

MARA FREILICH

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PROFESSIONAL APPOINTMENTS

Brown University, Assistant Professor *2023-present*
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

MIT-WHOI Joint Program, Doctor of Philosophy in Physical Oceanography *2015-2021*
Brown University, Bachelor of Science in Applied Math with honors, *magna cum laude* *2011-2015*

PUBLICATIONS

Peer-reviewed book

1. **Freilich, M.**, Turan, I., Varner, J., Yarina, L. (under contract, forthcoming 2025). Climate Changed: Models and the Built World. Columbia University Press.

Peer-reviewed journal publications

* - indicates authors contributed equally. Group members are underlined.

22. Centeno, D., Arzeno-Soltero, I., Delgado, A., **Freilich, M.**, Marquez, C., Montgomery, Q., Palomino, A., Penalber, G., Sinclair, R. (2023). *Salton Sea Environmental Work and the Importance of Community Science*. Oceanography.
21. Youngs, M., **Freilich, M.**, Lovenduski, N. (2023). *Air-Sea CO₂ Fluxes Driven By Topography in a Southern Ocean Channel*. Geophysical Research Letters.
20. Plummer, A.*, **Freilich, M.***, Choi, C.J., Sudek, L., Benzi, R., Toschi, F., Worden, A.Z., Mahadevan, A. (2023). *Oceanic frontal divergence alters phytoplankton competition*. Journal of Geophysical Research: Oceans, e2023JC019902.
19. **Freilich, M.**, Lenain, L., Gille, S. (2023). *Characterizing the role of non-linear interactions in the transition to submesoscale dynamics at a dense filament*. Geophysical Research Letters, 50 (15), e2023GL103745.
18. Lenain, L., Smeltzer, B., Pizzo, N., **Freilich, M.**, Colosi, L., Ellingsen, S., Grare, L., Peyriere, H., Statom, N. (2023). *Airborne observations of surface winds, waves and currents from meso to submesoscales*. Geophysical Research Letters, 50 (8), e2022GL102468.
17. 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. (2023). *Inertial oscillations and frontal instabilities at an Alboran Sea front: Effects on divergence and vertical transport*. Journal of Geophysical Research: Oceans, 128 (3), e2022JC019004.
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., Centurioni, 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)

4. Hsu, T.-Y., Mazloff, M., Gille, S., **Freilich, M.**, Sun, R., Cornelle, B. (in review). *Response of Sea Surface Temperature to Atmospheric Rivers*.
3. Cao, H., **Freilich, M.**, Song, X., Jing, Z., Fox-Kemper, B., Qiu, B., Hetland, R., Chai, F., Chen, D., Ruiz, S. (in review) *Isopycnal submesoscale stirring sustains subsurface chlorophyll maximum in ocean cyclonic eddies*.
2. **Freilich, M.**, Poirier, C., Dever, M., Alou, E., Allen, J., Cabornero, A., Choi, C., Sudek, L., Ruiz, S., Pascual, A., Farrar, J.T., D'Asaro, E., Worden, A.Z., Mahadevan, A. (in review). *Microbially enriched*

intrusions from the deep chlorophyll maximum transport carbon to the mesopelagic ocean.

1. 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?*.

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

Chemical Currencies of a Microbial Planet , Faculty Fellowship	2023-2024
Oberwolfach Leibniz Graduate Student Grant	2022
Scripps Institutional Postdoc Program	2021-2023
AGU Voices for Science Fellowship	2021-2022
EAPS Community Builder Award (team award to Towards Increasing Diversity in EAPS)	2021
Fye Award for Excellence in Oceanographic Research Graduate Student Best Paper Award	2020
Martin Fellowship for Sustainability	2018-2020
Fulbright Fellowship	2016
National Defense Science and Engineering Graduate Fellowship	2015-2018
Jerome L Stein Memorial Award , Division of Applied Math, Brown University	2015
Summer Student Fellowship, Woods Hole Oceanographic Institution	2014
Phi Beta Kappa (elected as a junior)	2014
Royce Fellowship , Brown University research fellowship	2013
Columbia Economics Review Climate Policy Competition , Winner	2012
American Meteorological Society Scholarship	2011

GRANTS

Current

NASA Applied Sciences, *NASA Earth Observations for Resilient Salton Sea Communities*, PI **MA Freilich**, co-Is Alianza Coachella Valley, I.B. Arzeno-Soltero, K. Heitz, R. Sinclair, Q. Montgomery, \$1,133,000 2023-2027

NASA Sub-Mesoscale Ocean Dynamics Experiment, *Mechanistic insight into vertical biogeochemical fluxes using S-MODE observations*, subaward to **MA Freilich**, \$100,000 to Brown 2024-2025

NSF STC Chemical Currencies of a Microbial Planet, *Biophysical mechanisms of dissolved organic carbon flux*, subaward to **MA Freilich**, \$40,000 to Brown 2023-2024

NASA Ocean Vector Winds Science Team, *Coupling between the ocean and the atmosphere from meso to submesoscales*, PI L Lenain, co-Is **MA Freilich**, N Pizzo \$877,921 total, \$111,327 to Brown 2023-2027

Burroughs Wellcome Fund, *Environmental geochemistry, human health, and environmental justice: Hydrogen sulfide and the Salton Sea*, PI **MA Freilich**, Collaborators I Arzeno Soltero, R Sinclair, Climate Change and Human Health Seed Grant \$50,000 2023-2024

Conicyt (Chile), Exploración 2022, *Biological and Quantum Open System Dynamics: evolution, innovation and mathematical foundations*, PIs Pablo Marquet and Rolando Rebolledo, co-PIs NR Aburto, L Videla, C

Completed

ESI Curriculum Mini-Grants for Infusing Sustainability in STEM	2021
Access to the Sea , 1 day of ship time on R/V Neil Armstrong	2019
Grassle Fellowship Fund	2018
Montrym Fund	2018
MISTI-Chile – UC Graduate Student Seed Fund	2017-2018

FIELDWORK

· S-MODE IOP 2 (North Pacific Ocean), Biological sampling lead	April 6-May 3, 2023
· S-MODE IOP 1 (North Pacific Ocean), Biological sampling lead	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

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

Curriculum Assistant

<i>Write climate science-related problem sets for first year math courses</i>	2019-2021 MIT
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English for Action: ESOL and math volunteer coordinator and facilitator

<i>Curriculum design for participatory math and English classes for adult immigrants</i>	2012-2015 Providence, RI
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Race and Gender in the Scientific Community (currently APMA1910)

<i>Group Independent Study Project</i>	Fall 2014 Brown University
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MENTORING

Research mentor

· Lilian Dove, NOAA Climate & Global Change Postdoctoral Fellow (Brown University)	2023-2025
· Diego Centeno, research assistant (Brown University)	2023-2024
· Undergraduate researchers at UCSD and WHOI: Farah Azmi (UCSD June-August 2022), Yaseen Zaky (UCSD January-June 2022), Yoana Guzman Hernandez (WHOI June-August 2020), Margaret Conley (WHOI March-June 2018)	

EAPS Graduate Student Advisory Council , peer mentorship coordinator <i>recognized with MIT School of Science award for work on mentorship program</i>	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

Invited presentations and seminars

2023: Scripps Institution of Oceanography, Oregon State University, University of Rhode Island, Sante Fe Institute, APS Physics of Climate webinar

2022: NASA Jet Propulsion Lab, University of Washington Applied Physics Lab, Winds and Currents Webinar, Alfred Wegener Institute Carbon Seminar, FilaChange Paris, Second National Conference: Justice in Geoscience, CYU ECODEP 2022 Conference on Networks Reconstruction, Brown University, University of California Berkeley EPS Seminar, Yale University EPS Seminar, Ocean Sciences Meeting “New insights into submesoscale ocean biogeochemistry”, NYU Courant Institute Atmosphere Ocean Science Colloquium

2021: Physical Oceanography Dissertation Symposium, NOAA Coastal Ocean Modeling Science Seminar, University of California Santa Barbara, Marine Science Seminar, Woods Hole Oceanographic Institution Department of Physical Oceanography, MIT Program in Atmosphere, Oceans, and Climate

2020: University of Massachusetts, Dartmouth School for Marine Science & Technology Seminar, University of Washington Oceanography Seminar, Caltech Oceanography Seminar

2019: Woods Hole Oceanographic Institution Department of Physical Oceanography

2018: Brown University, Sarah Doyle Center for Women and Gender, Brown University Department of Earth, Environmental, and Planetary Sciences

2015: Princeton University Department of Atmospheric and Oceanic Sciences

2014: Intensive Workshop on Greenhouse Gas Emissions Reductions in RI: From Goals to Implementation

Contributed talks

- 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.
- 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.
- Freilich, M.** and Mahadevan, A. (2020 February). *The Vertical Structure of Vertical Velocity*. Talk presented at Ocean Sciences Meeting. San Diego, CA.
- Freilich, M.** and Mahadevan, A., (2020 February). *Is vertical nutrient supply influenced by phytoplankton physiology?*. Talk presented at Ocean Sciences Meeting. San Diego, CA.
- Freilich, M.**, Curry, R., Flierl, G., Mahadevan, A. (2018 February) *Deciphering Pathways for Vertical Nutrient Supply*. Talk presented at Ocean Sciences Meeting. Portland, OR.
- 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. Multiscale Wave-Turbulence Dynamics in the Atmosphere and Ocean, MFO, Oberwolfach (2022 September).
3. Environmental Data Science Summit, National Center for Ecological Analysis and Synthesis (2023 February).
2. Gordon Research Conference on Ocean Mixing (2018 June, 2022 June).
1. Life in a Turbulent Environment: How the dynamic ocean shapes the distribution, diversity and growth of microorganisms, Harvard Radcliffe Institute (2015 February).

ACADEMIC AND UNIVERSITY SERVICE

- *Service to scientific community*

Associate Editor , Journal of Physical Oceanography	2022-present
Executive Committee , APS Topical Group on the Physics of Climate, member-at-large	2022-2024
Conference organizer , From Filaments to Climate Change (CLIVAR workshop)	2022
Session Convener	
· American Physical Society [Session: Statistical and Nonlinear Physics of Earth and its Climate]	2023
· Ocean Sciences Meeting. [Session: Vertical Transport]	2022
· Graduate Climate Conference	2017, 2019
· Ocean Carbon and Biogeochemistry meeting. [Session: Student lightning talks]	2017
Society for Women in Marine Science , treasurer	2019-2021
Executive committee and outreach lead , Graduate Climate Conference	2017, 2019
Reviewer for 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, Nature Climate Change, Science Advances
Abstract reviewer for SACNAS

- *University Service*

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

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

OUTREACH

Scientific Lead , Salton Sea Environmental Timeseries	2021-present
Outreach in schools , 14 presentations in English and Spanish to over 300 students	2015-present
The Old Farmer's Almanac , "Current Events: How and why the oceans hold a key to our future climate", (circulation 3 million).	2024
UNESCO , invited panelist. "Empowering women in the Ocean Decade."	November 2020
MIT Science Policy Initiative , invited panelist, "Oceans and Climate"	November 2019
Rhode Island School of Design , keynote speaker, "Reclaiming STEAM"	April 2019
Science Fair Judge , McCormack Middle School	February 2019
National Park Service , PLACE fellowship, presenter "Career Pathways to Marine Science"	November 2018
Oceanus magazine , "Forecasting Where Ocean Life Thrives."	2018
https://www.whoi.edu/oceanus/feature/forecasting-where-ocean-life-thrives/	
Public Lecture Series on Climate Science and Policy , lecturer and coordinator	January 2016