

KIRSTIN E. KOEPNICK

Climate dynamics · Paleoclimate and surface processes · Earth-system modeling · Machine Learning

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EDUCATION

Ph.D. in Applied Mathematics | Harvard University, Cambridge, MA 2021–Expected May 2027

Dissertation: “Climate reorganizations across spatial and temporal timescales using hierarchical climate modeling”

Committee: Dr. Eli Tziperman, Dr. Peter Huybers, Dr. Zhiming Kuang

Advisor: Dr. Eli Tziperman

M.A. in Applied Mathematics | Harvard University, Cambridge, MA 2024

B.A. | Bates College, Lewiston, ME 2017–2021

Physics & Astronomy; Mathematics

Advisors: Dr. Jeffrey Oishi & Dr. Peter Wong

Advanced Climate Dynamics Courses | Abisko, Sweden Summer 2025

Advanced Course | The Abdus Salam International Centre for Theoretical Physics, Trieste, Italy Summer 2022

RESEARCH EXPERIENCE

Doctoral Researcher | Harvard University 2021–present

Advisor: Dr. Eli Tziperman

Investigate nonlinear and state-dependent climate responses across modern and past climates using comprehensive and idealized Earth-system models, machine learning, and targeted numerical experiments. Projects examine glacial-cycle timing, ice-sheet-climate feedbacks, and interactions among ENSO, the QBO, and Southern Hemisphere circulation.

Undergraduate Honors Thesis Researcher—Physics & Astronomy | Bates College 2019–2021

Advisor: Dr. Jeffrey Oishi

Investigated the minimal requirements for topologically protected waves.

Undergraduate Honors Thesis Researcher—Mathematics | Bates College 2019–2021

Advisor: Dr. Peter Wong

Explored fluid stirring on a sphere using braid groups and topological entropy.

Undergraduate Researcher (DOE SULI) | Princeton Plasma Physics Laboratory Summer 2020

Advisor: Dr. Chris Smiet

Investigated knotted stellarator fields using hypersphere coordinates.

Undergraduate Researcher | Bates College Environmental Studies Summer 2019

Advisor: Dr. Francis Eanes

Analyzed municipal costs associated with proposed development ordinances in agricultural zones in Auburn, Maine.

PUBLICATIONS & MANUSCRIPTS

Peer-reviewed publication

Koepnick, K. and Tziperman, E. “Distinguishing between insolation-driven and phase-locked 100-kyr ice-age scenarios using example models.” *Paleoceanography and Paleoclimatology* 39, e2023PA004739 (2024).

Manuscripts under review

Posternack, M. and **Koepnick, K.** “Beyond a Single Southern Annular Mode Pattern: Identifying Southern Hemisphere Circulation Classes with a Convolutional Autoencoder.” In revision, *Machine Learning and Computation*.

Koepnick, K., Harnik, N., Randall, M., and Tziperman, E. “*The seasonality of QBO peaks and ENSO–QBO interaction.*” In revision, Geophysical Research Letters.

Koepnick, K., Fu, M., and Tziperman, E. “*Comparing the surface mass balance of the Laurentide Ice Sheet during the last deglaciation with geophysical reconstructions.*” In revision, Paleoceanography and Paleoclimatology.

Manuscripts in preparation

Koepnick, K., Zhu, J., Fu, M., and Tziperman, E. “*Melt-season preconditioning controls Laurentide surface mass balance sensitivity.*” In preparation.

Koepnick, K., Harnik, N., Randall, M., and Tziperman, E. “*Can ENSO–QBO correlations arise mechanistically?*” In preparation.

UNDERGRADUATE RESEARCH MENTORING

Advisor, Undergraduate Independent Research Project 2025–present

Supervise an undergraduate-led project using a convolutional autoencoder and hierarchical clustering to identify regimes and transition states of the Southern Annular Mode; resulting manuscript is in revision.

Advisor, SPHEER REU Program | Harvard University Earth and Planetary Sciences Summer 2026

Supervise two undergraduate students investigating the Southern Annular Mode trends and Antarctic sea-ice variability; guided project design, computational analysis, interpretation, and scientific presentation.

TEACHING EXPERIENCE

Graduate Teaching Fellow | Harvard University 2023–present

EPS Course Development: Emulators & Climate Spring 2027

A new course on emulators to understand climate phenomena responsibilities include guest lecturing, assessment, office hours, and advising student presentations.

Introduction to Physical Oceanography Spring 2026

Guest lectured, graded assignments, held office hours, and advised student presentations.

Linear Algebra & Big Data Spring 2025

Guest lectured, graded assignments, held office hours, and organized undergraduate teaching assistants.

Paleoclimate as a Proxy Fall 2024

Helped develop and grade assignments, held office hours, and advised final projects.

Global Warming Science Spring 2023

Held office hours, guest lectured, and graded assignments.

Undergraduate Teaching Assistant | Bates College 2019–2021

Introduction to Abstraction Fall 2020

Held office hours and supported in-class work.

Linear Algebra Spring 2019–Spring 2021

Held regular office hours.

Multivariable Calculus Fall 2019–Spring 2021

Held office hours, supported in-class work, and graded assignments.

Grader | Bates College 2019–2020

Introduction to Quantum Mechanic and Abstract Algebra

General Tutor | Bates College Mathematics and Statistics Workshop 2018–2021

Tutored calculus at all levels, linear algebra, and differential equations.

AWARDS & FELLOWSHIPS

Herbert S. Winokur SEAS Graduate Fellowship | Harvard University 2021–2022

Endowed fellowship in Engineering and Applied Sciences.

DOE Science Undergraduate Laboratory Internship | Princeton Plasma Physics Laboratory Summer 2020

CONFERENCE PRESENTATIONS

Koepnick, K., Harnik, N., Randall, D., and Tziperman, E. *The seasonality of QBO peaks and ENSO–QBO interaction*. European Geosciences Union General Assembly, May 2026. **Oral presentation.**

Koepnick, K., Harnik, N., Randall, D., and Tziperman, E. *The seasonality of the timing of peak QBO events*. 25th Conference on Atmospheric and Oceanic Fluid Dynamics, Jan. 2026. **Oral presentation.**

Koepnick, K., Harnik, N., Randall, D., and Tziperman, E. *ENSO–QBO correlations: A robust dynamical coupling or a coincidence due to the short record?* American Geophysical Union Fall Meeting, Dec. 2025. **Poster presentation.**

Koepnick, K., Zhu, J., Fu, M., and Tziperman, E. *What are the climate factors that determined when the Laurentide Ice Sheet grew or retreated?* American Geophysical Union Fall Meeting, Dec. 2025. **Oral presentation.**

Koepnick, K., Fu, M., and Tziperman, E. *Investigating the surface mass balance of the Laurentide Ice Sheet during the last deglaciation*. American Geophysical Union Fall Meeting, Dec. 2024. **Oral presentation.**

Koepnick, K. and Tziperman, E. *Are the Pleistocene 100-kyr ice ages driven or phase-locked by Milankovitch forcing?* American Geophysical Union Fall Meeting, Dec. 2023. **Poster presentation.**

Koepnick, K. and Tziperman, E. *Examining alternative scenarios of nonlinear glacial-cycle dynamics*. American Geophysical Union Fall Meeting, Dec. 2022. **Poster presentation.**

Koepnick, K. and Tziperman, E. *Examining alternative scenarios of nonlinear glacial-cycle dynamics*. 23rd Conference on Atmospheric and Oceanic Fluid Dynamics, June 2022. **Poster presentation.**

TECHINICAL SKILLS & LANGUAGES

Scientific computing & communication: Python, MATLAB, Fortran, Mathematica, Jupyter, LaTeX

Climate Modeling: CESM1, CESM2, CESM2-WACCM, CAM, CLM; comprehensive, slab-ocean, paleo-ice-sheet configurations, and idealized configurations

Data and Computing: NetCDF, xarray, NCO, Git, Linux, shell scripting, HPC workflows

Machine learning: PyTorch, convolutional autoencoders, clustering, encoders, interpretable machine learning

Languages: English (native); German (intermediate); French (basic)

REFERENCES

Eli Tziperman

Harvard University

Pamela & Vasco McCoy Jr. Prof. of Oceanography & Applied Physics
eli@eps.harvard.edu | 617.384.8381

Peter Huybers

Harvard University

Prof. of Earth and Planetary Sciences; Department Chair
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David Randall

Colorado State University

University Distinguished Prof., Dept. of Atmospheric Science
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Minmin Fu

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