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HENRI F. DRAKE

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EDUCATION

MIT/WHOI Joint Program in Oceanography *2016 - Present*
PhD Candidate in Physical Oceanography

Haverford College *2011 - 2015*
B.S. in Mathematics, Magna Cum Laude

RESEARCH EXPERIENCE

Graduate Research Assistant, MIT/WHOI Joint Program in Oceanography *2016 - Present*

- Developed a quasi-realistic high-resolution simulation of the Brazil Basin Tracer Release Experiment, to help interpret enigmatic results from the twenty-year old observational campaign, and to inform the practical planning of an upcoming follow-up campaign.
- Developed novel theoretical and numerical ocean circulation models to unite several independent decades-long research tracks into a unified conceptual model of abyssal ocean circulation and stratification.
- Developed a simple and user-friendly climate-economic model for use in climate education, outreach, and answering research questions that conventional Integrated Assessment Models are not well suited for.
- Decoded data from forgotten decades-old climate simulations and compared them against both historical observation data and modern generations of climate models (CMIP3, 5, 6).

Research Specialist in Physical Oceanography, Princeton University *2015 - 2016*

- Simulated millions of Lagrangian particle trajectories in a high-resolution model of the Southern Ocean and analyzed the spatial and temporal pathways of deep ocean upwelling.

TEACHING EXPERIENCE

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 (2020) (1 hour session) for *Introduction to computational thinking for real-world problems* [MIT 18.S191 course website]. Interactive Julia demo exploring climate feedbacks, instability, and multiple equilibria via a simple zero-dimensional energy balance model with the ice-albedo effect.

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.

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

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

Staff tutor (2014-2015) for Haverford College Math Question Center.

AWARDS

Goodwin Medal (Nominated), for a "graduate TA [...] who has performed above and beyond the norm, and whose teaching efforts can truly be characterized as 'conspicuously effective'" [Description]. *2019*

National Science Foundation Graduate Research Fellowship (Awarded) *2017 - 2020*

MIT Rosenblith Presidential Fellowship (Awarded) *2016 - 2017*

RESEARCH PUBLICATIONS

In preparation

Drake, H. F., Ogden, K., Ledwell, J., Thurnherr, A., Ferrari, R. **Simulated Brazil Basin Tracer Release Experiments**.

Drake, H. F., Callies, J., Ogden, K., Ledwell, J., Thurnherr, A., Ferrari, R. **Dynamics of mixing-driven flow up and down Mid-Ocean Ridge fracture zone valleys**.

Drake, H. F., Rivest, R. L., Deutch, J., Edelman, A. **A multi-control climate policy process for a trusted decision maker**. [Preprint]

Drake, H. F., Lickley, M., Abbott, T., Brady, R. X. **Assessing climate model projections of anthropogenic warming patterns**. [Preprint]

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., Rühs, 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 Modelling*, **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

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]

SERVICE

Seminar series, conferences, and workshops

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

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

Executive Committee Co-Chair (2019), **Graduate Climate Conference**.

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

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

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

Departmental Leadership and Administrative roles

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

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

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

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

Mentoring and Advising

Graduate Residential Advisor for **26 MIT undergraduates in Maseeh Hall** (2020-present)

"Near-peer" mentor for **1 WHOI Summer Student Fellow** (2020)

Peer mentor for **3 MIT/WHOI Joint Program PhD students** (2018-present)

Peer review

Reviewer for: *Nature* (1), *Ocean Sciences* (1), *Journal of Geophysical Research: Oceans* (1), *Journal of Physical Oceanography* (1).

OUTREACH

K-12 Outreach

– Active participant of Skype-a-Scientist program with over 15 virtual classroom visits (2016–present).

– *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 Modelling: 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 & Sommerville, MA (2017, twice).

Online Science Communication

– Active climate science communicator on Twitter (@henrifdrake), 3000+ followers.

– Active on reddit.com/r/science/, an online science forum with 20+ million members, where I am an accredited panelist on the topics of Ocean Circulation and Climate Modelling (/u/aClimateScientist) have had over 26,000 users engage with my educational comments.

– Founder of Climate Gamers, a program that used computer games to communicate climate science.

FIELD WORK

Upcoming (2021)	**Bottom Layer Turbulence** (30-40 day cruise). Will investigate the turbulent bottom boundary layer 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 injections to measure turbulence statistics.
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.

SELECTED PRESENTATIONS

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. (2017). **Spatial and Temporal Structure of Southern Ocean Upwelling**. *Graduate Climate Conference*, Woods Hole, MA. [POSTER]

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 Modelling (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]