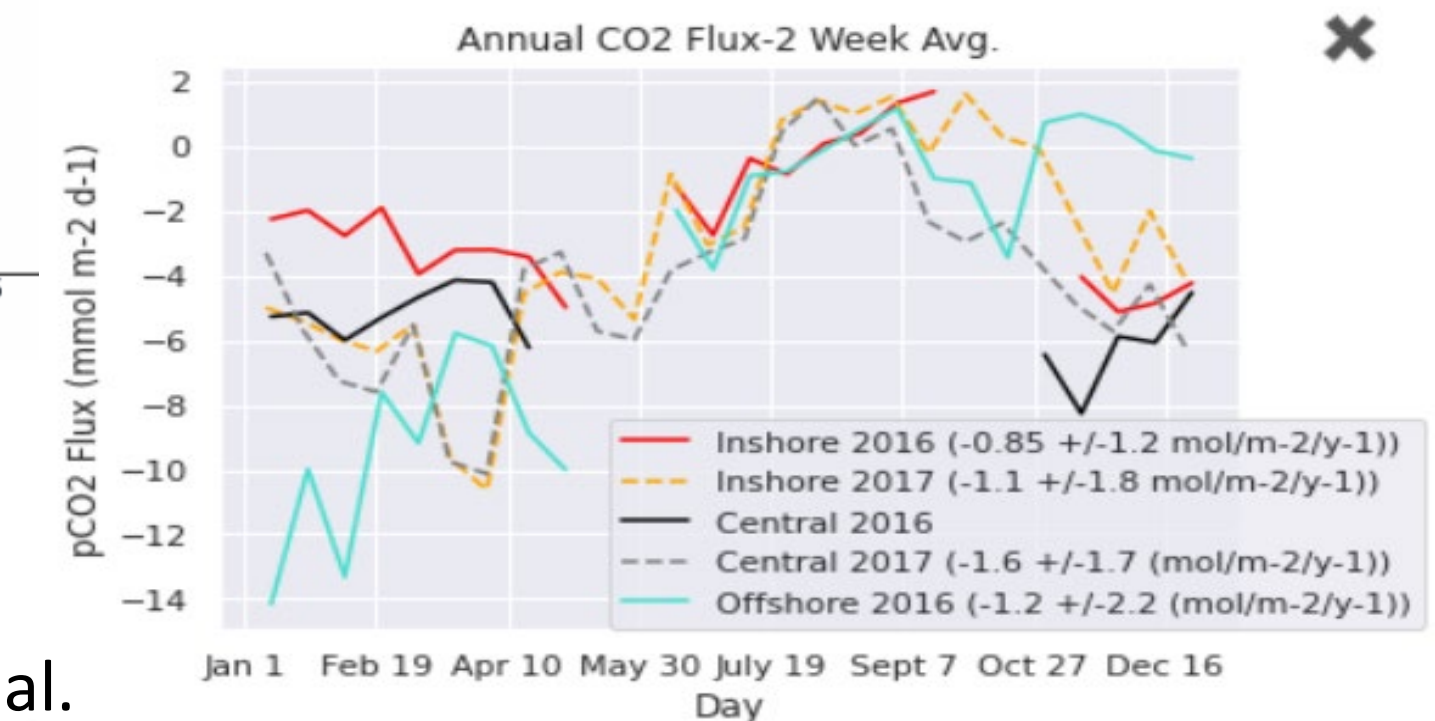
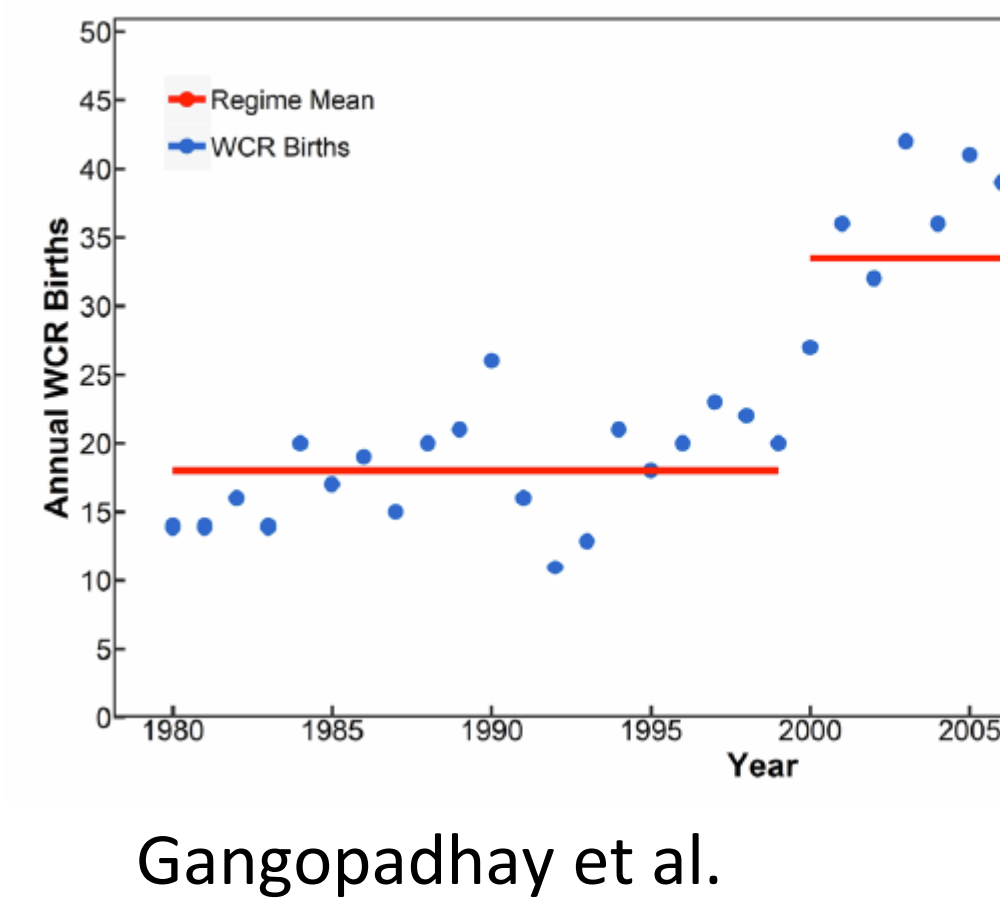
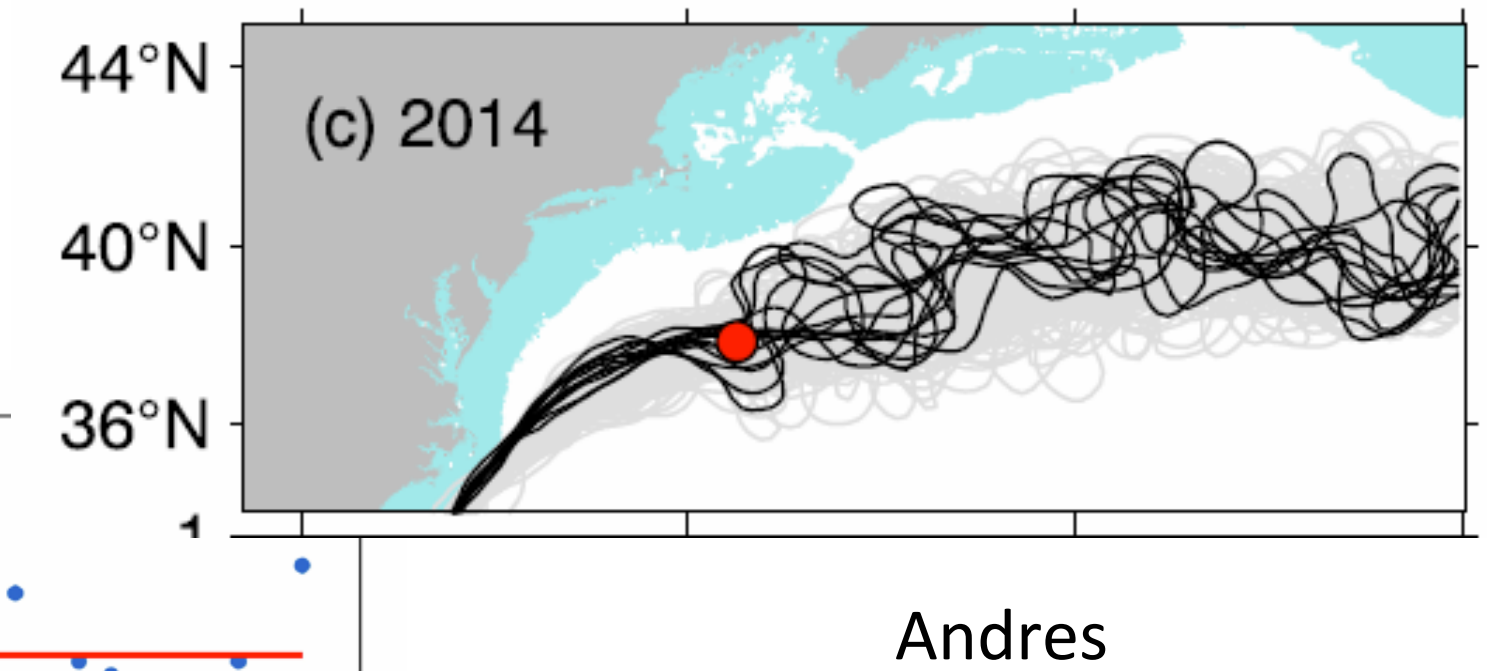
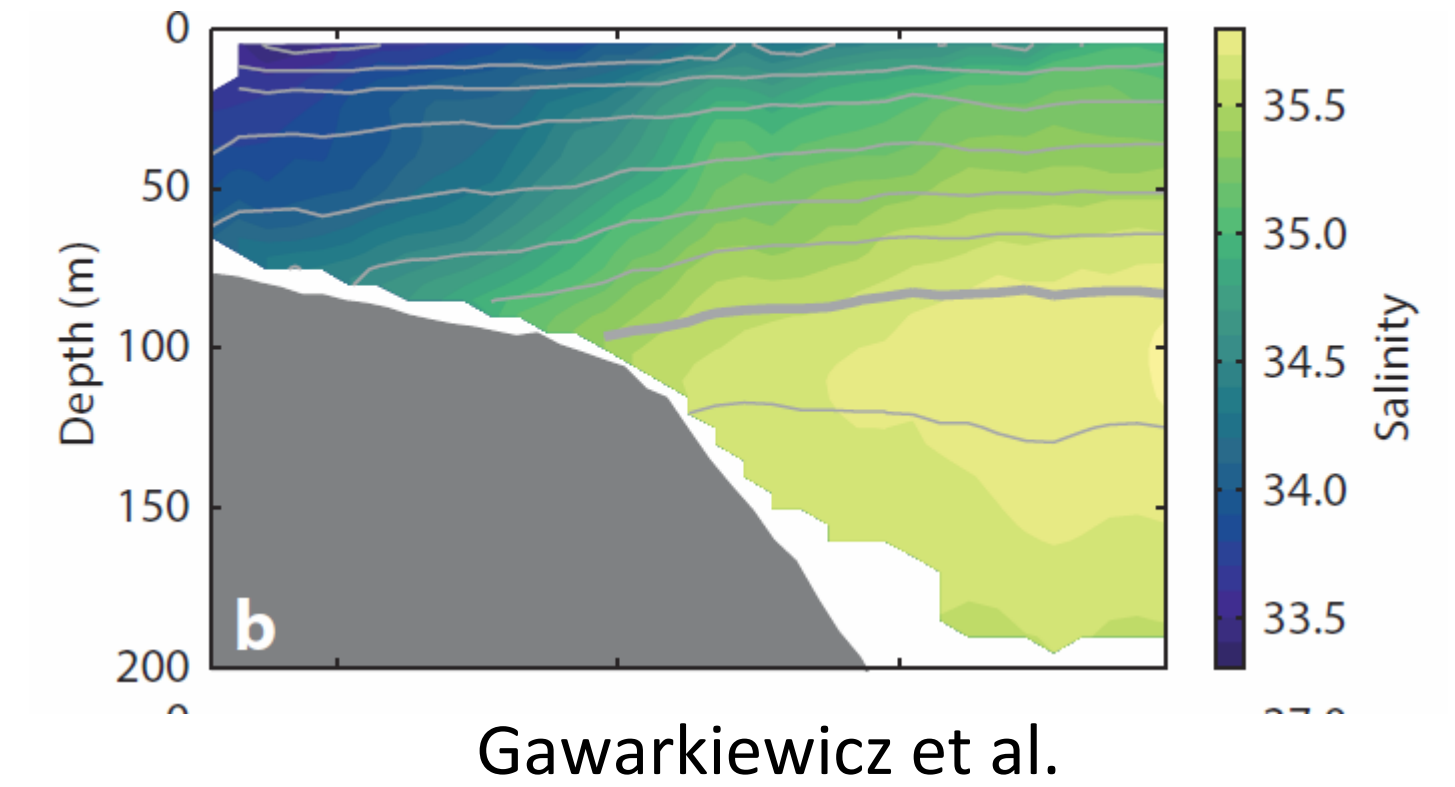
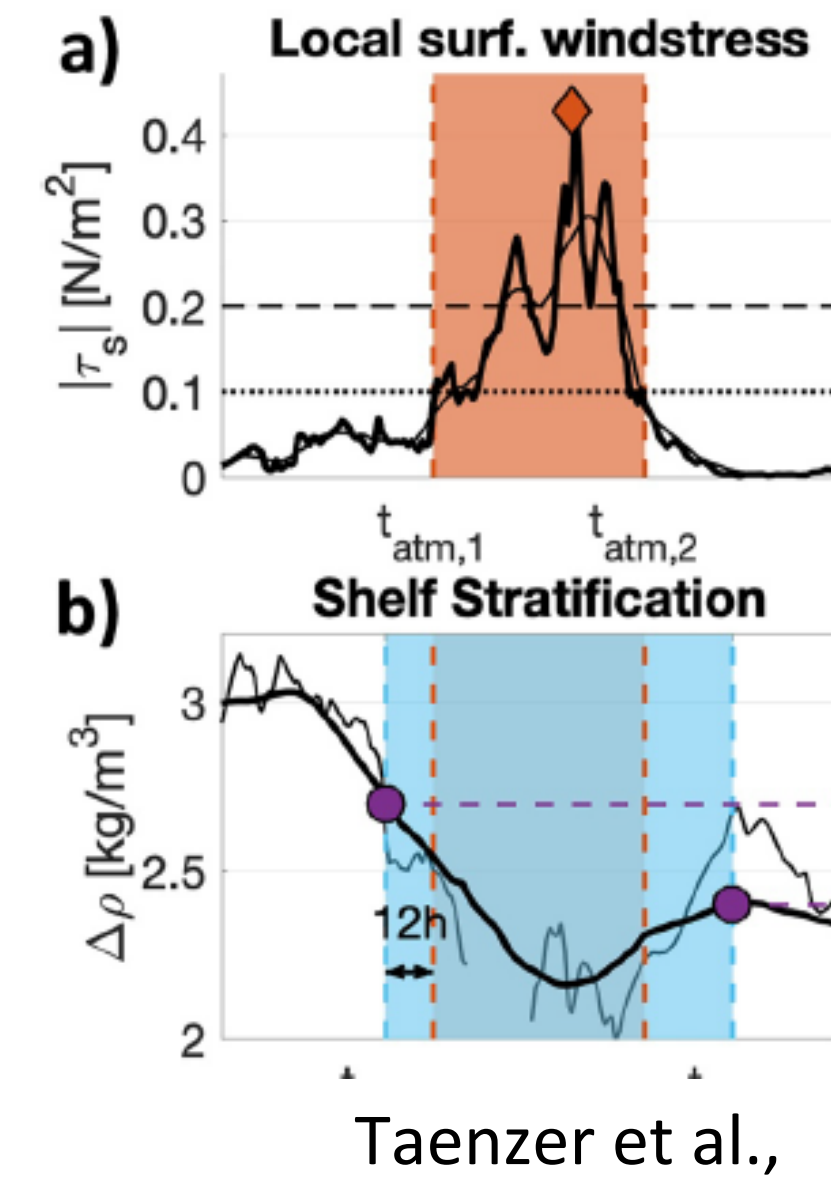


Gawarkiewicz et al. 2018



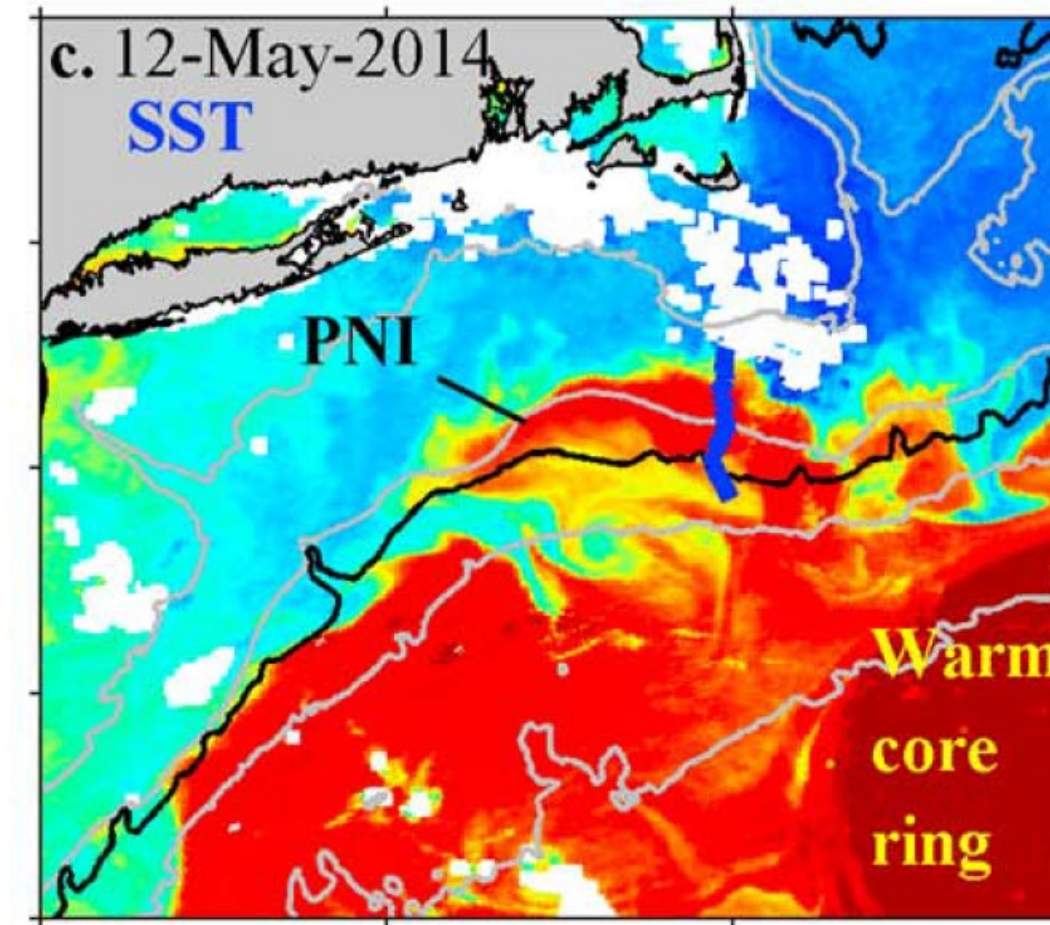
Regional Processes

- Gulf Stream stability changing
 - Andres, 2016
- More WCR in the slope sea
 - Gangopadhyay et al., 2019
- Marine heat waves
 - Gawarkiewicz et al., 2019
- Shelf water getting saltier
 - Gawarkiewicz et al., 2018
- De-stratification by storms
 - Taenzer et al., 2023
- CO2 exchange over shelf seas
 - Eveleth and students, 2020
 - Lima et al., 2023

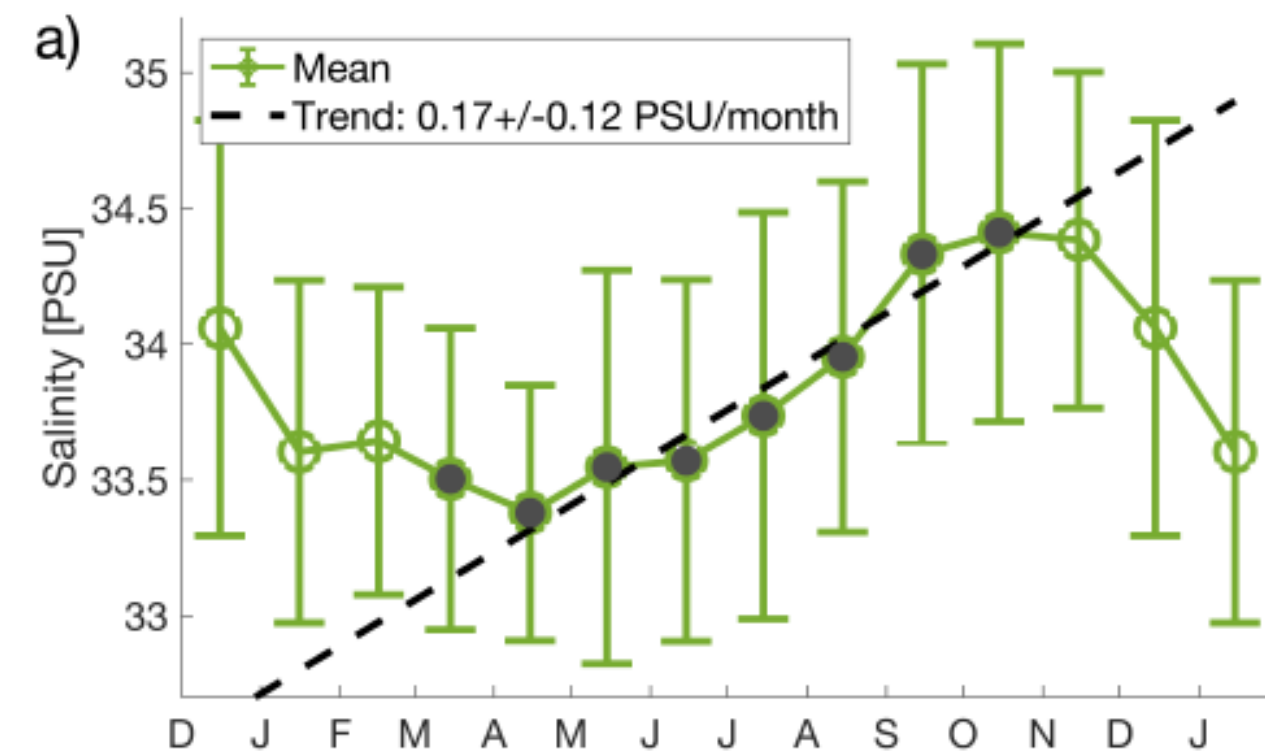


Shelf-Slope Dynamics

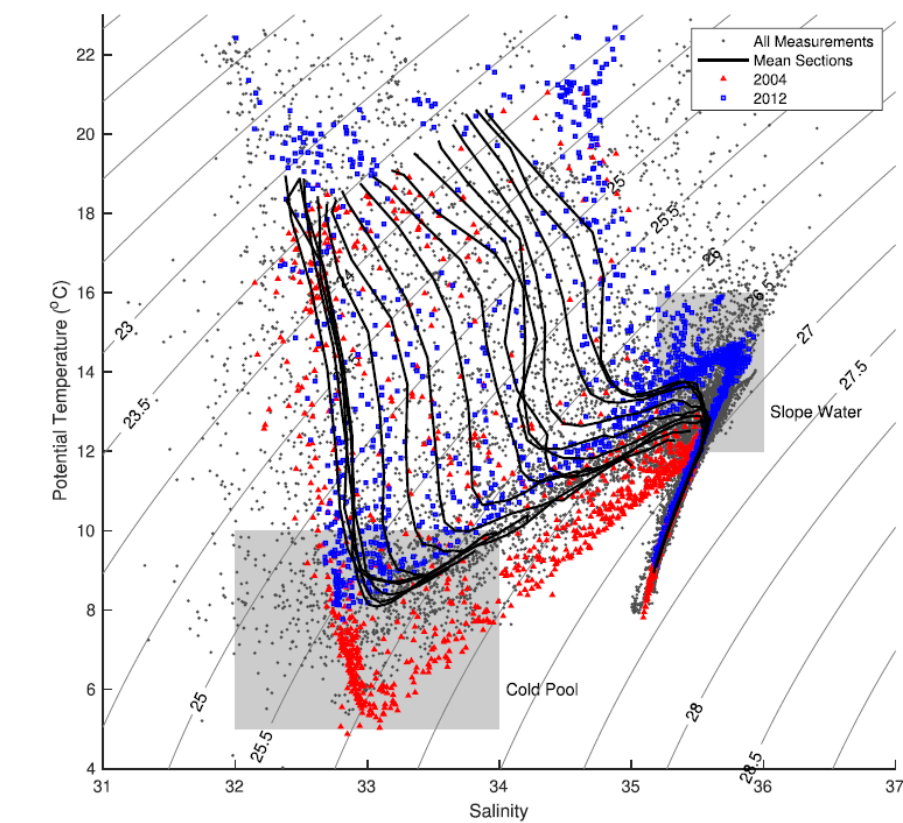
- T/S changes at the shelfbreak
 - Gawarkiewicz et al., 2012;
Harden et al., 2020
- Ring water intrusion
 - Zhang and Gawarkiewicz, 2015
- Shelf water subduction
 - Zhang and Partida, 2018
- Subsurface intrusions
 - Chen et al., 2022;
Gawarkiewicz et al., 2022
- Salinification of the cold pool
 - Taenzer et al., submitted



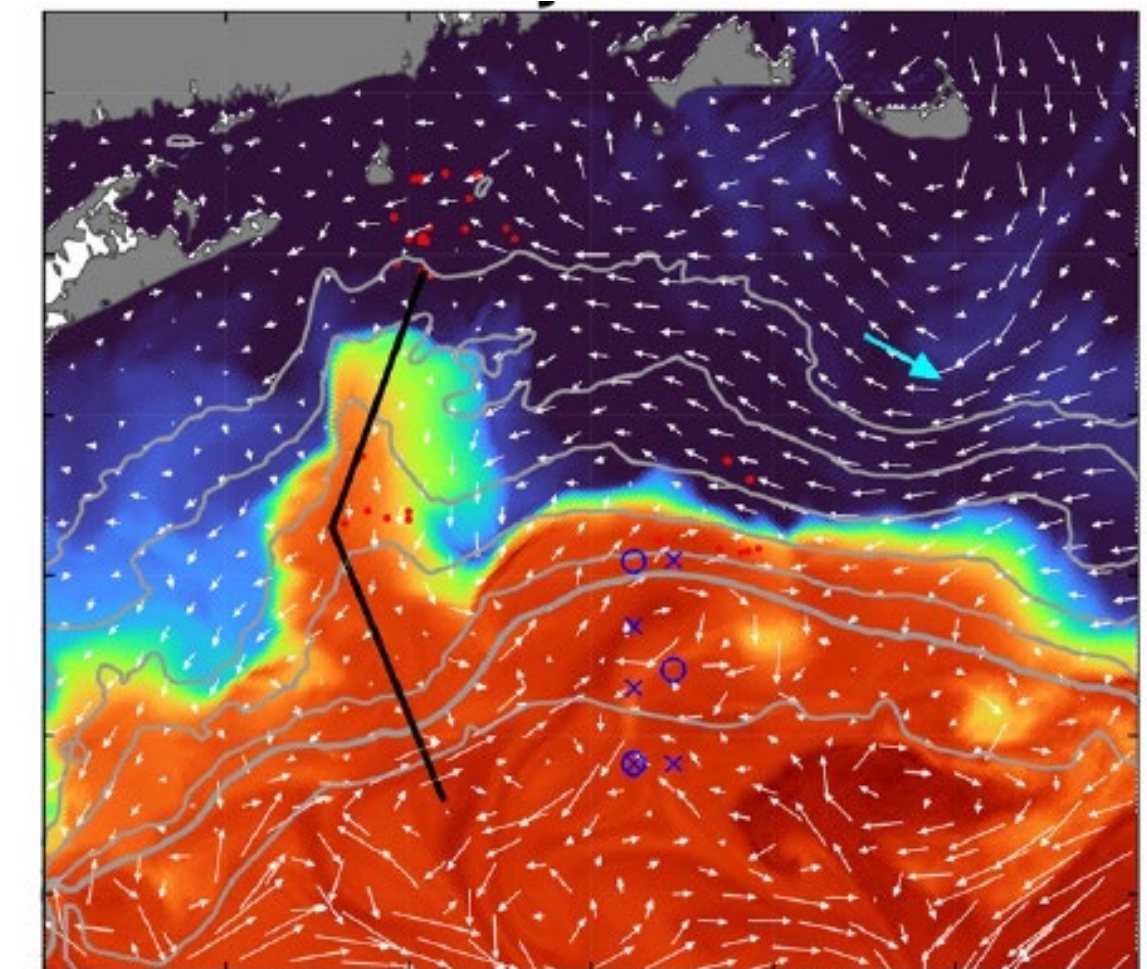
Zhang and Gawarkiewicz



Taenzer et al.



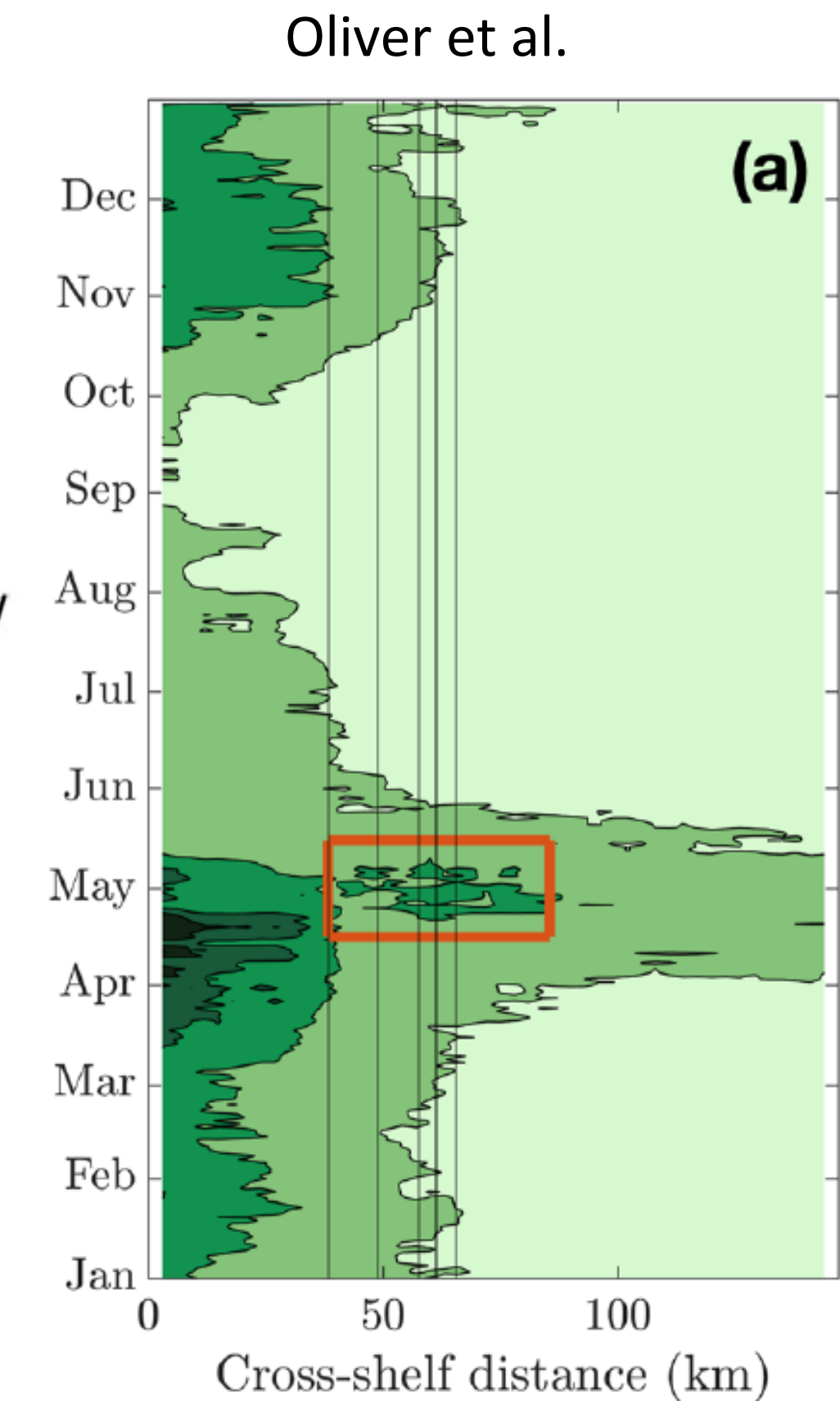
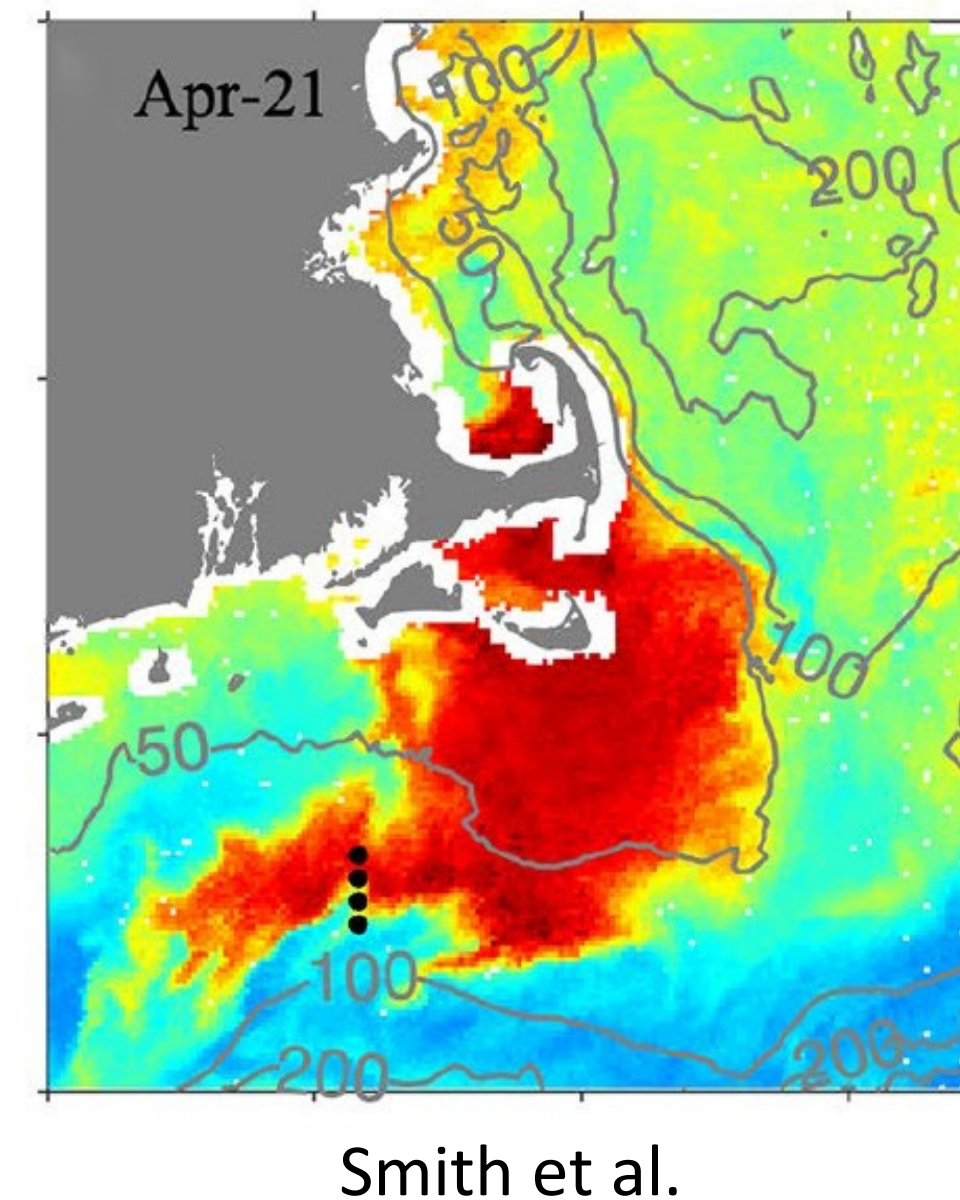
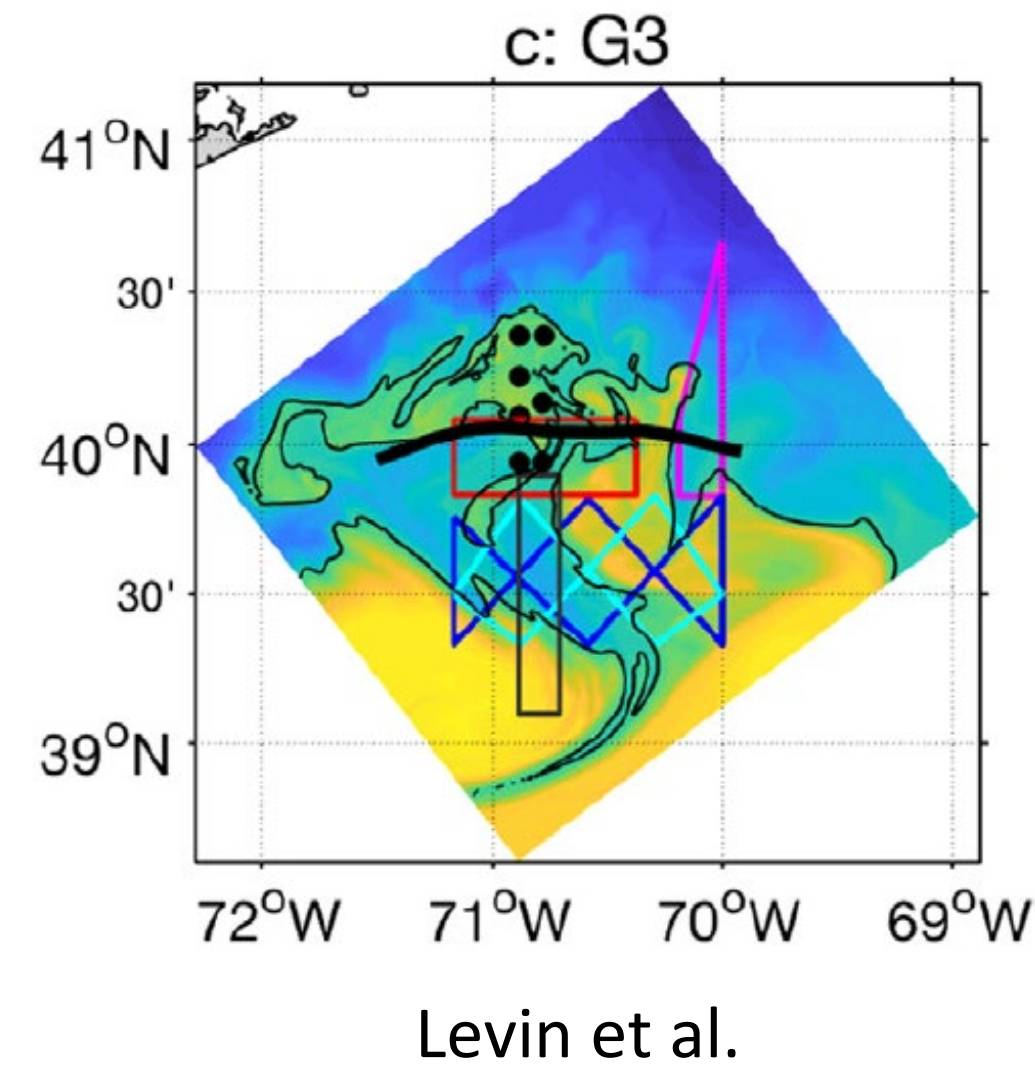
Harden et al.



Chen et al.

Interdisciplinary Science

- Assimilative regional modeling
 - Levin et al., 2020, Part 1 & 2;
 - Lopez et al., 2020;
 - Moore et al., 2021
- Phytoplankton dynamics
 - Oliver et al., 2021, 2022;
 - Smith et al., 2021
- Process Studies
 - NES-LTER, SPIROPA, NESBA, SMax



Summary

Pioneer NES shows successful implementation of a multi-platform, multi-scale, shelf-slope array

Impacts

- First sustained shelfbreak observatory
- New frontal dynamics and exchange mechanisms
- First glimpse of a changing coastal regime
- Interdisciplinary exploration of continental shelf ecosystems



Summary

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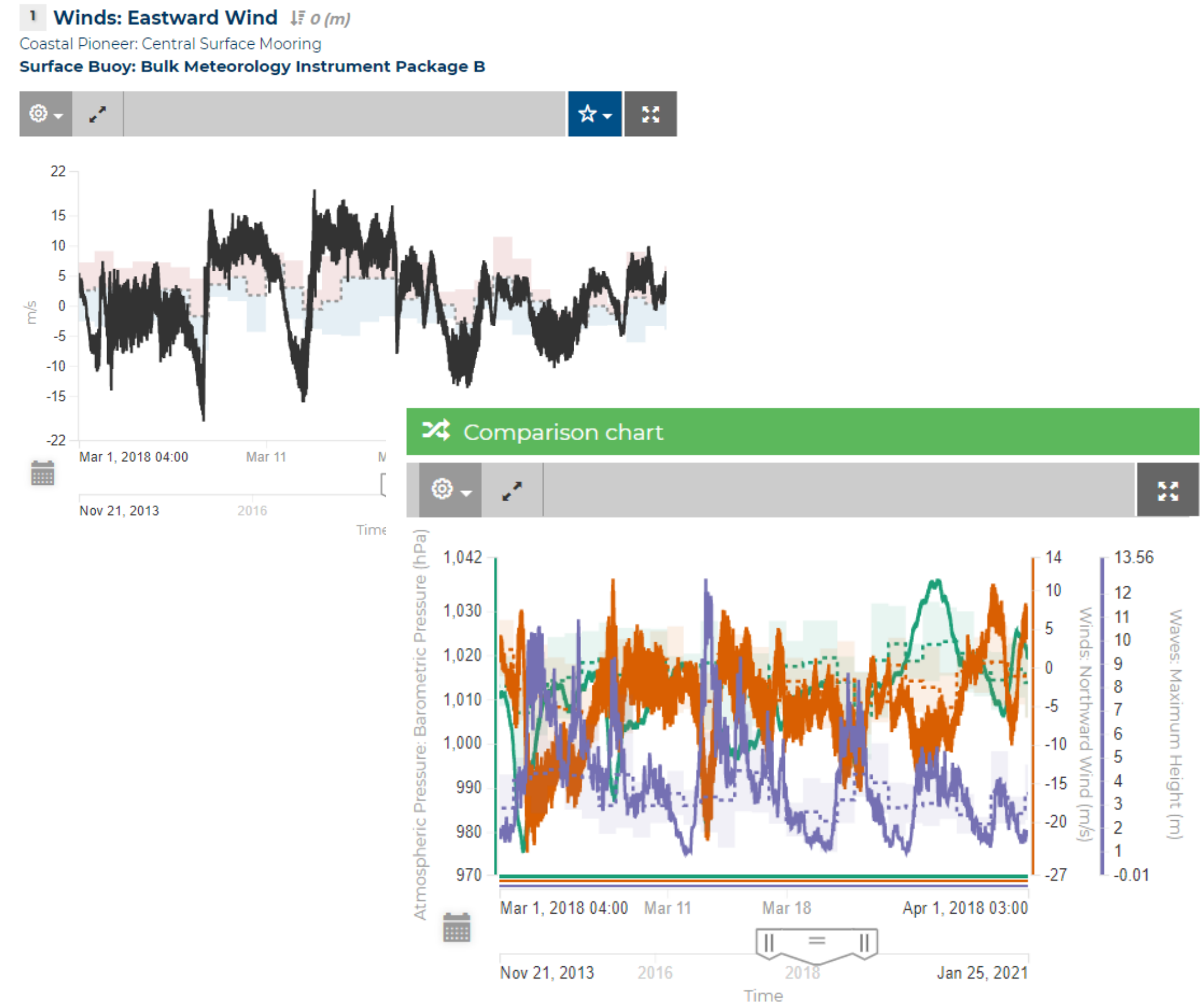
Lessons Learned

- Good array design will allow for new discoveries
- Moorings under-resolved the upper ocean
- Glider tracks were too far from the moored array



Data Access: <http://oceanobservatories.org>

- Data Explorer
 - GUI with data discovery, plotting and download
- THREDDS server
- ERDDAP server
- Machine to Machine interface
- Raw data archive
- And more...
- Questions:
 - help@oceanobservatories.org





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Questions?

