# Maike Sonnewald, Ph.D.

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## Current position

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|---|---|
| 7/2023–present | Assistant Professor: **University of California Davis, CA** |
| 7/2023–present | Visiting Scholar: **Princeton University, NJ** |
| 1/2022–present | Affiliate Assistant Professor:**University of Washington, WA** |
| 2/2020–present | Affiliate Researcher: **NOAA Geophysical Fluid Dynamics Laboratory (GFDL), NJ** |
| 8/2022–present | Associate Editor: Journal of Artificial Intelligence for the Earth Systems [1] |

## Education

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

## Academic positions

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| 11/2023 | Visiting Professor: **UC Lovaine, Bel.** |
| 2/2020–6/2023 | Associate Research Scholar: **Princeton University, NJ** |
| 2/2019–1/2022 | Visiting Scientist: **University of Washington** |
| 10/2015–2/2020 | Postdoctoral Associate: **Massachusetts Institute of Technology**. Advisor.: C. Wunsch, P. Heimbach & S. Dutkiewicz |
| 2/2017–10/2019 | Visiting Scientist: **Harvard University** |
| 12/2018–1/2019 | Visiting Scientist: **Grenoble Les Alpes, Fr.** |
| 2016& 2017-2018 | Visiting Scientist: **University of Texas at Austin** |

## Review articles (total: 3)

[1] Bronner, U., **Sonnewald, M.** and Wisbeck, M., *Marine modelling as the key to sustainable use and protection of the marine environment.* Invited, 2023, **The International Hydrographic Review**.

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

[2] 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*, 2021, **Nature Machine Intelligence**. Featured on: Carbonbrief, Helmholtz Association of German Research Centers press release, Physics.org, engtgtalks and Newsbreak.

## Peer reviewed publications (total: 13)[2]

**'*' indicates student advised and press coverage in blue**

[4] Yik, W.*, **Sonnewald, M.**, Clare, M.*, Lguensat, R. *Southern Ocean Dynamics Under Climate Change: New Knowledge Through Physics-Guided Machine Learning.* 2023, **NeurIPS Climate Change AI workshop**.

[2] Manuscripts in preparation and in revision available at co-authors' discretion.

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

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

[7] 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**.

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

[9] 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.** `https://doi.org/10.1038/s43247-022-00419-4`.

[10] **Sonnewald, M.**, and Lguensat, R. *Revealing the impact of global heating on North Atlantic circulation using transparent machine learning*, 2021, **Journal of Advances in Modeling Earth Systems**. Available: `https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2021MS002496`. Featured on cover, and separately in the "Machine Learning Application to Earth System Modeling" edition.

[11] **Sonnewald, M.**, and Lguensat, R. , Radhakrishnan, A., Sayibou, Z.*, Wittenberg, A.T. and Balaji, V. *Revealing the impact of global warming on climate modes using transparent machine learning and a suite of climate models*, 2021, **International Conference on Machine Learning: Spotlight paper at ClimateChangeAI Workshop**. Available: `https://www.climatechange.ai/papers/icml2021/13`

[12] **Sonnewald, M.**, Dutkiewicz, S., Hill, C. and Forget, G. *Elucidating Ecological Complexity: Unsupervised Learning determines global marine eco-provinces*, 2020, **Science Advances**. DOI: 10.1126/sciadv.aay4740. Featured on: EOS science news by AGU, MIT News, Hakai Magazine, ECCO story map, The Batch, SciTechDaily, Yahoo! Finance, Dailyhunt, Firstpost and Scienceblog.

[13] 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**. DOI: 10.1175/JPO-D-19-0111.1.

[14] **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". 6. `https://doi.org/10.1029/2018EA000519`. Featured on: MIT News, Artificial Intelligence Research, Physics.org and ECN magazine.

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

[16] 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**, 42, `DOI:10.1002/2014GL061796`.

[17] **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**, 9, (6), 1057-1069. `DOI:10.5194/os-9-1057-2013`.

[18] In review: **Sonnewald, M.**, *A hierarchical ensemble manifold methodology for new knowledge: An application to ocean physics*, in review, **JAMES.**

[19] In review: Navarra, G.G*, **Sonnewald, M.**, Deng, Y., Liguori, G. and Di Lorenzo, E. *Using Deep Learning to forecast marine fishery indicators in the North Pacific.* In review **Nature Communications Biology**.

[20] In review: 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 vorticity1budget in a global ocean simulation.* JAMES.

[21] In review: Kaiser, B. and **Sonnewald, M.** *Build AI with scientific definitions of interpretability and explainability.* In review. **Nature Machine Intelligence.**

### Other publications (total: 3)

[22] **The ECCO Consortium**. *A Twenty-Year Dynamical Oceanic Climatology: 1994-2013. Part 1: Active Scalar Fields*, 2017, **MIT DSpace**: `https://dspace.mit.edu/handle/1721.1/107613`.

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

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

## Selected awards and honours

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| 2023 | **Honour:** Elected a UC Davis Faculty Scholar of the Center for the Advancement of Multicultural Perspectives on Science (CAMPOS). |
| 2023 | **Honour:** Received certificate of recognition from **California State Assembly.** |
| 2023 | **Policy impact:** US CLIVAR by World Climate Research Program by **UNESCO and the International Science Council**, invited talk. |
| 2023 | **Grant:** Improving coastal sea level predictions with ocean process insight guided by machine learning. To NOAA Climate Program Office. PI. $578,000 |
| 2023 | **Podcast feature:** AGU "Third pod from the sun" and "Carry the two" collaboration. |
| 2023 | **Grant:** *Bridging theory to reality in projections of the Asian and West African monsoons (BRIDGE)*. National Environmental Research Council (UK). Co-I. **£958,000**. |
| 2022 | **Policy impact:** US CLIVAR World Climate Research Program by **UNESCO and the International Science Council**, invited panel speaker. |
| 2021 | **Core member:** University of California, Santa Barbara, **Kavli Institute for Theoretical Physics (KITP)**, "ML in the Physics of Climate". |
| 2021 | **Policy impact:** Dept of Energy AI workshop 'Ocean Grand Challenges' keynote. |
| 2021 | Grant: French National Centre for Scientific Research (CNRS) laboratory collaboration, £2000. |
| 2021 | **Policy impact: NOAA artificial intelligence strategy 2021-2025**. Agency wide recommendations. |
| 2020-2021 | **Grant:** Amazon Sustainability Data Initiative (ASDI), $31,032. |
| 2020 | **Grant:** ASDI, $48,595 |
| 2020 | **Policy impact: Work contributed to science basis for New Zealand's Marine Protected Area legislation.** |
| 2017 | **Award:** Kaufman Teaching Certificate Program (KTCP), MIT. |
| 2016 | Physical Oceanography Dissertation Symposium grant, University of Hawaii at Manoa, USA. $1500. |
| 2010 | **Graduate Scholarship:** Engineering and Physical Sciences Research Council (ESPRC, UK). |

## Scientific cruises

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| 2016 | NORSEMAN II, Bering Strait mooring recovery and high resolution synoptic survey including Chukchi Sea. |

## Invited conference panels

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| 2021 | **Incorporating Data Science and Open Science in Aquatic Research Summit**. 624 participants. |
| 2020 | **AGU**, *Challenges and opportunities of applying AI, ML and DL to problems in the environmental and geosciences.* ∼1200+ participants. |
| 2020 | **NOAA Workshop**, *Leveraging AI in the Environmental Sciences.* 60+ participants. |

## Selected keynotes and invited talks (total: 63)

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| 2023 | total: 17 |
| - | **CLIVAR** Predictability, Predictions, and Applications Interface Panel. |
| - | **United Nations** International Telecommunication Union. |
| - | **University of Toronto** Nobel Seminar Series. |
| 2022 | total: 14 |
| - | **CLIVAR** Physical Oceanography review panel. |
| - | **NOAA GFDL HQ site review**. |
| Others | **Climate Informatics**, **University of Liege**, textbfSIAM, **U. Cambridge**, **UC Davis**, **SIAM DS**, **U. Wisconsin-Madison**, **Max Planck Institute for Meteorology**, **UC Berkeley**, **MIT for EAPS and Mechanical Engineering**, **U. Rhode Island** (Nov.), **IMSI, U. Chicago**. |
| 2021 | Talks total: 14 |
| - | **AGU**. |
| - | **Dept of Energy** AI workshop. |
| - | **Climate Change AI**. |
| - | **NOAA**, AI workshop. |
| Others | **KITP**, **Scripps Institute of Oceanography**, **U. Washington**, **U. Chicago**, **International Conference on Machine Learning**, **Summit: Incorporating Data Science and Open Science in Aquatic Research**, **University Corporation for Atmospheric Research (UCAR)**, **U. California, Santa Cruz**, **GEOMAR Helmholtz Centre for Ocean Research**, **Technical U. Munich**, **Potsdam Institute for Climate Impact**. |
| 2020 | Talks total: 7 |
| - | **NOAA Senior Management Meeting, Oceanic and Atmospheric Research**. |
| Others | **Los Alamos National Laboratory**, **U. Washington** (engineering), **U. Washington** (phys. oceanography), **U. British Columbia**, **NOAA**, workshop, **U. Washington** (bio. oceanography). |
| 2019 | Talks total: 7 |
| - | **AGU**. |
| - | **Norway-US bilateral AI workshop**. Two talks. |
| Others | **Princeton University**, **WHOI**, **U. Tromsø**, **U. Bergen**. |
| 2012-2018 | Total talks: 17 |
| - | **WHOI**. |
| - | **Columbia University, LDEO**. |
| - | **Yale University**. |
| Others | **MIT** (2018 & 2015), **Stony Brook University**, **U. Texas at Austin**, **U. Washington**, **Oregon State University**, **U. Oxford**, **MIT** (Two invited student talks), **U. Bristol**, **NOCS** (2015, 2014 & 2013) and **MONCACO meeting**. |

### Mentoring and advising

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| 2023- | **Advising:** Simon Draeger, UC Davis, Graduate. |
| 2023- | **Committee:** Lin Yao, UC Davis, Graduate. |
| 2023- | **Advising:** William Yik, Harvey-Mud, Holling Scholar (NOAA). Undergraduate. |
| 2021- | **Committee:** Jacob Cohen, University of Washington. Ph.D. student. |
| 2021- | **Committee:** Yvonne Jenniges, Alfred Wegener Institute (DE), Ph.D. student. |
| 2021 | **Advising:** Mariana Clare, Imperial College London, National Centre for Scientific Research (CNRS, Fr), Ph.D. student, now researcher at European Center for Medium Range Weather Forecasting. |
| 2021-2022 | **Advising:** Giangiacomo Navarra, Georgia Tech. Ph.D. student, now postdoc at Princeton. |
| 2021 | **Advising:** Zouberou Sayibou, Bronx Community College, undergraduate, now Junior at Stanford. |
| 2019- | **Mentoring:** Catherine Wilka, now postdoc at Stanford. |

## Service

### Review duties

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| Journals | Nature, JAMES, Geophysical Research Letters, Ocean Modelling, Journal of Geophysical Research, Journal of Physical Oceanography, Data Science and others. |
| Review Panel | **NASA review panel 2017** |