Nitrate Response to Coastal Upwelling on the Oregon Shelf: Insights from OOI Endurance Array Profilers

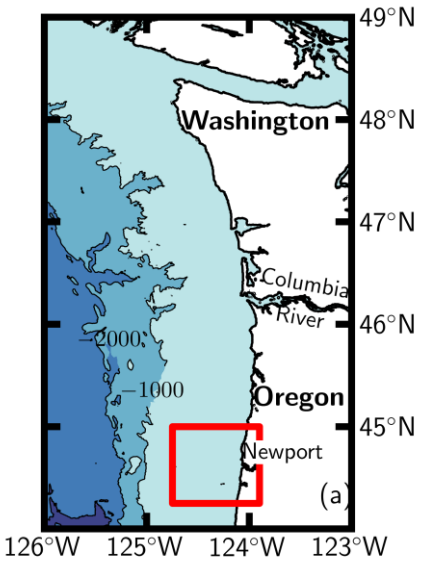
Presenter: Andrew Scherer

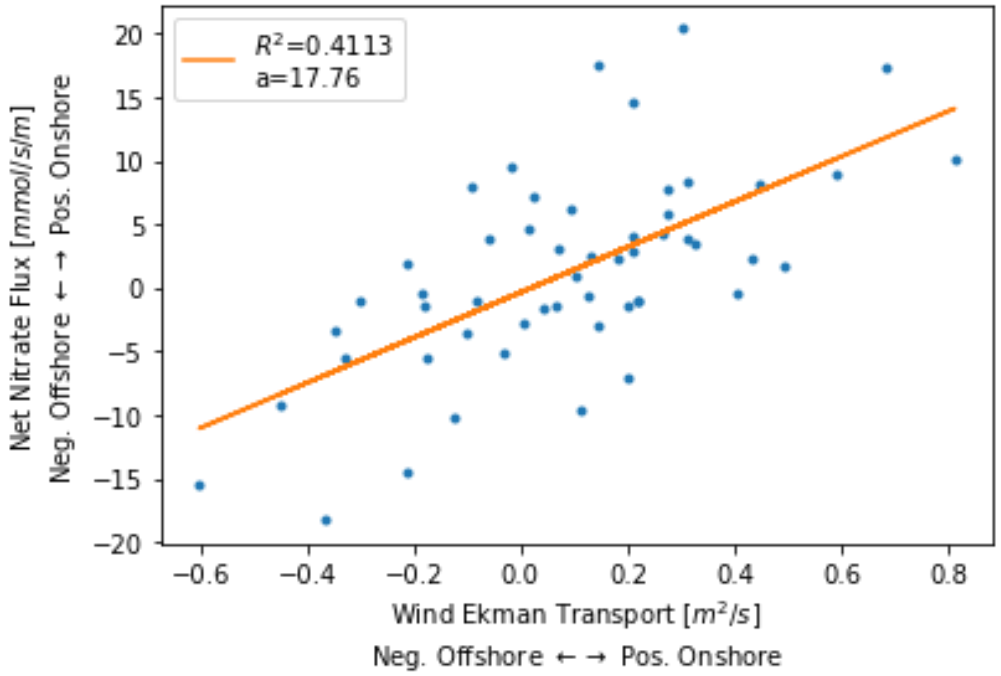
scherand@oregonstate.edu

Melanie Fewings, Thomas Connolly, Maria Kavanaugh, Jennifer Fisher

OOI Endurance Array data has shaped my early career

- I was introduced to OOI Endurance Array data at the 2021 California State University, Monterey Bay REU, working with Thomas Connolly at Moss Landing Marine Labs.
- REU was done remote from Cleveland, Ohio during COVID – publicly accessible data made a huge difference!





PhD Research at Oregon State

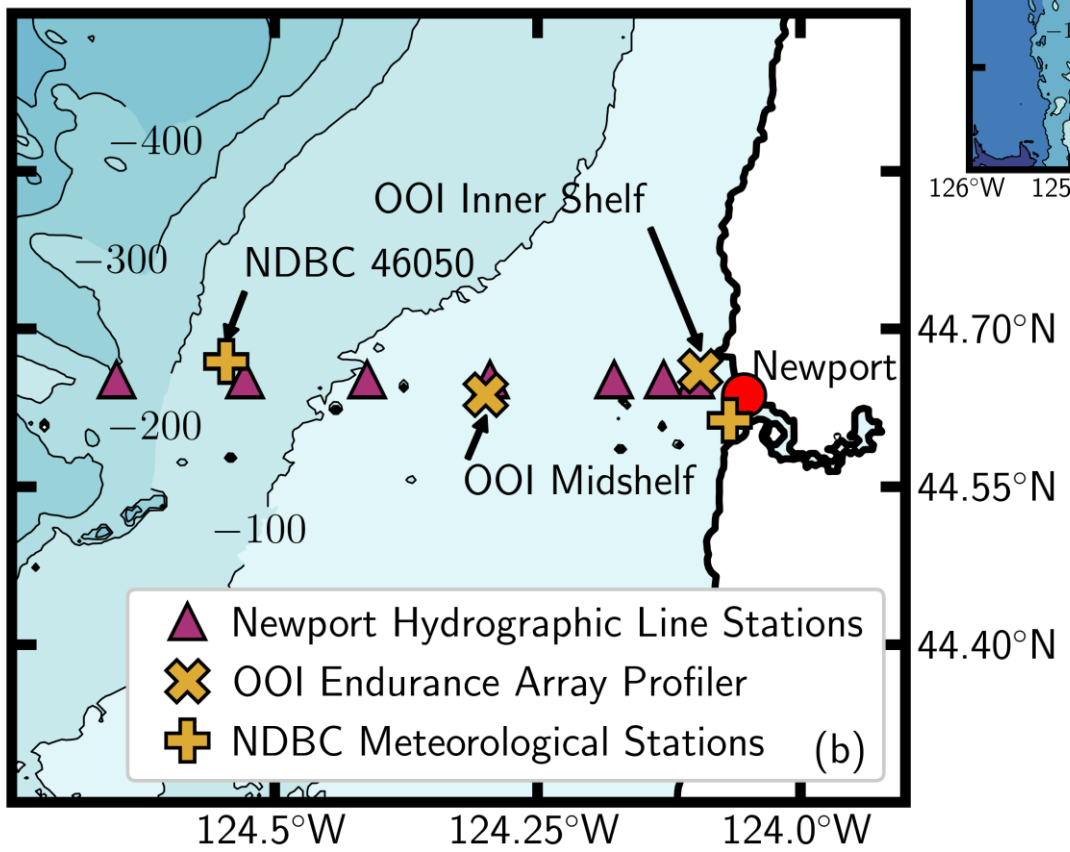
- Inspired by my REU research, I wanted to continue research on nitrate dynamics in upwelling systems for my PhD.
  - Nitrate is a unique tracer that is influenced by both physics and biology.
  - Northern California Current System primary production is largely nitrate limited, motivating nitrate research in this region specifically.
- Existing shelf nitrate studies are limited in time span, with sparse data usually only covering a couple of years.
- My research investigates the **response of nitrate on upwelling event and seasonal timescales** – requires long datasets of collocated physical, chemical, and biological properties.

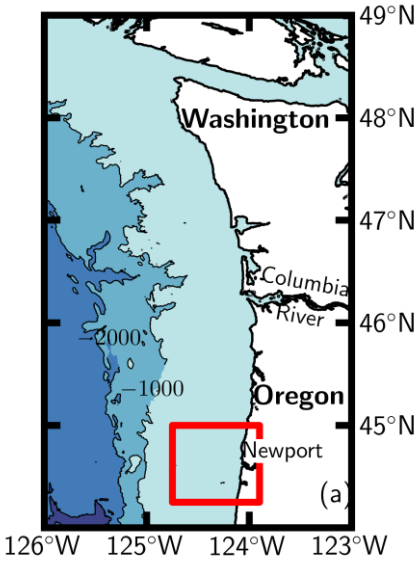
OOI Endurance Array Profilers: A perfect fit for my research questions

- Profilers were the best platform for my work:
  - Obvious benefits: Whole water column measurements (vertical structure of nitrate is important) and high time resolution (~1 day)
  - Shorter deployment times = less opportunity for sensor drift and biofouling
- **Collocated observations** of nitrate, salinity, temperature, and chlorophyll.

OOI Endurance Array Profilers

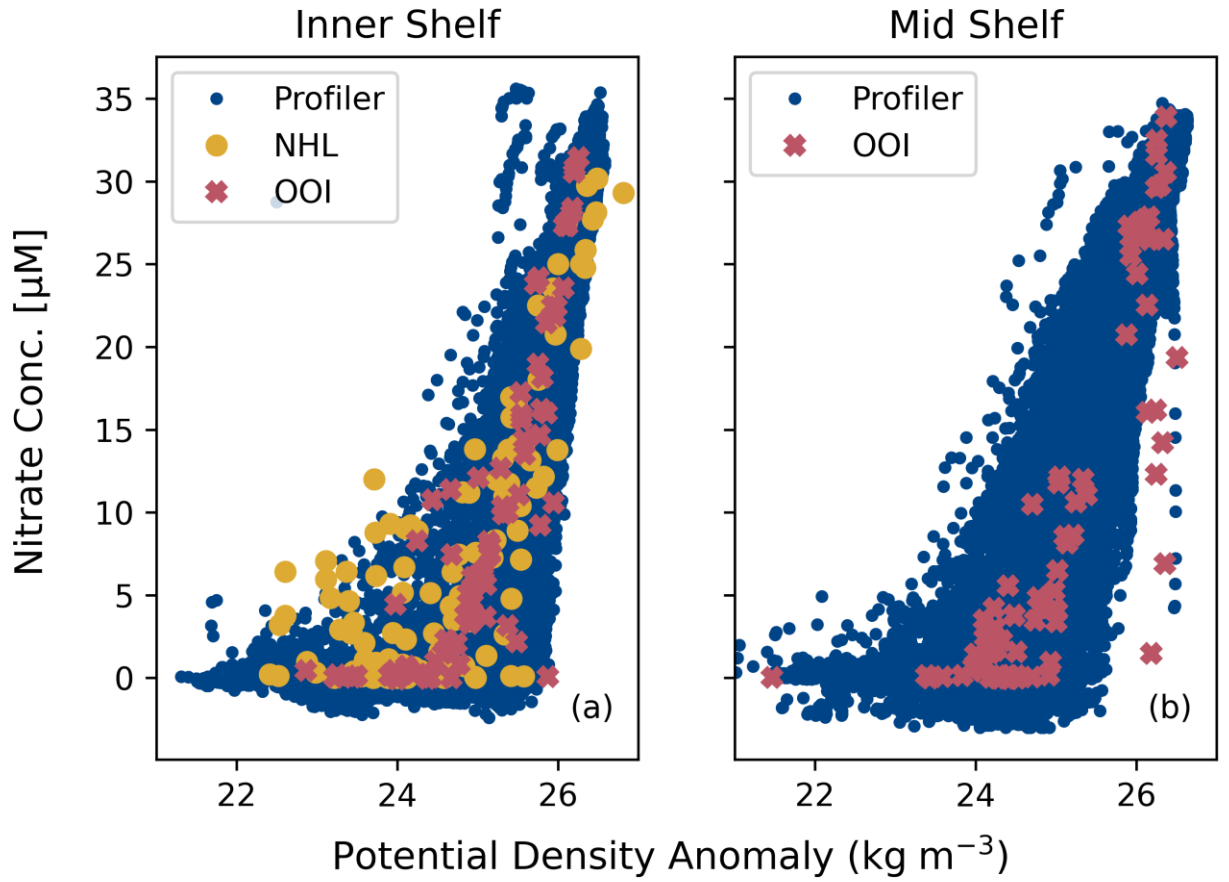
- Nitrate data from the OOI mid-shelf profiler (CE02SHSP) and inner-shelf profiler (CE01ISSP)
- Winds, currents, and CTD data from both OOI and a variety of other historic sampling on the Newport Hydrographic Line (NHL)



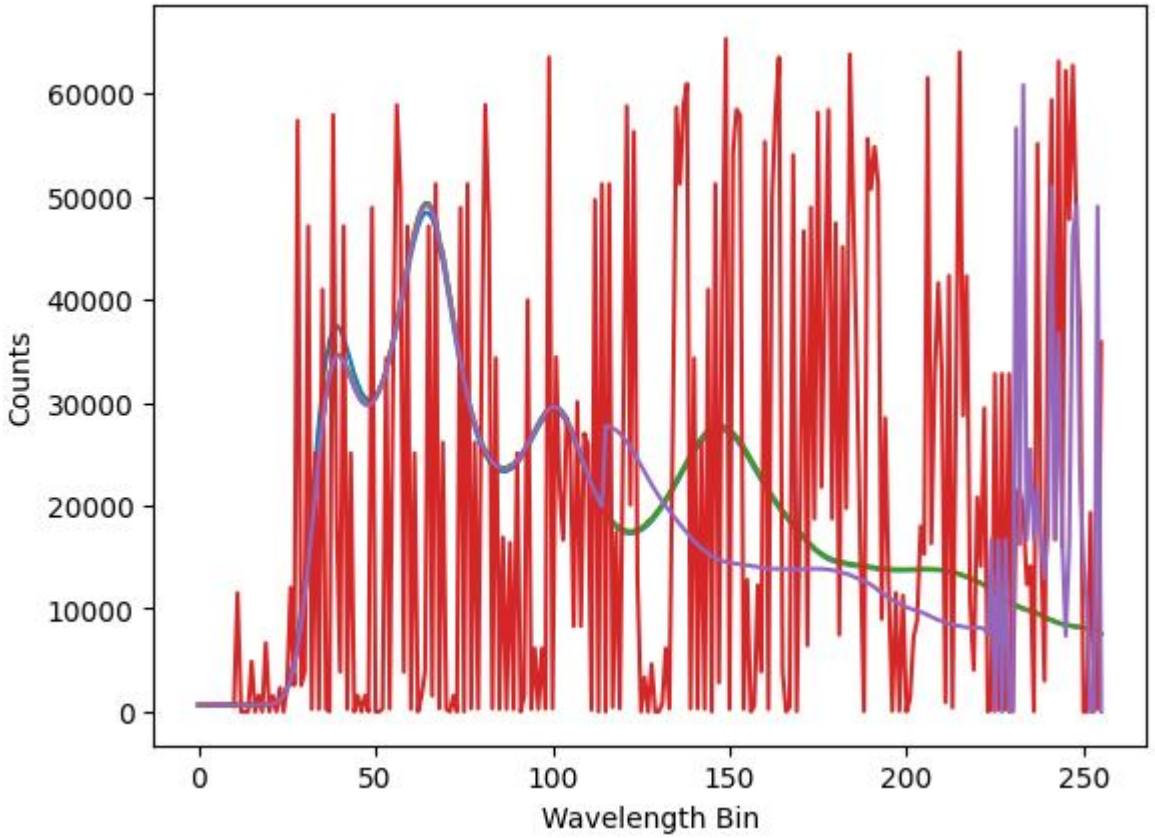


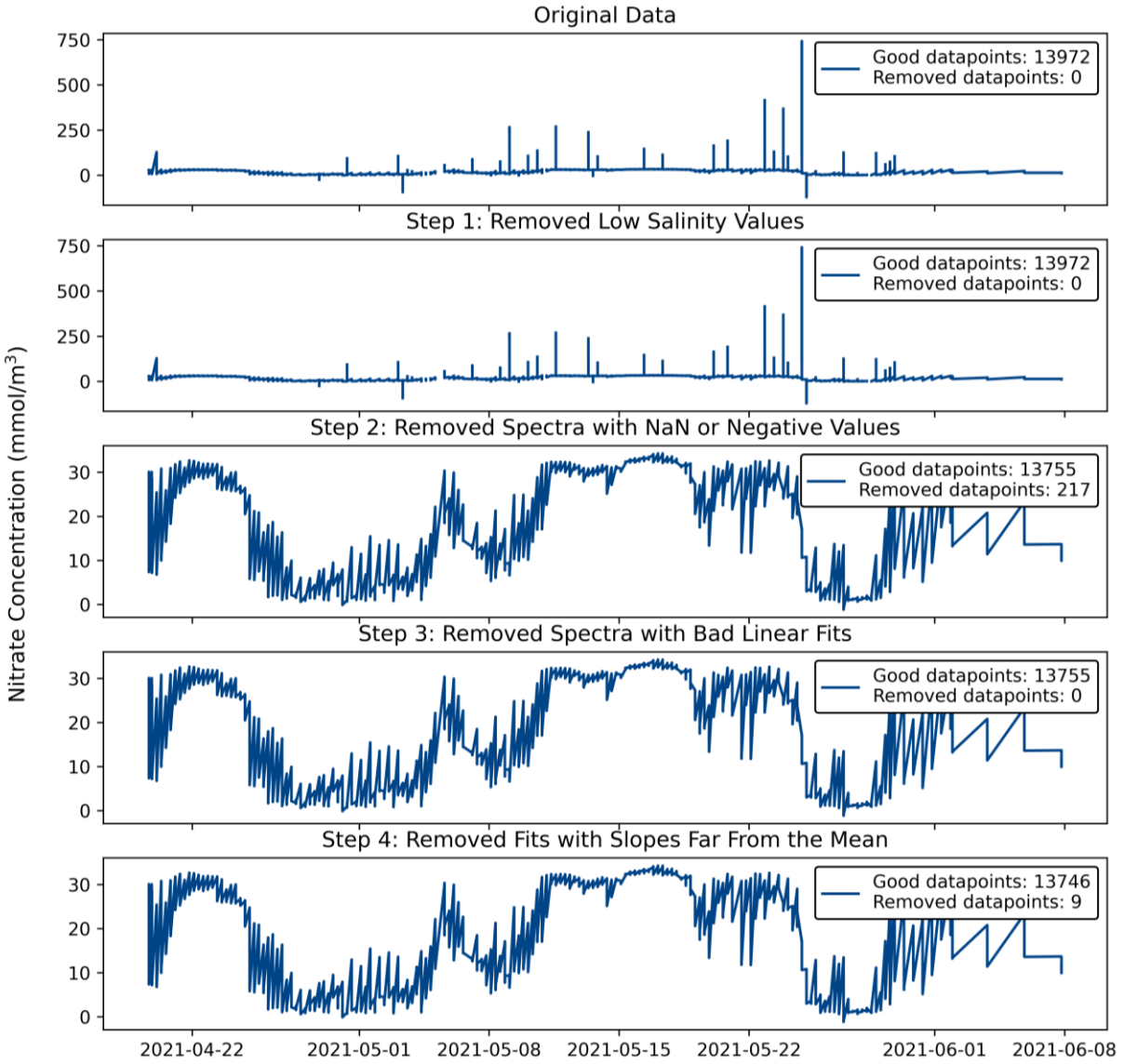
The challenges working with OOI Endurance Array Profiler nitrate data

- Particularly with profilers, very few nitrate samples are taken on cruise turn-arounds.
- QARTOD climatology tests flag a lot of good data as suspect due to climatology calculated on short periods.



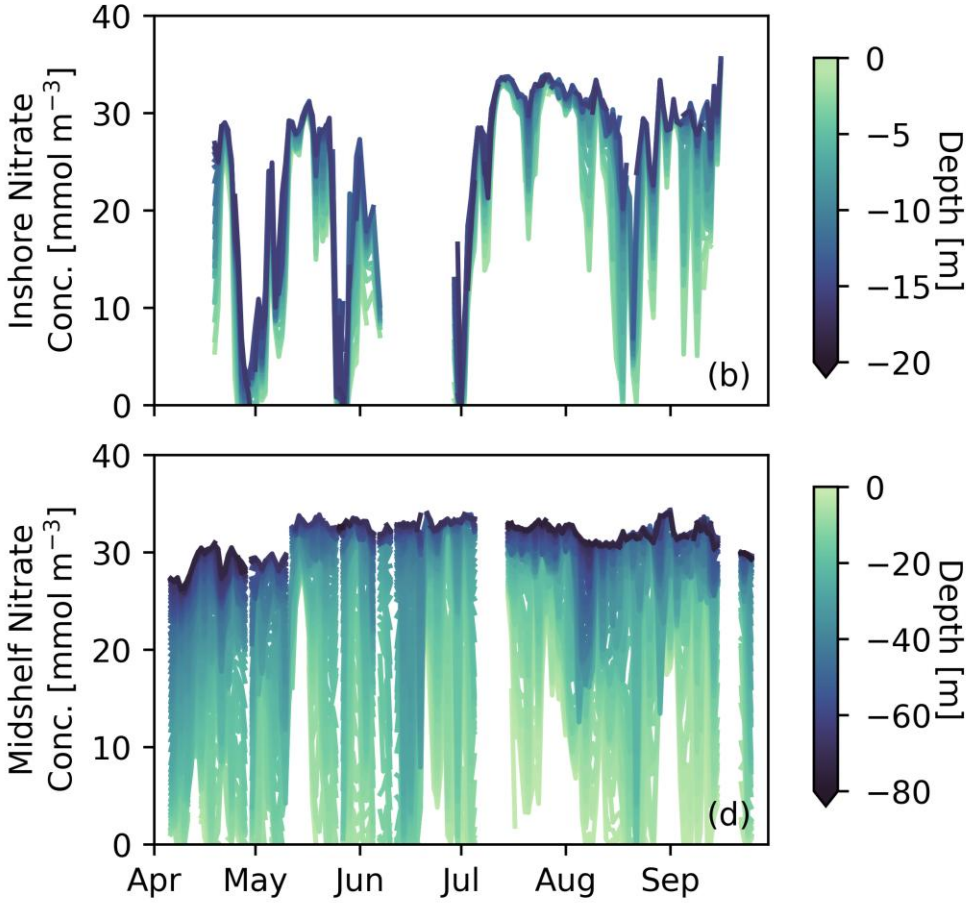
Nitrate Spectra QC





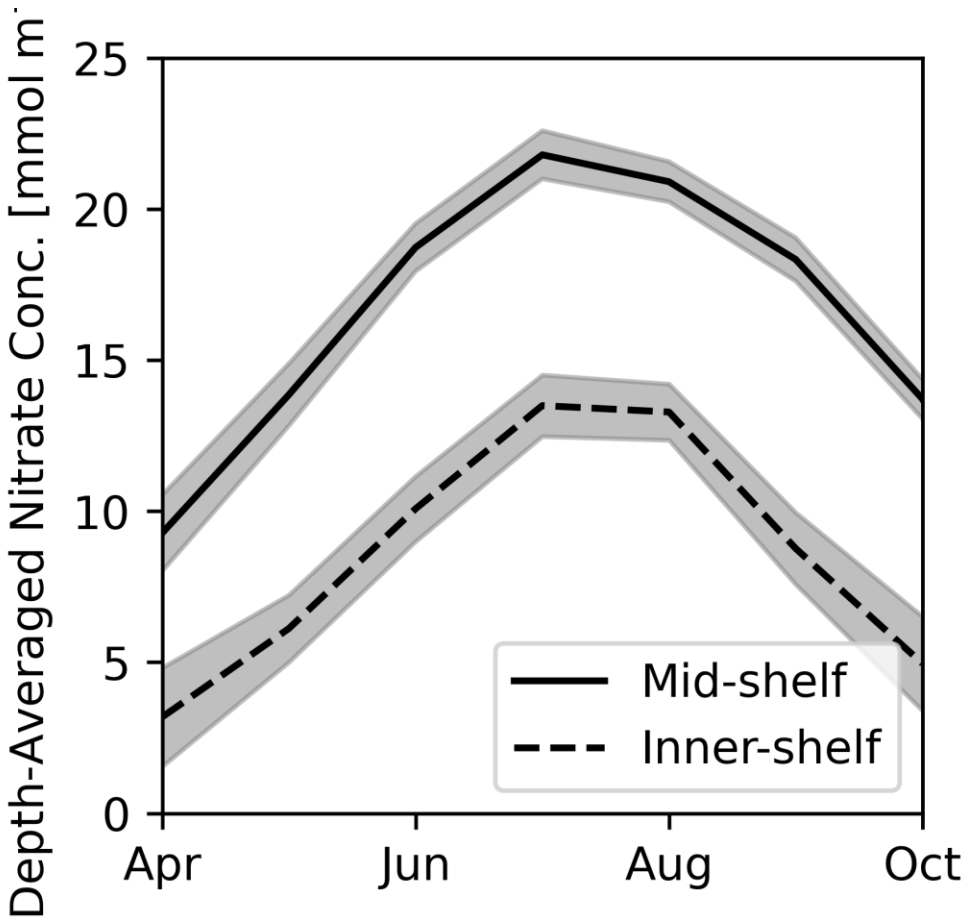
Unique nitrate dynamics between sites

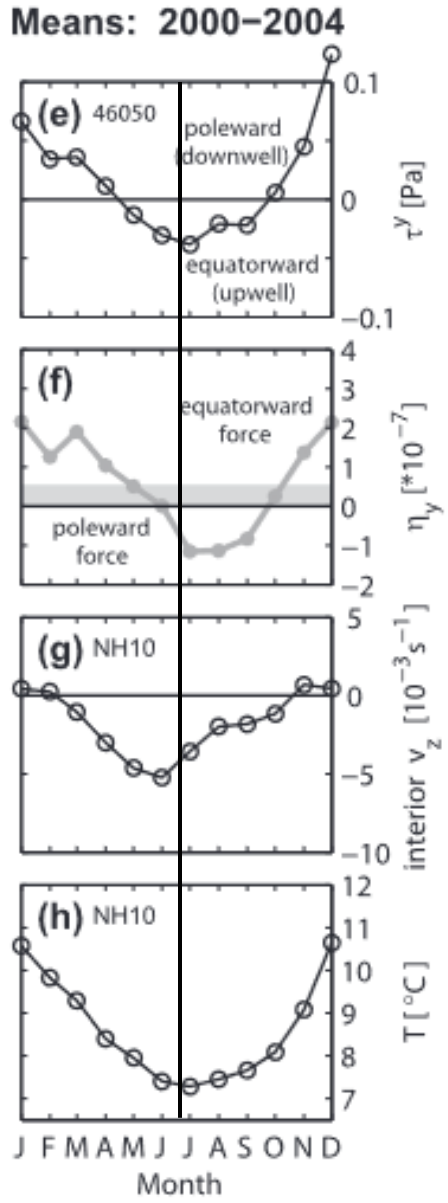
- Inner-shelf (top) is weakly stratified but has strong variability on upwelling event timescales (~weekly).
- Mid-shelf (bottom) is much more stratified with variability primarily on seasonal timescales.



Strong seasonal cycle in mean nitrate

- Seasonal evolution of depth mean nitrate concentration at both sites aligns with timing of seasonal cycles of other physical properties

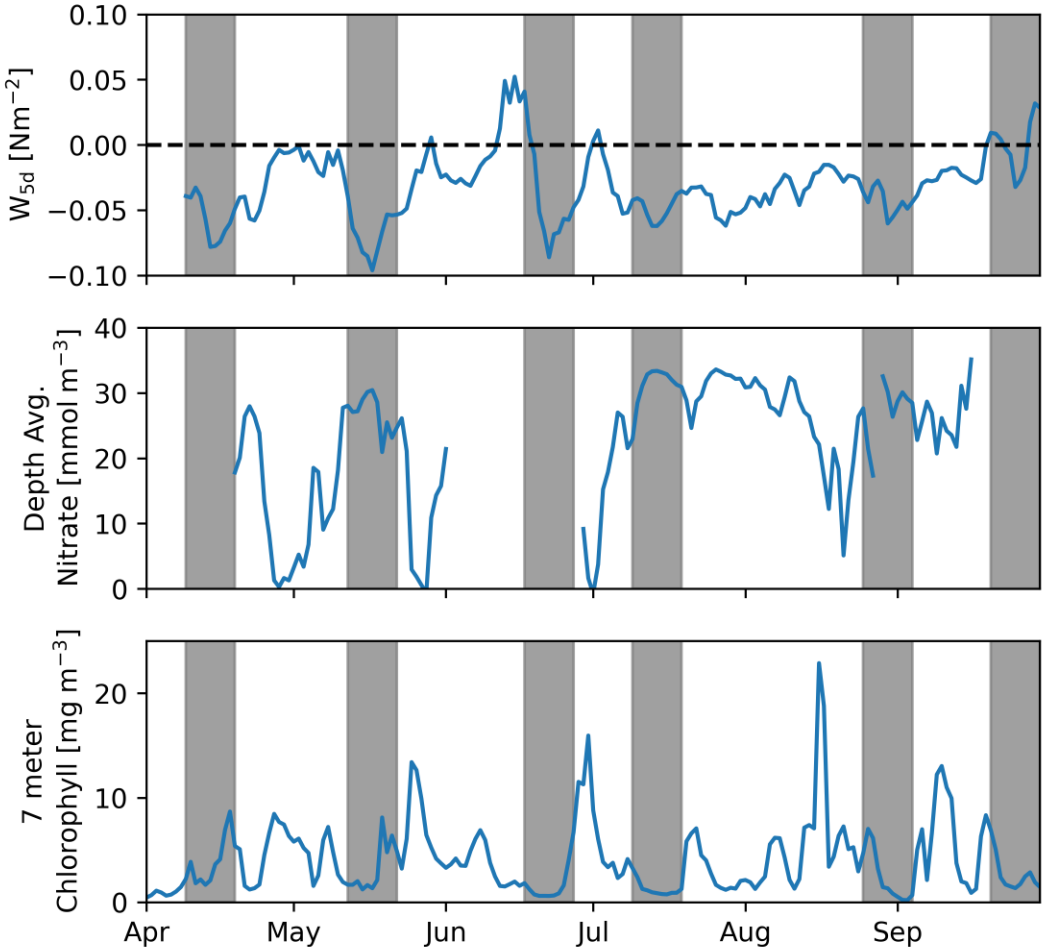




McCabe et. al., 2015

Competing controls on shelf nitrate

- Under strong upwelling winds, inner-shelf nitrate quickly increases towards a maximum value
- As winds relax, peaks in chlorophyll align with rapid decreases in nitrate
- Highlights competing bottom-up, physical controls on nitrate and top-down, biological controls on nitrate.



The good of working with OOI nitrate data

- **Collocated observations:**
  - Winds, currents, temperature, salinity, nitrate, chlorophyll.
- Raw spectra from SUNA included in dataset – super useful!
- Great community and workshops!
- *OOI Biogeochemical Sensor Data: Best Practices & User Guide* – published during the first summer of my PhD.

OOI Biogeochemical Sensor Data:
Best Practices & User Guide

Version Number: 1.1.1
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Hilary I. Palevsky[1*], Sophie Clayton[2†*], Dariia Atamanchuk[3], Roman Battisti[4], Jennifer Batryn[5], Annie Bourbonnais[6], Ellen M. Briggs[7], Filipa Carvalho[8], Alison P. Chase[9], Rachel Eveleth[10], Rob Fatland[11], Kristen E. Fogaren[1], Jonathan Peter Fram[12], Susan E. Hartman[8], Isabela Le Bras[5], Cara C. M. Manning[13], Joseph A. Needoba[14], Merrie Beth Neely[15], Hilde Oliver[5], Andrew C. Reed[5], Jennie E. Rheuban[5], Christina Schallenberg[16], Michael F. Vardaro[17], Ian Walsh[18], Christopher Wingard[12]

[1] Boston College, Department of Earth and Environmental Sciences, [2] Old Dominion University, Department of Ocean and Earth Sciences, [3] Dalhousie University, [4] Cooperative Institute for Climate, Ocean and Ecosystem Studies/Pacific Marine Environmental Laboratory, [5] Woods Hole Oceanographic Institution, [6] University of South Carolina, School of the Earth, Ocean and Environment, [7] University of Hawaii at Manoa, [8] National Oceanography Centre, UK, [9] Applied Physics Laboratory, University of Washington, [10] Oberlin College, Department of Geosciences, [11] University of Washington, eScience Institute, [12] Oregon State University, [13] University of Connecticut, Department of Marine Sciences, [14] Oregon Health & Science University, OHSU-PSU School of Public Health [15] Global Science and Technology, Inc., [16] Commonwealth Scientific and Industrial Research Organisation, Environment, Hobart, Australia, [17] University of Washington, School of Oceanography, [18] Freelance researcher

* co-lead, corresponding authors: Hilary I. Palevsky, palevsky@bc.edu; Sophie Clayton, sclayton@odu.edu
† now at National Oceanography Center, Southampton, UK

Conclusions

- Long-term, high-resolution, vertical profiles of collocated observations have been invaluable in connecting physical and biogeochemical shelf dynamics.
- OOI datasets provide a lot of power to the user but could benefit from **curated datasets** and more regular bottle samples, particularly on profiler turn-around cruises.
- Long time series necessary for investigating seasonal (or longer) variability – coming up on a decade of observations, annual and decadal scale variability may begin to be resolved, but important to keep these running.