# Patrick Heimbach, Ph.D.

C.V. (2021/09)

**The University of Texas at Austin**
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**Relevant Experience:**

Leading role in the "Estimating the Circulation and Climate of the Ocean (ECCO) since 2000 at MIT and now UT Austin; interested in the ocean's role in global climate variability and change, cryosphere-ocean interactions, and sea level science; emerging interests are in formal uncertainty quantification, quantitative observing system design, scientific machine learning, and differentiable programming.

**Education:**

- Ph.D.: Geophysics, Max-Planck-Institute for Meteorology and Uni. Hamburg, Germany, 1998
- M.Sc.: Physics, University of Bonn, Germany, 1993

**Professional Experience:**

**Current Positions:**

2020–present: Professor at UT Austin, tenure in the Department of Geological Sciences; joint appointments at the Oden Institute for Computational Engineering and Sciences (core faculty), the Jackson School of Geosciences, and the Institute for Geophysics

2015–present: W. A. "Tex" Moncrief, Jr., Chair III in Simulation-Based Engineering and Sciences

**Previous Positions:**

2016-2019: Visiting Associate Professor in EAPS, Massachusetts Institute of Technology

2015-2020: Associate Professor at UT Austin, tenure in the Department of Geological Sciences

2013-2019: MIT/WHOI Joint Program Visiting Scientist at Woods Hole Oceanographic Institution (WHOI)

1999-2015: Postdoc (until 2000), Research Scientist (until 2008), Principal Research Scientist (until 2012), Senior Research Scientist (until 2015) in EAPS, Massachusetts Institute of Technology

1993-1998: Research Assistant, Max Planck Institute for Meteorology, Hamburg, Germany

**Selected Professional Activities/Services:**

Since 2020: WCRP Lighthouse Activity team "Explaining and Predicting Earth System Change"

Since 2020: U.S. National Committee for the UN Decade of Ocean Science for Sustainable Development

Since 2020: US CLIVAR Ocean Uncertainty Quantification Working Group

Since 2018: NSF Advisory Committee for Cyberinfrastructure (ACCI)

Since 2017: NSF Advisory Committee for the Office of Polar Programs (AC-OPP)

Since 2017: CLIVAR/CliC Northern Oceans Region Panel (NORP)

Since 2017: Co-founder and co-chair of the Deep Ocean Observing Strategy (DOOS) project (now IOC United Nations Ocean Decade endorsed programme)

Since 2016: National Academy of Sciences' Ocean Studies Board (OSB); since 2019 OSB's liaison to the Board on Atmospheric Sciences and Climate (BASC)

Since 2009: Co-founder & co-organizer of the annual Advanced Climate Dynamics Courses (ACDC)

**Selected Publications (2018 – present):**

Bigdeli, A., A.T. Nguyen, H. Pillar, V. Ocana, and P. Heimbach, 2020: Enhanced Late-season Arctic Sea-ice Growth Following Early-season Atmospheric Warming: A Key Role for Snow. Geophys. Res. Lett., 47(20).

Fukumori, I., P. Heimbach, R.M. Ponte, and C. Wunsch, 2018: A Dynamically-Consistent Ocean Climatology and Its Temporal Variations. Bull. Amer. Met. Soc., 99(10), 2107-2128, doi:10.1175/BAMS-D-17-0213.1

Goldberg, D.N., T.A. Smith, S.H.K. Narayanan, P. Heimbach, and M. Morlighem, 2020: Bathymetric influences on Antarctic ice-shelf melt rates. J. Geophys. Res., 125(11). doi:10.1029/2020JC016370

Goldberg, D.N., K. Snow, P. Holland, J.R. Jordan, J.-M. Campin, P. Heimbach, R. Arthern, and A. Jenkins, 2018: On representing grounding line migration in synchronous coupling between a marine ice sheet model and a z-coordinate ocean model. Ocean Modelling, 125, 45-60, doi:10.1016/j.ocemod.2018.03.005

Heimbach, P., I. Fukumori, C.N. Hill, R.M. Ponte, D. Stammer, et al., 2019: Putting it all together: Adding value to the global ocean and climate observing systems with complete self-consistent ocean state and parameter estimates. Frontiers in Marine Science, 6, 55, doi:10.3389/fmars.2019.00055.

Huang, T., M. DeBellis, I., Fenty, P. Heimbach, J.C. Jacob, O. Wang, and E. Yam, 2019: Analytics Center Framework for Estimating the Circulation and Climate of the Ocean. 2019 IEEE International Geoscience and Remote Sensing Symposium (IGARSS 2019), Yokohama, Japan, doi:10.1109/IGARSS.2019.8897904

Khatiwala S., H. Graven, S. Payne, and P. Heimbach, 2018: Changes to the Air-Sea Flux and Distribution of Radiocarbon in the Ocean Over the 21st Century. Geophys. Res. Lett., 45, doi:10.1029/2018GL078172

Kostov, Y., H. Johnson, D. Marshall, P. Heimbach, G. Forget, P. Holliday, S. Lozier, F. Li, H. Pillar, and T.A. Smith, 2021: Contrasting sources of variability in subtropical and subpolar Atlantic overturning. Nature Geoscience, 14, 491–495, doi: 10.1038/s41561-021-00759-4

Logan, L.C., S.H.K. Narayanan, R. Greve, and P. Heimbach, 2020: SICOPOLIS-AD v1: an open-source adjoint modeling framework for ice sheet simulation enabled by the algorithmic differentiation tool OpenAD. Geosci. Model Dev., 13, 1845-1864, doi:10.5194/gmd-13-1845-2020

Loose, N. and P. Heimbach, 2021: Leveraging Uncertainty Quantification to Design Ocean Climate Observing Systems. J. Adv. Model. Earth Syst., 13(4), e2020MS002386. doi:10.1029/2020MS002386

Loose, N., P. Heimbach, H. Pillar, and K. Nisancioglu, 2020: Quantifying Dynamical Proxy Potential through Shared Adjustment Physics in the North Atlantic. J. Geophys. Res., 125(9), doi: 10.1029/2020JC016112

Moon, T., T. Scambos, W. Abdalati, A. Ahlstrom, R. Bindschadler, J. Gambill, P. Heimbach, R. Hock, K. Langley, I. Miller, and M. Truffer, 2020: Ending a sea of confusion: A scientist perspective on lessons and opportunities in sea level change communication. Environment Magazine, 62(5), 4-15.

Nguyen, A. T., H. Pillar, V. Ocana, A. Bigdeli, T. A. Smith, and P. Heimbach, 2021: The Arctic Subpolar gyre sTate Estimate (ASTE): Description and assessment of a data-constrained, dynamically consistent ocean-sea ice estimate for 2002-2017. J. Adv. Model. Earth Syst., 13(5), e2020MS002398.

Nguyen, A.T., P. Heimbach, V. Garg, V. Ocana , C. Lee, and L. Rainville, 2020: Impact of synthetic Arctic Argo-type floats in a coupled ocean-sea ice state estimation framework. J. Atmos. Ocean Technol., 37(8), 1477-1495, doi:10.1175/JTECH-D-19-0159.1

Nguyen, A.T., R. Woodgate, and P. Heimbach, 2020: Elucidating large-scale atmospheric controls on Bering Strait throughflow variability using a data-constrained ocean model and its adjoint. J. Geophys. Res., 125(9), doi: 10.1029/2020JC016213

Quinn, K.Q., R.M. Ponte, P. Heimbach, I. Fukumori, and J.-M. Campin, 2019: Ocean angular momentum from a recent global state estimate, with assessment of uncertainties. Geophys. J. Int., 216(1), 584-597.

Smith, T. and P. Heimbach, 2019: Atmospheric origins of variability in the South Atlantic meridional overturning circulation. J. Clim., 32(5), 1483-1500, doi:10.1175/JCLI-D-18-0311.1.

Sonnewald, M., C. Wunsch, and P. Heimbach, 2019: Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions. *Earth and Space Science*, 6(5), 784-794, doi:10.1029/2018EA000519

Sonnewald, M., C. Wunsch, and P. Heimbach, 2018: Linear predictability: A sea surface height case study. J. Clim., 31(7), 2599-2611, doi:10.1175/JCLI-D-17-0142.1

Willcox, K., O. Ghattas, and P. Heimbach, 2021: The imperative of physics-based mod- eling and inverse theory in the future of computational science. Nature Computational Science, 1, 166-168.

Zanna, L., S. Khatiwala, J. Gregory, J. Ison, and P. Heimbach, 2019: Estimates and Attribution of Atlantic Ocean Heat Content and Sea Level Change. Proc. Natl. Acad. Sci. USA, 116(4), 1126-1131.