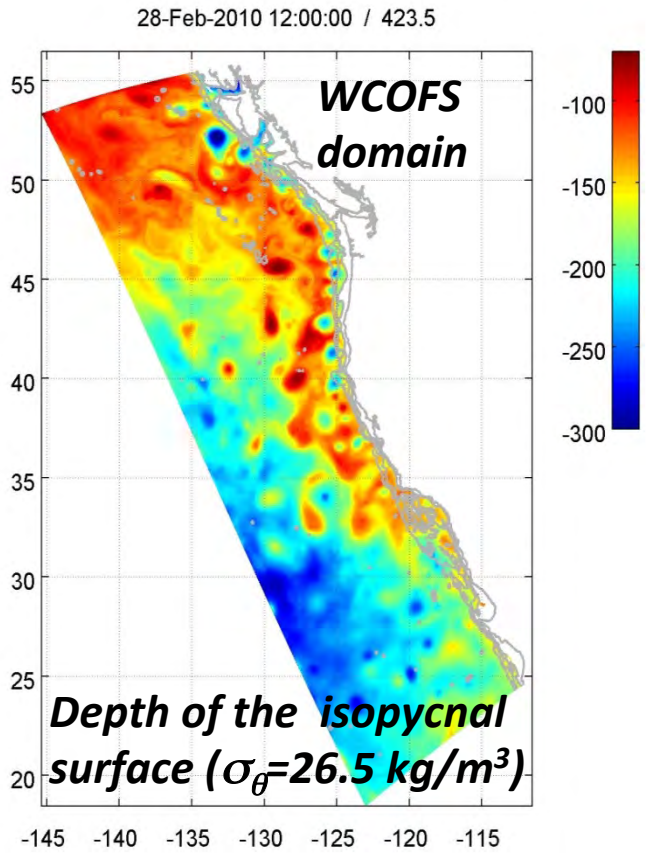
Coastal ocean circulation modeling and data assimilation (*A. Kurapov, Oregon State U.*)

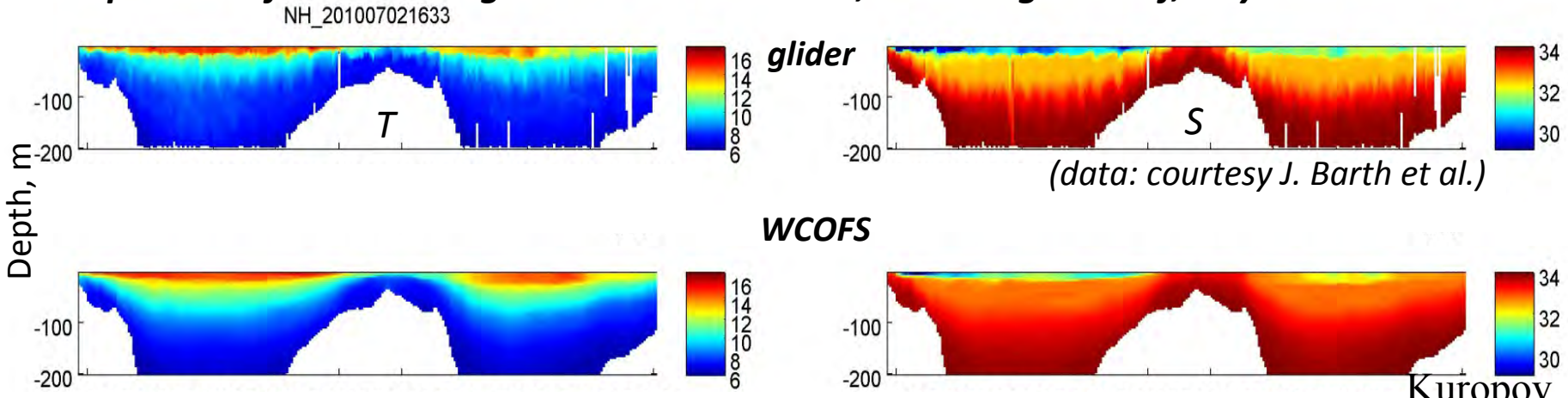
WCOFS: West Coast Ocean Forecast System (multi-year simulations, data assimilation, forecasting), 2-km horizontal resolution, 2008-present (support: NOAA NOS/ NESDIS/JCSDA; NSF OCE; NOAA IOOS COMT)

Process studies: understand interannual variability in the undercurrent, source waters for upwelling, coastal-interior ocean interactions

Data assimilation studies: understand the impact of assimilation of surface and subsurface observations



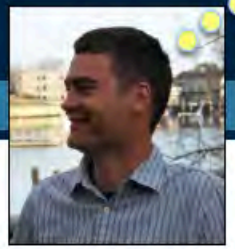
Comparison of model and glider T and S sections, mid-Oregon shelf, July 2010

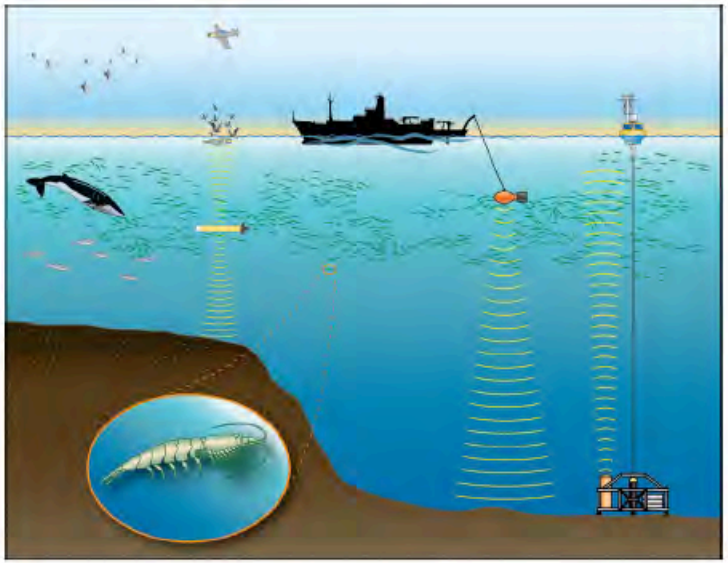


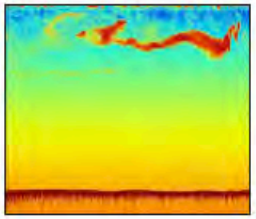
(data: courtesy J. Barth et al.)

Kuropov

Gareth Lawson - WHOI







Research Interests:

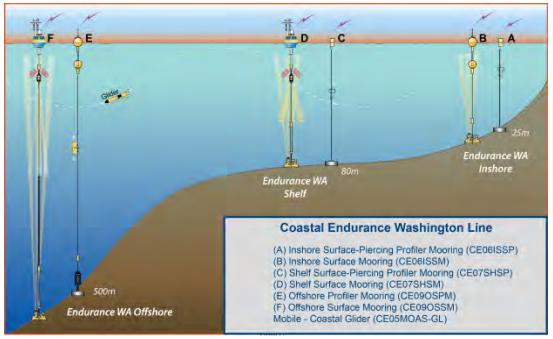
- Spatial and temporal variability in zooplankton and micronekton abundance and distribution in relation to physical processes and chemical conditions.
- Interactions with commercial fish and marine mammals.
- Development of acoustic sampling methods.

Coastal Array Goals:

- Link Pioneer Array bio-acoustic sonar data to other array data streams.
- Conduct process studies leveraging Pioneer data and ground-truthing acoustic observations.

Science topics:

- Ecosystem responses to seasonally and event-scale variation in cross-shelf current structure and upwelling intensity, duration and intermittency on the Washington coast



- HAB monitoring and prediction

How I see using the OOI:

- Combining the continuous WA Endurance Array data with shipboard cross-shelf surveys of growth and micro- and mesozooplankton grazing and community measurements, and regional biophysical circulation model

- Adding imaging instruments (e.g. the FlowCytobot) for continuous monitoring for phyto/microzoo communities and abundance with changing conditions

Evelyn Lessard , University of Washington

Coastal Endurance observations to investigate:

- Role of Columbia River in formation and dynamics of the coastal currents

OOI arrays to investigate:

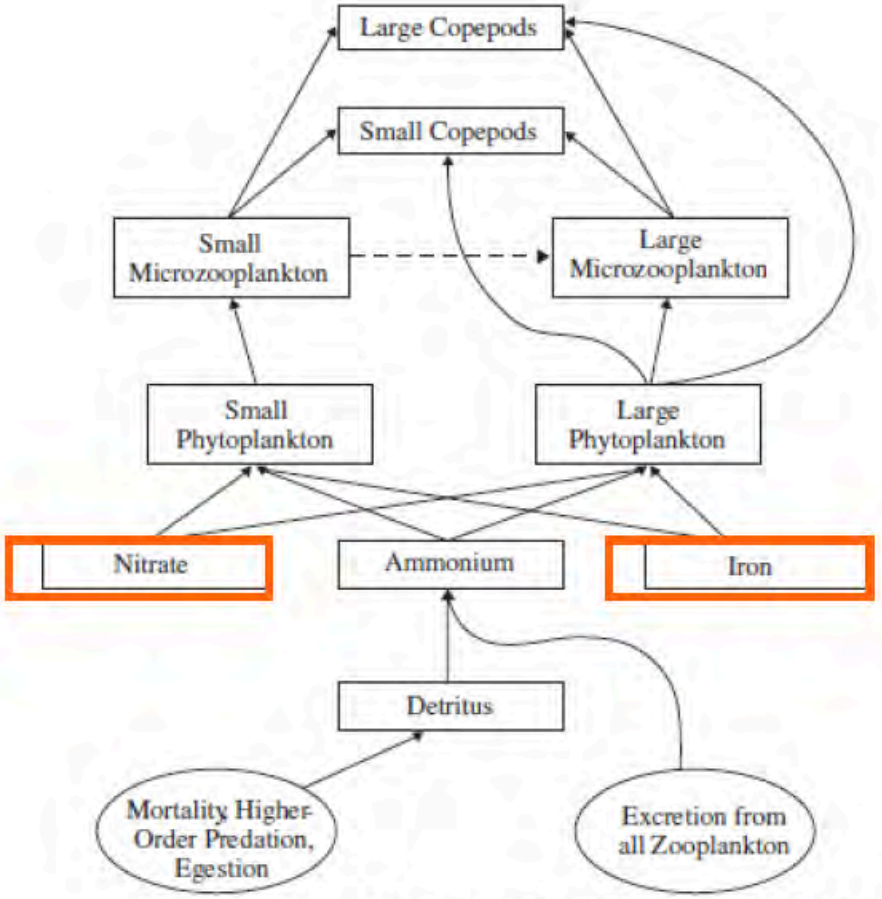
- Wave-current interaction
- Near surface turbulence mixing
- Exchange of momentum and energy from atmosphere to ocean

OOI as Instrument Validation Site

- opportunity for new measurements, in particular for trace nutrients

- critical density of chemical and biological measurements to put new data in context

- learning about biogeochemical linkages and drivers, productivity, improve ecosystem model predictions

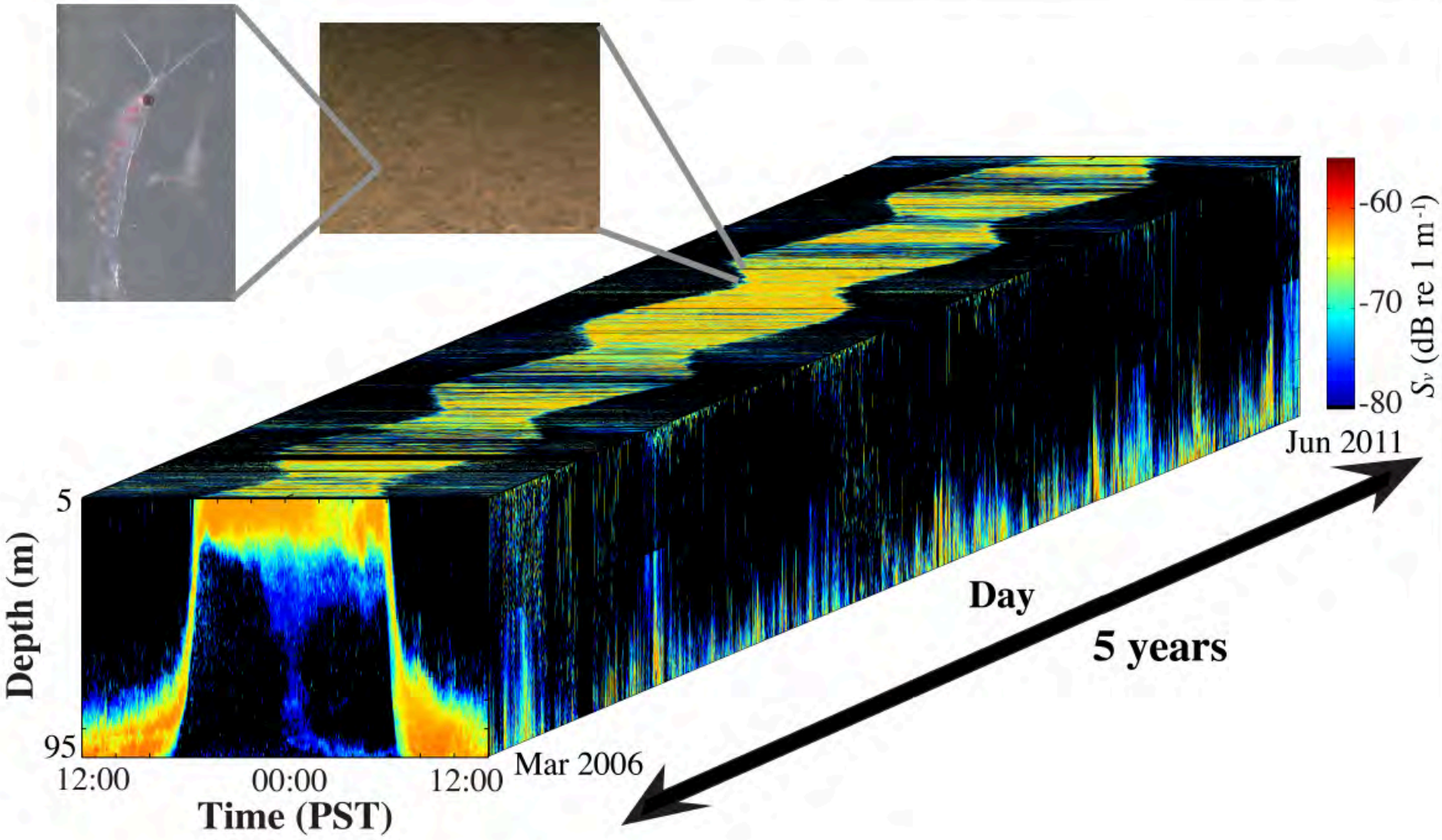


From: Hinckley et al., 2009

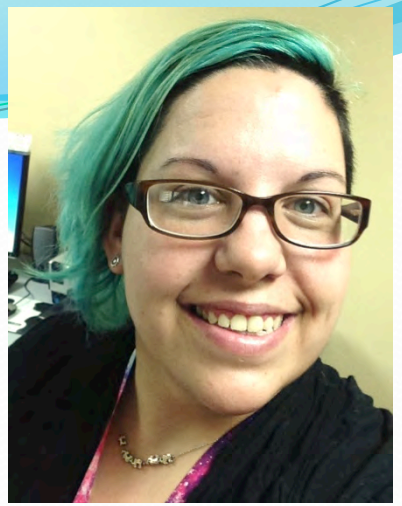
Mueller

How do small-scale changes in upwelling alter animal behavior?

Mei Sato (Oregon State Univ)



Kate Tremblay - Transitioning Student



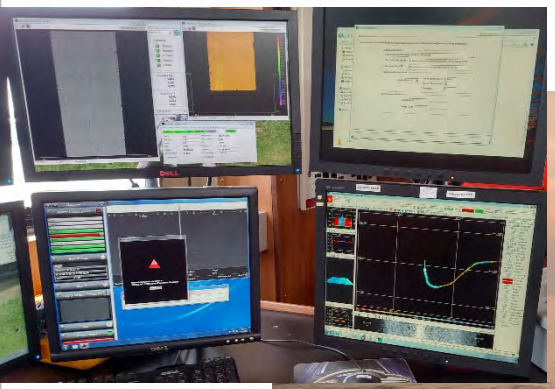
- 2015 MATE Intern
- SEA Semester Volunteer
- Women in Engineering
- STEM / ROV Advisor
- MTS New England Member
- THSOA Student Outreach Program

Why This Workshop?

- Ocean Plastic / Pollutant Flow
- Following Sea Level Rise
- Addressing the change in fisheries
- Funding, funding, funding.

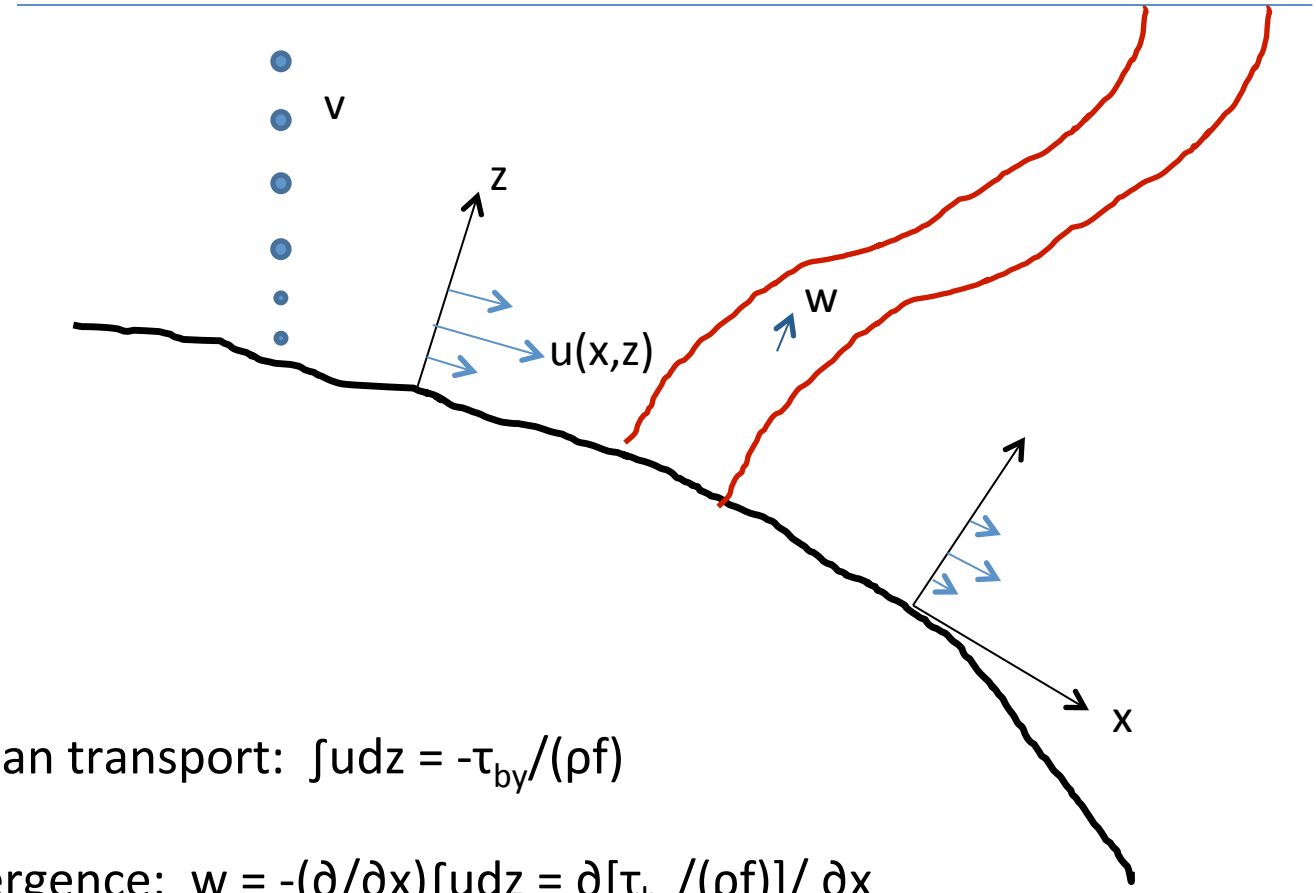
Why Me?

- I want to be an asset.
- Target my learning.
- Build useable data sets.
- Big ocean tech nerd!



R/V Langseth

Role of bottom stress in upwelling near the shelf break



Ekman transport: $\int u dz = -\tau_{by}/(\rho f)$

Divergence: $w = -(\partial/\partial x)\int u dz = \partial[\tau_{by}/(\rho f)]/\partial x$

Trowbridge

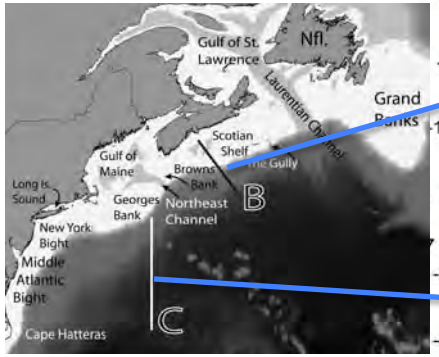
Nutrient Flux at Mid-Atlantic Bight Shelfbreak

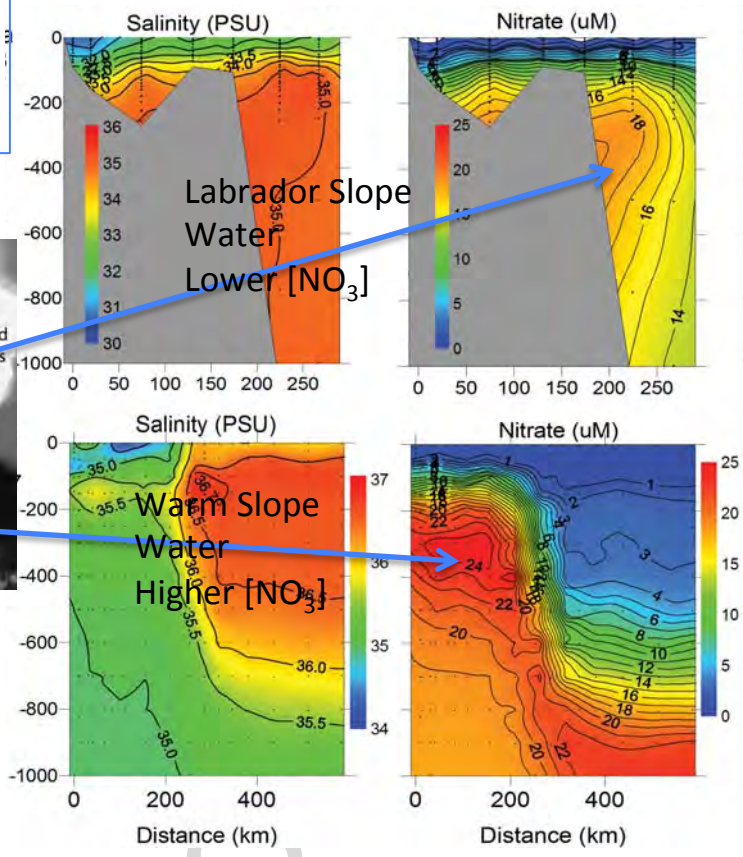
Dave Ullman and Jaime Palter (University of Rhode Island)

Biogeochemical budget studies indicate that ecosystems of Western N. Atlantic shelves are dependent upon nutrients from offshore (e.g. Nixon et al., 1996).

- Slope waters offshore of MAB have variable [NO_3] concentrations depending on the water mass present.
- Evidence of interannual variability in these water masses (correlated with NAO).

Townsend and Ellis, 2010





Questions:

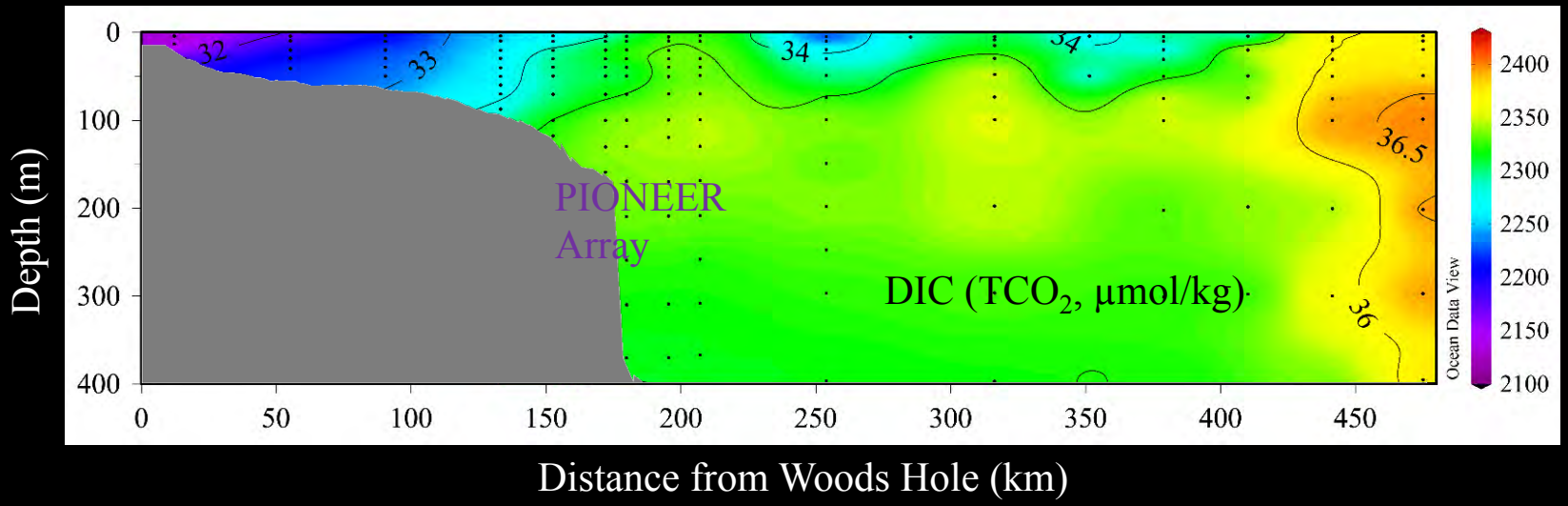
- What is magnitude and variability of cross-isobath nutrient flux at Pioneer Array?
- How does flux vary on interannual timescales (e.g. NAO)?
- What is the effect on cross-isobath nutrient fluxes of Gulf Stream rings impinging on the slope?

Compute nitrate flux using data from optical nitrate sensors on surface piercing profilers and AUVs (along with concurrent velocity measurements).

Application of OOI Coastal Array

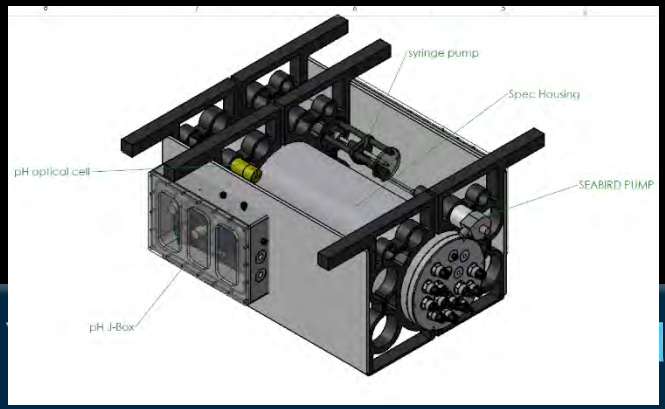
Aleck Wang, Woods Hole Oceanographic Institution

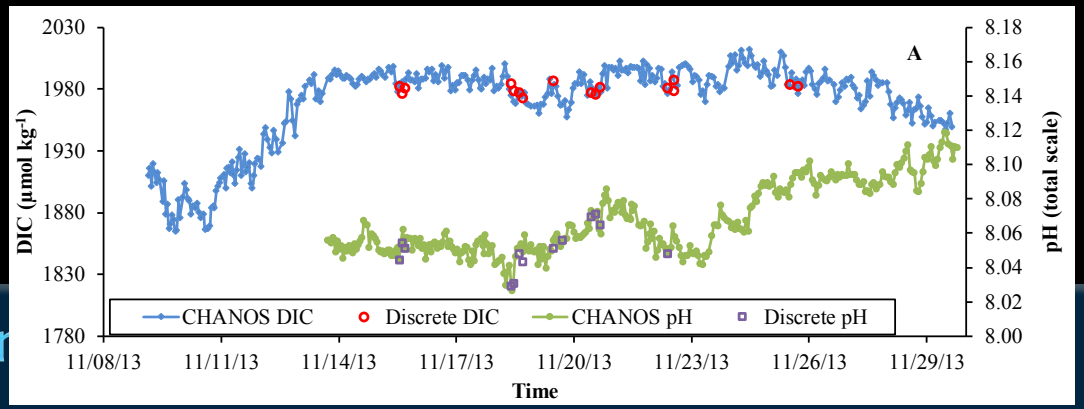
1. Cross-shelf exchange of carbon; Ocean acidification



2. Test and deploy new sensors

Channelized Optical System (CHANOS): DIC, pH (pCO_2)





ED ZARON'S PLANS & INTERESTS RE: OOI

Long-Term Observations –
Internal tides

- Stationary vs. non-stationary.
- Relation to internal wave continuum.
- Modal structure.
- Interactions with ambient.

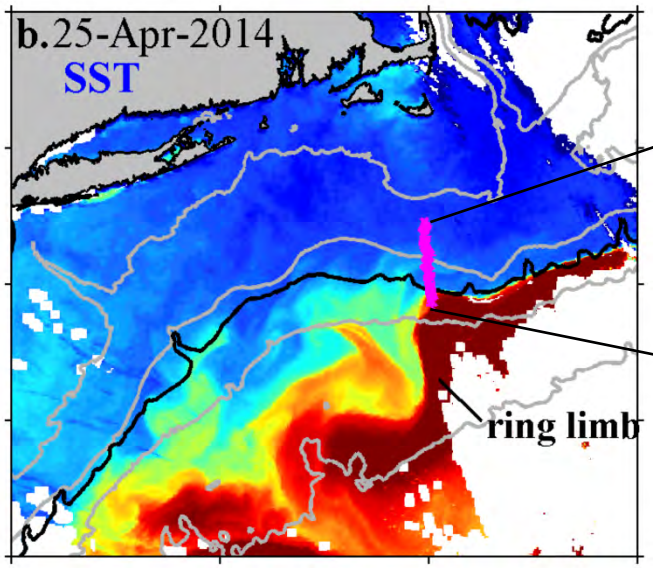
New instrument –
Two-axis laser-Doppler velocimeter system-on-a-chip:

- Philips PLN20xx sensor.
- Approx. 1 cm × 1 cm × 0.5 cm.
- 50 mW power consumption.

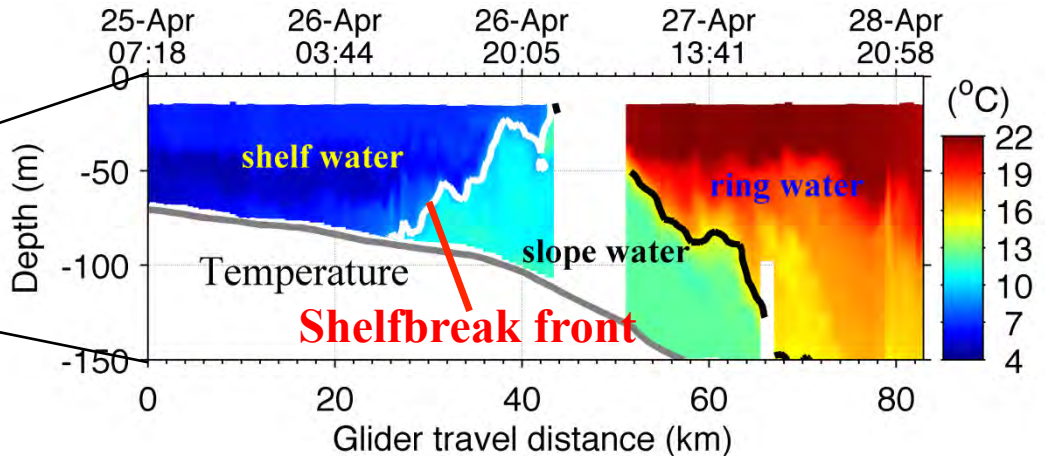
Zaron

Combining the Pioneer Array data with numerical models to study the shelfbreak frontal dynamics and cross-frontal exchange

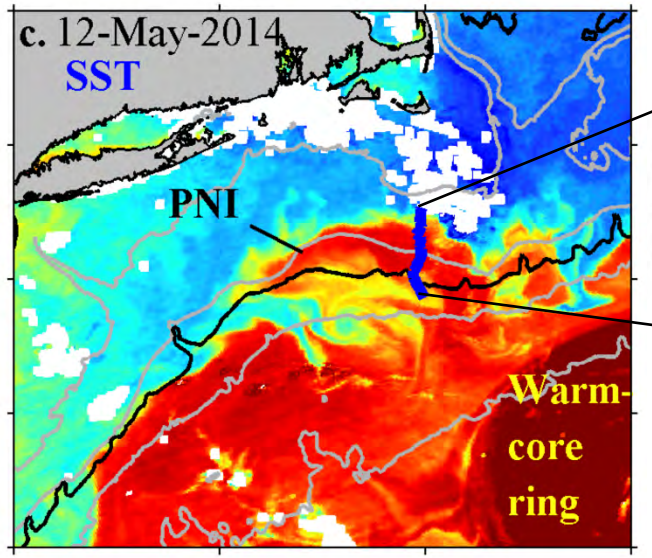
Weifeng (Gordon) Zhang --- Woods Hole Oceanographic Institution

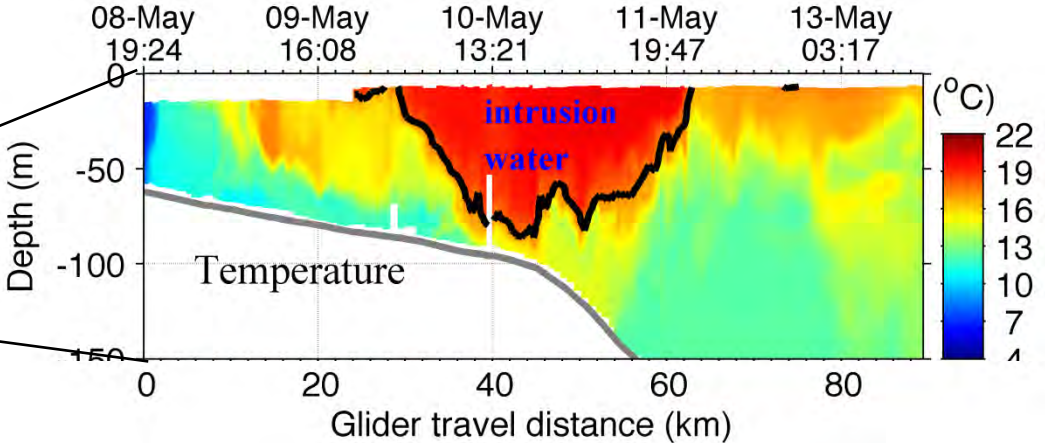


Pioneer Array glider data



Topic 1: The variability and biological impact of the shelfbreak front



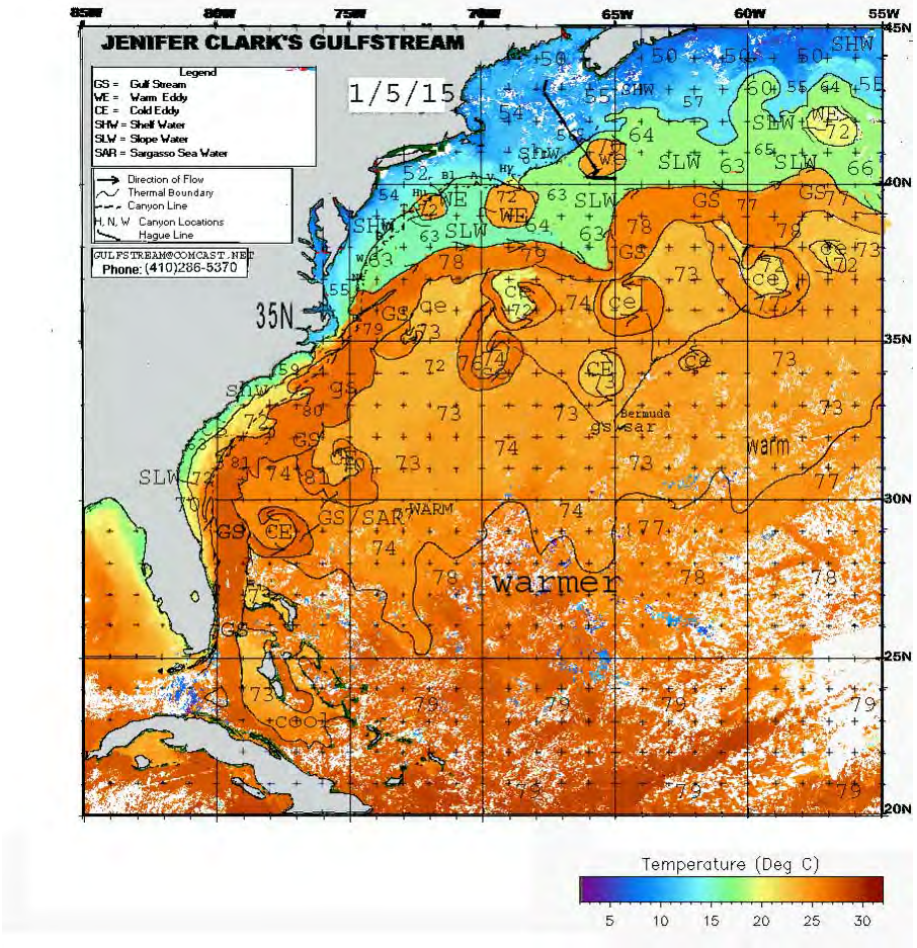


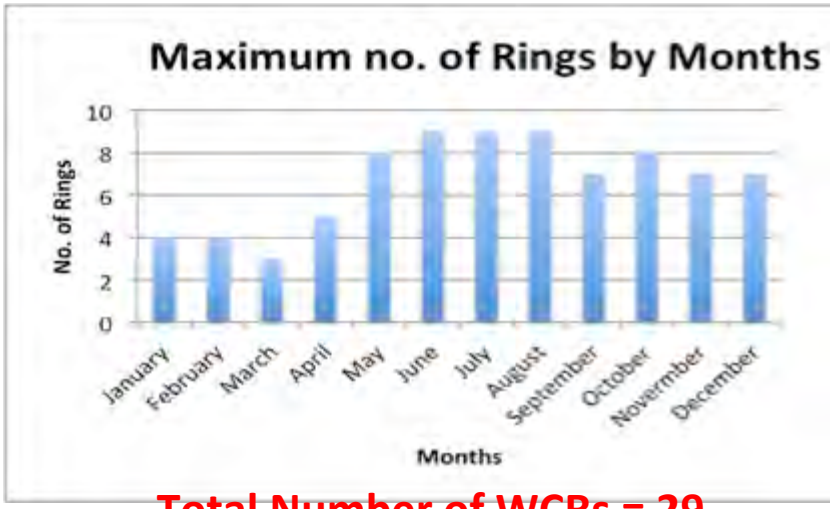
Topic 2: Characteristics of the cross-shelf exchange, e.g., velocity pattern of the intrusion

Investigating Climatic impact on the GS, WCR, SSF and Shelf (MAB/GOM) using a Nested Modeling and Data Synthesis Approach

Avijit Gangopadhyay
Andre Schmidt
Mahmud Monim

The Western North Atlantic in 2015

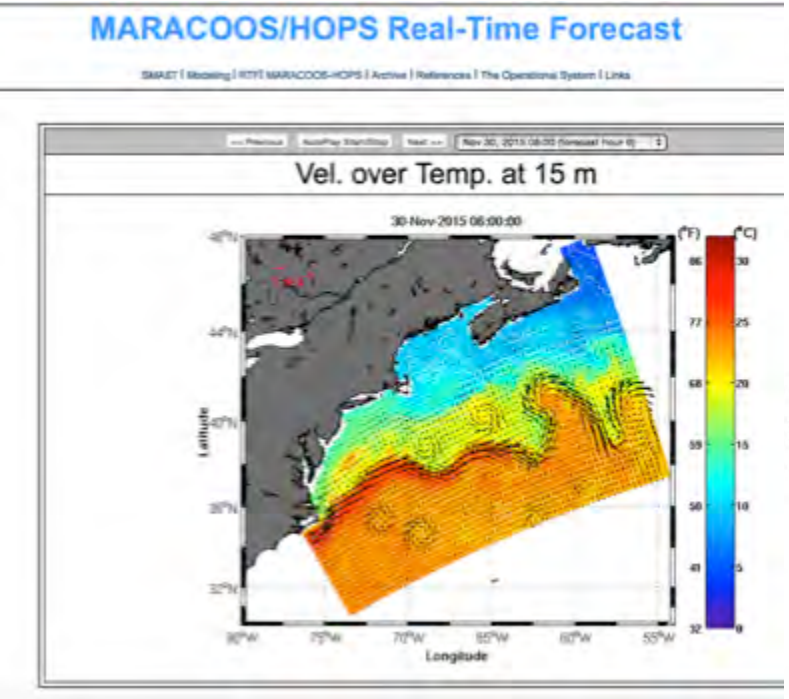




Total Number of WCRs = 29

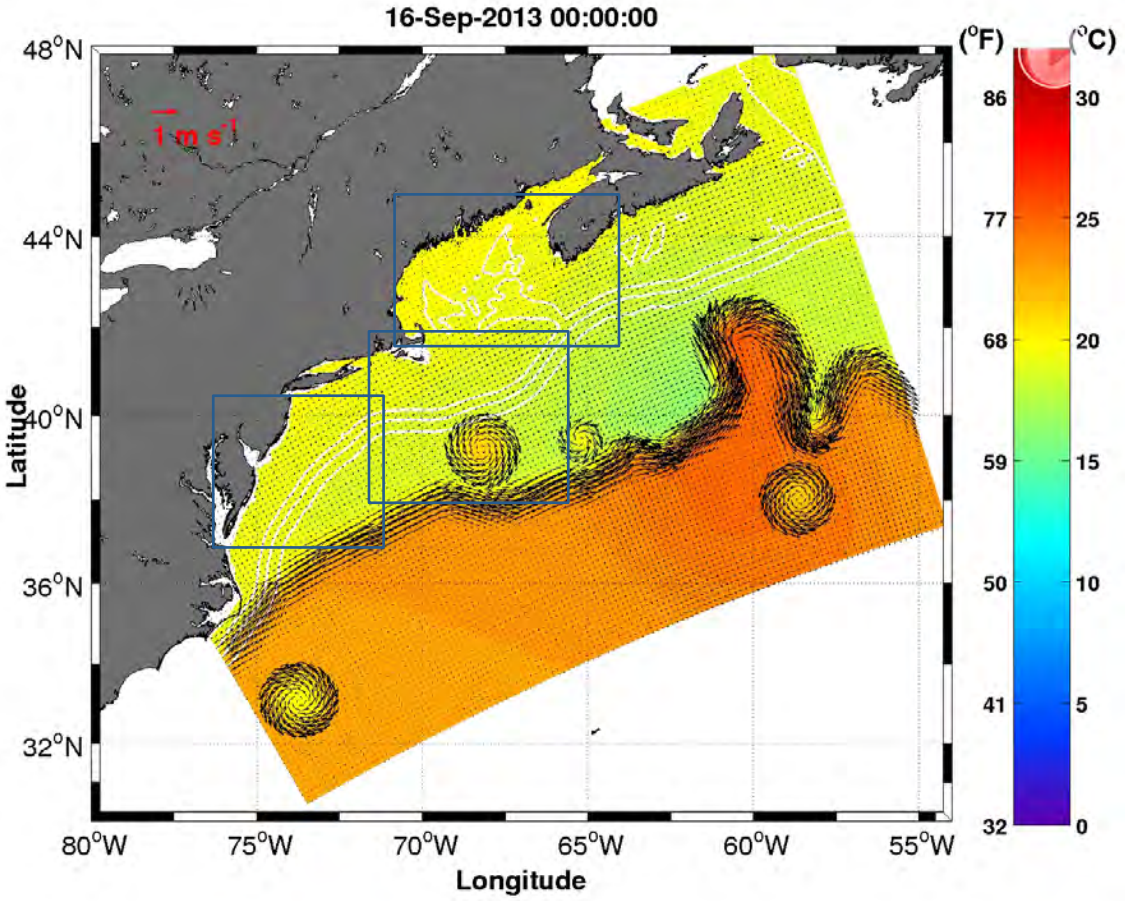
MARACOOS Weekly Operational System SMAST-HOPS (2009-2016)

www.smast.umassd.edu/modeling



Test run with GS and WCR Feature Model only

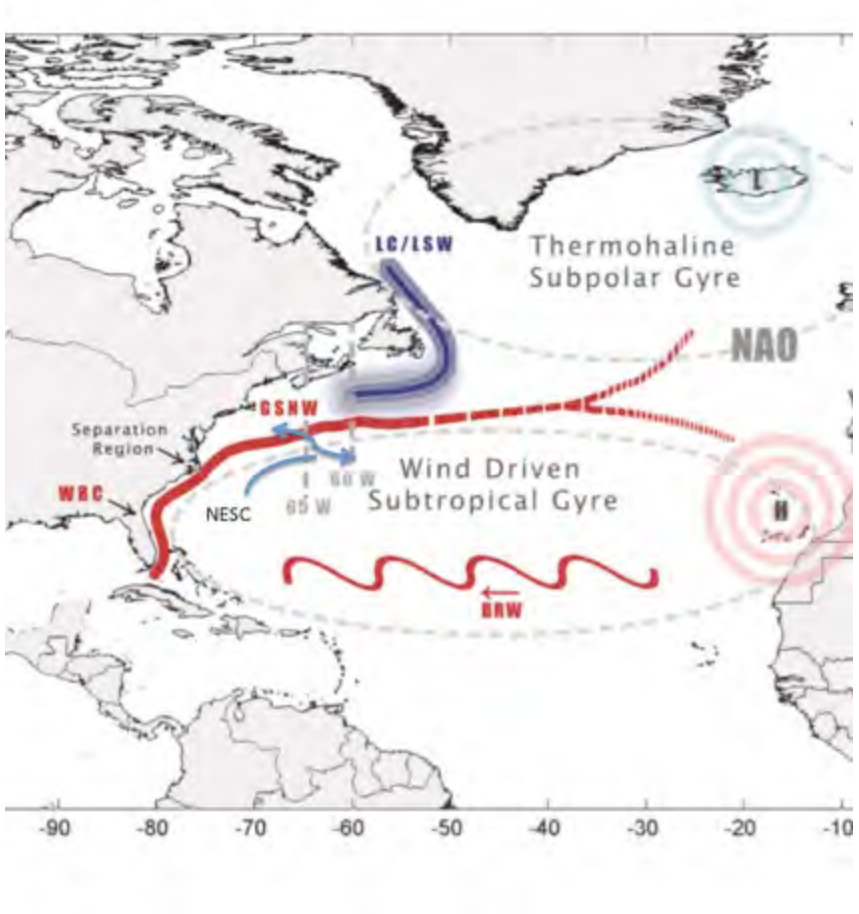
3km domain (1km Nests planned)



Brown et al. (2007, 2012)
Gangopadhyay et al. (2012)
Schmidt and Gangopadhyay (2012)
Schofield et al. (2010)

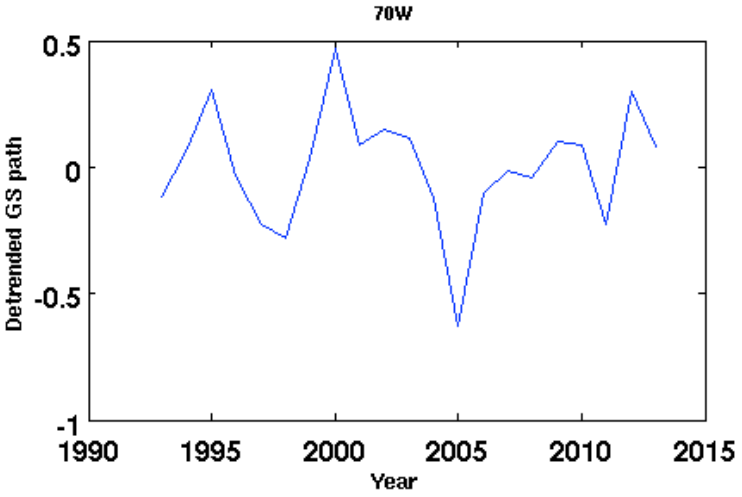
Approach/Ideas

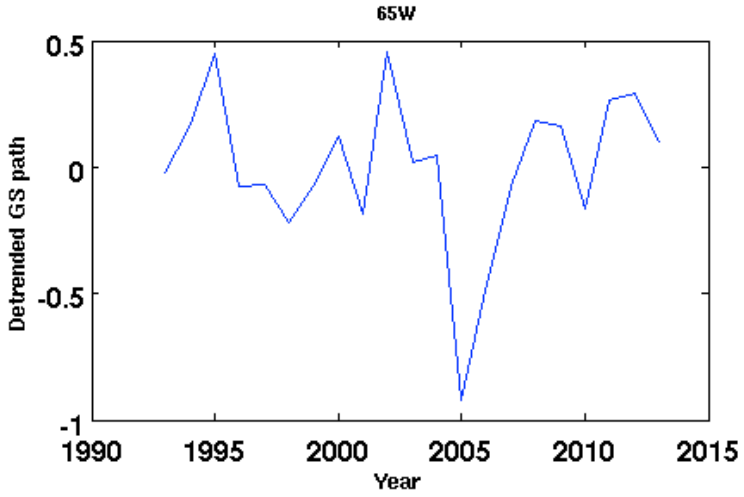
- **Retrospective Analysis (2013-2015) with Pioneer data, GS, WCRs**
- **Process Studies and Real-time assimilation/ forecast for MARACOOS with Nested Modeling**
- **Study and contrast the Extreme conditions over past 5 years in comparison to last 40 years (1975-2015) – link to NAO, AO, PDO, AMOC**

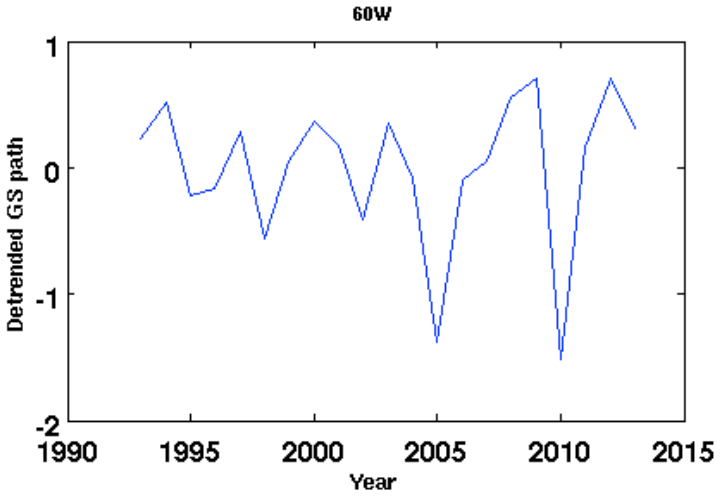


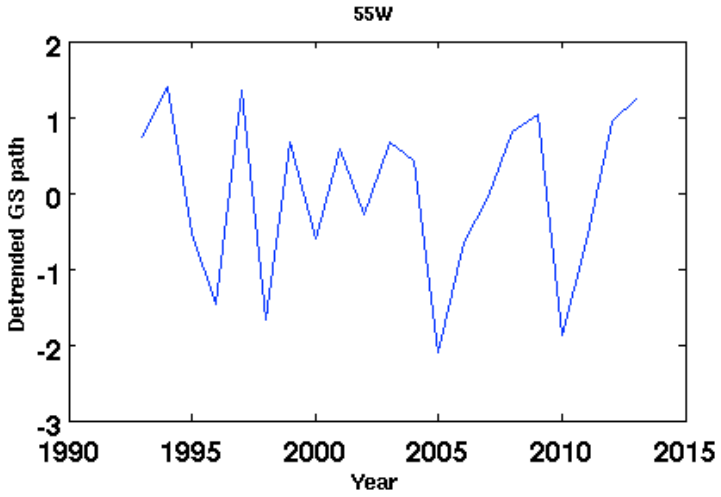
Gangopadhyay et al. 2015, Earth Interaction

Gulf Stream path temporal variability west and east of 65°W

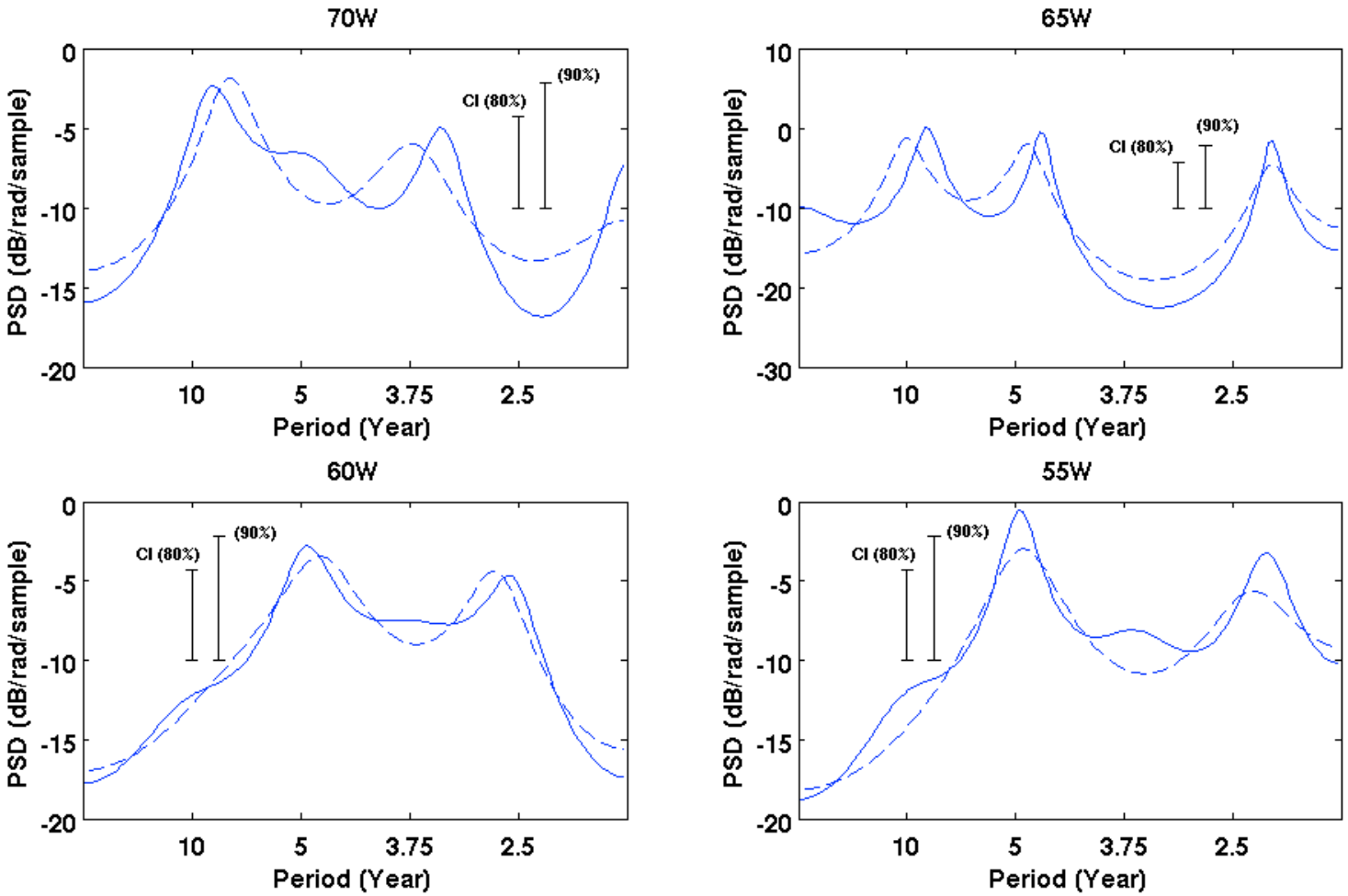








8-10 years 65°W 4-5 years



4-dimensional variational data assimilation approach for regional interdisciplinary ocean modeling

Christopher A. Edwards, *University of California Santa Cruz*
Hajoon Song (MIT), *Paul Mattern (UCSC)*
Andrew M. Moore (UCSC), *Jerome Fiechter (UCSC)*

An example of fully coupled data assimilation using the NEMURO Biogeochemical model.

Hope to use OOI assets to produce a model/ data synthesis for the California Current System for a variety of scientific questions:

- Coupled shelf processes
- Cross-shelf transport
- Carbon cycling