Integrating Ocean Observatories Initiative (OOI) data into Undergraduate Geoscience Courses at University of Washington Pre- & Post onset of COVID

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Introduction

Motivation

We live in a 'big data' world where there are 'oceans of data' available for anyone to download and explore. Easily accessible data provide an opportunity to teach students standard approaches to working with data that can be applied broadly across many fields and prepare them for their future careers. However, many students lack the skills required to navigate these large data sets on their own.

Evolution of Integrating OOI Data Activities into Undergraduate Courses at UW

Beginning in 2016, faculty from University of Washington (UW) Seattle and Tacoma started to explore ways to integrate OOI data into oceanography classes on both campuses. Initially, data activities were incorporated into both lectures and labs using the original materials from *Data Explorations* developed by the Ocean Observatories Initiative (OOI) Data Lab Project at Rutgers University with the intent of increasing student engagement and enhancing students' ability to use and interpret oceanographic data. Between 2017-2019 faculty attended workshops run by the OOI education group at Rutgers University and did studies to assess the impact of OOI seawater modules on student learning, as well as evaluated student data literacy and attitudes about the use of data in the classroom. Results of these studies were presented at scientific meetings. The pre-COVID modules primarily consisted of using the original *Data Exploration* activities and materials to teach the concepts of salinity, density and stratification to Introductory Oceanography students at the two UW campuses. Visualizations and data explorations, particularly for real-time data from the Regional Cabled Array (RCA) (https://interactiveoceans.washington.edu/), were also regularly incorporated into course material and activities.

Starting in 2019, the original *Data Exploration* activities were expanded to include more modules and materials, many of which are being developed by the expanding community of educators using these data for teaching. In addition, levels of complexity have been added to the suite of resources; such as OOI Python Jupyter Notebook data analysis tools. The umbrella for all these OOI teaching resources is now the *OOI Ocean Data Labs Project* (https://datalab.marine.rutgers.edu/) and is maintained by the Rutgers OOI education team run by Janice McDonnell & Sage Lichtenwalner. In winter 2020 the *OOI Ocean Data Labs Project* developed, with the help of the educator community, an expanded second edition of an online OOI Lab Manual, just in time for COVID. The UW faculty pivoted using these new resources, as well as the old modules to move entire lab and field courses online. Examples of online adaptation incorporating OOI data are presented here for undergraduate oceanography and geology courses. Even though we are returning to in person classes, faculty are continuing to use more OOI resources in courses than prior to COVID.

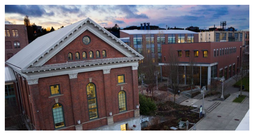
OOI educational resources include: the original Data Explorations plus additional Data Explorations (https://datalab.marine.rutgers.edu/data-explorations/) created as part of the educator development workshops hosted by the Rutgers OOI education team, the online OOI Lab Manual 2nd Ed. (https://datalab.marine.rutgers.edu/ooi-lab-exercises/) , as well as curricular wrappers such as lesson plans, data worksheets, data nuggets and Python Jupyter notebooks for data analysis.

Interactive Data Portals include: the original OOINET Data Explorer which is a bit "klunky" (https://ooinet.oceanobservatories.org/) ; the new Data Explorer – development started for this platform in 2019 and this is a much more user-friendly tool with which explore and visualize data (https://dataexplorer.oceanobservatories.org/) and the Regional Cabled Array (RCA) interactive data portal (https://interactiveoceans.washington.edu/). NOTE: There are a variety of ways to access data directly though systems such as ERDDAP, Thredds, M2M or JupyterHub.

Student Demographics

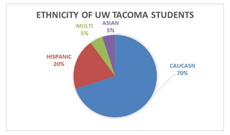
UW Seattle (R1)

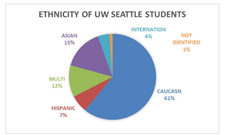
- ~46,000 Students
- 32% Graduate Students
- Ranked 3rd in Public Universities by US News & World Report

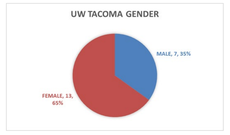


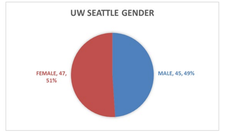
UW Tacoma (PUI)

- ~5,000 Students
- 14% Graduate Students
- Over 50% transfer students
- 64% first in family to attend college
- 27% unrepresented minorities
- Urban Serving









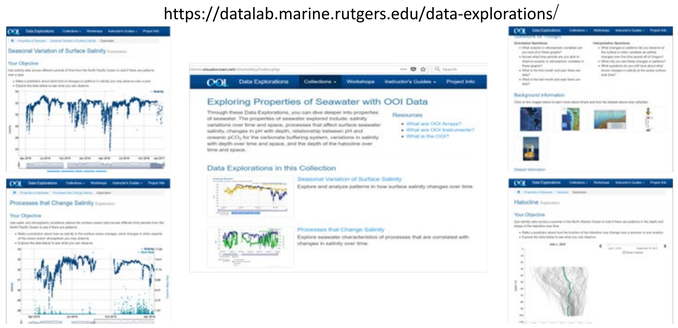
UNIVERSITY of WASHINGTON

Pre-COVID

OOI Education Portal

OCEAN 101 & TGEOS 241

https://datalab.marine.rutgers.edu/data-explorations/



Exploring Properties of Seawater with OOI Data collection *asks students to explore seawater characteristics and processes that are correlated with changes in salinity over time, with water depth and between different locations.*

"The Big Pivot" – COVID hits Spring 2020

Mikelle QUESTION: Could I effectively prepare and teach an online, hands-on lab course with just 3 weeks notice?

ANSWER: Yes, with the OOI Lab Manual!

OCEAN 101

Monday: Weekly topic introduced with environmental or climate hook

Tuesday: Exploration of concept using OOI data widgets and either "Think, Pair (in Breakout Rooms), Share" or Polls

Wednesday: Online OOI Labs in set Breakout Room Groups

Friday: In-class activity or quiz based on assessment questions in Lab Manual

Adapting OOI Data Explorations as Homework

Develop assignments to guide introductory students through OOI Data Explorations

OCEAN 200

Students learn about:
- Maps and physical setting of locations
- Ocean technology
- Sampling techniques

Student learn how to:
- Explore interactive graphics
- Read graphs
- Describe data
- Interpret data patterns

Student practice:
- Explaining why seawater properties change with location, time and depth
- Making predictions
- Applying knowledge to new situations

Using OOI Data to Teach Integrative Oceanography & Environmental Justice

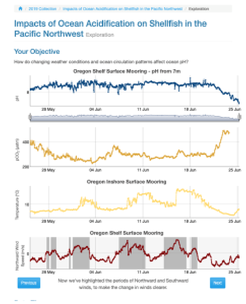
OCEAN 102

End of Unit Case Study (Canvas Module) designed to teach the importance of shellfish aquaculture in the Pacific Northwest and how changing ocean conditions are threatening the success of the industry and impacting the community groups who value shellfish as a resource.

Students are invited into the activity by sharing their personal experience with shellfish consumption or harvest.

Students asses the value and economic contribution of shellfish farming and wild harvest in Washington and translate research findings into fact sheets to share on course website

Students use interactive data widgets to explore how changing weather conditions and ocean circulation patterns affect ocean pH & predict when coastal waters would be harmful to shellfish.



UW Courses: Spring 2020-Fall 2021

UW SEATTLE Course	Enrollment/Class	OOI Data Product	Use during COVID
OCEAN 101 Oceanography of the PNW 1x Synchronous	100	Online Lab Manual – 2nd Ed. *Labs 1 – 8*	Weekly online labs to teach data skills, support learning of lecture materials and assess understanding of important concepts
OCEAN 102 The Changing Oceans 1x both Sync. & Async.	250	Data Explorations *Impacts of OA on Shellfish in PNW*	Module used to demonstrate connection among atmospheric processes, ocean circulation, biology and chemistry and explore the threat of OA on shellfish aquaculture and aquaculturists in the PNW
OCEAN 200 Introduction to Oceanography 2x both Sync. & Async	85	Data Explorations *Exploring Properties of Seawater with OOI Data*	Homework assignment to introduce students to ocean technology and methodology. Support learning of basic oceanographic concepts
OCEAN 201 Introduction to Oceanography Lab 2x -Synchronous	36	Online Lab Manual – 2nd Ed. *Labs 3 - Plate Tectonics & the Seafloor; Lab 4 - Seafloor Changes in a Volcanically Active Setting*	Online labs aligned to explore lecture concepts and assess learning of basic concepts
OCEAN 210 Integrative Oceans 1x Hiflex – in person	100	Data Explorations *Exploring Primary Production & Exploring Properties of Seawater* Online Lab Manual – 2nd Ed. *Lab 1*	Homework assignments to introduce students to ocean technology, data skills and assess understanding of important concepts. Data widgets shown in lecture to engage students, encourage participation and assess learning.

UW TACOMA Course	Total Enrollment	OOI Data Product	Use during COVID
TGEOS 241 Introduction to Oceanography w/Lab 1x Synchronous online & 1x In Person	48	Data Explorations *Exploring Properties of Seawater with OOI Data*	Online lab to support learning of basic oceanographic concepts and explore realtime data. Breakout rooms
TGEOS 445 Field Class – converted to Data Analysis class TESC 490 2x Synchronous online	18	Online Lab Manual – 2nd Ed. *Lab 8 – Anoxic Events – Solve the mystery of the dying crabs*	Online lab to support learning of basic oceanographic concepts and tie together idea of coastal upwelling impact on ocean parameters. Breakout rooms
TGEOS 117 Introduction to Physical Geology w/Lab 2x Synchronous online	48	Online Lab Manual – 2nd Ed. *Lab 4 - Seafloor Changes in a Volcanically Active Setting*	Online labs aligned to explore lecture concepts and assess learning of basic concepts. Breakout rooms