

# Maike Sonnewald, Ph.D.

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## Current position

2/2020–present	<b>Princeton University, NJ</b> Associate Research Scholar
2/2020–present	<b>NOAA Geophysical Fluid Dynamics Laboratory (GFDL), NJ</b> Research Affiliate
12/2019–present	<b>University of Washington, WA</b> Visiting scientist

## Education

2011–2016	<b>University of Southampton, UK.</b> Ph.D. Complex Systems Simulation. Joint: National Oceanography Center and School of Computer Science. Dissertation: Ocean model utility dependence on horizontal resolution
2011	<b>University of Southampton, UK.</b> M. Sci. <i>magna cum laude</i> , complex systems simulation
2006–2010	<b>University of Southampton, UK.</b> M. Sci. <i>magna cum laude</i> , physical oceanography

## Academic positions

11/2021–12/2021	<b>University of California, Santa Barbara, Kavli Institute for Theoretical Physics, Core member</b> <ul style="list-style-type: none"><li>• “Machine Learning and the Physics of Climate” activity</li></ul>
10/2015–2/2020	<b>Massachusetts Institute of Technology (MIT), Earth, Atmosphere and Planetary Sciences (EAPS), Postdoctoral Associate</b> <ul style="list-style-type: none"><li>• <b>Led:</b> Objective global assessment of dynamical regimes using Barotropic Vorticity using machine learning. Collab: <b>P. Heimbach, C. Wunsch</b></li><li>• <b>Led:</b> Discovering global biogeography using ML. Collab: <b>S. Dutkiewicz and C. Hill</b></li><li>• <b>Led:</b> Develop benchmark of predictability of ECCO SSH. Collab: <b>C. Wunsch</b></li><li>• <b>Led:</b> Closing the momentum budget in the ECCO state estimate.</li></ul>
2/2017–10/2019	<b>Harvard University, Earth and Planetary Science (EPS), visiting scientist</b> <ul style="list-style-type: none"><li>• <b>Led:</b> Machine Learning exploration of Barotropic Vorticity budget in ECCO. Collab: <b>P. Heimbach &amp; C. Wunsch</b></li><li>• Using in-situ data and ECCO closing vorticity budgets on isopycnals. Collab: <b>I. Le Bras</b></li></ul>
12/2018–1/2019	<b>Grenoble Les Alpes, Lab. des Ecouls. Geophysiques et Industriels, Fr. visiting Scientist.</b> <ul style="list-style-type: none"><li>• <b>Leading:</b> Applying dynamical systems theory to mapping chaos in the OCCIPUT ensemble. Collab: <b>T. Penduff, N. Le Bihan and J. Le Sommer</b></li></ul>
10/2018–10/2017 & 10/2016–2/2017	<b>University of Texas (UT) at Austin, Inst. for Computational Engineering and Sciences (ICES), visiting scientist</b> <ul style="list-style-type: none"><li>• <b>Led:</b> Team software effort for scalable Open Source analytical tools for physical.</li><li>• <b>Led:</b> Assessment of Lagrangian Coherent Structures in ensembles. Collab: <b>M. Allhouse</b></li></ul>
2/2014–4/2014	<b>MIT, EAPS, visiting Graduate Research Assistant. Advisor: Raffaele Ferrari</b> <ul style="list-style-type: none"><li>• Assessed Mixed Layer Depth (MLD) dynamics in model and in-situ data.</li><li>• Identify source of asymmetry in Southern Ocean MLD, using 1D mixing scheme model.</li></ul>

2011–2015	<p><b>NOCS/ICSS.</b> Graduate Research Assistant. Advisors: <b>J. J.-M. Hirschi, G. Nurser and J. Dyke.</b></p> <ul style="list-style-type: none"> <li>• <b>Thesis:</b> <i>Ocean model utility dependence on horizontal resolution.</i> <a href="https://eprints.soton.ac.uk/397412/">https://eprints.soton.ac.uk/397412/</a></li> <li>• Entropy extremum principles for model parameterisation.</li> <li>• Global overturning assessment with increasing model resolution, using GFD theory with focus on topographic interactions and surface-depth signal communication and HPC tools.</li> <li>• Ocean model <i>utility</i> quantification using tools from economics</li> <li>• Satellite use in high latitude waters. Collab: <b>A.I. Bulczak, S. Bacon</b></li> </ul>
7/2008–8/2008	<p><b>GEOMAR,</b> Kiel, Germany Research assistant. Host: <b>J. Karstensen and M. Visbeck</b></p> <ul style="list-style-type: none"> <li>• Internal gravity waves in North Atlantic mooring data exploration.</li> </ul>

## Review articles

2021: **Sonnewald, M.**, Brajard, J., Duben, P., Lguensat, R. and Balaji, V., *Bridging theory, simulation, and observations of the global ocean using Machine Learning.* **Environmental Research Letters.**

2021: Irrgang, C., Boers, N., **Sonnewald, M.**, Elizabeth A. Barnes, Christopher Kadow, Staneva, J., and Saynisch-Wagner, J. *Towards neural Earth system modelling by integrating artificial intelligence in Earth system science.* Nature Machine Intelligence. DOI: 10.1038/s42256-021-00374-3 <https://arxiv.org/abs/2101.09126>

## Publications<sup>1</sup>

Upcoming: **Sonnewald, M.**, Lguensat, R., A. Adcroft, V. Balaji and A. Radhakrishna *Southern Ocean wind gyres buffer global heating in climate models.* In preparation.

Upcoming: Kaiser, B., Saenz, J.A., **Sonnewald, M.** and Livescu, D., *Objective discovery of dominant dynamical processes with machine learning.* In review **Nature.**

Upcoming: J. Krasting, M. De Palma, J. Dunne, J. John, and **Sonnewald, M.** *Regional Sensitivity Patterns of Arctic Ocean Acidification Revealed With Machine Learning.* Major revisions, **Nature Communications Earth & Environment.**

Upcoming: Bingham, R. and **Sonnewald, M.** *Stable Atlantic overturning circulation revealed by a dynamically-proximate reconstruction.* In revision, **Geophysical Research Letters.**

Upcoming: **Sonnewald, M.**, Hirschi, J.J.-M., Nurser, A.G., Firing, Y., Coward, A. and Hyder, P. *Increasing ocean model resolution reveals impact of tuning eddy permitting models.* In revision. **Journal of Advances in Modeling Earth Systems.**

2021: **Sonnewald, M.**, and Lguensat, R. *Revealing the impact of global warming on climate modes using transparent machine learning.* **Journal of Advances in Modeling Earth Systems.** Available: <https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021MS002496>. Featured on cover.

2021: **Sonnewald, M.**, and Lguensat, R. , Radhakrishnan, A., Sayibou, Z., Wittenberg, A.T. and Balaji, V. *Revealing the impact of global heating on North Atlantic circulation using transparent machine learning.* **International Conference on Machine Learning: Spotlight paper at ClimateChangeAI Workshop.** Available: <https://www.climatechange.ai/papers/icml2021/13>

2020: **Sonnewald, M.**, Dutkiewicz, S., Hill, C. and Forget, G. *Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces.* **Science Advances.** DOI: 10.1126/sciadv.aay4740

2019: Le Bras, I., **Sonnewald, M.**, Toole, J.M. A bulk Potential Vorticity budget for the western North Atlantic based on observations. **Journal of Physical Oceanography.** DOI: 10.1175/JPO-D-19-0111.1.

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<sup>1</sup>Manuscripts in preparation and in revision available at co-authors' discretion.

2019: **Sonnwald, M.**, Wunsch, C. and Heimbach, P. *Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions*. **Journal of Earth and Space Science** edition “Geoscience paper of the future”. 6. <https://doi.org/10.1029/2018EA000519>

2018: **Sonnwald, M.**, C. Wunsch, and P. Heimbach, *Linear Predictability: A Sea Surface Height Case Study*. **Journal of Climate**, 31, 2599–2611, DOI.org/10.1175/JCLI-D-17-0142.1

2018: Gille, S., Abernathey, A., Chereskin, T., Cornuelle, B., Heimbach, P., Mazloff, M., Menemenlis, D., Rocha, C., Soares, S., **Maike Sonnwald**, Villas Boas, B., Wang, J. *Open Code Policy for NASA Space Science: A perspective from NASA-supported ocean modeling and ocean data analysis*. **NASA White Paper**, Available: <https://tinyurl.com/NASA-WhitePaper>

2017: **The ECCO Consortium**. *A Twenty-Year Dynamical Oceanic Climatology: 1994-2013. Part 1: Active Scalar Fields: Temperature, Salinity, Dynamic Topography, Mixed-Layer Depth, Bottom Pressure*. **MIT DSpace**: <https://dspace.mit.edu/handle/1721.1/107613>.

2017: **The ECCO Consortium**. *A Twenty-Year Dynamical Oceanic Climatology: 1994-2013. Part 2: Velocities and Property Transports*. **MIT DSpace**: <https://dspace.mit.edu/handle/1721.1/109847>.

2014: Bulczak, A.I., Bacon, S., Naveira Garabato, A.C., Ridout, A., **Sonnwald, M.**, and Laxon, S.W. *Seasonal Variability of Sea Surface Height in the Coastal Waters and Deep Basins of the Nordic Seas*. **Geophysical Research Letters** (42) (DOI:10.1002/2014GL061796).

2013: **Sonnwald, M.**, Hirschi, J.J.-M., Marsh, R., McDonagh, E.L. and King, B.A. *Atlantic meridional ocean heat transport at 26N: impact on subtropical ocean heat content variability*. **Ocean Science**, 9, (6), 1057-1069. DOI:10.5194/os-9-1057-2013.

## Coverage by popular press

Sonnwald 2020

- **EOS science news by the American Geosciences Union (AGU)**, vol 101, nr. 8, “*How Machine Learning Redraws the Map of Ocean Ecosystems*”, by J. Duncombe.
- **MIT News**, “*Machine learning helps map global ocean communities*”, by J. Chu.
- **Hakai Magazine**, “*The Ocean’s 12 Megaprovinces*”, by J. Snow.
- **Story Map**, “*Defining the Fluid Nature of Ocean Ecosystems*”, interactive article by A. Annette deCharon, [ecco-group.org](http://ecco-group.org).
- **The Batch**, “*Underwater Atlas*”, from [deeplearning.ai](http://deeplearning.ai).
- Featured on **SciTechDaily**, **Yahoo! Finance**, **Dailyhunt**, **Firstpost** and **Scienceblog**.

Sonnwald 2019

- **MIT News**, “*Machine learning identifies links between world’s oceans*” by K. Tsipis.
- Also featured in **Artificial Intelligence Research**, **Physics.org** and **ECN magazine**.

## Teaching experience

Upcoming	<b>Lecture:</b> AOS 551: deep learning in geophysical fluid dynamics, <i>participants 10, developed material, taught.</i>
2021	<b>Invited tutorial:</b> Society for Industrial and Applied Mathematics (SIAM): Conference on Mathematical and Computational Issues in the Geosciences. Milan, Italy, <i>participants 60, developed material, taught.</i>
2020	<b>Lecture:</b> Oceanhackweek 2020, “ <i>Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces</i> ”, <i>class size 20, developed material, taught.</i>
2020	<b>Lecture:</b> GFDL interns, undergraduate level: “ <i>Machine learning for the geosciences</i> ”. <i>Class size 6, developed material, taught.</i>

2019	<b>Guest lecture:</b> Harvard University for Marine Denolle and Brad Lipovsky, graduate level: “Machine Learning in Geoscience”. <i>Class size 10, developed material, taught</i>
2019	<b>Guest lecture:</b> Harvard University Data Science Club lecture: “The good, the bad and the ugly of applied unsupervised learning”, <i>class size 60, developed material, taught</i>
2019	<b>Invited workshop lecturer for three day course</b> , Princeton University&GFDL workshop for graduate students: “Machine learning and climate modeling”, <i>class size 20-30, developed material, taught</i>
2016	<b>Guest lecture:</b> UT (ICES) for Patrick Heimbach, graduate level: “Vertical Mixing Schemes: Why we need them & what they do”, <i>class size 5, developed material, taught</i> .
2014	<b>Taught:</b> Workshop for SCCS on “Finite differences methods”, <i>class size 40+, dev. material, taught</i> .
2014	<b>Taught:</b> Workshop for SCCS “Importance of model validation”, <i>class size 40+, dev. material, taught</i> .
2013	<b>Teaching Assistant:</b> NOCS, undergraduate level: “Physical Oceanography II”, (class size 50).
2012	<b>Teaching Assistant:</b> NOCS, undergraduate level: “MSc Fieldwork Boat Week”, (class size variable due to weather 5-9, taught on the Research Vessel Callista).
2012	<b>Teaching Assistant:</b> NOCS, undergraduate level: “Physical Oceanography I”, (class size 90).

## Mentoring and advising

Upcoming	<b>Advising:</b> Lapenta Internship (NOAA). Currently advertising.
2021	<b>Advising:</b> Mariana Clare, Imperial, on CNRS grant.
2021-	<b>Committee member:</b> Yvonne Jenniges, Alfred Wegener Institute (DE), first year Ph.D. Title: Defining and characterizing ocean regions.
2021 Summer	<b>Advising:</b> Zouberou Sayibou, Bronx Community College. Princeton University CIMES Scholar, targeted at minorities. Graduate level, 9 weeks. Resulted in ICML and AGU contribution and EEO student letter highlight. Now Junior at Stanford.
2019-	<b>Mentoring:</b> Catherine Wilka, was graduate student at MIT, now postdoc at Stanford.
2016-	Informal graduate student mentoring.

## Awards and grants

Active	<b>Principal Investigator:</b> <i>Revealing trophic dynamic provinces in the sea: using unsupervised machine learning to map energy and material fluxes from nutrients to fisheries production</i> . To NOAA Climate Program Office to fund a postdoctoral associate.
2018-2020	Visiting Scientist Grant from Data Institute Univ. Grenoble Alpes
2017	<b>Award from the Kaufman Teaching Certificate Program (KTCP)</b> , MIT.
2016	Physical Oceanography Dissertation Symposium grant, Univ. of Hawaii at Manoa, USA.
2015	International Council for the Exploration of the Sea’s North Pacific Marine Science Organization 3rd Climate Change Symposium grant.
2014	Awarded grant to run first NOCS Software Carpentry workshop for Ph.D. students.
2014	Awarded ICSS grant to visit MIT.
2013	International Association for the Physical Sciences of the Oceans 2013 conference grant.
2011	Best poster, Student Conference on Complexity Science 2011.
2010	<b>Graduate Scholarship</b> from Engineering and Physical Sciences Research Council (EPSRC).
2006–2010	<b>Undergraduate Scholarship</b> Norwegian Lanekassen.
2005–2006	<b>Undergraduate Scholarship</b> Danish Statens Uddannelsesstøtte.

## Languages

Native speaker	Norwegian, Danish and German
Excellent	English
Proficient	French

## Invited conference panels

2021	<b>Virtual Summit: Incorporating Data Science and Open Science in Aquatic Research.</b> Virtual, 624 participants.
2020	<b>AGU</b> , <i>Challenges and opportunities of applying AI, ML and DL to problems in the environmental and geosciences.</i> Virtual, 1200 participants.
2020	<b>NOAA Workshop</b> , <i>Second NOAA Workshop on Leveraging AI in the Environmental Sciences.</i> Virtual, 60+ named participants.

## Invited talks<sup>2</sup>

Upcoming	<b>AGU2021</b> , TBA.
Upcoming	<b>Max Planck Institute, Hamburg</b> , TBA.
Upcoming	<b>Kavli Institute for Theoretical Physics</b> , TBA.
Upcoming	<b>Climate Change AI</b> , TBA.
2021	<b>NOAA AI, 3rd workshop</b> , Revealing the impact of global warming on climate modes using transparent machine learning and a suite of climate models. Virtual.
2021	<b>Virtual Summit: Incorporating Data Science and Open Science in Aquatic Research</b> , No free lunch: Robustly revealing mechanisms of ocean circulation change under global heating with transparent ML. Keynote speaker for Virtual Summit. Virtual.
2021	<b>International Conference on Machine Learning</b> , Revealing the impact of global warming on climate modes using transparent machine learning and a suite of climate models. <i>ClimateChangeAI Workshop spotlight.</i> Virtual.
2021	<b>University of Chicago</b> , Department of Statistics, Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces. Keynote speaker for workshop/institute launch <i>Verification, Validation, and Uncertainty Quantification Across Disciplines.</i>
2021	<b>University Corporation for Atmospheric Research</b> , Revealing the impact of global heating on North Atlantic circulation using transparent machine learning, Climate & Global Dynamics Seminar. Virtual.
2021	<b>University of California, Santa Cruz</b> , Revealing the impact of global heating on North Atlantic circulation using transparent machine learning, Ocean Sciences Department Colloquium. Virtual.
2021	<b>GEOMAR Helmholtz Centre for Ocean Research</b> , Revealing the impact of global heating on North Atlantic circulation using transparent machine learning, Ocean Circulation and Climate Dynamics Colloquium, Kiel, Germany. Virtual.
2020	<b>Second NOAA Workshop on Leveraging AI in the Environmental Sciences</b> , <i>Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces.</i> Virtual.
2020	<b>NOAA Senior Management Meeting, Oceanic and Atmospheric Research</b> , <i>Building geographies of ocean dynamical regimes.</i> Virtual.
2020	<b>Los Alamos National Laboratory</b> , textitLiving on the Manifold: A geography of ocean dynamical regimes from eddy to global scale. Los Alamos, USA.
2020	<b>University of Washington</b> Department of Mechanical engineering Kuntz group, <i>Living on the Manifold: A geography of ocean dynamical regimes from eddy to global scale.</i> Seattle, USA.
2020	<b>University of Washington</b> , Department of Ocean Sciences, <i>Living on the Manifold: A geography of ocean dynamical regimes from eddy to global scale.</i> Seattle, USA.
2020	<b>University of Washington</b> , <i>Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces</i> , Seattle, USA.
2020	<b>University of British Columbia</b> , <i>Ocean exploration with machine learning: An Antidote to Chaos?</i> , Vancouver, Canada.
2019	<b>AGU</b> , <i>The case for machine learning in geoscience.</i> San Fransisco, USA.
2019	<b>University of Bergen</b> , <i>Ocean exploration with machine learning: An Antidote to Chaos?</i> . Bergen, Norway.
2019	<b>Princeton Univeristy</b> , <i>Ocean exploration with machine learning: An Antidote to Chaos?</i> Princeton, USA.
2019	<b>Norway-US bilateral AI workshop</b> , <i>Elucidating Ecological Complexity.</i> Austin, USA.
2019	<b>Norway-US bilateral AI workshop</b> , <i>Recognising ocean physical regimes.</i> Austin, USA.
2019	<b>WHOI</b> , <i>Ocean exploration with machine learning: An Antidote to Chaos?</i> Woods Hole, USA.

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<sup>2</sup>Only first author presentations listed

2019 **University of Tromsø**, *Ocean exploration with machine learning: An Antidote to Chaos?* Tromsø, Norway.

2018 **MIT**, *Machine learning for global biogeography?* Cambridge, USA.

2018 **WHOI**, *Unsupervised learning classifies global ocean dynamical regions.* Woods Hole, USA.

2017 **Columbia University, Lamont-Doherty Earth Observatory**, *Linear predictability: A sea surface height case study*, Palisades, USA.

2017 **Stony Brook University**, *Linear predictability: A sea surface height case study.* Stony Brook, USA.

2017 **Yale University**, *Ocean model utility dependence on horizontal resolution.* Yale, USA.

2016 **UT at Austin**, *Linear predictability: A sea surface height case study.* Austin, USA.

2016 **University of Washington**, *Southern Ocean Mixed Layers and Bottom Pressure Torque in a hierarchy of GCM runs.* Seattle, USA.

2016 **Oregon State University**, *Ocean model utility dependence on horizontal resolution.* Corvallis, USA.

2016 **University of British Columbia** *Linear predictability: A sea surface height case study.* Vancouver, Canada.

2015 **MIT**, *Ocean model utility dependence on horizontal resolution.* Cambridge, USA.

2015 **WHOI**, *Ocean model utility dependence on horizontal resolution.* Woods Hole, USA.

2015 **NOCS**, *Resolution dependence and Southern Ocean zonal asymmetries in mixed layer depth variability in the NEMO GCM.* Southampton, UK.

2014 **University of Oxford**, *Resolution dependence and Southern Ocean zonal asymmetries in mixed layer depth variability in the NEMO GCM.* Oxford, UK.

2014 **MIT PO Student talk**, *Changing ocean model resolution: What we learn from the density space streamfunction.* Cambridge, US.

2014 **MIT Student talk**, *Ekman's Demon: The stunted conversation between the atmosphere and ocean.* Cambridge, US.

2014 **University of Bristol**, *Changing ocean model resolution: What we learn from the overturning streamfunction.* Bristol, UK.

2014 **NOCS**, *Atlantic meridional ocean heat transport at 26°N: impact on subtropical ocean heat content variability.* Southampton, UK.

2013 **NOCS**, *Atlantic ocean meridional heat transport at 26N: Impact on subtropical ocean heat content variability.* Southampton, UK.

2012 **MONCACO meeting**, *Oceanic dominance of interannual subtropical North Atlantic heat content variability.* Southampton, UK.

## Conference contributions Only first author presentations listed

2021 **ICML 2021**, *Revealing the impact of climate modes using transparent machine learning.* **Poster.**

2021 **Knowledge Guided Machine Learning (KGML), 2021**, *Revealing the impact of climate modes using transparent machine learning.* **Poster.**

2021 **EGU 2021**, *Revealing mechanisms of change in the Atlantic Meridional Overturning Circulation under global heating.* Vienna/virtual. **Highlighted vPICO.**

2020 **AGU 2020**, *Revealing mechanisms of change in the Atlantic Meridional Overturning Circulation under global heating.* San Francisco/virtual. **Poster.**

2020 **Climate Informatics 2020**, *Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces.* Oxford/virtual. **Talk.**

2020 **Climate Informatics 2020**, *Understanding the ocean dynamics of climate models using deep neural networks*, Oxford/virtual. **Poster.**

2019 **European Geosciences Union (EGU)**, *Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions*, Vienna, Austria.

2018 **AGU**, *textitUnsupervised Learning Reveals Geography of Global Ocean Dynamical Regions.* Washington, USA.

2018 **ECCO meeting 2018**, *Diffusivities as barriers to mixing: Control Vectors give glimpse into mixed layer dynamics.* UT at Austin, USA. **Talk.**

2018 **ECCO meeting 2018**, *textitUnsupervised learning classifies global ocean dynamical regions+Biogeography.* UT at Austin, USA. **Talk.**

2018 **Ocean Science Meeting**, *Vorticity budgets and the North Atlantic gyre overturning.* Portland, OR, USA. **Poster.**

2017 **ECCO meeting 2017**, *Objectively classified vorticity: A global assessment of dynamical closures.* California Institute of Technology, USA. **Talk.**

2017	<b>Society of Engineering Science</b> , <i>Understanding Uncertainty: Coherent Structure Properties in Parameter Space</i> . Boston, USA. <b>Talk</b> .
2017	<b>World Climate Research Programme (WCRP), Intergovernmental Oceanographic Commission of UNESCO (IOC) Sea Level</b> , <i>Linear predictability: A sea surface height case study</i> . NYC, USA. <b>Poster</b> .
2017	<b>EGU</b> , <i>Linear predictability: A sea surface height case study</i> . Vienna, Austria. <b>Talk</b> .
2016	<b>Physical Oceanography Dissertation Symposium (PODS)</b> , <i>Ocean model utility dependence on horizontal resolution</i> . University of Hawaii at Manoa, USA. <b>Talk</b> .
2016	<b>Ocean Sciences</b> , <i>How do Ocean Heat Fluxes Depend on Bottom Pressure Torque?</i> New Orleans, USA. <b>Talk</b> .
2015	<b>EGU</b> , <i>How do heat fluxes in the Southern Ocean depend on bottom pressure torque?</i> Vienna, Austria. <b>Talk</b> .
2015	<b>EGU</b> , <i>Southern Ocean zonal asymmetries in mixed layer depth variability in the NEMO GCM</i> . Vienna, Austria. <b>Poster</b> .
2015	<b>Society for Industrial and Applied Mathematics (SIAM)</b> , <i>How do heat fluxes in the Southern Ocean depend on seafloor interactions?</i> Reading, UK. <b>Talk</b> .
2014	<b>SIAM</b> , <i>Climate model divergence: Using Lyapunov exponents</i> . Reading, UK. <b>Talk</b> .
2014	<b>Student Conference on Complex Systems (SCCS)</b> , <i>Ekman's Demon: The conversation between the atmosphere and ocean</i> . Brighton, UK. <b>Talk</b> .
2013	<b>Graduate Climate Conference</b> , <i>How sensitive is ocean model utility to resolution?</i> Woods Hole, US. <b>Talk</b> .
2013	<b>SCCS</b> , <i>How sensitive is ocean model utility to resolution?</i> Oxford, UK. <b>Talk</b> .
2013	<b>International Association for the Physical Sciences of the Oceans (IAPSO)</b> , <i>Atlantic ocean meridional heat transport at 26N: Impact on subtropical ocean heat content variability</i> . Gothenburg, Sweden. <b>Talk</b> .
2013	<b>NOCS, POETS Corner</b> , <i>NEMO model utility changes with resolution</i> . NOCS, UK. <b>Talk</b> .
2012	<b>ICSS</b> , <i>Stochastic parameterisation methods: Applications to ocean models?</i> , Southampton, UK. <b>Talk</b> .
2012	<b>Ocean Modeling Group</b> , <i>Oceanic dominance of interannual subtropical North Atlantic heat content variability</i> . Norwich, UK. <b>Talk</b> .
2012	<b>Challenger Conference</b> , <i>Oceanic dominance on interannual subtropical North Atlantic heat content variability</i> . UK. <b>Poster</b> .
2012	<b>EGU</b> , <i>Insights from extremum principles: The effects of diffusivity parameters on entropy budgets within an ocean-atmosphere-ice model</i> . Vienna, Austria. <b>Poster</b> .
2012	<b>EGU</b> , <i>Oceanic dominance of interannual subtropical North Atlantic heat content variability</i> . Vienna, Austria. <b>Poster</b> .
2012	<b>SCCS</b> , <i>Impacts of resolution on ocean model fidelity: An Arctic case study</i> . Warwick, UK. <b>Talk</b> .
2011	<b>SCCS</b> , <i>Insights from extremum principles: The effects of diffusivity parameters on entropy budgets within an ocean-atmosphere-ice model</i> . Winchester, UK. <b>Poster</b> .

## Service

### Review duties

Journals	<b>Nature</b> , <b>Journal of Advances in Modeling Earth Systems</b> , <b>Geophysical Research Letters</b> , <b>Ocean Modelling</b> , <b>Journal of Geophysical Research</b> , <b>Journal of Physical Oceanography</b> , <b>Data Science</b> , <b>Frontiers in Marine Science</b> .
Review Panel	<b>NASA review panel 2017</b>

### Conference, workshop and seminar organization

2022	<b>EGU</b> , <i>Machine learning for Earth system modelling</i>
2021	<b>Conference on Neural Information Processing Systems (NeurIPS)</b> , <i>Climate Change AI's workshop on "Tackling Climate Change with Machine Learning"</i> , Program Committee.
2021	<b>EGU</b> , <i>ITS4.4/AS4.1: Machine learning for Earth system modelling</i> .
2020	<b>AGU</b> , <i>OS014: Innovation and exploration in observed and model oceanographic data using interpretable machine learning</i> , oral and poster, <b>head-convener</b> .
2020	<b>AGU</b> , <i>A084: Machine Learning for Weather and Climate Modeling</i> , oral and poster, <b>co-convener</b> .
2020	<b>The 2nd NOAA Workshop on Leveraging AI in Environmental Sciences</b> "Exploiting Space- and Ground-Based Observations and Enhancing Earth System Prediction". <b>Session chair</b> .

2020	<b>EGU, ITS4.3/AS5.2: Machine learning for Earth System modelling</b> , oral and poster, <b>co-convener</b> .
2019	<b>OceanObs'19</b> , breakout session, <i>Open Source Software Revolution</i> , <b>co-convener</b> .
2019	<b>AGU, GC33C - Innovation and Exploration of Observations and Earth System Models Using Machine Learning and Big Data Analysis</b> , oral and poster, <b>head convener</b> .
2015–2016	<b>MIT Sack Lunch</b> , seminar, <b>organizing member</b> .
2014	<b>SCCS</b> , conference, <b>web-design, organizing member</b> .
2014	<b>SCCS</b> , conference, Earth System Complexity session, <b>head-convener</b> .
2014	<b>SCCS</b> , workshop on “The importance of model validation”, <b>organized with Martin Wood</b> .
2014	<b>SCCS</b> , Workshop on “Finite differences methods” <b>organized with Martin Wood</b> .
2014	<b>NOCS Software Carpentry</b> , workshop, <b>single organizer</b> .
2014	<b>Polar Network Workshop: Science and Society</b> , workshop, <b>organizing member</b> .
2014–2015	<b>POETS Corner</b> , seminars <b>organizing member</b> .
2013–2015	<b>Dynamical discussions series</b> , seminars, <b>organizing member</b> .
2012–2013	<b>Complex earth system modelling and physical Understanding</b> , seminars, <b>organizer</b> .
2012	<b>SCCS</b> , conference, <b>ICSS representative</b> .
2012	<b>SCCS</b> , conference, <b>ICSS representative</b> .
2011–2013	<b>Rhubarb series</b> , seminars <b>organizing member</b> .
2011	<b>SCCS</b> , conference, <b>organizing member</b> .
2011	<b>SCCS</b> , conference, Physical Systems Chair, <b>convener</b> .

## Diversity, equity and inclusion activities

2021-present	<i>POD member</i> , <b>Unlearning racism in Geoscience (URGE)</b> . Program to develop anti-racist policies and strategies at Princeton University, <i>POD member</i> .
2021	<i>Advising</i> : CIMES internship.
2020	<i>Speaker at</i> , <b>Bronx Community College</b> , NYC, USA. Effort by the Bronx Community College STEM Advisory Board to encourage students to consider STEM careers.
2017	<i>Leader</i> , <b>Massachusetts Institute of Technology Outing Club</b> . Organization aimed at enabling students and MIT associates of varied cultural and financial backgrounds to access the outdoors by providing leadership expertise and access to gear (such as skies).

## Public engagement and outreach

2020	<i>Taught “Climate change 101”</i> , <b>Virtual “Summer Climate Camp” by SynergyEd</b> . Class size 10, ages 11-13 years, developed material, taught.
2019	<i>Helper</i> : <i>Nautical day at the MIT museum</i> , <b>MIT Museum</b> , USA.
2018	<i>Attendee</i> , <b>US Software Sustainability Institute NSF workshop</b> , Berkeley, USA.
2016	<i>Copezilla team</i> , <b>Red Bull Flugtag</b> , Boston, USA. <b>MIT EAPS outreach activity</b> .
2013	<i>Speaker</i> : <i>Ocean Model fidelity and resolution</i> , <b>ICSS Open Day</b> , Southampton, UK.
2012	<i>Speaker</i> : <i>Impact of resolution in ocean models</i> , <b>ICSS Industrial and International Advisory Board meeting</b> , Southampton, UK. <b>Invited talk</b> .
2012	<i>Speaker</i> : <i>Ocean Model fidelity and resolution</i> , <b>ICSS Open Day</b> , Southampton, UK.
2009	<i>Information tent scientist helper for “Climate Change”</i> , <b>United Nations Climate Change Conference (COP 15)</b> , Copenhagen, Denmark.

## Seagoing experience

July 2016	<b>RV NORSEMAN II</b> , Mooring recovery in the Bering Strait and high resolution synoptic survey of the Strait and Chukchi Sea area. Chukchi Sea glider deployment.
August 2010	<b>RV Callista</b> , Falmouth Bay data collection.

## Professional memberships

2010–present	European Geosciences Union
2016–present	American Geosciences Union