

# MARA FREILICH

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## PROFESSIONAL APPOINTMENTS

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**Brown University**, Assistant Professor (tenure-track) (starting 2023)  
Division of Applied Mathematics and Department of Earth, Environmental, and Planetary Sciences  
**Scripps Institution of Oceanography, UCSD**, Postdoctoral Fellow 2021-2023  
**Pontificia Universidad Católica de Chile**, Fulbright Fellow 2016

## EDUCATION

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**MIT-WHOI Joint Program**, Doctor of Philosophy in Physical Oceanography 2015-2021  
*Thesis*: “Vertical Fluxes in the Upper Ocean” advised by Dr Amala Mahadevan  
**Brown University**, Bachelor of Science in Applied Math with honors, *magna cum laude* 2011-2015  
*Thesis*: “Numerical modeling of the effect of transport processes on ocean biogeochemistry” advised by Professor Baylor Fox-Kemper and Professor Bjorn Sandstede

## PUBLICATIONS

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\* - indicates authors contributed equally

16. Aravind, H.M., Verma, V., Sarkar, S., **Freilich, M.**, Mahadevan, A., Haley, P., Lermusiaux, P.F.J., and Allshouse, M.R. (2023). *Lagrangian surface signatures reveal upper-ocean subduction*. Ocean Modelling, 181, 102136.
15. Cutolo, E., Pascual, A., Ruiz, S., Johnston, T.M.S., **Freilich, M.**, Mahadevan, A., Shcherbina, A., Poulain, P-M., Ozgokmen, T., Centuroni, L.R., Rudnick, D., D’Asaro, E. (2022). *Diagnosing Frontal Dynamics from Observations using a Variational Approach*. Journal of Geophysical Research: Oceans, 127 (11), e2021JC018336.
14. Hall, C. A., Illingworth, S., Mohadjer, S., Koll Roxy, M., Poku, C., Otu-Larbio, F., Reano, D., **Freilich, M.**, Veisaga, M-L, Valencia, M., Morales, J. (2022). *GC Insights: Diversifying the Geosciences in Higher Education: a Manifesto for Change*. Geoscience Communication, 5, 275–280.
13. **Freilich, M.**, Flierl, G., Mahadevan, A. (2022). *Diversity of growth rates maximizes phytoplankton productivity in an eddying ocean*. Geophysical Research Letters, e2021GL096180.
12. **Freilich, M.**, Mignot, A., Flierl, G., and Ferrari, R. (2021). *An investigation of grazing behaviors that result in winter phytoplankton biomass accumulation*. Biogeosciences, 18, 5595–5607.
11. Ranganathan, M., Lalk, E., Freese, L., **Freilich, M.**, Wilcots, J., Duffy, M., and Shivamoggi, R (2021). *Trends in the representation of women among US geoscience faculty from 1999-2020: the long road towards gender parity*. AGU Advances, 2 (3), e2021AV000436.
10. **Freilich, M.** and Mahadevan, A. (2021). *Coherent pathways for subduction from the surface mixed layer at ocean fronts*. Journal of Geophysical Research: Oceans, 126 (5), e2020JC017042.
9. **Freilich, M.**, Rebolledo, R., Corcoran, D., and Marquet, P. (2020). *Reconstructing ecological networks with noisy data*. Proceedings of the Royal Society A, 476 (2237), 20190739.
8. Dever, M., **Freilich, M.**, Farrar, J.T., Hodges, B., Lanagan, T., Baron, A., Mahadevan, A., (2020). *EcoCTD for profiling oceanic physical-biological properties from an underway ship*. Journal of Atmospheric and Oceanic Technology, 37 (5), 825-840.

7. Shroyer, E., Gordon, A., Spiro Jaeger, G., **Freilich, M.** Waterhouse, A., Farrar, J.T., Sarma, V.V.S.S., Venkatesan, R., Weller, R., Moum, J., and Mahadevan, A. (2019) *Upper Layer Thermohaline Structure of the Bay of Bengal during the 2013 Northeast Monsoon*. Deep Sea Research II, 104630.
6. **Freilich, M.** and Mahadevan, A. (2019). *Decomposition of vertical velocity for nutrient transport in the upper ocean*. Journal of Physical Oceanography, 49 (6), 1561-1575.  
*Awarded Fye Award for Excellence in Oceanographic Research Graduate Student Best Paper Award*
5. **Freilich, M.**, Weiters, E., Broitman, B., Navarrete, S. (2018) *Species co-occurrence networks: can they reveal trophic and non-trophic interactions in ecological communities?*. Ecology, 99 (3), 690-699.
4. Mahadevan, A., Spiro-Jaeger, G., **Freilich, M.** Omand, M., Shroyer, E., Sengupta, D., Sharma, R. (2016) *Freshwater in the Bay of Bengal: Its fate and role in air-sea heat exchange*. Oceanography, 29 (2), 72-81.
3. Lucas, A.J., Nash, J.D., Pinkel, R., MacKinnon, J.A., Tandon, A., Mahadevan, A., Omand, M., **Freilich, M.**, Sengupta, D., Ravichandran, M., Le Boyer, A., and Moum, J. (2016) *Adrift upon a salinity-stratified sea: a view of upper ocean processes in the Bay of Bengal during the southwest monsoon*. Oceanography, 29 (2), 134-145.
2. Gordon, A., Shroyer, E., Mahadevan, A., Sengupta, D., and **Freilich, M.** (2016) *Bay of Bengal: Upper Ocean Circulation from the 2013 Northeast Monsoon*. Oceanography, 29 (2), 82-91
1. **Freilich, M.** and Connolly, S. (2015). *Phylogenetic Community Structure When Similarity-Based Competition and Environmental Filtering Determine Abundances*. Global Ecology and Biogeography, 24: 1390-1400.

*Pre-prints (manuscript available upon request)*

6. Lenain, L., Smeltzer, B., Pizzo, N., **Freilich, M.**, Colosi, L, Ellingsen, S., Grare, L., Peyriere, H., Statom, N. (in review). *Airborne observations of surface winds, waves and currents from meso to submesoscales*.
5. **Freilich, M.\***, Plummer, A. \*, Choi, C.J., Sudek, L., Benzi, R., Toschi, F., Worden, A.Z., Mahadevan, A. (in review). *Oceanic frontal divergence alters phytoplankton competition*.
4. **Freilich, M.**, Alou, E., Poirier, C., Bachy, C., Dever, M., Choi, C., Sudek, L., Allen, J., Cabornero, A., Ruiz, S., Pascual, A., Farrar, T., D'Asaro, E., Worden, A., Mahadevan, A. (in review). *Microbially enriched intrusions from the deep chlorophyll maximum transport carbon to the mesopelagic ocean*.
3. Esposito, G., Donnet, S., Berta, M., Shcherbina, A., **Freilich, M.**, Centurioni, L., D'Asaro, E., Farrar, J.T., Johnston, T.M.S., Mahadevan, A., Ozgokmen, T., Pascual, A., Poulain, P.-M., Ruiz, S., Tarry, D., Griffa, A. (in review). *Inertial oscillations and frontal instabilities at an Alboran Sea front: Effects on divergence and vertical transport*.
2. Arboleda-Baena, C, **Freilich, M**, Pareja, C, Logares, R, De la Iglesia, R, and Navarrete, S. (in review). *Microbial communities network structure across strong environmental gradients: How do they compare to macroorganisms?*.
1. Youngs, M., **Freilich, M.**, Lovenduski, N. (in prep). *Air-Sea CO<sub>2</sub> Fluxes Driven By Topography in a Southern Ocean Channel*.

*Non-peer reviewed publications*

3. Lerner, P., Palevsky, H.I., Busecke, J., **Freilich, M.**, Cavan, E., Eddebbar, Y., Fassbender, A., Lauderdale, J., Luo, J., Mongwe, P., Stephens, B., Traylor, S. *CMIP6 Biogeochemistry*  
doi: <https://doi.org/10.5281/zenodo.3559209> [Project coordinator]
2. Dever, M., **Freilich, M.**, Hodges, B.A., Farrar, J.T., Lanagan, T., Mahadevan, A., "UCTD and EcoCTD Observations from the CALYPSO Pilot Experiment (2018): Cruise and Data Report", 2019-01, DOI:10.1575/1912/23637, <https://hdl.handle.net/1912/23637>

1. Haitians and Guantanamo: Who is a refugee? What is a refuge? Guantanamo Public Memory Project. National Traveling Exhibit. 2012.

## FELLOWSHIPS AND ACADEMIC HONORS

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<b>Scripps Institutional Postdoc Program</b>	2021-2023
<b>AGU Voices for Science Fellowship</b>	2021-2022
<b>EAPS Community Builder Award</b> (team award to Towards Increasing Diversity in EAPS)	2021
<b>Fye Award for Excellence in Oceanographic Research Graduate Student Best Paper Award</b>	2020
<b>Martin Fellowship for Sustainability</b>	2018-2020
<b>Fulbright Fellowship</b>	2016
<b>National Defense Science and Engineering Graduate Fellowship</b>	2015-2018
<b>Jerome L Stein Memorial Award</b> , Division of Applied Math, Brown University	2015
<b>Summer Student Fellowship, Woods Hole Oceanographic Institution</b>	2014
<b>Phi Beta Kappa</b> (elected as a junior)	2014
<b>Royce Fellowship</b> , Brown University research fellowship	2013
<b>Columbia Economics Review Climate Policy Competition</b> , Winner	2012
<b>American Meteorological Society Scholarship</b>	2011

## GRANTS

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<b>ESI Curriculum Mini-Grants for Infusing Sustainability in STEM</b>	2021
<b>Ocean Ventures Fund</b> (cancelled due to COVID-19 pandemic)	2020
<b>Access to the Sea</b> , 1 day of ship time on R/V Neil Armstrong	2019
<b>School of Science Quality of Life grant</b>	2019
<b>Grassle Fellowship Fund</b>	2018
<b>Montrym Fund</b>	2018
<b>MISTI-Chile – UC Graduate Student Seed Fund</b>	2017-2018

## FIELDWORK

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· S-MODE IOP 1 (North Pacific Ocean)	October 6-November 1, 2022
· Physical Oceanography Ship Time Cruise (Northeast US Shelfbreak), Co-PI	November 15-22, 2019
· Joint Program Cruise (Northeast US Shelfbreak), Co-Chief Scientist	September 20-22, 2019
· Calypso (Western Mediterranean Sea), Biogeochemical sampling lead	March 21 - April 12, 2019
· Calypso Pilot (Western Mediterranean Sea), Biogeochemical sampling lead	June, 2018
· Investigating Vertical Exchanges (Mediterranean Sea), Biogeochemical sampling lead	July 17-24, 2017

## TEACHING

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### Teaching Assistant

· Geophysical Fluid Dynamics (Dr Amala Mahadevan, MIT/WHOI)	Fall 2018
· Land Use and Capitalism (Professor Jo Guldi, Brown University)	Fall 2014
· Principles of Ecology (Professor Jon Witman, Brown University)	Spring 2013, 2014
· Intermediate Calculus (Professor Bianca Viray, Brown University)	Fall 2013

### University Course Guest Lectures

· Computational Ocean Modeling, MIT-WHOI	2022
· Ethics Seminar, MIT	2020, 2021
· Sociopolitical Perspectives on Math and Science Education, University of Illinois at Urbana-Champaign	2020
· Social Movements in Boston, Northeastern University	2019

· Biophysical Interactions, MIT-WHOI	2019, 2021
<b>Curriculum Assistant</b> <i>Write climate science-related problem sets for first year math courses</i>	2019-2021 MIT
<b>WHOI summer math review coordinator and lecturer</b> <i>Coordinate a 5 week math course for incoming graduate students</i>	Summer 2016-2019
<b>Kaufman Teaching Certificate Program</b> <i>Completed semester-long teaching course</i>	Fall 2017 MIT
<b>English for Action: ESOL and math volunteer coordinator and facilitator</b> <i>Curriculum design for participatory math and English classes for adult immigrants</i>	2012-2015 Providence, RI
<b>Race and Gender in the Scientific Community (currently APMA1910)</b> <i>Group Independent Study Project</i>	Fall 2014 Brown University

## MENTORING

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### Research mentor

· Farah Azmi, HMEI intern	June-August 2022
· Yaseen Zaky, UCSD undergraduate honors research	January-June 2022
· Yoana Guzman Hernandez, WHOI summer student fellow	June-August 2020
· Margaret Conley, Field assistant	March-June 2018

**EAPS Graduate Student Advisory Council**, peer mentorship coordinator  
*recognized with MIT School of Science award for work on mentorship program* 2017-2019

### Graduate school applicant mentoring

· <i>Joint Program Applicant Support and Knowledgebase</i> , coordinator	2019
· <i>Científico Latino</i> , mentor	2019-2021
· <i>GradCatalysts</i> , workshop facilitator	2019-2021

**Peer mentor** for 5 undergraduate students and 3 graduate students 2013-2021

## PRESENTATIONS

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### *Invited presentations and seminars*

25. Jet Propulsion Lab Seminar (2022 November).
24. University of Washington Applied Physics Lab (2022 November).
23. Odysea Webinar (2022 November).
22. Alfred Wegener Institute, Carbon Seminar (2022 November).
21. Second National Conference: Justice in Geoscience (2022 August).
20. CYU ECODEP 2022 Conference on Networks Reconstruction (2022 June).
19. Brown University Seminar (2022 March).
18. University of California Berkeley EPS Seminar (2022 March).
17. Yale University EPS Seminar (2022 February).
16. Ocean Sciences Meeting, "New insights into submesoscale ocean biogeochemistry" (2022 February).
15. NYU Courant Institute, Atmosphere Ocean Science Colloquium (2022 January).

14. Physical Oceanography Dissertation Symposium (2021 October).
13. NOAA Coastal Ocean Modeling Science Seminar (2021 July).
12. University of California Santa Barbara, Marine Science Seminar (2021 May).
11. Woods Hole Oceanographic Institution Department of Physical Oceanography (2021 March).
10. MIT Program in Atmosphere, Oceans, and Climate (2021 March).
9. University of Massachusetts, Dartmouth School for Marine Science & Technology Seminar (2020 November).
8. University of Washington Oceanography Seminar (2020 October).
7. Caltech Oceanography Seminar (2020 October).
6. Ocean Carbon and Biogeochemistry Summer Webinar Series (2020 July).
5. Woods Hole Oceanographic Institution Department of Physical Oceanography (2019 July).
4. Brown University, Sarah Doyle Center for Women and Gender (2018 November).
3. Brown University Department of Earth, Environmental, and Planetary Sciences (2018 October).
2. Princeton University Department of Atmospheric and Oceanic Sciences (2015 January).
1. Intensive Workshop on Greenhouse Gas Emissions Reductions in RI: From Goals to Implementation, Providence, RI. (2014 October).

*Contributed talks*

6. **Freilich, M.**, Alou, E., Poirier, C., Bachy, C., Dever, M., Choi, C., Sudek, L., Allen, J., Cabornero, A., Ruiz, S., Pascual, A., Farrar, T., D'Asaro, E., Worden, A., Mahadevan, A. (2022 February). *Microbially enriched intrusions from the deep chlorophyll maximum transport carbon to the mesopelagic ocean*. Talk presented at Ocean Sciences Meeting. Virtual.
5. **Freilich, M.** and Mahadevan, A. (2020 November). *Coherent pathways for vertical transport from the surface mixed layer to ocean interior*. Talk presented at the American Physical Society Division of Fluid Dynamics meeting. Virtual.
4. **Freilich, M.** and Mahadevan, A. (2020 February). *The Vertical Structure of Vertical Velocity*. Talk presented at Ocean Sciences Meeting. San Diego, CA.
3. **Freilich, M.** and Mahadevan, A., (2020 February). *Is vertical nutrient supply influenced by phytoplankton physiology?*. Talk presented at Ocean Sciences Meeting. San Diego, CA.
2. **Freilich, M.**, Curry, R., Flierl, G., Mahadevan, A. (2018 February) *Deciphering Pathways for Vertical Nutrient Supply*. Talk presented at Ocean Sciences Meeting. Portland, OR.
1. **Freilich, M.**, Rebolledo, R., Marquet, P. (2018 January) *Reconstructing species interaction networks from time series data: The effect of stochastic noise*. Talk presented at MIT Ecology Meeting. Cambridge, MA.

*Contributed posters*

9. **Freilich, M.**, Pacini, A., Suca, J., Lobert, L., (22 student co-authors) Gawarkiewicz, G. (2020 February). *Hurricane Dorian Impacts on Northeast US Shelf Marine Hydrography and Ecosystem*. Poster presented at Ocean Sciences Meeting, San Diego, CA.
8. **Freilich, M.**, Mignot, A., Flierl, G., and Ferrari, R. (2018 June). *Rethinking the critical depth: Non-linear mortality required to model wintertime phytoplankton growth*. Poster presented at Ocean Carbon and Biogeochemistry meeting. Woods Hole, MA.
7. **Freilich, M.** and Mahadevan, A (2018 June). *Deciphering Pathways for Vertical Nutrient Supply*. Poster presented at Gordon Research Conference on Ocean Mixing.

6. Mahadevan, A., **Freilich, M. (presenting author)**, Ruiz, S., Farrar, J.T., Pascual, A., Poirier C., Worden, A. (2018 February) *Effects of vertical motion on phytoplankton at a front*. Poster presented at Ocean Sciences Meeting. Portland, OR.
5. **Freilich, M.** and Mahadevan, A. (2017 June). *What components of vertical velocity contribute to nutrient transport?*. Poster presented at Ocean Carbon and Biogeochemistry meeting. Woods Hole, MA.
4. **Freilich, M.** and Mahadevan, A. (2016 May). *Lagrangian exploration of submesoscale vertical transport*. Poster presented at Liege Colloquium on Submesoscale Dynamics. Liege, Belgium.
3. **Freilich, M.**, Fox-Kemper, B., Sandstede, B. (2015 May). *Mathematical Modeling of Oceanic Phytoplankton Blooms in Chaotic Flows*. Poster presented at The Tony and Pat Houghton Conference on Non-Equilibrium Statistical Mechanics, Providence, RI.
2. **Freilich, M.**, Mahadevan, A. (2014 December). *Lagrangian modeling of Aquarius surface salinity in the Bay of Bengal*. Poster presented at American Geophysical Union, San Francisco, CA.
1. **Freilich, M.**, Aluthge, D., Bryant, R., Knox, B., McAdams, J., Plummer, A., Schlottman, N., Stanley, Z., Suglia, E., and Watson-Daniels, J. (2014 December). *Undergraduate-driven interventions to increase representation in science classrooms*. Poster presented at American Geophysical Union, San Francisco, CA.

*Conference participation (as invited participant)*

4. Environmental Data Science Summit, National Center for Ecological Analysis and Synthesis (delayed to 2023 February).
3. Gordon Research Conference on Ocean Mixing (2018 June, 2022 June).
2. Life in a Turbulent Environment: How the dynamic ocean shapes the distribution, diversity and growth of microorganisms, Harvard Radcliffe Institute (2015 February).
1. NCAR Undergraduate Leadership Workshop (2014 June).

## ACADEMIC AND UNIVERSITY SERVICE

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*- Service to scientific community*

<b>Associate Editor</b> , Journal of Physical Oceanography	2022-present
<b>Executive Committee</b> , APS Topical Group on the Physics of Climate, member-at-large	2022-2024
<b>Session Convener</b>	
· Ocean Sciences Meeting. [Session: Vertical Transport]	2022
· Graduate Climate Conference	2017, 2019
· Ocean Carbon and Biogeochemistry meeting. [Session: Student lightning talks]	2017
<b>Society for Women in Marine Science</b> , treasurer	2019-2021
<b>Executive committee and outreach lead</b> , Graduate Climate Conference	2017, 2019
<b>Reviewer for</b> AGU books, Biogeosciences, Deep Sea Research I, Ecology Letters, FEMS Microbiology Reviews, Geophysical Research Letters, The ISME Journal, Journal of Geophysical Research: Oceans, Journal of Physical Oceanography, Marine Ecology Progress Series, Science Advances	
<b>Abstract reviewer for</b> SACNAS	

*- University Service*

<b>Towards Inclusion and Diversity in EAPS (TIDE)</b>	2019-2021
<b>WHOI Committee on Diversity and Inclusion</b> , member	2020-2021
<b>Graduate Student Advisory Group to faculty search</b> , chair	2019-2020
<i>awarded 2020 School of Science Spot award</i>	
<b>Program in Atmosphere, Ocean, and Climate Colloquium Committee</b> , chair	2017-2018
<b>Women in Course XII</b> , core board member	2017

*Professional affiliations:* American Geophysical Union, The Oceanography Society, American Physical Society

## OUTREACH

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<b>Outreach in schools</b> , 14 presentations in English and Spanish to over 300 students	2015-present
<b>The Old Farmer's Almanac</b> , "Current Events: How and why the oceans hold a key to our future climate", (circulation 3 million).	2024
<b>UNESCO</b> , invited panelist. "Empowering women in the Ocean Decade."	November 2020
<b>MIT Science Policy Initiative</b> , invited panelist, "Oceans and Climate"	November 2019
<b>Rhode Island School of Design</b> , keynote speaker, "Reclaiming STEAM"	April 2019
<b>Event organizer</b> , Mashpee Nine film screening, WHOI	March 2019
<b>Science Fair Judge</b> , McCormack Middle School	February 2019
<b>National Park Service</b> , PLACE fellowship, presenter "Career Pathways to Marine Science"	November 2018
<b>Oceanus magazine</b> , "Forecasting Where Ocean Life Thrives."	2018
<a href="https://www.whoi.edu/oceanus/feature/forecasting-where-ocean-life-thrives/">https://www.whoi.edu/oceanus/feature/forecasting-where-ocean-life-thrives/</a>	
<b>Public Lecture Series on Climate Science and Policy</b> , lecturer and coordinator	January 2016