

# HENRI F. DRAKE

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## EDUCATION

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<b>MIT/WHOI Joint Program in Oceanography</b> PhD in Physical Oceanography	<i>2016 - 2021</i>
<b>Haverford College</b> B.S. in Mathematics (Honors); Magna Cum Laude	<i>2011 - 2015</i>

## AWARDS

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<b>NOAA Climate and Global Change Postdoctoral Fellowship</b>	<i>2021 - present</i>
<b>Harvard University Environmental Fellow Program</b> (declined)	<i>2021 - 2023</i>
<b>National Science Foundation Graduate Research Fellowship</b>	<i>2017 - 2020</i>
<b>MIT Rosenblith Presidential Fellowship</b>	<i>2016 - 2017</i>

## EMPLOYMENT / RESEARCH EXPERIENCE

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<b>Postdoctoral Fellow, NOAA Climate &amp; Global Change Program</b> Hosted by Sonya Legg (Princeton University and NOAA GFDL)	<i>2021 - present</i>
<b>Graduate Research Assistant, MIT/WHOI Joint Program in Oceanography</b> Advised by Raffaele Ferrari (MIT)	<i>2016 - 2021</i>
<b>Research Specialist in Physical Oceanography, Princeton University</b> Advised by Jorge Sarmiento (Princeton University) and Stephen Griffies (NOAA GFDL)	<i>2015 - 2016</i>
<b>Summer Research Assistant in Topology, Haverford College</b>	<i>2014</i>
<b>Summer Research Assistant in Quantum Computing, University of Southern California</b>	<i>2013</i>
<b>Summer Research Assistant in Environmental Engineering, Clarkson University</b>	<i>2012</i>

## RESEARCH PUBLICATIONS

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### In preparation

[Drake, H. F.](#), Legg, S. **Parameterization of Bottom Mixing Layer Instabilities**

[Drake, H. F.](#), Pratt, L. **Hydraulic control of rotating and stratified channel flow with non-zero potential vorticity**

### Submitted / Under Review

[Drake, H. F.](#), Ruan, X., Ferrari, R. **Diapycnal motion, diffusion, and stretching of tracers in the ocean.** *Journal of Physical Oceanography* (minor revisions). [\[Preprint\]](#)

[Drake, H. F.](#), Ruan, X., Callies, J., Ogden, K., Thurnherr, A., Ferrari, R. **Dynamics of eddying abyssal mixing layers over rough topography.** *Journal of Physical Oceanography* (minor revisions). [\[Preprint\]](#)

## Accepted

8. Drake, H. F., Henderson, G. **A defense of usable climate mitigation science: how science can contribute to social movements.** *Climatic Change*.

## 2021

7. Brady, R. X., Maltrud, M. E., Wolfram, P. J., Drake, H. F., Lovenduski, N. C. **The influence of ocean topography on the upwelling of carbon in the Southern Ocean.** *Geophysical Research Letters*. [doi] [Preprint]
6. Drake, H. F., Rivest, R. L., Deutch, J., Edelman, A. **A simple model for assessing climate control trade-offs and responding to unanticipated climate outcomes.** *Environmental Research Letters*. [doi]

## 2020

5. Drake, H. F., Ferrari, R., Callies, J. **Abyssal circulation driven by near-boundary mixing: water mass transformations and interior stratification.** *Journal of Physical Oceanography*. [doi].
4. Hausfather, Z., Drake, H. F., Abbott, T., Schmidt, G. A. **Evaluating the performance of past climate model projections.** *Geophysical Research Letters*, **46**. [doi]

## 2018

3. Drake, H. F., Morrison, A. K., Griffies, S. M., Sarmiento, J. L., Weijer, W., Gray, A. R. (2018). **Lagrangian timescales of Southern Ocean upwelling in a hierarchy of model resolutions.** *Geophysical Research Letters*, **45**. [doi] [Read online]
2. van Sebille, E., Griffies, S. M., Abernathey, R., Adams, T. P., Berloff, P., Biastoch, A., Blanke, B., Chassignet, E. P., Yu Cheng, Y., Cotter, C. J., Deleersnijder, E., Döös, K., Drake, H. F., Drijfhout, S., Gary, S. F., Heemink, A. W., Kjellsson, J., Koszalka, I. M., Lange, M., Lique, C., MacGilchrist, G. A., Marsh, R., Adame, C. G. M., McAdam, R., Nencioli, F., Paris, C. B., Piggott, M. D., Polton, J. A., Rühls, S., Shah, S. H. A. M., Thomas, M. D., Wang, J., Wolfram, P. J., Zanna, L., Zika, J. D. (2018). **Lagrangian ocean analysis: fundamentals and practices.** *Ocean modeling*, **121**, 49-75. [doi] [Download PDF]

## 2017

1. Tamsitt, V., Drake, H. F., Morrison, A. K., Talley, L. D., Dufour, C. A., Gray, A. R., Griffies, S. M., Mazloff, M. R., Sarmiento, J. L., Wang, J., Weijer, W. (2017). **Spiraling up: pathways of global deep water to the surface of the Southern Ocean.** *Nature Communications*, **8**, 172. [doi] [Download PDF]

## OTHER PUBLICATIONS

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Freilich, M., Wilka, C., Shivamoggi, R., Freese, L., Heiderich, J., Drake, H. F., Cantine, M. (2019). **Young Climate Scientists Speak Out.** *Special Climate Crisis Issue of DigBoston* [url]

Drake, H. F. (2019). **Eight ways to support women in science.** *EOS* [doi] [Download PDF]

## TEACHING EXPERIENCE

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**Co-Instructor (2020)** for *Introduction to Computational Thinking* (six lectures) [MIT 18.S191 course website]. Developed a flipped-classroom curriculum for introducing undergraduate Computer Science and Math majors to climate modeling through *reactive* notebooks in the Julia programming language.

**Organizer and Instructor (2020)** for *Practical Computing Tutorials for Earth Scientists (PraCTES)* [course website], a student-led January-term workshop for MIT EAPS and MIT/WHOI students. Responsibilities included curriculum design, development of live code tutorials (via binder), assisting other instructors during live hands-one exercises, and presenting two 2 hour lectures.

**Teaching Assistant (2019)** for *Climate Change* [MIT 6.S898 course website], a project-based climate change seminar course cross-listed in the Computer Science and Earth, Atmospheric, and Planetary Sciences departments. Responsibilities included curriculum design, helping students with final projects, leading discussions of assigned readings, and presenting 3 hours of lectures on climate models and data analysis.

**Guest lecturer (2019)** (1.5 hour session) for graduate-level physical oceanography course at University of Rhode Island Graduate School of Oceanography. Lecture on the abyssal ocean circulation.

**Guest Lecturer (2020)** (1 hour session) for *Dimensions of Geoengineering* [MIT course 12.884[J]]. Interactive ClimateMARGO.jl demo exploring trade-offs between emissions mitigation, carbon dioxide removal, solar geoengineering, and adaptation.

**Lecturer (2017-2019)** (four 1.5 hour sessions) for *MIT/WHOI Summer Math Review* for incoming graduate students. Blackboard refresher on key concepts in Linear Algebra, ODEs, and PDEs.

## MENTORING AND ADVISING

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### Research Advising

Undergraduate researchers (2): Kaila Uyeda (Haverford College); Freddie Furia (Princeton University).

### Career and Peer Mentoring

Peer mentor for MIT/WHOI Joint Program PhD students (4) (2018-2020)

Mentor for WHOI Summer Student Fellow (1) (2020)

Mentor for students attending Ocean Sciences Meetings (2) (2022)

Graduate Residential Advisor for MIT undergraduates in Maseeh Hall (50) (2020-2021)

## LEADERSHIP AND SERVICE

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### Seminar series, conferences, and workshops

Virtual Session Convener (2022), Ocean Sciences Meeting.

Co-Organizer (2020-2021), MIT EAPS Student Seminar.

Co-Organizer (2020-2021), MIT PAOC Sack Lunch Seminar (SLS).

Co-Chair (2019), Graduate Climate Conference.

Executive Committee Member (2017, 2020), Graduate Climate Conference [url].

### Accessibility, Justice, Equity, Diversity, Inclusion (AJEDI)

Committee member (2022), NOAA GFDL Diversity, Equity, and Inclusion Committee

Pod co-leader [url] (spring 2021), MIT EAPS' Unlearning Racism in Geoscience (URGE) pod

Web developer [url] (2020-2021), Towards Inclusion and Diversity in EAPS (TIDE).

DEI Scorecard [url] maintainer (2020-2021), Towards Inclusion and Diversity in EAPS (TIDE).

Executive Committee Member (2018), Society for Women in Marine Sciences Annual Symposium.

## Departmental Leadership and Administrative roles

MIT/WHOI Joint Program Representative (2020-2021), **MIT Graduate Student Council**.

Student Representative for Physical Oceanography (2019-2020), **MIT/WHOI Joint Program**.

## Community Building

Co-Organizer of the *ClimateGrad* Slack workspace for 500+ early-career researchers in climate to support each other and network throughout the SARS-Cov-2 pandemic (2020-2022).

Department Retreat Committee Chair (2017), **MIT Program for Atmospheres, Oceans, and Climate**.

## Peer review

*Nature* (1), *Geophysical Research Letters* (1), *Journal of Physical Oceanography* (2), *Journal of Geophysical Research: Oceans* (4), *Ocean Sciences* (1), *Geoscientific Model Development* (1), *Climatic Change* (1).

## OUTREACH

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### Online Science Communication (>100,000 engagements)

- Publisher of ([margo.plutojl.org](http://margo.plutojl.org)), an interactive web application that introduces the concept of climate change using my simple climate-economic model, hosted using Pluto.jl's novel reactive notebooks.
- Lead instructor for a series of eight [hour-long YouTube lectures / live code demos](#) on Climate Modeling, hosted on the official Julia programming language channel and reaching tens of thousands of viewers.
- Science communicator on Twitter with 3500 followers (formerly [@henrifdrake](#), deactivated 10/2021).
- Panelist on the topics of Ocean Circulation and Climate modeling for [reddit.com/r/science/](https://reddit.com/r/science/), an online science forum with 20+ million members, over 30,000 of which have personally engaged with my educational content.
- Founder of [Climate Gamers](#), an educational program that used computer games to communicate climate science to the public (see article in [The Verge](#)), reaching tens of thousands of viewers.

### K-12 Outreach

- Active participant of [Skype-a-Scientist](#) program with over 15 virtual classroom visits (2016–2020).
- *Ocean Currents* virtual lecture and discussion with several classrooms of 5th–8th grade students via [Exploring By The Seat Of Your Pants \[Youtube Recording\]](#) (2018)
- Rotating-tank fluid demonstrations at MIT Museum Girls Day event (2017, 2018, 2019).
- Rotating tank “Nor’Easter” demonstration for Science Club at Boston International School (2017).

### General Audience Lectures

- *Climate modeling: Whence, What, and Why* lecture for MIT EAPS administrative staff (2019)
- *Warming Oceans and Sea Level Rise* lecture at Science in the News DayCon symposium, open to local residents of Cambridge & Somerville, MA (2017, twice).

## FIELD WORK

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- October 2021     **Bottom Layer Turbulence and Abyssal Recipes (Leg #2)**  
(39 day cruise on *RRS Discovery*, DY138)  
The project goal is to quantify the deep bottom boundary layer flows along the continental slope of the Rockall Trough (off the west coast of Ireland), using a combination of ship-based casts, anchored mooring arrays, free-falling profilers, and inert tracer & dye injections to infer turbulent fluxes. I contributed estimates of turbulence from ship-board CTD and LADCP data using various fine-structure parameterizations. The diapycnal transport inferred from the released dyes and tracer will be used to test theoretical predictions from my PhD.
- June 2018        **MIT-WHOI Joint Program Orientation**  
(10 days on *R/V Corwith Cramer*)  
Conducted hydrographic and biological surveys of the shelf break jet south of Cape Cod and a warm core eddy on the northern flank of the Gulf Stream.

## INVITED TALKS

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- Scripps Institution of Oceanography, UC San Diego**     05/05/2022  
Bottom boundary layer control on the abyssal overturning circulation
- Oregon State University, Physics of Oceans and Atmospheres**     04/12/2022  
Bottom boundary layer control on the abyssal overturning circulation
- University of Rhode Island, Graduate School of Oceanography**     04/08/2022  
Bottom boundary layer control on the abyssal overturning circulation
- Princeton University, Atmospheric and Oceanic Sciences' Climate Seminar**     03/14/2022  
Climate Mitigation Modelling: Whence, Whither, Why?
- University of California, Irvine, Department of Earth System Science**     03/07/2022  
The little eddies that could: control of global climate by deep ocean turbulence.
- Dartmouth College, Ice+Climate Seminar**     02/04/2022  
Mixing-Driven Upwelling of Antarctic Bottom Water: Bottom Boundary Layer and Basin-Scale Dynamics
- University of Liege, GeoHydrodynamics and Environment Research**     12/05/2021  
Bottom boundary layer control on the abyssal overturning circulation
- Johns Hopkins University, Atmospheres and Oceans**     03/31/2021  
Bottom boundary layer control on the abyssal overturning circulation: basin and submeso-scale dynamics
- University of Washington, School of Oceanography**     02/24/2021  
Bottom boundary layer control on the abyssal overturning circulation: basin and submeso-scale dynamics
- Princeton University and the Geophysical Fluid Dynamics Laboratory (GFDL)**     02/01/2021  
Bottom boundary layer control on the abyssal overturning circulation: global and regional-scale dynamics

## SELECTED PRESENTATIONS

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- Drake, H. F., Ruan, X., Ferrari, R. (2022). **Diapycnal motion, diffusion, and shear dispersion of tracers in the ocean.** *Ocean Sciences Meeting*, Virtual. [TALK]

- Drake, H. F., Deutch, J. M., Edelman, A., Rivest, R. (2020). **A simple policy process for responding to climate control shortfalls and climate surprises** *American Geophysical Union Fall Meeting* [POSTER]
- Drake, H. F., Hausfather, Z., Abbott, T., Schmidt, G. (2019). **How accurate have climate models been so far?** *Graduate Climate Conference*, Woods Hole, MA. [POSTER]
- Drake, H. F., Callies, J., Ferrari, R. (2019). **Circulation and stratification of an abyssal ocean controlled by bottom boundary mixing.** *Atmospheric and Oceanic Fluid Dynamics (AOFD) Conference*, Portland, ME. [POSTER]
- Drake, H. F., Callies, J., Ferrari, R. (2018). **Impact of Mixing Layer Flows on the Abyssal Circulation and Stratification.** *Workshop on Bottom Boundary Layer Turbulence and the Ocean Overturning Circulation*, Massachusetts Institute of Technology, MA. [TALK]
- Drake, H. F., Callies, J., Ferrari, R. (2018). **Boundary Mixing Forcing Abyssal Overturning.** *Gordon Research Conference on Ocean Mixing*, Hannover, NH. [POSTER]
- Drake, H. F., Callies, J., Ferrari, R. (2018). **Testing a New Paradigm for the Abyssal Ocean Circulation.** *Ocean Sciences Meeting*, Portland, OR. [TALK]
- Drake, H. F., Tamsitt, V., Morrison, A. K., Sarmiento, J. L., Griffies, S. M., Weijer, W., Gray, A. R., Talley, L., Wang, J., Mazzlof, M., Dufour, C. (2016). **Three-Dimensional Pathways of Deep Water Upwelling in the Southern Ocean.** *Southern Ocean Carbon and Climate Observations and modeling (SOCCOM) Annual Meeting*, Scripps Institution of Oceanography, CA. [TALK]
- Drake, H. F., Morrison, A. K., Sarmiento, J. L., Griffies, S. M., Weijer, W., Gray, A. R., Dufour, C. (2016). **Lagrangian Upwelling Pathways of Deep Waters in the Southern Ocean.** *Ocean Sciences Meeting*, New Orleans, LA. [POSTER]

## REFERENCES

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Raffaele Ferrari  
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Princeton University  
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