Round up of offshore wind energy research activities in Oregon

Energy Digital

Karina J. Nielsen, Director Oregon Sea Grant

PFMC Marine Planning Committee - August 12, 2024

Sea Grant OREGON

Oregon State University

A rapid round up of offshore wind energy research activities in Oregon

Sources

- Surveyed Oregon Ocean Policy Advisory Council (OPAC) scientific and technical advisory committee members
- Oregon State University “Offshore Wind in Oregon” campus-wide discussion
- Requested input from OSU researchers
- Online award abstract databases at NSF, DOE

Important caveats

- Not comprehensive, mostly OSU sources, researchers
- Plenty of relevant research being done by other organizations and outside of OR
- Not all relevant research is tagged as “offshore wind” research

Pacific Offshore Wind Consortium

https://powc.us/

PACIFIC OFFSHORE WIND CONSORTIUM

Core Member Organizations

PMEC Pacific Marine Energy Center

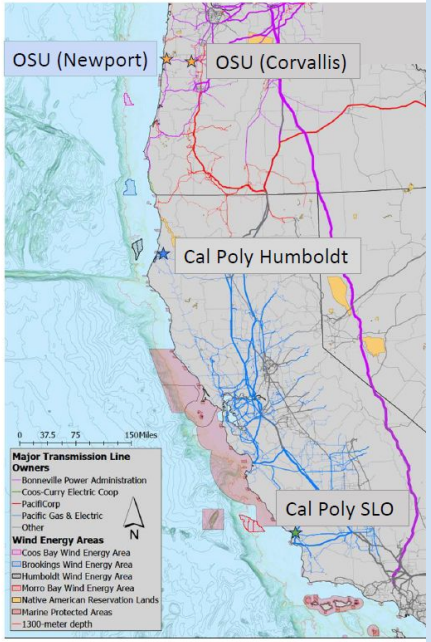
Oregon State University

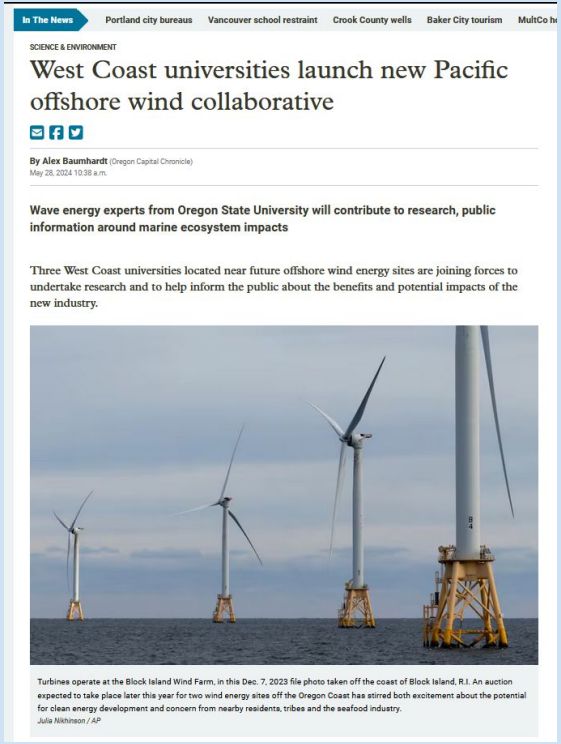
Schatz Energy Research Center

Cal Poly Humboldt.

CAL POLY Center *for* Coastal Marine Sciences

CAL POLY SAN LUIS OBISPO





In The News | Portland city bureaus | Vancouver school restraint | Crook County wells | Baker City tourism | MultCo h

SCIENCE & ENVIRONMENT

West Coast universities launch new Pacific offshore wind collaborative

By Alex Baumhardt (Oregon Capital Chronicle)
May 28, 2024 10:38 a.m.

Wave energy experts from Oregon State University will contribute to research, public information around marine ecosystem impacts

Three West Coast universities located near future offshore wind energy sites are joining forces to undertake research and to help inform the public about the benefits and potential impacts of the new industry.

Turbines operate at the Block Island Wind Farm, in this Dec. 7, 2023 file photo taken off the coast of Block Island, R.I. An auction expected to take place later this year for two wind energy sites off the Oregon Coast has stirred both excitement about the potential for clean energy development and concern from nearby residents, tribes and the seafood industry.
Julia Nikhinson / AP

OSU: Prosperity Widely Shared

Initial focus areas for research growth

- **Climate science and related solutions**
- **Clean energy and related solutions**
- Robotics
- Integrated health and biotechnology

https://leadership.oregonstate.edu/strategic-plan

Funding Notice: Nearly $50 Million Funding Opportunity for Offshore Wind National and Regional Research and Development

Wind Energy Technologies Office

Office: Wind Energy Technologies Office (WETO)
FOA Number: DE-FOA-0003334
Link to Apply: Apply on EERE Exchange

FOA Amount: $48.6 million

The U.S. Department of Energy plans U.S. offshore wind technology, supply monitoring.

South Fork

The U.S. Department of Energy's (DOE's) Wind Energy Technologies Office (WETO) announced the Offshore Wind National and Regional Research and Development Funding Opportunity, which will award $48.6 million for projects that address several major areas of need for offshore wind. The areas include accelerating research and development of floating offshore wind platforms; exploring innovations for fixed-bottom foundations; improving offshore wildlife protection through new monitoring technologies; expanding the reach of the domestic supply chain; advancing U.S. academic leadership in floating offshore wind; and investigating solutions to protect future infrastructure from lightning.

Topics

- Topic Area 1: Floating Offshore Wind Platform Research and Development ($20 million) +
- Topic Area 2: Innovation for Fixed-Bottom Offshore Wind Foundation Types and Supporting Infrastructure ($7.5 million) +
- Topic Area 3: Technology Advancement to Inform Risk to Birds and Bats from Offshore Wind Energy ($8 million) +
- Topic Area 4: Development of a Manufacturing and Supply Chain Offshore Wind Consortium in Great Lakes Region ($5 million) +
- Topic Area 5: Floating Offshore Wind Center of Excellence ($3.8 million) +
- Topic Area 6: Protecting the Future Offshore Wind Fleet against Lightning ($4.3 million) +

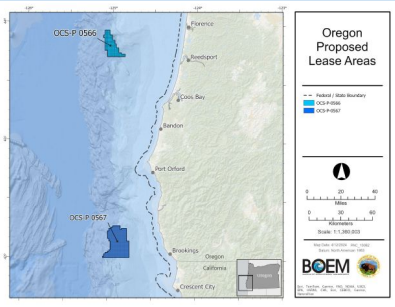
Oregon-based offshore wind energy research projects

Active, relevant research underway in

- Social science/human dimensions
- Marine ecology
- Wildlife
- Fisheries
- Oceanography
- Engineering
- Supply-chain/manufacturing

esadaphorn/Shutterstock.com

Social Science/Human Dimensions



Masters of Public Policy - Capstone Course Project

Qualitative analysis of public comments submitted to BOEM (fall 2023)

Major themes

- Ecology
- Economic Development
- Inefficiency concerns
- Climate change concerns
- Whales concerns

Gaps in Knowledge

- Impacts on whales and birds
- Infrastructure and hazard interaction
- Impacts on CA Current and upwelling

Social Science/Human Dimensions (con't)

PacWave: Perceptions of marine renewable energy development

Hilary Boudet, OSU/PMEC

- Surveys 2023, 2024 in OR, WA, CA
- Interviews in OR
- White paper, public presentation fall 2024
- PacWave website

Community benefits from offshore wind development

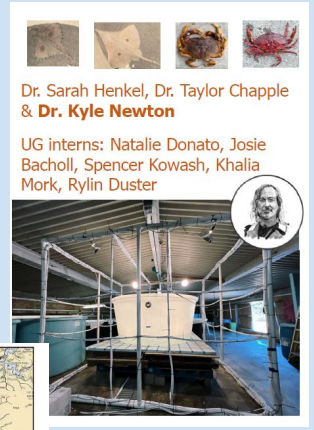
Hilary Boudet and Shawn Hazboun, OSU/PMEC

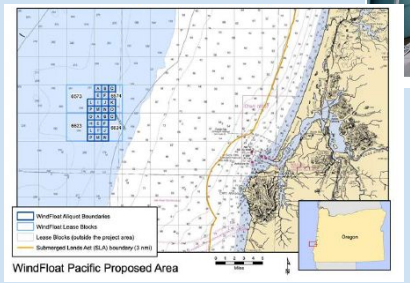
- Interviews, case studies, surveys: Oregon, Washington, California, Maine 2023-2026
- Community perspectives on potential benefits of offshore wind development
  - Local economies, rural communities
- Community benefits info, toolkit for communities
- Partners: UD, UM, Humboldt, UW, ATNI, Renewable NW, Sea Grant (OR, ME, WA)
- DOE

Marine ecology

Effects of altered electro- & geo-magnetic fields on the behavior of crabs & skates

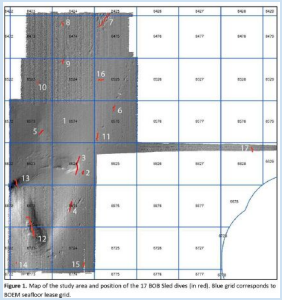
- Sarah Henkel, Taylor Chapple, Kyle Newton - OSU/PMEC
- Could EMFs impact magnetically based navigation behaviour?
- NOAA, Oregon Sea Grant, NSF, PMEC





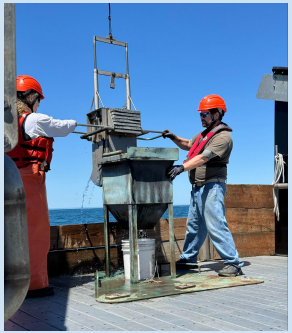
Benthic habitat characterization

- Sarah Henkel, OSU/PMEC
- Proposed OWE pilot project, Principle Power, Inc. 2013 off of Coos Bay
- BOEM, USGS



PacWave South: Effects of cable installation on benthos

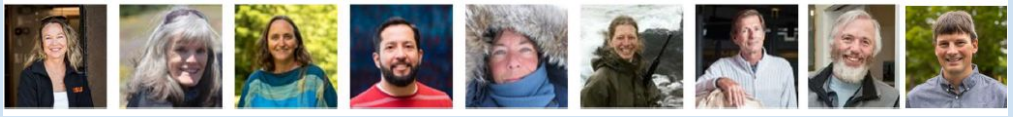
- Sarah Henkel, OSU/PMEC
- Box core surveys fall 2023, spring 2024 before installation. (and again after)



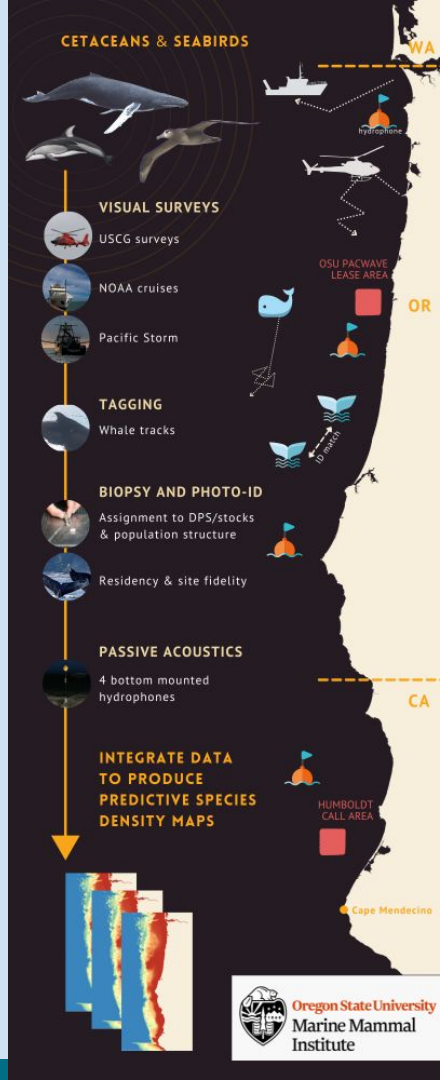
Marine mammals and seabirds

Marine offshore species assessments to inform clean energy (MOSAIC)

- Lisa Ballance, Barb Lagerquist, Scott Baker, Elizabeth Becker, John Calambokidis, Ladd Irvine, Rachael Orben, Daniel Palacios, Kate Stafford, Leigh Torres - OSU/MMI, Cascadia Research Collective
- Phase 1 - field research (2022-2024)
- Phase 2 - analysis and products (2024-2026)
- DOE, BOEM, NOAA



https://mmi.oregonstate.edu/marine-mammals-offshore-wind



Fisheries

Vulnerability assessment for Oregon fisheries related to floating offshore wind

- Francis Chan, OSU, CIMERS
- NOAA special project funds

Chris Peterson/Action Works Photography

Chris Peterson/Action Works Photography

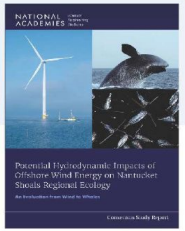
Oceanography

NATIONAL ACADEMIES Sciences Engineering Medicine | Consensus Study Report Highlights

COMMITTEE ON EVALUATION OF HYDRODYNAMIC MODELING AND IMPLICATIONS FOR OFFSHORE WIND DEVELOPMENT: NANTUCKET SHOALS (2024)

Eileen E. Hofmann (Chair), Old Dominion U.; Jeffrey Carpenter, Helmholtz-Zentrum Hereon; Qin Jim Chen, Northeastern U.; Josh Kohut, Rutgers U.; Richard Merrick, NOAA Fisheries; Erin L. Meyer-Gutbrod, U. South Carolina; Douglas P. Nowacek, Duke U. Kaustubha Raghukumar, Integral Consulting Inc.; Nicholas Record, Bigelow Laboratory for Ocean Sciences

Potential Hydrodynamic Impacts of Offshore Wind Energy on Nantucket Shoals Regional Ecology: An Evaluation from Wind to Whales



CONCLUSION

The **impacts** of offshore wind projects on the North Atlantic right whale and the availability of their prey in the Nantucket Shoals region will **likely be difficult to distinguish from the significant impacts of climate change and other influences on the ecosystem**. As planning and construction of wind farms in the Nantucket Shoals region continue, **further study and monitoring of the oceanography and ecology of the area is needed** to fully understand the impact of future wind farms.

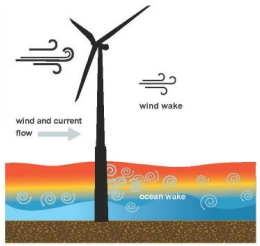


FIGURE 3: Schematic of the effects of an individual turbine on local hydrodynamics. As the wind blows across a turbine or wind farm, wind energy is extracted, thus creating a wind wake behind the turbine and reducing wind-driven circulation in the upper ocean. Additionally, the turbine structure in the water column causes an ocean wake, meaning the water becomes more turbulent behind the turbine.

https://nap.nationalacademies.org/catalog/27154/potential-hydrodynamic-impacts-of-offshore-wind-energy-on-nantucket-shoals-regional-ecology

frontiers | Frontiers in Energy Research

ORIGINAL RESEARCH

Effect of Floating Offshore Wind Turbines on Atmospheric Circulation in California

Kaustubha Raghukumar[1]*, Chris Chartrand[1], Grace Chang[1], Lawrence Cheung[2] and Jesse Roberts[2]

[1]Integral Consulting Inc., Santa Cruz, CA, United States, [2]Sandia National Laboratories, Livermore, CA, United States

In California offshore waters, sustained northwesterly winds have been identified as a key energy resource that could contribute substantially to California's renewable energy mandate. It is these winds that drive upwelling, which is responsible for much of the primary productivity that sustains one of the richest ecosystems on the planet. The goal of this study is to quantify changes in wind fields at the sea surface as the result of offshore wind turbine deployments by use of an atmospheric model. Modeled wind fields from this study will drive an ocean circulation model. The Weather Research and Forecasting model was implemented on a regional scale along the U.S. west coast, with a higher resolution nest along the California continental shelf. Simulated arrays of offshore wind turbines were placed within call areas for wind farm development offshore of Central and Northern California. At full build-out, it was found that wind speeds at 10 m height are reduced by approximately 5%, with wakes extending approximately 200 km downwind of the nominated lease block areas. The length scale of wind speed reductions was found to be several times the internal Rossby radius of deformation, the spatial scale at which rotationally-influenced ocean circulation processes such as upwelling occur.

OPEN ACCESS

Edited by: Joanna Staneva, Institute of Coastal Systems, Helmholtz Centre Hereon, Germany

Reviewed by: Yongsheng Huang, Xiamen University, China; Yi-Leng Chen, University of Hawai'i at Manoa, United States

Keywords: offshore wind, environmental effect analysis, wake effect, weather research and forecasting (WRF) model, wind farm (WF), atmospheric model

***Correspondence:** Kaustubha Raghukumar kraghukumar@integral-corp.com

Specialty section: This article was submitted to Wind Energy, a section of the journal Frontiers in Energy Research

Received: 27 January 2022
Accepted: 05 April 2022
Published: 1 June 2022

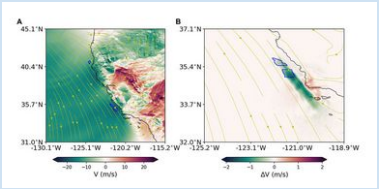
Citation: Raghukumar K, Chartrand C, Chang G, Cheung L and Roberts J (2022) Effect of Floating Offshore Wind Turbines on Atmospheric Circulation in California. Front. Energy Res. 10:863995. doi: 10.3389/fenrg.2022.863995

1 INTRODUCTION

In California offshore waters, sustained northwesterly winds have been identified as a key energy resource, with the offshore wind resource potential estimated at 112 gigawatts (Musial et al., 2016). This resource could contribute substantially to California's renewable energy mandate (Senate Bill [SB] 100). The key advantage of offshore wind over its land-based counterpart is that the offshore wind resource is far more consistent, reliable, and energetic, with little of the topographic and small-scale variability typically observed over land. It is believed that floating offshore wind technologies could reach capacity factors of more than 70%, and the levelized cost of energy of floating offshore wind projects is projected to decrease by as much as 53% by 2050 (Wiser et al., 2016), making offshore wind a viable energy source. However, a lack of understanding of potential environmental impacts is a current barrier to offshore wind that requires further investigation and mitigation.

Wind-driven upwelling is responsible for much of the primary productivity that sustains one of the richest ecosystems on the planet (Xiu et al., 2018). Wind-driven upwelling along the California coast is forced in two ways (**Figure 1**). First, northwesterly winds drive offshore Ekman transport near the coast, which produce coastal divergence and consequently, upwelling of deep, nutrient-rich waters in a band adjacent to the coast whose width is approximately

https://www.frontiersin.org/articles/10.3389/fenrg.2022.863995/full



communications earth & environment

ARTICLE

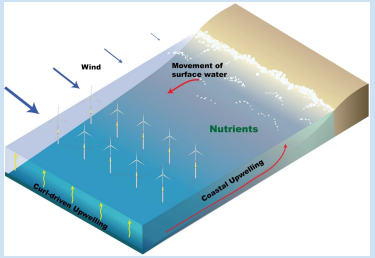
https://doi.org/10.1038/s43247-023-00780-y OPEN

Projected cross-shore changes in upwelling induced by offshore wind farm development along the California coast

Kaustubha Raghukumar[1✉], Timothy Nelson[1], Michael Jacox[2,3], Christopher Chartrand[4], Jerome Fiechter[5], Grace Chang[1], Lawrence Cheung[4] & Jesse Roberts[4]

In California offshore waters, sustained northwesterly winds have been identified as a key resource that can contribute substantially to renewable energy goals. However, the development of large-scale offshore wind farms can reduce the wind stress at the sea surface, which could affect wind-driven upwelling, nutrient delivery, and ecosystem dynamics. Here we examine changes to upwelling using atmospheric and ocean circulation numerical models together with a hypothetical upper bound buildout scenario of 877 turbines spread across three areas of interest. Wind speed changes are found to reduce upwelling on the inshore side of windfarms and increase upwelling on the offshore side. These changes, when expressed in terms of widely used metrics for upwelling volume transport and nutrient delivery, show that while the net upwelling in a wide coastal band changes relatively little, the spatial structure of upwelling within this coastal region can be shifted outside the bounds of natural variability.

https://www.nature.com/articles/s43247-023-00780-y



Conclusions:

- **reduced upwelling on the inshore side**
- **increased upwelling on the offshore side**

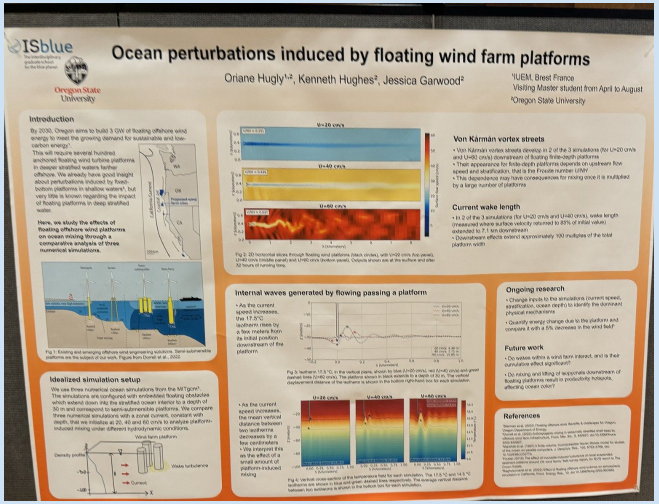
} shifted outside the bounds of natural variability

- **net upwelling in a wide coastal band changes relatively little**
- **consequences of these physical changes on the ecosystem are unknown**

Oceanography

Ocean perturbation induced by floating wind farm platforms

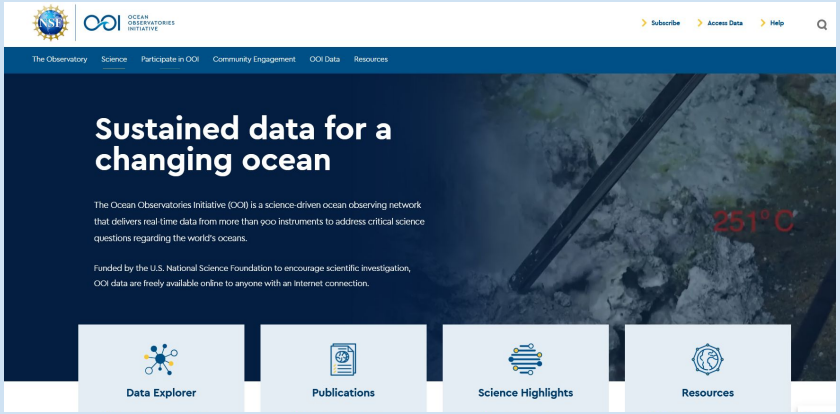
- Oriane Hugly (IUEM, Brest France) - visiting MS student Kenneth Hughes, **Jessica Garwood** OSU/CEAOS
- Numerical simulation comparisons
- Embedded floating obstacles,semi-submersible platform depth (30 m)
- Varied current speeds
- Platform induced mixing



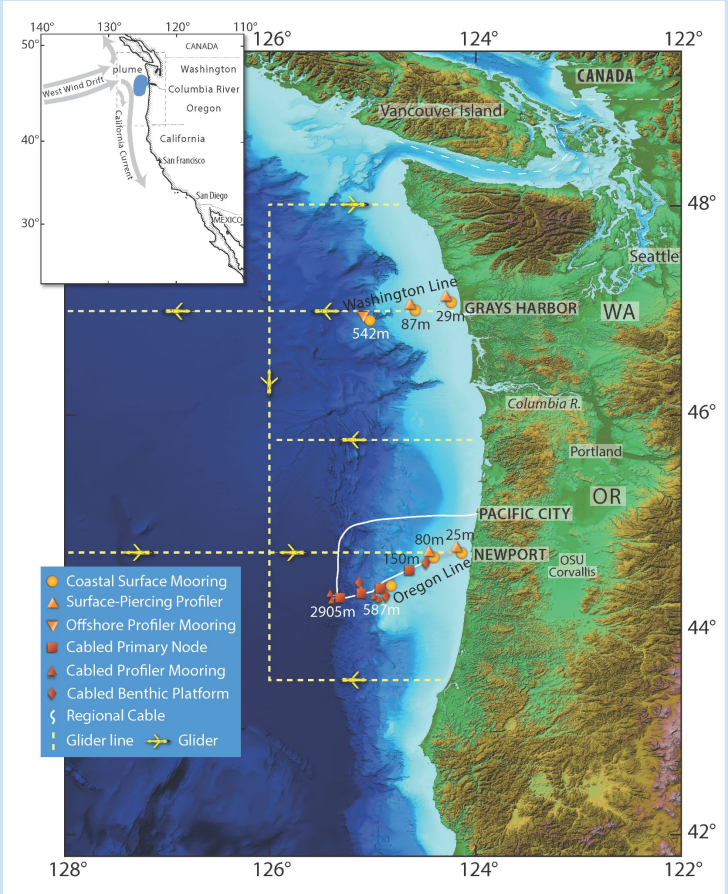
Oceanography

Ocean Observatories Initiative

- Jonathan Peter Fram, OSU/ OOI
- Moorings and gliders -> glider line at 43.5' N (Coos Bay)
  - ~1-2 mos of data since 2015
- Newport Hydrographic, Grays Harbor have been priorities
- OOI can re-prioritize to Coos Bay line



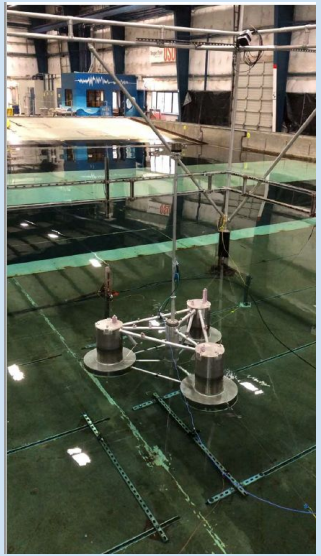
https://oceanobservatories.org/

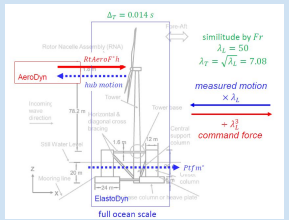


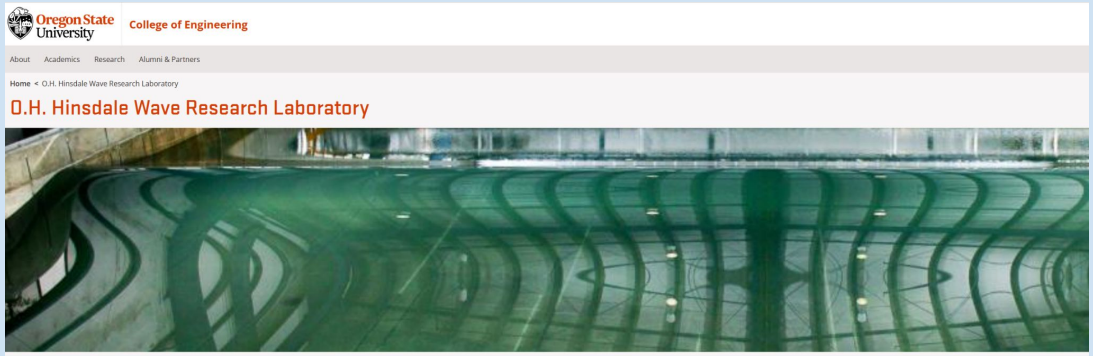
Engineering

Real-time hybrid offshore wind modelling

- Bryson Robertson, OSU/PMEC







Supply chain/manufacturing

Fabricated Tension-Leg Floating Offshore Wind Turbine Platforms

- Alicia Chapman, Willamette Technical Fabricators
- Phase I: robotic welding system - optimize fabrication of large tubular steel components; cutting-edge manufacturing techniques to improve the cost competitiveness of scaling this design; reduce fabrication timeline and cost for US manufacture, improve quality and reliability
- Phase II: extended research and prototyping,
- Phase III: commercialization and mass production
- DOE

National Academies

Standing Committee on Environmental Science and Assessment for Ocean Energy Management

Kevin Stokesbury (UMass Dartmouth, Chair), Jack Barth (OSU, Member)

NATIONAL ACADEMIES Sciences Engineering Medicine

- About
  - Upcoming Events
  - Description
  - Committee

The National Academies' Ocean Studies Board and Board on Earth Sciences and Resources have established a committee to provide ongoing assistance to the Bureau of Ocean Energy Management (BOEM) in its efforts to manage development of the nation's offshore energy resources in an environmentally and economically responsible way.

Standing Committee on Offshore Wind Energy and Fisheries

James Sanchirico (UC Davis, Chair), Stephen Joner (Makah consultant, Member), Sara Maxell (UW Bothell, Member)

- About
  - Description
  - Committee
  - Sponsors

This committee will provide ongoing assistance to the Bureau of Ocean Energy Management (BOEM) in its efforts to engage the fisheries community as it manages the development of offshore wind. The standing committee will serve as a forum to discuss the state of science and pressing concerns related to the development of offshore wind and its potential impacts to fisheries.

Thank you!

Questions?

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Sea Grant OREGON

Oregon State University