Jacob Steinberg

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Research Interests and Experience

interests: ocean heat content change, sea level (open-ocean to coastal sea level connectivity), mesoscale turbulence, eddy vertical structure, deep-ocean dynamics, remote sensing, AUVs

N.O.A.A. Geophysical Fluid Dynamics Laboratory [current] Princeton, NJ
Research Physical Scientist - Ocean and Cryosphere Division 2023 – present

- Investigating the patterns and drivers of sea level change using a suite of regional and global ocean and climate models. Carrying out concurrent and integrated analyses of coastal, in-situ and remotely sensed observations to better understand observed variability. Developing and implementing a dynamical downscaling coastal sea level forecasting framework while contributing to GFDL's next-generation global climate model development.

Woods Hole Oceanographic Institution Woods Hole, MA
Postdoctoral Investigator 2020 – 2023

- Developed a framework to quantify ocean scale dependent eddy kinetic and potential energy seasonal cycles. Aided in the development of mesoscale eddy parameterizations in global climate models. (Ocean Transport and Eddy Energy Climate Process Team w/ S. Cole)
- Investigated the regional patterns and drivers of sea level variability with a focus on ocean dynamics connecting ocean heat content change, coastal sea level, and ocean mass redistribution. (NASA-OSTST w/ C. Piecuch)

University of Washington Seattle, WA
Graduate Research Assistant 2013–2020

- Focus: ocean mesoscale eddy radial-vertical structure, evolution, and decay, geostrophic turbulence, energy cascades, and surface expressions of interior motions. Development, deployment, piloting, and extensive use of Seaglider and Deepglider autonomous underwater vehicles.

Education

University of Washington Seattle, WA
Ph.D. in Physical Oceanography, Advisor: Charles Eriksen 2020

- Thesis: "Eddy Vertical Structure and Variability: vortex evolution and the geography of geostrophic turbulence"

University of Washington Seattle, WA
M.S. in Applied Mathematics 2016

University of Washington Seattle, WA
M.S. in Physical Oceanography 2016

University of Maryland College Park, MD
B.S. in Civil and Environmental Engineering, Magna Cum Laude (minor: project management) 2013

Manuscripts in Preparation and Submitted

"The GFDL-CM4X climate model hierarchy, Part I: model description and thermal properties, Part II: case studies". S. Griffies, A. Adcroft, M. Alberty, R. Beadling, M. Bushuk, H. Drake, R. Dussin, R. Hallberg, M. Harrison, W. Hurlin, H. Khatri, J. Krasting, S. Legg, M. Lobo, G. MacGilchrist, T. Morrison, B. Reichl, A. Sane, O. Sergienko, M. Sonnewald, **J.M. Steinberg**, J.E. Tesdal, M. Thomas, K. Turner, M. Ward, M.

Winton, N. Zadeh, R. Zhang, W. Zhang, M. Zhao. Submitted to the *Journal of Advances in Modeling Earth Systems* (2024-11), resubmitted.

"A Landscape of Eddy Vertical Structure: methods of characterization and the role of bathymetryic slope and roughness". **J.M. Steinberg**, E. Yankovsky, S. Cole, L. Zanna. Submitted to the *Journal of Physical Oceanography* (2025-02), accepted (2025-07).

"Deep Ocean Steric Sea level Change in the Northwest Atlantic Ocean". N. Zilberman, W. Llovel, **J.M. Steinberg**, B. Meyssignac, M. Ablain, R. Fraundeau. Submitted to the *Geophysical Research Letters* (2024-12), accepted (2025-07).

"Understanding the role for internal variability in driving past and future ocean dynamic sea-level trends in CMIP6 simulations". S. Coats, P.R. Thompson, C.G. Piecuch, J.T. Fasullo, B.D. Hamlington, K.B. Karnauskas, R.S. Nerem, A.R. Rodriguez, and **J.M. Steinberg**. Submitted to the *Journal of Climate* (2024-06), accepted (2025-06).

Peer Reviewed Publications

Steinberg, J.M., Griffies, S., Krasting, J., Piecuch, C., & Ross, A. (2024). A Link Between U.S. East Coast Sea Level and North Atlantic Subtropical Ocean Heat Content. *Journal of Geophysical Research: Oceans*. https://doi.org/10.1029/2024JC021425

Steinberg, J.M., Piecuch, C., Hamlington, B., Thompson, P., & Coats, S. (2024). Influence of Deep Ocean Warming on Coastal Sea Level Trends in the Gulf of Mexico. *Journal of Geophysical Research: Oceans*. https://doi.org/10.1029/2023JC019681

Toole, J., Musgrave, R., Fine, E., **Steinberg, J.M.**, & Krishfield, R. (2023). On the Vertical Structure of Deep Ocean Subinertial Variability. *Journal of Physical Oceanography*. https://doi.org/10.1175/JPO-D-23-0011.1

Loose, N., Abernathey, R., Grooms, I., Busecke, J., Guillaumin, A., Yankovsky, E., Marques, G., **Steinberg, J.M.**, Ross, A., Khatri, H., Bachman, S., Zanna, L., & Martin, P. (2022). GCM-Filters: A Python Package for Diffusion-based Spatial Filtering of Gridded Data. *Journal of Open Source Software*. https://doi.org/10.21105/joss.03947

Marques, G., Loose, N., Yankovsky, E., **Steinberg, J.M.**, Chang, C.-Y., Bhamidipati, N., Adcroft, A., Fox-Kemper, B., Griffies, S., Hallberg, R., Jansen, M., Khatri, H., & Zanna, L. (2022). NeverWorld2: An idealized model hierarchy to investigate ocean mesoscale eddies across resolutions. *Geoscientific Model Development*, *15*. https://doi.org/10.5194/gmd-15-6567-2022

Steinberg, J.M., Cole, S., Drushka, K., & Abernathey, R. (2022). Seasonality of the Mesoscale Inverse Cascade as Inferred from Global Scale-Dependent Eddy Energy Observations. *Journal of Physical Oceanography*. https://doi.org/10.1175/JPO-D-21-0269.1

Steinberg, J.M., & Eriksen, C. (2022). Eddy Vertical Structure and Variability: Deepglider Observations in the North Atlantic. *Journal of Physical Oceanography*, *52*, 1091–1110. https://doi.org/10.1175/JPO-D-21-0068.1

Grooms, I., Loose, N., Abernathey, R., **Steinberg, J.M.**, Bachman, S., Marques, G., Guillaumin, A., Yankovsky, E., & Zanna, L. (2021). Diffusion-based smoothers for spatial filtering of gridded geophysical data. *Journal of Advances in Modeling Earth Systems*. https://doi.org/10.1029/2021MS002552

Steinberg, J.M., & Eriksen, C. (2020). Glider Sampling Simulations in High-Resolution Ocean Models. *Journal of Atmospheric and Oceanic Technology*, *37*, 975–992. https://doi.org/10.1175/JTECH-D-19-0200.1

Steinberg, J.M., Pelland, N., & Eriksen, C. (2019). Observed Evolution of a California Undercurrent Eddy. *Journal of Physical Oceanography*, *49*, 649–674. https://doi.org/10.1175/JPO-D-18-0033.1

Pelland, N., Bennett, J., **Steinberg, J.M.**, & Eriksen, C. (2018). Automated Glider Tracking of a California Undercurrent Eddy Using the Extended Kalman Filter. *Journal of Atmospheric and Oceanic Technology*, *35*, 2241–2264. https://doi.org/10.1175/JTECH-D-18-0126.1

Prior Work

"Bioextractive Removal of Nitrogen by Oysters in Great Bay Piscataqua River Estuary, New Hampshire, USA". S. Bricker, R. Grizzle, P. Trowbridge, J. Rose, J. Ferreira, K. Wellman, C. Zhu, E. Galimany, C. Saurel, R. Landeck-Miller, J. Wands, R. Rheault, **J.M. Steinberg**, A. Jacob, E. Davenport, S. Ayvazian, M. Chintala, and M. Tedesco. *Estuaries and Coasts*. 2020.

"Role of Shellfish Aquaculture in the Reduction of Eutrophication in an Urban Estuary". S. Bricker, J. Ferreira, C. Zhu, J. Rose, E. Galimany, G. Wikfors, C. Saurel, R. Landeck-Miller, J. Wands, P. Trowbridge, R. Grizzle, K. Wellman, R. Rheault, **J.M. Steinberg**, A. Jacob, E. Davenport, S. Ayvazian, M. Chintala, and M. Tedesco. *Environmental Science and Technology*. 2018.

Fieldwork

Seaglider and Deepglider Operations — UW
Graduate Research Assistant — 2013–2020

– Preparation, deployment, piloting, and recovery of Seaglider and Deepglider autonomous underwater vehicles.

Ocean Inquiry Project — Seattle, WA
field and classroom instructor and diver — 2014–2019

Academic / Teaching Experience

- **PhD thesis committee member** at Temple University — 2024-
  Member of a graduate student's PhD advisory committee
- **Guest Lecturer** at Princeton University — Fall 2024
  Chemical and Biological Engineering (CBE341)
- **Teaching Assistant** at the University Washington — Winter 2018-2019, 2019-2020
  Geophysical Fluid Dynamics (OCN 512)

  Lectured, organized course content, and carried out demonstrations in the UW GFD lab.
- **Teaching Assistant** at the University Washington — Fall 2017
  Physics Across Oceanography: Fluid Mechanics and Waves (OCN 285)
- **Teaching Assistant** at the University Washington — Fall 2015
  Introduction to Fluid Mechanics (OCN 511)

Professional Activities

- U.S. CLIVAR - Phenomena, Observations, and Synthesis Panel Member — 2024-2028
- Ocean Sciences Meeting: Session Convener, Co-Chair — Feb. 2024
  RH001 Advances in Understanding, Monitoring, and Simulating Sea Level
- National Academies: Gulf Research Program Fellowship Reviewer — June 2023
- NASA Physical Oceanography: ROSES PO-22 Proposal Review Panel Member — Sept. 2022
- Climate Process Team renewal proposal - drafting and revision — funded - summer 2022
- Ocean Sciences Meeting: Session Convener, Co-Chair — Feb. 2022
  PL06 Mesoscale Eddy Energy and Ocean Transport
- peer reviewer for: National Science Foundation, Journal of Physical Oceanography, Journal of Geophysical Research: Oceans, Geophysical Research Letters, Journal of Advances in Modeling of Earth Systems, Journal of Climate, Quarterly Journal of the Royal Meteorological Society, Continental Shelf Research, Advances in Space Research, Limnology and Oceanography, Earth's Future, Journal of Marine Systems

Mentoring, Outreach & Volunteering

- NOAA GFDL - mentor to NOAA Hollings, NOAA Lapenta, and Princeton CIMES summer interns 2023-2025
  Advisor to undergraduate research scholars
- University of Washington: Student Seaglider Center 2022–2023
  Advisor and mentor to undergraduates participating in a hands-on course to build, deploy, and pilot Seaglider autonomous underwater vehicles.
- MIT: EAPS Mentoring Program 2020–2021
  Mentor to graduate students in the Joint MIT-WHOI Program

Recent Invited Presentations

- Rutgers University New Brunswick, Apr. 2025
  Regional Patterns and Drivers of Sea Level Change
- Temple University Philadelphia, Mar. 2025
  Regional Patterns and Drivers of Sea Level Change
- University of Maryland: Center for Environmental Science Cambridge, Oct. 2024
  A link between U.S. east coast sea level rise and offshore subsurface ocean warming
- Understanding Gulf Ocean Systems Seminar Series (NAS Gulf Research Program) Apr. 2024
  Influence of Deep-Ocean Warming of Coastal Sea Level Rise in the Gulf of Mexico
- Institute of Science and Technology Austria Vienna, May 2022
  Ocean Energetics: Interesting and Outstanding Problems in Observational Physical Oceanography
- NCAR Boulder, Aug. 2022
  Exploring Mesoscale Eddy Vertical Structure Regimes in the Global Ocean

Recent Conference Presentations and Seminars

- American Geophysical Union - Annual Meeting Washington, D.C., Dec. 2024
  Towards an Improved Understanding of the Physical Processes Connecting Coastal and Offshore Sea Level
- Ocean Sciences Meeting New Orleans, Feb. 2024
  A Mechanistic Link between U.S. East Coast Sea Level and Offshore Ocean Heat Content
- American Meteorological Society Annual Meeting Baltimore, Jan. 2024
  A Mechanistic Link between U.S. East Coast Sea Level and Offshore Ocean Heat Content
- NOAA GFDL Lunchtime Seminar Princeton, Nov. 2023
  Regional Patterns and Drivers of Sea Level Change
- Climate Process Team Annual Meeting: Ocean Transport and Eddy Energy Woods Hole, May 2023
  A Landscape of Eddy Vertical Structure - controls on the vertical distribution of mesoscale eddy kinetic energy
- University of Washington: Physical Oceanography Seminar Seattle, Feb. 2023
  Influence of Deep-Ocean Warming of Coastal Sea Level Rise in the Gulf of Mexico
- ECCO Annual Meeting Pasadena, Jan. 2023
  Influence of Deep-Ocean Warming of Coastal Sea Level Rise in the Gulf of Mexico
- Caltech Special Seminar Pasadena, Jan. 2023
  A Landscape of Eddy Vertical Structure
- Ocean Surface Topography Science Team Meeting Venice, Oct. 2022
  Influence of Deep-Ocean Warming of Coastal Sea Level Rise in the Gulf of Mexico
- GRACE Science Team Meeting Oct. 2022
  Influence of Deep-Ocean Warming of Coastal Sea Level Rise in the Gulf of Mexico
- EGU Annual Meeting Vienna, May 2022
  Seasonality of the Mesoscale Inverse Cascade
- Climate Process Team Annual Meeting: Ocean Transport and Eddy Energy Boulder, Apr. 2022
  A Landscape of Eddy Vertical Structure
- Ocean Sciences Meeting Feb. 2022
  Observed Seasonality of the Mesoscale Inverse Cascade in the Global Ocean
- NOAA Monster Jam Seminar: Invited Talk May 2021

Using Deepglider AUVs to explore the structure of large ocean eddies and the role they play in the redistribution of energy and tracers

- UCLA: Biogeochemistry Group: Invited Talk Mar. 2021
  Eddy Vertical Structure and Variability: Deepglider Observations of Geostrophic Turbulence in the North Atlantic
- NCAR-CESM: Ocn. Model Working Group / CPT: Ocn. Transport and Eddy Energy Annual Meeting Feb. 2021
  Scale Aware Eddy Kinetic Energy from Along-Track Sea Surface Height Measurements
- Woods Hole Oceanographic Institution: Department Seminar July 2020
  Eddy Vertical Structure and Variability: Deepglider Observations of Geostrophic Turbulence in the N. Atlantic

Selected Workshops

- US CLIVAR Workshop: Optimizing Ocean Observing Networks for Detecting the Coastal Climate Signal Sept. 2024
  Invited Talk: A link between U.S. east coast sea level rise and offshore subsurface ocean warming
- Aspen Center for Physics: Transport and Mixing of Tracers in Geophysics and Astrophysics June 2021
- US CLIVAR Workshop: Sources and Sinks of Ocean Mesoscale Eddy Energy Mar. 2019