Maike Sonnewald, Ph.D.

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Research Focus

My research develops AI methods to understand ocean circulation and marine ecosystems, translating fundamental discoveries into tools for climate prediction, fisheries management, and policy decisions. My work has influenced national AI strategy, international marine legislation, and modeling systems used globally.

Current position

2023–present	Assistant Professor at **University of California, Davis**
2022–present	Affiliate Assistant Professor at **University of Washington**
2020–present	Affiliate Researcher at **NOAA Geophysical Fluid Dynamics Laboratory**
2022–present	Associate Editor: American Meteorological Society (AMS) **AI for the Earth Systems**
2024–present	Editorial Board: Institute of Physics (IOP) **Machine Learning: Earth**

Policy and Societal Impact

2025	Consulted Louisville Metro Government (Kentucky) in strategic plan for AI rollout
2021	Featured in **NOAA's artificial intelligence strategic plan 2021-2025**, a response to the President's Executive Order on Maintaining American Leadership in AI. View document
2021	Research methods adopted by **IPCC climate modeling centers** (NOAA-GFDL, IPSL) contributing to global climate assessments used by 195+ countries
2021	Citation by the **World Meteorological Organization (WMO)** of the UN in concept note on AI applications in environmental modeling. More information
2020	Research contributed to scientific basis for **New Zealand's Marine Protected Area legislation**
2020	Cited in **European Union** policy recommendation: "Artificial intelligence and the fisheries sector". More information

Selected Recognition and Awards

2024	Expert Committee for US Computational System for Frontier Climate Simulation summit
2023	Certificate of recognition from the **California State Assembly**
2023	**UC Davis Faculty Scholar of the Center for the Advancement of Multicultural Perspectives on Science (CAMPOS)**
2021	Spotlight paper at the International Conference on Machine Learning (ICML)
2021	Core member in Kavli Institute for Theoretical Physics (KITP) "ML in the Physics of Climate"
2019	Simons Foundation visualization competition winner
2017	**Kaufman Teaching Certificate Program (KTCP)** awarded from MIT
2011	Engineering and Physical Sciences Research Council graduate fellowship (UK)

Education

2011-2016	**University of Southampton**, UK. Ph.D. Complex Systems Simulation through the National Oceanography Center Dissertation: Ocean model utility dependence on horizontal resolution Advisors: George Nurser, Joel J.-M. Hirschi, James Dyke
2006-2011	**University of Southampton**, UK. M. Sci. *magna cum laude*, complex systems simulation, 2011 M. Sci. *magna cum laude*, physical oceanography, 2010

Professional history

2020–2023	Associate Research Scholar at **Princeton University**
2016–2020	Postdoctoral Associate at **Massachusetts Institute of Technology**

Other positions

2023	Visiting Professor at **Université Catholique de Louvain, Belgium**
2019–2022	Visiting Scientist at **University of Washington**
2017–2019	Visiting Scientist at **Harvard University**
2018–2019	Visiting Scientist at **Université Grenoble Alpes, France**
2016–2018	Visiting Scientist at **University of Texas at Austin**

Selected grants ($3.0M+ total)

2025	**$7500** – PI: "Building Resilient Fisheries Under Climate Change". UC Davis Global Affairs Advancing Sustainable Development Goals.
2024	**$1,148,868** – PI: "AI for Ocean of Mixed Layer Heat Variability". NSF.
2023	**$578,000** – PI: "Improving sea level predictions with ocean insight and machine learning". NOAA.
2023	**$1,290,757** – Co-I: "Bridging theory and reality of the monsoons". National Environmental Research Council (UK).
2021-2020	**$79,127** – Co-I: Amazon Sustainability Data Initiative (ASDI)

Review articles (total: 4)

[1] Lai C.-Y., Hassanzadeh, P., Sheshadri, A., **Sonnewald, M.**, Ferrari, R., Balaji, V. *Machine learning for climate physics and simulations*, in press, *Annual Reviews of Condensed Matter Physics.*

[2] Bronner, U., **Sonnewald, M.** and Visbeck, M., *Marine modeling as the key to sustainable use and protection of the marine environment*, invited, 2023, The International Hydrographic Review.

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

[4] Irrgang, C., Boers, N., **Sonnewald, M.**, Elizabeth A. Barnes, Christopher Kadow, Staneva, J., and Saynisch-Wagner, J. *Towards neural Earth system modeling by integrating artificial intelligence in Earth system science*, 2021, Nature Machine Intelligence.

Peer reviewed publications (total: 16, '*' indicates student/postdoc advised)

[5] Jenniges, Y.*, **Sonnewald, M.**, Maneth, S., Olsen, A. and Koch, B.P., *Unveiling 3D Ocean Biogeochemical Provinces in the North Atlantic: A Systematic Comparison and Validation of Clustering Methods*. 2025, Ecological Informatics.

[6] Khatri, H., Griffies, S.M., Storer, B.A., Buzzicotti, M., Aluie, H., **Sonnewald, M.**, Dussin, R. and Shao, A., *A scale-dependent analysis of the barotropic vorticity budget in a global ocean simulation*. 2024, *Journal of Advances in Modeling Earth Systems*.

[7] Yik, W.*, **Sonnewald, M.**, Clare, M.*, Lguensat, R. *Southern Ocean Dynamics Under Climate Change: New Knowledge Through Physics-Guided Machine Learning*. 2023, *Conference on Neural Information Processing Systems (NeurIPS) Climate Change AI workshop*.

[8] **Sonnewald, M.**, Reeve, K., Lguensat, R. *A supergyre modulates the global overturning through upwelling in the Southern Ocean*. 2023, *Nature Commun. Earth Environ.*

[9] Jones, D., **Sonnewald, M.**, Rosso, I., Zhou, S., and Boehme, L., *Unsupervised classification identifies coherent thermohaline structures in the Weddell Gyre*. 2023, *Ocean Science*.

[10] Clare, M.*, **Sonnewald, M.**, Lguensat, R., Deshayes, J. and Balaji, V., *Explainable Artificial Intelligence for Bayesian Neural Networks: Towards trustworthy predictions of ocean dynamics*. 2022, **Journal of Advances in Modeling Earth Systems**.

[11] Kaiser, B., Saenz, J.A., **Sonnewald, M.** and Livescu, D., *Automated identification of dominant physical processes*, 2022, **Engineering Applications of Artificial Intelligence**.

[12] J. Krasting, M. De Palma, J. Dunne, J. John, and **Sonnewald, M.**, *Regional Sensitivity Patterns of Arctic Ocean Acidification Revealed With Machine Learning*, 2022, Nature Commun. Earth Environ.

[13] **Sonnewald, M.**, and Lguensat, R. *Revealing the impact of global warming on climate modes using transparent machine learning*, 2021, **Journal of Advances in Modeling Earth Systems**.

[14] **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*, 2021, **International Conference on Machine Learning: Spotlight paper at ClimateChangeAI Workshop**.

[15] **Sonnewald, M.**, Dutkiewicz, S., Hill, C. and Forget, G. *Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces*, 2020, **Science Advances**.

[16] Le Bras, I., **Sonnewald, M.**, and Toole, J.M. *A bulk Potential Vorticity budget for the western North Atlantic based on observations*, 2019, **Journal of Physical Oceanography**.

[17] **Sonnewald, M.**, Wunsch, C. and Heimbach, P. *Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions*, 2019, **Journal of Earth and Space Science** edition "Geoscience paper of the future".

[18] **Sonnewald, M.**, Wunsch, C. and Heimbach, P. *Linear Predictability: A Sea Surface Height Case Study*, 2018, **Journal of Climate**.

[19] Bulczak, A.I., Bacon, S., Naveira Garabato, A.C., Ridout, A., **Sonnewald, M.**, and Laxon, S.W. *Seasonal Variability of Sea Surface Height in the Coastal Waters and Deep Basins of the Nordic Seas*, 2014, **Geophysical Research Letters**.

[20] **Sonnewald, 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*, 2013, **Ocean Science**.

Preprints (total: 10, '*' indicates student/postdoc advised)

[21] Rosenfeld K., **Sonnewald M.** et al., *Building Understandable Messaging for Policy and Evidence Review (BUMPER) with AI*. In review. Preprint.

[22] Kaiser, B., Wu, T., **Sonnewald, M.**, Thackray, C., Callis, T. *A Moonshot for AI Oracles in the Sciences*. In review. Preprint.

[23] Dräger S.*, **Sonnewald M.** *The Importance of Architecture Choice in Deep Learning for Climate Applications*. Preprint..

[24] **Sonnewald M.** *A hierarchical ensemble manifold methodology for new knowledge on spatial data: An application to ocean physics*. In review. Preprint.

[25] Griffies, S.M., ... **Sonnewald M.**.. *The GFDL-CM4X climate model hierarchy, Part I: model description and thermal properties*. In review. Preprint.

[26] Griffies, S.M., ... **Sonnewald M.**.. *The GFDL-CM4X climate model hierarchy, Part II: case studies*. In review. Preprint.

[27] Navarra, G.G.*, Deutsch, C., Clare, M.*, **Sonnewald, M.** *Predicting Southern Ocean Dissolved Oxygen: Bayesian vs. Deterministic Approach to Forecasting*. In review.

[28] Wang, J.*, **Sonnewald, M.**, Pirlet, N., Massonnet, F., Goosse, H., Chen, D., Yang, Q, *Identification of Antarctic sea ice regimes using objective data mining*, Nature Communications. In review.

[29] Suri, S.*, and **Sonnewald, M.** *Machine Learning at the Tipping Point: Validation of Physical Dependencies in Atlantic Circulation,* AI for Earth Systems. In review.

[30] McDevitt, M.*, and **Sonnewald., M.** *Ingerring planktonic ecosystems from space: Lessons gained from AI,* Science Advances. In review.

Selected invited talks (87 total, policy-facing venues highlighted)

Policy-facing	**US CLIVAR** (UN World Climate Research Program), **NOAA Senior Management**, **DOE** workshop keynote, **California Ocean Science Trust**, **AMS Washington Forum**, **United Nations** International Telecommunication Union
2024-2025	AMS Annual Meeting, UC San Diego, Dynamics Days, ELLIS Summer School keynote
2023	University of Toronto Nobel Seminar, University of Miami, UC Davis, Sorbonne University
2022	MIT (EAPS & Mech. Eng.), UC Berkeley, Max Planck Institute, Cambridge University
2021	AGU, Climate Change AI (2500+ views), KITP, UC Santa Cruz, GEOMAR Helmholtz
2020	Los Alamos National Laboratory, University of Washington, University of British Columbia

Teaching and advising

Postdoc advising

2025–present	Sanah Suri, UC Davis
2025–present	Laique Merlin Djuetchang, UC Davis.
2023–present	Arijeet Dutta, with U. Birmingham.

Graduate advising

2025–present	Kieran Ringel, UC Davis
2025–present	Lumina Kinsinger-Dang, UC Davis
2025–present	Jake Tallman, UC Davis
2024–present	Makayla Mcdevit, UC Davis
2023–present	Lily Walker, Okinawa Institute for Science and Technology (JP)
2021–present	Yvonne Jenniges, Alfred Wegener Institute (DE)
2023–2025	Jinfei Wang, Université Catholique de Louvain (BE) Subsequently postdoc at Université Catholique de Louvain (BE).
2024–2025	Avery Wood, UC Davis. M.Sci.
2024–2025	Sanah Suri, Washington University in St. Louis Subsequently postdoc at UC Davis.
2023	Simon Draeger, UC Davis
2021	Mariana Clare, Imperial College London, National Centre for Scientific Research (CNRS, Fr), Subsequently researcher at European Center for Medium-Range Weather Forecasting.
2021–2022	Giangiacomo Navarra, Georgia Tech Subsequently postdoc at Princeton.
2021–2025	Jacob Cohen, University of Washington

Undergraduate advising

2025–present	Tianyang Dou, Wuhan Univeristy (CN)
2024–2025	Jasper Dong, UC Davis. Subsequently MSci program at Univeristy of Washington.
2023–2024	William Yik, Harvey-Mudd, Holling Scholar (NOAA). Subsequently, Ph.D. program at University of Washington with a Department of Energy Fellowship.
2021	Zouberou Sayibou, Bronx Community College. Subsequently, transfer to Stanford.

Instructor of record

2024	**UC Davis ECS171**: "Introduction to Machine Learning", undergraduate. *Participants: 150, developed material, taught.*
2023	**UC Davis ECS199**: "Special Study for Advanced Undergraduates", undergraduate. *Participants: 1, developed material, taught.*
2023	**European Centre for Medium-Range Weather Forecasts (ECMWF) Massive Open Online Course**: "Machine Learning in Weather and Climate". Registered: over 9000, developed material, taught.
2021	**Princeton University AOS 551**: "Deep learning in geophysical fluid dynamics". Graduate level. Participants: 10, developed material, taught.

Service

Selected program committee, conference, workshop, and seminar organization since 2020

Conveening	**Ocean Science Meeting** (2026, 2024), **American Geophysical Union** (2024, 2023, 2022, 2020 (2), 2019), **European Geosciences Union** (2023, 2022, 2021, 2020).
Program Committee	**Platform for Advanced Scientific Computing** (2024), **NeurIPS** Climate Change AI workshop (2021).
2024-2025	Research colloquia **UC Davis CAMPOS**.
2021	Research colloquia **NOAA GFDL seminar series**.
2020	Workshop **NOAA** on Leveraging AI in Environmental Sciences

Selected diversity, equity, and inclusion activities

2025	**Organizing**: Mentoring lunch for "Hidden Figures in Computer Science".
2024	**UC Davis Women's Day features**: International Women's Day spotlights in Engineering and Computer Science.
2021-2023	**POD member, Unlearning racism in Geoscience (URGE)**. Program to develop anti-racist policies at Princeton University.
2020	**Speaker**: **Bronx Community College** STEM Advisory Board efforts to encourage underrepresented students.

Selected public engagement

2024	**The Guardian**: Interviewed for "Atmospheric river storms are getting stronger".
2024	**Exploratorium museum San Francisco**: "Open Question: Extreme Environments" talk series.
2023	**Podcast**: AGU "Third pod from the sun" - "Solving for climate: Coasts in the machine".