Emma Shie Nuss

CONTACT INFORMATION

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RESEARCH INTERESTS

Coastal physical oceanography; Numerical modeling; Machine-learning; Surf zone and nearshore processes; Estuarine dynamics; Physical-biological interactions

EDUCATION

University of Washington, Seattle, WA

Ph.D., Civil and Environmental Engineering, December 2024

- Thesis Topic: *An investigation of surf-zone vorticity using phase-resolved numerical modeling and eddy tracking*
- Advisor: Melissa Moulton, Ph.D.

University of Hawai'i at Mānoa, Honolulu, HI

M.S., Oceanography, Aug. 2016

- Thesis: *Predicting Pathogenic Bacteria with a Coupled Microbial-Physical Model*
- Advisor: Brian Powell, Ph.D

University of California San Diego, La Jolla, CA

B.S., Probability and Statistics, June 2013

RESEARCH EXPERIENCE

Post-doctorate research assistant Jan 2025 to Present
Pacific Northwest National Laboratory,
Supervisor: Rob Hetland
Assisting in the development of REMORA, a gpu-enabled version of ROMS, and exploring the representation of coastal regional processes in climate simulations.

Graduate Research Assistant July 2020 to Dec 2024
Group: *Environmental Fluid Mechanics*,
Supervisor: Melissa Moulton, Ph.D
Dept. of Civil and Environmental Engineering,
University of Washington, Seattle, WA
Investigating transient rip current dynamics using a combination of laboratory data, phase-resolved modeling, and machine-learning techniques. The goal of my work is to understand and quantify the wave-breaking processes that drive transient rip currents and integrate that knowledge, via machine-learning, into coastal models to improve predictions.

Associate Environmental Scientist Jan. 2017 to May 2020
Focus: *Hydrodynamic Modeling and Nutrient Impairment*,
San Francisco Estuary Institute, Richmond, CA
Developed, ran, and validated a hydrodynamic model of San Francisco Bay using Delft 3D Flexible Mesh, including compiling inputs from available datasets. Analyzed observations and model output to explore science questions related to current water quality issues and future scenarios. Compiled results into technical reports for stakeholder review.

Operational Ocean Modeler Aug. 2016 to Jan. 2017
Group: *Pacific Islands Ocean Observing System*,
Supervisor: Brian Powell, Ph.D
Research Corporation of the University of Hawai'i, Honolulu, HI
Coordinated a field study of the Ala Wai Canal in Waikiki to improve an operational ROMS model of the South Oahu coast.

Graduate Research Assistant Jul. 2013 to Aug. 2016
Group: *Physical Oceanography Division*,
Supervisor: Brian Powell, Ph.D
University of Hawai'i at Mānoa, Honolulu, HI
Developed a coupled microbial-physical model of the South Oahu coast in ROMS of the pathogenic bacteria, *V. vulnificus*. Analyzed the effect of physical forcings on *V. vulnificus*, such as the nonlinear microbial response to extreme rainfall events in the Ala Wai Canal.

REU Intern Sept. 2012 to Jun. 2013
Group: *California Current Ecosystem: Long Term Ecological Research*,
Supervisor: Art Miller, Ph.D
Scripps Institute of Oceanography,
La Jolla, CA
Used ROMS model output of the California Current to understand the dynamics of phytoplankton in eddy currents and the ability of phytoplankton signals to advect across eddies.

Research Assistant Jun. 2012 to Sept. 2012
Group: *UC Santa Cruz Ocean Modeling and Data Assimilation*,
Supervisor: Andy Moore, Ph.D
University of California Santa Cruz,
Santa Cruz, CA
Assisted in analysis of 30 years of ROMS output of the California Current.

Journal Publications

Papers in prep & review

2. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M., Travis, S. (in prep), "An eddy perspective of the surf zone", *Geophysical Research Letters*.

1. Baker, C. M, Moulton, M., Chickadel, C.C., **Nuss, E.S**, M., Palmsten, M., Brodie, K. (in prep), "Vertical vorticity production by short-crested breaking waves", *Journal of Physical Oceanography*

Published papers

7. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M. (2025), "Modeled surf-zone eddies on a laboratory scale barred beach with varying wave conditions", *JGR: Oceans*.

6. **Nuss, E. S.**, Powell, B., Jerolmon, C., Nigro, O., Gajigan, A.P., Giancaterino, S., Steward, G.F. (2025), "Predicting *V. vulnificus* Concentrations Using a Coupled Microbial-Physical Model", *Estuarine, Coastal and Shelf Science*.

5. Casper, A., **Nuss, E.S.**, Baker, C.M., Moulton, M., Dusek, G. (2024), "Assessing NOAA Rip-Current Hazard Likelihood Predictions: Comparison with Lifeguard Observations and Parameterizations of Bathymetric and Transient Rip-Current Types", *Weather and Forecasting*

4. Baker, C. M, Moulton, M., Chickadel, C.C., **Nuss, E.S**, M., Palmsten, M., Brodie, K. (2023), "Two-dimensional inverse energy cascade in a laboratory surf zone for varying wave directional spread", *Physics of Fluids*

3. Baker, C. M, Moulton, M., Palmsten, M., Brodie, K., **Nuss, E. S.** (2023), "Remote sensing of short-crested breaking waves in a laboratory directional wave basin", *Coastal Engineering*

2. Zhou, J., Stacey, M. T., Holleman, R. C., **Nuss, E.**, Senn, D. B. (2020), "Numerical Investigation of Baroclinic Channel-Shoal Interaction in Partially Stratified Estuaries". *Journal of Geophysical Research: Oceans*, 125, e2020JC016135.

1. Neveu, E., Moore, A. M., Edwards, C. A., Fiechter, J., Drake, P., Crawford, W. J., Jacox, M. G., **Nuss, E.** (2016), "An historical analysis of the California Current circulation using ROMS 4D-Var: System configuration and diagnostics". *Ocean Modelling*, 99, 133-151.

Published Technical Reports

2. **Nuss, E.**, Zhang, Z., Holleman, R., Chelsky, A., Winchell, T., Wu, J., Senn, D. (2018). "Hydrodynamic and Water Quality Model Calibration and Application in San Francisco Bay." SFEI Contribution No. 913. San Francisco Estuary Institute: Richmond, CA.

1. Holleman, R., **Nuss, E.**, Senn, D. (2017). "San Francisco Bay Interim Model Validation Report." SFEI Contribution No. 850. San Francisco Estuary Institute: Richmond, CA.

Conference Presentations

18. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M. (2024) *Modeled surf-zone eddies on a laboratory scale barred beach with varying wave period and directional spread*, oral presentation at Ocean Sciences Meeting, February.

17. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M., Brodie, K., Palmsten, M. (2023) *How does surfzone eddy activity vary with wave conditions on a laboratory scale barred beach?*, oral presentation at Gordon Research Seminar Coastal Ocean Dynamics, June 18-23.

16. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M., Brodie, K., Palmsten, M. (2023) *How does surfzone eddy activity vary with wave conditions on a laboratory scale barred beach?*, oral presentation at Gordon Research Seminar Coastal Ocean Dynamics, June 17-18.

15. **Nuss, E. S.**, Moulton, M., Suanda, S., Kutz, N., Baker, C.M., (2023) *Using machine learning to predict wave-breaking induced eddy generation in the surf zone*, poster presentation at American Meteorological Society Annual Meeting, Jan.

14. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C.M., Brodie, K., Palmsten, M. (2022) *Breaking-wave crest lengths and associated vorticity input under varying directional spread*, oral presentation at the American Geophysical Union, in person, Dec.

13. Baker, C., Moulton, M., Palmsten, M., Brodie, K., **Nuss, E. S.** (2022) *Deciphering determinants of breaking wave crest length in the surf zone by remotely sensing directional wave fields in the laboratory*, oral presentation at Wind wave In the Earth System (WISE) Meeting, 20 May - 2 Jun.

12. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C. (2022) *Integrating Machine Learning with Numerical Models to Improve Coastal Predictions*, poster presentation at AI Institute Kick Off Meeting, University of Washington, Seattle, 16-17 March.

11. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C., Brodie, K., Palmsten, M. (2021) *Investigating short-crested breaking waves under variable directional spreads using phase-resolved modeling and laboratory observations*, oral presentation at Ocean Science Meeting, Virtual, 1 March.

10. Baker, C., Moulton, M., Palmsten, M., Brodie, K., **Nuss, E. S.** (2021) *Vorticity injection at crest ends, eddy evolution, and transient rip current formation in a laboratory surf zone*, oral presentation at Ocean Science Meeting, Virtual, 1 March.

9. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C., Brodie, K., Palmsten, M. (2021) *Phase-Resolved Modeling and Laboratory Investigation of Surfzone Eddies and Transient Rip Currents*, oral presentation at Coastal and Estuarine Research Federation, Virtual, 10 Nov.

8. **Nuss, E. S.**, Moulton, M., Suanda, S., Baker, C., Brodie, K., Palmsten, M. (2021) *Phase-Resolved Modeling and Laboratory Investigation of Surfzone Eddies and Transient Rip Currents*, oral presentation at the Young Coastal Scientists and Engineers Conference, Mytrle Beach, SC, 29-31 Oct.

7. Baker, C. M., **Nuss, E.**, Brodie, K., Palmsten, M., and Moulton, M. (2021) *Short-Crested Wave Breaking, Eddies, and Transient Rip Currents in a Laboratory Wave Basin*, oral presentation at Coastal Dynamics, Delft, Netherlands, 28 June - 2 July.

6. **Nuss, E.**, Baker, C. M., Moulton, M., and Kumar, N. (2020). *Phase-Resolved Modeling and Laboratory Investigation of Surfzone Eddies and Transient Rip Currents*, poster presentation at the American Geophysical Union, San Francisco, CA, 14 Dec., Abstract ID: 739635.

5. **Nuss, E.**, Holleman, C. D., Zhou, J., Senn, D. B. (2020). *Implications of Shifting Stratification Dynamics on Phytoplankton Blooms in San Francisco Bay Under Future Climate Scenarios*, poster presentation at the Ocean Sciences Meeting, San Diego, CA, 16-21 Feb., Abstract ID: 1082

4. **Nuss, E.**, Holleman, R., Senn, D., Zhang, Z., Zhou, J., Stacey, M. (2018). *Predicting Ecosystem Response to Shifting Drivers in San Francisco Bay*, oral presentation at the Eastern Pacific Ocean Conference, Mt. Hood, OR, 12-15 Sept.

3. **Nuss, E.**, Holleman, R., Zhang, Z., and Senn, D. (2017). *Sensitivity of the San Francisco Bay ecosystem to future scenarios*, poster presentation at the State of the Estuary, Oakland, CA, 10-11 Oct.

2. **Nuss, E.**, Powell, B., Steward, G., and Merrifield, M. (2017) *Predicting pathogenic bacteria concentrations using a coupled microbial-physical model*, poster presentation at the Association for the Sciences of Limnology and Oceanography (ASLO) Meeting, Honolulu, HI, 26 Feb - 3 Mar.

1. **Nuss, E.**, Powell, B., Steward, G., and Nigro, O. (2014). *Predicting pathogenic bacteria in coastal waters*, poster presentation at the Ocean Sciences Meeting, Honolulu, HI, 23-28 Feb.

Department Presentations

West Coast Collaboratorium Seminar — 2024
Oregon State University

Applied Physical Lab Seminar — 2023
University of Washington

Virtual Coastal Ocean Fluid Dynamics Laboratory (COFDL) Presentation
Co-Presentation with Melissa Moulton & Christine Baker — 2021
Woods-Hole Oceanographic Institute

Physical Oceanography Graduate Student Symposium — 2014, 2015
University of Hawai'i

Awards and Honors

Outstanding Poster Presentation — 2023
Gordon Research Conference Coastal Ocean Dynamics

Outstanding Oral Presentation — 2021
Young Coastal Scientist and Engineers of the Americas Conference

College of Engineering Dean's Fellowship — 2021-2022
University of Washington

STAR Achievement Scholarship — 2015
University of Hawai'i

Teaching Experience

Teaching Assistant — Winter 2024
University of Washington, Seattle, WA
- Teaching assistant for undergraduate fluid mechanics
- Held weekly review workshops, office hours, and bi-weekly labs

Teaching Assistant — Spring 2023
University of Washington, Seattle, WA
- Teaching assistant for senior undergraduate/graduate course in coastal engineering and water wave mechanics
- Held office hours to assist in teaching homework concepts, debugging code, and installing SWAN software

Guest Lecturer
Coastal Engineering, *University of Washington*, Seattle, WA — June 2023

Guest Lecturer
Coastal Circulation, *Naval Post Graduate School*, Monterey, CA — Nov 2022

Lecturer — Fall 2016
Kapi'olani Community College, Honolulu, HI
- Instructor for an introductory undergraduate oceanography lecture and lab.
- Developed curriculum and taught coordinated lectures and laboratories exploring principles of geological, physical, chemical, and biological oceanography.

Teaching Assistant — Spring 2016
University of Hawai'i at Mānoa, Honolulu, HI
- Teaching assistant for an introductory undergraduate oceanography lab.
- Implemented laboratory exercises that quantitatively explored topics in geologic,

physical, chemical, and biological principles of earth and marine science.

Teaching Assistant Fall 2015
University of Hawai'i at Mānoa, Honolulu, HI
- Teaching assistant for a global environmental change laboratory course focused on environmental problem solving.
- Tutored students on problem solving and quantitative skills for homework assignments and taught introductory Matlab skills.

Calculus Tutor 2015 - 2016
University of Hawai'i at Mānoa, Honolulu, HI
- Tutored incoming Oceanography graduate students preparing for the department required Calculus Proficiency Exam.
- Topics covered single and multi variate differentiation and integration, infinite series, differential equations, vector algebra, vector valued functions, and optimization.

Mentorship

- *Co-advisor to Audrey Casper* June 2022 - Present
  Co-advised Audrey Casper on research tasks and manuscript writing during their CICOES summer internship and continued work as a research assistant at the Applied Physics Lab at UW.

- *Global Environmental Science Mentor Program*, 2015 - 2016
  Mentored two undergraduate students in the Global and Environmental Science major at the University of Hawai'i at Mānoa. Met with both students at a minimum of once per semester to check in on school and life.

Outreach

- *Public article on rip current science and safety* July 2023
  Lead a co-authored public article on rip current science and safety for the news organization *The Conversation*

- *Mauka to Makai*, April 2016
  Volunteered at the PacIOOS exhibit for Waikīkī Aquarium's annual community outreach day. Facilitated hands on experiments and demonstrations related to coastal water quality to the public.

- *SOEST Summer Bridge*, July 2015
  Assisted in coordination of the Kapi'olani Community College Summer Bridge SOEST Outreach Program. Program included mock interviews with scientists and professionals in STEM fields, guided STEM activities, and tours of SOEST facilities at the University of Hawai'i at Mānoa.

- *Guest on ThinkTech Hawai'i*, March 2015
  Guest with Dr. Grieg Steward on a local non-profit broadcasting corporation that focuses on raising public awareness and engagement on news and issues relevant to Hawai'i. Interview focused on our research about the Ala Wai Canal and the pathogenic bacteria that thrive in the canal.

- *School of Ocean and Earth Science and Technology Open House*, 2013, 2015
  Volunteered during the biennial open house for various oceanography exhibits. Gave hands on demonstrations and tours of oceanography related work including coastal water quality, runoff, wave gliders and density to school groups and the public.

- *Speaker at Hanauma Bay Education Program*, Dec 2013
  Gave a public talk on thesis research as a part of the Hanauma Bay Education Program seminars organized by University of Hawai'i Sea Grant.

Volunteer Activities

- Western Coastal Collaboratorium (WCC) Sept 2022 - Present
  Served as the University of Washington representative for the WCC organizing committee. Acted to coordinate and set up monthly student-led seminars held at alternating locations between West Coast institutions with fellow co-organizers.

- University of Washington Faculty Search Committee Fall/Winter 2021/2022
  Served as the graduate student representative on the Department of Civil and Environmental Engineering faculty search committee.

- Silicon Valley Women in Engineering Conference Career Panel March 2022
  Served as a panelist on the Building, Infrastructure, and the Environment career panel for the Silicon Valley WIE Conference.

Skills

Numerical Models
- FUNWAVE-TVD
- REMORA
- Regional Ocean Modeling System (ROMS)
- Delft3D Flexible Mesh (DFM)
- General Ocean Turbulence Model (GOTM)
- Simulating Waves Nearshore (SWAN)

Programming
- Python, Linux
- Familiarity with R, MATLAB, Fortran, C/C++

Other Programs
- QGIS, Inkscape

Field Experience

- *During Nearshore Event Experiment (DUNEX)*, Oct. 2021
  Assisted in wave drifter deployments in the surf zone at the Army Corps of Engineers Field Research Facility in Duck, NC.

- *Hawai'i Ocean Time-Series (HOT) Cruises*, Nov. 2014, Jul. & Aug. 2015
  Participated in three 5-day cruises to Station ALOHA and assisted in salinity and temperature sampling, CTD rosette deployment, and meteorological observations.