Maike Sonnewald, Ph.D.

Computer Science Department
University of California, Davis
One Shields Avenue, Davis, CA 95616

sonnewald@ucdavis.edu
Personal: `msonnewald.com`
Group: `compclimate.com`
+1 413-406-9121

Current position

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 by the American Meteorological Society

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

Academic positions

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 since 2019 (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**.

- DOI: `https://doi.org/10.58440/ihr-29-a04`

[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**.

- Impact factor: 6.9, DOI: `https://doi.org/10.58440/ihr-29-a04`

- **Citation by World Meteorological Organization (WMO)**. Available: `https://library.wmo.int/idurl/4/66272`

[3] 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**.

- Impact factor: 25.9, DOI: `https://doi.org/10.1038/s42256-021-00374-3`

- Coverage by five news outlets

Peer reviewed publications since 2019 (total: 11)

[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**.

- Impact factor: 23.27, DOI: `https://doi.org/10.48550/arXiv.2310.13916`

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

- Impact factor: 7.9, DOI: `https://doi.org/10.1038/s43247-023-00793-7`

[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**.

- Impact factor: 4.3, DOI: `https://doi.org/10.5194/egusphere-2022-1484`

[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**.

- Impact factor: 8.5, DOI: `https://doi.org/10.1029/2022MS003162`

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

- Impact factor: 7.8, DOI: `https://doi.org/10.1016/j.engappai.2022.105496`

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

- Impact factor: 7.9, DOI: `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**.

- Impact factor: 8.5, DOI: `https://doi.org/10.1029/2021MS002496`
- Cover Feature and in "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: Climate Change AI**.

- Impact factor: Available: `https://www.climatechange.ai/papers/icml2021/13`
- Workshop Spotlight.

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

- Impact factor: 13.1, DOI: `https://doi.org/10.1126/sciadv.aay4740`
- Data in science basis for **New Zealand's Marine Protected Area legislation**
- **Cited in European Union** policy recommendation publication: Directorate-General for Internal Policies of the Union report on Artificial intelligence and the fisheries sector. Available: `https://op.europa.eu/en/publication-detail/-/publication/3f1ca47c-ede8-11ec-a534-01aa75ed71a1`
- Coverage by seven news outlets

[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**.

- Impact factor: 3.5, DOI: `https://doi.org/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**.

- Impact factor: 3.7, DOI: `https://doi.org/10.1029/2018EA000519`
- [Feature in NOAA AI Strategy, an action in response to the President's Executive Order on Maintaining American Leadership in AI](). Available: `https://sciencecouncil.noaa.gov/wp-content/uploads/2022/08/Artificial-Intelligence-Strategic-Plan_Final-Signed.pdf`
- In "Geoscience paper of the future" edition
- Coverage by four news outlets

[15] **Sonnewald, M.**, C. Wunsch, and P. Heimbach, *Linear Predictability: A Sea Surface Height Case Study*, 2018, **Journal of Climate**, 31, 2599–2611,

- Impact factor: 5.4, DOI: `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.

- Impact factor: 5.6, DOI: `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.

- Impact factor: 4.3, `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`

Honours and impact

2024	**Honour:** Invited talk to UC Davis College of Engineering Executive Committee.
2023	**Honour:** Elected 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:** Invited talk for US CLIVAR by the World Climate Research Program under **United Nations** auspices. Panel: Predictability, Predictions, and Applications Interface.
2023	**Podcast feature:** AGU "Third pod from the sun" and "Carry the two".
2022	**Policy impact:** Invited talk for US CLIVAR by the World Climate Research Program under **United Nations** auspices. Panel: Physical Oceanography.
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	**Policy impact: NOAA artificial intelligence strategy 2021-2025**, a response to the President's Executive Order on Maintaining American Leadership in AI.
2020	**Policy impact: Work contributed to science basis for New Zealand's Marine Protected Area legislation.**

Grants

2023	**Grant:** Improving coastal sea level predictions with ocean process insight guided by machine learning. To NOAA Climate Program Office. PI. $578,000
2023	**Grant:** *Bridging theory to reality in projections of the Asian and West African monsoons (BRIDGE).* National Environmental Research Council (UK). Unfunded Co-I. £958,000.
2021	**Grant:** French National Centre for Scientific Research (CNRS) laboratory collaboration, £2000.
2020-2021	**Grant:** Amazon Sustainability Data Initiative (ASDI), $31,032.
2020	**Grant:** ASDI, $48,595

Invited conference panels

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: 78)

<u>2024</u> May:	<u>total: 1, upcoming 3</u> **SIO**
-	**Deans Executive Committee**
-	**OSM** A Southern Ocean supergyre as a unifying dynamical framework.
-	**Dynamics Days** Equations as emergent phenomena determined using machine learning: An ocean case study.
<u>2023</u>	<u>total: 17</u>
-	**CLIVAR** Predictability, Predictions, and Applications Interface Panel.
-	**United Nations** International Telecommunication Union.
-	**University of Toronto** Nobel Seminar Series.
<u>2022</u>	<u>total: 14</u>
-	**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**.
<u>2021</u>	<u>Talks total: 14</u>
-	**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**.

Selected conference contributions (13 posters and 23 talks) [1]

2023	Contributions total: 2
-	**EGU**,**Talk**.
-	**AGU**,**Poster**.
2021	Contributions total: 5
-	**AGU**, Elucidating ecological complexity. **Talk**.
-	**EGU**, *Mechanisms of change in the AMOC under global heating*. **Highlighted vPICO**.
Others	**Ocean Science**, **ICML** and **Knowledge Guided Machine Learning (KGML)**.
2020	Contributions total: 3
	Climate Informatics, *Elucidating Ecological Complexity*. Oxford/virtual. **Talk**.
Others	**Climate Informatics** and **AGU**.
2011-2019	Contributions total: 27
-	**EGU**, *Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions*. **Talk**.
-	**AGU**, *Unsupervised Learning Reveals Geography of Global Ocean Dynamical Regions*. **Poster**
-	**World Climate Research Programme (WCRP)**, **Intergovernmental Oceanographic Commission of UNESCO (IOC) Sea Level**, *Linear predictability: An SSH case study*. **Poster.**
-	**Int. Ass. for the Physical Sciences of the Oceans (IAPSO)**. Talk, grant recipient.
Others	**European Geosciences Union (EGU)** (2019, 2017, 2015x2, 2012x2), **AGU**, **ECCO meeting**(2018, 2017x2), **Ocean Science Meeting** (2016, 2018), **Society of Engineering Science**, **Physical Oceanography Dissertation Symposium (PODS)**, **SIAM** (2015, 2014), **Student Conference on Complex Systems (SCCS)** (2014, 2013, 2012, 2011), **Graduate Climate Conference**, **ICSS**, **Ocean Modeling Group** and **Challenger Conference**.

Mentoring and advising

2023-	**Advising:** Simon Draeger, UC Davis, Graduate.
2023-	**QE Committee:** Lin Yao, UC Davis, Graduate.
2023-	**QE Committee:** Mohamed Abuelanin Hussien, UC Davis, Graduate.
2023-	**QE Committee:** Vishal Singh, UC Davis, Graduate.
2023-	**Advising:** Lily Walker, Okinawa Institute of Science and Technology, Graduate.
2023-	**Advising:** William Yik, Harvey-Mud, Holling Scholar (NOAA). Undergraduate.
2021-	**Committee:** Jacob Cohen, University of Washington. Ph.D. student.

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[1]Only first author presentations

2021-	**Advising:** 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.

Selected recent teaching experience

2023	**Course ECS171:** Introduction to Machine Learning *Participants: 100, developed material, taught.*
2023	**Lecture:** UC Louvaine (Be.) *Participants: 50, developed material, taught.*
2023	**Lecture:** Ocean Data Science Summer School. *Participants: 17, developed material, taught.*
2023	**Lecture:** ECMWF Massive Open Online Course: "Unsupervised learning to understand the ocean", open to public. *Registered: 9000, developed material, taught.*
2022	**Lecture:** University of Washington: "Uses and misuses of machine learning for geoscience", undergraduate. *Participants 20, developed material, taught.*
2021	**Lecture:** Princeton University: "Deep learning in geophysical fluid dynamics", graduate. *Participants 10, developed material, taught.*
2021	**Tutorial/workshop:** Society for Industrial and Applied Mathematics (SIAM): Conference on Mathematical and Computational Issues in the Geosciences. Milan, Italy, graduate and undergraduate. *Participants 60, developed material, taught.*
2020	**Lecture:** Oceanhackweek 2020, *class size 20, developed material, taught.*
2020	**Lecture:** GFDL Holling, CIMES and Lapenta interns, undergraduate level: "Machine learning for the goesciences" *Class size 6, developed material, taught.*
2019	**Lecture:** Harvard University EPS: "Machine Learning in Geoscience", graduate. *Class size 10, developed material, taught*
2019	**Lecture:** Harvard University Data Science Club: "The good, the bad and the ugly of applied unsupervised learning", graduate and undergraduate. *class size 60, developed material, taught.*
2019	**Tutorial/workshop (3 day)**, Princeton University & GFDL workshop at graduate level: "Machine learning and climate modeling", graduate. *Class size 20-30, developed material, taught*
2016	**Lecture:** University of Texas at Austin: "Vertical Mixing Schemes: Why we need them & what they do", graduate. *Class size 5, developed material, taught.*

Service

Review duties

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**

Conference, workshop and seminar organization

2024	**PASC**, *Climate, Weather and Earth Sciences*, **Program Committee.**
2024	**OSM**, *New Knowledge Through Machine Learning Guided Exploration of Large-Scale Data Sets in Physical Oceanography*, **convener.**
2023	**AGU**, *Interpretable Machine Learning for Marine Sciences*, **convener.**
2023	**Climate Informatics**, *12th International Conf. on Climate Informatics*, **Program Committee.**
2023	**EGU**, *Machine learning for Earth System modeling*, **convener.**
2022	**AGU**, *Interpretable Machine Learning for Marine Sciences*, **convener.**
2022	**EGU**, *Machine learning for Earth system modelling*, **convener.**
2021	**Conference on Neural Information Processing Systems (NeurIPS**, *Climate Change AI's workshop on 'Tackling Climate Change with Machine Learning'*, Program Committee.
2021	**EGU**, *Machine learning for Earth system modelling*, **convener.**
2020	**AGU**, *Exploration in observed and model oceanographic data using interpretable ML*, oral and poster, **head-convener.**
2020	**AGU**, *Machine Learning for Weather and Climate Modeling*, oral and poster, **convener.**
2020	**The 2nd NOAA Workshop on Leveraging AI in Environmental Sciences** "Exploiting Space- and Ground-Based Observations and EnhancingEarth System Prediction". **Session chair**.

2020	**EGU**, *Machine learning for Earth System modelling*, oral and poster, **co-convener.**
2019	**OceanObs'19**, breakout session, *Open Source Software Revolution*, **co-convener**.
2019	**AGU**, *Exploration of Observations and Models Using ML*, oral and poster,**head convener.**
2015–2016	**MIT Sack Lunch**, seminar, **organizing member.**
2014	**SCCS**, workshop on "The importance of model validation", **organized with Martin Wood**.
2014	**SCCS**, Workshop on "Finite differences methods"**organized with Martin Wood**.
2014	**NOCS Software Carpentry**, workshop, **single organizer**.
2014	**Polar Network Workshop: Science and Society**, workshop, **organizing member**.
2014–2015	**POETS Corner**, seminars **organizing member**.
2012–2013	**Complex earth system modelling and physical Understanding**, seminars, **organizer**.
2011–2013	**Rhubarb series**, seminars **organizing member**.
2011– 2014	**SCCS**, conference, **organizing member and session convener**.

Selected diversity, equity and inclusion activities

2021-present	*POD member*, **Unlearning racism in Geoscience (URGE)**. Program to develop anti-racist policies and strategies at Princeton University, POD member.
2021	*Advising:* CIMES internship.
2020	*Speaker at*, **Bronx Community College**, NYC, USA. Effort by the Bronx Community College STEM Advisory Board to encourage students to consider STEM careers.
2017	*Leader*, **Massachusetts Institute of Technology Outing Club**. Enabling students and MIT associates of diverse backgrounds to access the outdoors by providing leadership expertise.

Selected recent public engagement and outreach

2020	*Taught "Climate change 101"*, **Virtual "Summer Climate Camp" by black led SynergyEd**. Class size 10, ages 11-13 years, developed material, taught.
2019	*Nautical day at the MIT museum*, **MIT Museum**, USA.
2018	*Attendee*, **US Software Sustainability Institute NSF workshop**, Berkeley, USA.
2016	*Copezilla team*, **Red Bull Flugtag**, Boston, USA. **MIT outreach activity**.