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Research area: Ocean dynamics and climate change, with a focus on multiscale interactions, ocean warming, sea level, air-sea coupling through a hierarchy of models, machine learning methods, and the analysis of observations.

Professional Appointments

Present Affiliations

- 2020- Professor of Mathematics & Atmosphere/Ocean Science, **New York University, Courant Institute**, USA.
- 2019- Affiliated Faculty, **New York University, Center for Data Science**, USA.
- 2021- Scientific Director & Lead PI, **M²LInES - Multiscale Machine Learning In Coupled Earth System Modeling**.
- 2021- Geoscience Director, **Learning the Earth with AI and Physics**, NSF Science & Technology Center.
- 2019- Visiting Professor of Physics, **University of Oxford**, Dept of Physics, UK.

Previous Affiliations

- 2019-2020 Associate Professor (tenured), **New York University**, Dept of Mathematics, Courant Institute, USA.
- 2011-2019 (tenured 07/2016) Associate Professor, prev. Univ. Lecturer, **University of Oxford**, Dept of Physics, UK.
College affiliation: David Richards' Fellow, **Wadham College** (2018-2019); Fellow, **St Cross College** (2011-2018); Lecturer in Physics, **Christ Church College** (2014-2017).
- 2017-2018 Visiting Faculty, **Princeton University, AOS and GFDL**, USA.
- 2009-2011 James Martin Research Fellow, Oxford Martin School & Dept of Physics, **University of Oxford**, UK.
- 2009-2011 Junior Research Fellow, Balliol College. **University of Oxford**, UK.

Education

- 06/2009 PhD, **Harvard University**, Earth & Planetary Sciences. Adviser: Eli Tziperman.
Title: Optimal Excitation of Atlantic ocean circulation and implications for predictability.
- 09/2003 MSc, **Weizmann Institute of Science**, Environmental Sciences.
- 09/2001 BSc, **Tel Aviv University**, Geophysics, Atmospheric & Planetary Sciences. *Magna Cum Laude.*

Honors, Awards and Fellowships

- 2022 **Principal Lecturer**, Woods Hole Geophysical Fluid Dynamics Summer Program, Data-Driven GFD.
- 2020 **Nicholas P. Fofonoff Award**, American Meteorological Society. Citation: "*For exceptional creativity in the development and application of new concepts in ocean and climate dynamics.*"
- 2020 **Distinguished PhD Visiting Scientist**, Department of Meteorology, University of Reading, UK.
- 2019 **Sigma Xi Scientific Research Honor Society**.
- 2017-2018 **Visiting Research Scientist Fellowship**, Princeton University, AOS and GFDL.
- 2009-2012 **James Martin Fellowship**, Oxford Martin School.
- 2009-2012 **Junior Research Fellowship**, Balliol College.

- 2008 **Outstanding Student Paper Award**, American Geophysical Union, Fall Meeting (AGU).
- 2005-2008 **3 Certificates of Distinction in Undergraduate Teaching**, Harvard University.
- 2006 **Young Scientist Outstanding Paper Award**, European Geosciences Union, General Assembly.

Funding

US Active Funding

- 2022-2025 **NSF PO + NOAA**, Lead PI (9 universities, 3 modeling centres). Climate Process Team: Ocean Transport and Eddy Energy, 2-yr renewal (\$1.8M).
- 2021-2026 **NSF Science and Technology Center - Learning the Earth with Artificial Intelligence and Physics**. Led by Columbia University, with NYU, UC Irvine, Minnesota, teachers College (\$25M).
- 2021-2026 **Schmidt Futures**, Lead PI (other institutions: Princeton, GFDL, Columbia, LDEO, MIT, NCAR, IPSL, IGE Grenoble). M²LInES - Multiscale Machine Learning In coupled Earth System Modeling, \$10.3M (\$3.2M to NYU).
- 2020-2025 **VoLo Foundation**, Predicting Extreme Events: Sea level Change along the Gulf of Mexico and US East Coast. \$300K.
- 2020-2024 **NOAA CVP**, Lead PI (other institutions: Arizona + GFDL). Drivers of Coastal Sea Level Change Along the Eastern US, \$610K (550K to NYU).
- 2020-2023 **NOAA CVP**, co-PI (led by GMU). What sets the predictability timescales of SST and upper-ocean heat content in the Atlantic and Pacific basins?, \$615K (60K to NYU).
- 2019-2024 **NSF PO**, PI (led by UCSD-Scripps). Collaborative Research: Transient response of regional sea level to Antarctic ice shelf fluxes, \$1.1M (\$464K to NYU).
- 2019-2023 **NSF PO + NOAA**, lead PI (9 universities, 3 modeling centres). Climate Process Team: Ocean Transport and Eddy Energy, \$2.8M (\$782K to NYU).

Past UK Funding

- 2017-2022 **NERC Large Grant**, PI. Transient tracer-based Investigation of Circulation and Thermal Ocean Change (TICTOC), £3,342,981.
- 2017-2020 **NERC**, Co-PI. Addressing the Grand Challenge of regional sea level change prediction (UKFAFMIP), £584,852.
- 2017-2019 **Royal Society, International Exchanges Scheme**, PI. Quantifying the Variability of Tracer Transport across the Gulf Stream. £11,830.00.
- 2014-2019 **NERC Directed**, Co-I. Summer: Testing Influences and Mechanisms for Europe, £764,189.
- 2014-2017 **NERC**, PI. Modelling the Ocean Circulation with Random Numbers, £301,109.
- 2012-2016 **NERC Directed**, Co-PI. Representing uncertainty in ocean observations and ocean model, for coupled ensemble data assimilation & ensemble extended-range prediction, £378,722.
- 2013-2017 **NOAA Earth System Science Program**, Co-PI. Variability, stochastic dynamics, and compensating model errors of the Atlantic Meridional Ocean Circulation in coupled IPCC models, \$287,032.
- 2011-2014 **John Fell Fund**, PI. Dynamical Impacts of Unresolved Ocean Processes in Climate Models: Lessons from Stochastic Physics, £98,538.
- 2015-2016 **Met Office- Oxford Academic Partnership**, Undergraduate Research Experience Placement. PI, 2016: two proposals funded; 2015: one proposal funded, each for £2,000.

Mentoring & Teaching

Supervision (+ = co-advised with)

PhD Students: Adam Subel (2021 -); Aurora Basinski (2020-); Andrew Brettin (2020-). **Graduated Oxford PhD Students:** 2022 Matthias Aengenheyster (+ M. Allen); 2020 Thomas Bolton; 2018 Robert Fraser, Tomos David (+ D. Marshall); 2015: Ben Bronselaer.

Postdoctoral Scholars: Abigail Bodner (Simons Junior Fellow), Fabrizio Falasca, Pavel Perezhogin; Chris Pedersen; Elizabeth Yankovsky; Emily Newsom; Jiarong Wu.

Alumni Postdocs - NYU: Arthur Guillaumin, Andrew Ross, Ziwei Li. *Oxford:* Emily Newsom; Mike Byrne (*Marie Curie Fellow*); Alex Todd; Chris O'Reilly (+ T. Woollings); Joakim Kjellsson; Stephan Juricke (+ T. Palmer); Markus Huber (*funded by a S-NSF fellowship*); James Anstey; Fenwick Cooper (+ T. Palmer); Mirek Andrejczuk (+ T. Palmer); Luca Porta Mana.

Project Manager: Johanna Goldman (2021-)

MPhys Students (= senior thesis): (*=won a prize for best project in *Atmospheric, Oceanic and Planetary Physics*). 2016-2017: Jonny Ison, Kirill Mikhaylov. 2014-2015: Thomas Bolton*. 2013-2014: Andrew Bailey*; Michael Walker*. 2013: Tomos David. 2012: Shaomin Cai. 2011: Brodie Pearson.

Teaching Activities

2020-present *Lecturer*, **Courant Institute, NYU**; Nonlinear Dynamics and Chaos (undergrad, 2023); Ordinary Differential Equations (undergrad, 2022); Fundamentals of Atmosphere and Ocean dynamics (undergrad, 2019, 2020, 2021); Machine Learning for Atmosphere/Ocean/Climate Science (grad, 2019); Ocean Dynamics (grad, 2020).

2010-2019: *Lecturer and College Tutor*, **University of Oxford**: 2013-2019 *Lecturer*, Physics of the Oceans & Atmospheres (undergrad); 2014-2019 *Lecturer*, Climate Dynamics and Variability (grad); 2016-2019 *Lecturer*, Advanced Math and Numerical Methods (grad); 2010-2019 *College Tutor* (undergrad): Mechanics & Special Relativity, Circuit Theory & Electromagnetism, Flows, Fluctuations & Complexity (Nonlinear Dynamics, Chaos, Stochastic Processes, Biophysics).

2009 *Invited Lecturer*: **Joint UW-MIT-Bjerknes** Advanced Climate Dynamics Course, Bergen, Norway; **MIT** Course on Adjoint methods: from large scale optimization to climate modeling.

2004-2008 *Teaching Fellow*, **Harvard University**: Climate & Physical Oceanography (undergrad/grad); The Atmosphere (undergrad); Ordinary and Partial Differential Equations (undergrad/grad); Nonlinear Dynamical Systems (undergrad/grad).

1999-2002 *Special Educator, Teacher and Tutor*, **Balfour High School**, Mathematics.

2015, 2016 *Organizer and Speaker*, **University of Oxford**, Atmospheric Physics Research Experience Day for NERC Doctoral Training Program incoming graduate students.

Service and Membership

External activities (Current)

2023- Advisory Board Member, **Kavli Institute for Theoretical Physics**, Santa Barbara.

2023 Co-organizer, **Simons Foundation**, Symposium on Multi-scale Physics: Theoretical Astrophysics to Climate Science.

2022- **Schmidt Science Fellowship** Panel Finalists Member, **Schmidt Futures**.

2021- External Advisory Board Member, NSF CSSI Collaboration **DJ4Earth**.

2021- **NOAA C&GC Postdoctoral Fellowship**, Steering Committee Member.

2021- **American Meteorological Society**, **Oceanic Research Awards Committee**. Chair from 10/2022.

2020- **CESM** Advisory Board Member.

2020- **NSF AI Institute AI2ES** External Advisory Board Member.

2019- Editor, **Journal of Climate**, **American Meteorological Society**.

2021- Guest Editor, **JAMES**, American Geophysical Union, Special Issue on Machine Learning Application to Earth System Modeling.

2019- Mentor, **MPOWIR** (Mentoring Physical Oceanography Women to Increase Retention) + Invited Senior Scientist, Patullo Conference 2021.

2019- Steering Committee Member, **FAFMIP** (Flux-anomaly-forced model intercomparison project, CMIP6).

2006- **Reviewer**, *Articles*: J. of Climate, J. Phys. Ocean., Nature, Science, GRL, JAMES, Clim. Dyn., Ocean Modelling, J. of Phys. A, ERL, QJRMS, Phil. Trans. of the Royal Society. *Proposals*: National Academies, Schmidt Futures, NSF, NOAA, NERC, ISF, Irish Research Council, KAUST/ CRG. *Books*: SIAM, Cambridge University Press.

Memberships

- American Geophysical Union (AGU) member
- American Meteorological Society (AMS) member
- American Physical Society (APS) member

Previous Activities

- 2020-2023 [Ocean Model Development Panel](#) Member, **CLIVAR**.
- 2021- 2022 **National Academies of Sciences, Engineering, and Medicine's** Workshop Planning Committee Member on [Machine Learning and Artificial Intelligence to Advance Earth System Science](#).
- 2021-2022 Member, Scientific Organizing Committee, US Clivar. Workshop on the Pattern Effect: Coupling of SST patterns, radiative feedbacks, and climate sensitivity (May 2022).
- 2019-2022 Member of the [Working Group on Emerging Data Science Tools for Climate](#), **US CLIVAR**.
- 2021 Co-director [Kavli Institute for Theoretical Physics](#) Program and conference on Machine Learning and the Physics of Climate.
- 2017- 2020 [Schmidt Science Fellowship](#) Panel Member, **Schmidt Futures**, Earth Sciences.
- 2020 Co-organizer, **Columbia University**, Machine Learning in Science & Engineering, Environmental Science.
- 2017 Co-organizer, **Banff International Research Station**, Workshop on Transport in Unsteady Flow.
- 2018 Panel Member, **National Academies of Sciences, Engineering, and Medicine**, Gulf Research Program.
- 2011-2016 Member of Scoping group on the Role of Southern Ocean in the Earth System, 2016, **Natural Environment Research Council (NERC)** Peer Review College Member (Reviewer and Panel Member), **NERC**, 2011-16.
- 2015-2016 Expert Panel Member, **Belmont Forum & Joint Programming Initiative**. Connecting Climate Knowledge for Europe, Climate predictability & inter-regional linkages.
- 2018-2019 Committee Member, Lorenz Lecture Award, **American Geophysical Union**, Nonlinear Geophysics.
- 2014-2018 International Scientific Council Member, **European Institute for Marine Studies (IUEM)**, Brest.
- 2012-2020 Co-organizer at AGU, EGU, Ocean Sciences, APS: **AGU Fall Meeting 2020**, *Machine Learning for Weather & Climate Modelling*; **EGU 2020**, *Chaotic variability and modelling uncertainties in the ocean: towards probabilistic oceanography*; **AGU Ocean Sciences 2020**, *Ocean Transport and Eddy Energy*; **AGU Fall Meeting 2019**, *Machine Learning for Climate Modelling*; **American Physical Society - GPC 2018**, *Multi-Scale Flows & Pathways in the Climate System*; **AGU Ocean Sciences 2014**, *North Atlantic ocean dynamics: from natural fluctuations to externally forced response*; **AGU Ocean Sciences 2012**, *Oceanic Uptake of heat and greenhouse gases: dynamic and thermodynamic controls and inferences from tracers*.
- 2013-2022 Examiner for 6 external (**La Sorbonne**, **Columbia University**, **Imperial College London**, **Southampton University**, **University of Grenoble**) & 4 internal (**Oxford**) PhD/ DPhil, and 1 MRes/MSc.

Service within NYU

- 2023- Ad-hoc FAS-Courant planning committee member, Computational Science Initiative.
- 2022- Faculty Adviser, Association for Women in Mathematics.
- 2021- Chair and member of multiple faculty searches at NYU (Math, CAOS, CDS, and Tandon CUE).
- 2021- Lead, Climate Faculty Cluster Hire Initiative (Courant, Tandon, CDS).
- 2021- Faculty Steering Committee, NYU's All-University Climate Change Initiative.
- 2019- Appointment Committee (hiring, promotion and tenure), Dept of Mathematics, Courant Institute (except for 2022).
- 2019- PhD Advisory Group, Center for Data Science.
- 2019- Examiner, Math + CAOS, Courant (only a subset): PhD thesis defense; PhD thesis committees; General + Special Topic Exam.
- 2019- CAOS PhD committee.
- 2020- CAOS colloquium organizer.
- 2019- Presentations (only a subset): Alumni events; Board of Trustees Select Committee; AI Research Faculty.

Selected Service within Oxford

2010-2019 **Dept of Physics**: Assessor for Flows, Fluctuations & Complexity (2016-19); Invigilator for Physics of the Oceans & Atmospheres (2015-16); Internal Examiner for 18 students (2011-19); Personnel Committee (2012-18); Parking Committee (2017-18); Organizer for Atmospheric, Oceanic and Planetary Seminar Series (2011-2019); Organizer for Physical Oceanography & Climate Meetings (2010-2011).

2018-2019 **Wadham College**: Governing body; Academic Committee; Nominating Committee.

2016-2017 **Mathematical, Physical, Engineering & Life Sciences Division**: NERC Demand Management Decision Panel.

Presentations

Since 2009, I have given **76 invited Departmental or Institutional Seminars** (24 in the past three years), **83 invited talks at Workshops or Conferences** (36 in the last three years), and many contributed seminars or presentations. Below, I will only list invited presentations from the past 3 years, for space. Recent talks are often available on our [Group YouTube Channel](#) or [M²LInES YouTube channel](#).

Invited Departmental/Institutional Seminars

2023: MIT Distinguished Seminar Series in Computational Science and Engineering; BU Computing & Data Sciences Distinguished Lecture Series; UT Austin (DeFord Lecture); MPI-M Hamburg; Harvard University; Simons Foundation/Flatiron Institute Math+X.

2022: Princeton (Geosciences); UCLA (Statistics); UW Data-Driven Methods for Science and Engineering; Brown/DOE Physics Informed ML for multiscale systems; NCAR MMM; Columbia University (LEAP) .

2021: Caltech (CLiMA); U. of Toronto (Physics); Harvard Widely Applied Math; Harvard (Institute for Applied Computational Science); CU Boulder (Applied Math); Stanford (Earth Sciences); NYU (Tandon); U of Oxford (Physics).

2020: MIT (EAPS), U of Rhode Island (Oceanography); CSU (Atmospheric Science); GISS (Sea Level Seminar); Univ of Reading (Met Dept as part of Distinguished PhD visitor scientist).

Invited Workshops and Conferences

2023: NASEM Artificial Intelligence and Machine Learning in Geophysics 2023; AGU fall 2023 APS 2023; UN AI for Good: Earth and Sustainability Science (webinar); SciML Oden Institute. ICML Workshop (Keynote) WCRP Kigali, Rwanda

2022: Turing Institute + Nature Physics; AGU fall 2022; Simons Foundation: Wave Turbulence Annual Meeting; ML for Theoretical Physics; APS-GPC webinar; AISTATS, Valencia, Spain (plenary); Aspen Workshop on Machine Learning and Climate Science; CESM Annual Meeting (plenary).

2021: AI4ESP Workshop DOE; NeurIPS ML for Physical Sciences; AGU Fall 2021 (x 2); The science of global sea-level projections: progress, challenges and future directions (London); UN AI For Good: Accelerating Climate Science with AI; KITP Public Lecture; NOAA workshop on leveraging AI in Environmental Sciences; Climate and Carbon feedback workshop (UK); NYU Climate Connections; IMSI Confronting climate change (Chicago); Eddy - Mean Flow and Waves (Hamburg); Scaling Cascades for Complex Systems (Berlin, plenary); SIAM Mathematical & Computational Issues in the Geosciences (Milano); One World Mathematics of Climate (webinar); SIAM Annual Meeting (Spokane, plenary); Data Science Coast To Coast DSC2C ; AI4Climate (Paris) ; CESM workshop: Machine Learning Working Group; CESM Ocean Model Working Group meeting.

2020: The Institute for Mathematical and Statistical Innovation (IMSI Chicago, plenary); The National Academies, Climate and Weather (webinar); NASA GISS Sea Level Rise Seminar (webinar); Workshop on Knowledge Guided Machine Learning (KGML) (webinar).

Selected Outreach, College & Alumni Activities

1992- : Various activities and tutoring for middle- and high-school students (in France, Israel, USA and UK) with learning disabilities and/or from underrepresented groups.

2020: NYU Alumni Week, *AI for Climate*.

2018-2019 : Access to Excellence (students age 12 to 17), Wadham College.

2019: Wadham Cross-college Symposium: Disruption, *Ocean Physics & Climate Change*.

2017: Foundation Fellows Event, Wadham College, *Sea Level Rise*.

2015: Atmospheric Physics Alumni Event, Royal Society, *Oceans in Climate Change*.

2016: Oxford Physics Society, *Physics of Climate Change*.

2013: Oxford Alumni Weekend, *The Oceans in a Warming Climate*.

Publications

76 published peer-reviewed papers, in AGU, AMS, PNAS and Nature journals, including 44 led by a group member (student, postdoc or myself). Several of the publications on ocean heat uptake, sea level or machine learning were featured in international media reports (e.g., New York Times, Washington Post, The Guardian, BBC News) and/or in science news magazines (e.g., National Geographic, Physics Today, Quanta Magazine, EoS). Twelve publications are cited in the IPCC AR6 report, and the data reconstructions of ocean warming, and sea level are used in multiple chapters of the IPCC report.

PDFs of published or submitted manuscripts are available [here](#). For the complete publication list and citations, please visit my [Google Scholar page](#); for software and commonly requested datasets please visit our [GitHub repositories](#) and [data page](#), respectively.

* = first-author is a student or ** = postdoc supervised by LZ; underline = group member.

Manuscripts Submitted for publication

- [80] Gregory, Bushuk, Adcroft, Zhang, Zanna. Machine learning for online sea ice bias correction within global ice-ocean simulations. [doi:10.48550/arXiv.2310.02488](#).
- [79] Wu, Gregory, Zanna. Early acceleration and surface origin of global ocean heat uptake from an improved Green's function reconstruction.
- [78]* Basinki, Zanna. Estimating freshwater flux amplification with ocean tracers via linear response theory. In Review, *Earth Science Dynamics*. [doi:10.5194/esd-2023-14](#).
- [77]* Aengenheyster, ..., Zanna. Contribution of ocean forcing and air-sea interactions to atmospheric dynamics and extreme events.

Peer Reviewed Manuscripts Published/Accepted

2023

- [76] Camps-Valls, Gerhardus, Ninad, Varando, Martius, Balaguer-Ballester, Vinuesa, Diaz, Zanna, Runge. Discovering Causal Relations and Equations from Data. [doi:10.48550/arXiv.2305.13341](#).
- [76] Yu, et al. ClimSim: An open large-scale dataset for training high-resolution physics emulators in hybrid multi-scale climate simulators. *NeurIPS Data Set and Benchmark Track 2023*. [doi:10.48550/arXiv.2306.08754](#).
- [76] ** Newsom, Zanna, Gregory: Background Pycnocline depth constrains Future Ocean Heat Uptake Efficiency. In Press, *GRL*. [doi:10.48550/arXiv.2307.11902](#).
- [75] ** Pedersen, Zanna, Bruna, Perezhogin. Reliable coarse-grained turbulent simulations through combined offline learning and neural emulation. *ICML 2023, Workshop on the Synergy of Scientific and Machine Learning Modeling*. [doi:10.48550/arXiv.2307.13144](#).
- [74] Gregory, Bushuk, Adcroft, Zhang, Zanna. Deep learning of systematic sea ice model errors from data assimilation increments. *JAMES*, 15, e2023MS003757. [doi:10.1029/2023MS003757](#).
- [73]** Falasca, Brettin, Zanna, Griffies, Yin, Zhao: Exploring the non-stationarity of coastal sea level probability distributions. *Env. Data Science*, 2, E16. [doi:10.1017/eds.2023.10](#).
- [72] Zhang, Perezhogin, Gultekin, Adcroft, Fernandez-Granda, Zanna. Implementation and Evaluation of a Machine Learned Mesoscale Eddy Parameterization into a Numerical Ocean Circulation Model. In Press, *JAMES*. [arXiv:2303.00962](#).
- [71]** Perezhogin, Zanna, Fernandez-Granda. Generative data-driven approaches for stochastic subgrid parameterizations in an idealized ocean model. In Press, *JAMES*. [arXiv:2302.07984](#).
- [70] Gregory, ..., Zanna: A new conceptual model of global ocean heat uptake. In Press, *Climate Dynamics*.
- [69]* Otness, Zanna, Bruna Data-driven multiscale modeling of subgrid parameterizations in climate models. *ICLR 2023, "Tackling Climate Change with Machine Learning,"*.
- [68]** Ross, Li, Perezhogin, Fernandez-Granda, Zanna: Benchmarking of machine learning ocean subgrid parameterizations in an idealized model. *JAMES*, [doi.org/10.1029/2022MS003258](#).

2022

- [67]** Yankovsky, Zanna, KS Smith: Influences of Mesoscale Ocean Eddies on Flow Vertical Structure in a Resolution-Based Model Hierarchy. *JAMES*, [doi.org/10.1029/2022MS003203](#).

- [66] Marques, ... , Zanna :NeverWorld2: An idealized model hierarchy to investigate ocean mesoscale eddies across resolutions. *GMD*, doi.org/10.5194/gmd-15-6567-2022.
- [65] Cheng, von Schuckmann, Abraham, Trenberth, Mann, Zanna, England, Zika, Fasullo, Yu, Pan, Zhu, Newsom, Bronselaer, Lin.: Past and future ocean warming. *Nature Reviews Earth & Environment*, doi.org/10.1038/s43017-022-00345-1. *Example of press coverage*.
- [64] Christensen, Zanna: Parametrisation in Weather and Climate Models. *Oxford Research Encyclopedia of Climate Science*, doi.org/10.1093/acrefore/9780190228620.013.826.
- [63] Couldrey, Gregory, ... , Zanna. Greenhouse-gas forced changes in the Atlantic Meridional Overturning Circulation and related worldwide sea-level change. *Clim. Dyn.*, doi.org/10.1007/s00382-022-06386-y.
- [62] Liu, Kaku, Zhu, Leibovich, Mohan, Yu, Zanna, Razavian, Fernandez-Granda. Deep Probability Estimation. *ICML*, doi.org/arXiv:2111.10734.
- [61] Loose, Abernathey, Grooms, Busecke, Guillaumin, Yankovsky, Marques, Steinberg, Ross, Khatri, Bachman, Zanna, Martin: GCM-Filters: A Python Package for Diffusion-based Spatial Filtering of Gridded Data. *Journal of Open Source Software*, doi.org/10.21105/joss.03947.
- [60]** Newsom, Zanna, Khatiwala: Relating patterns of added and redistributed ocean warming. *J. Climate*, doi.org/10.1175/JCLI-D-21-0827.1.
- [59] Chemke, Zanna, Orbe, Sentman, Polvani. The future intensification of North Atlantic winter storms: the key role of dynamic ocean coupling. *J. Climate*, doi.org/10.1175/JCLI-D-21-0407.1.
- 2021**
- [58] Wang, Church, Zhang, Gregory, Zanna, Chen. Evaluation of the local sea-level budget at tide gauges since 1958. *GRL*, doi.org/10.1029/2021GL094502.
- [57]** Guillaumin, Zanna. Stochastic Deep Learning parameterization of Ocean Momentum Forcing. *JAMES*, doi.org/10.1029/2021MS002534.
- [56] Zanna, Bolton: Deep Learning for Ocean Subgrid Parameterizations. *Book Chapter* in “Deep learning for the Earth Sciences: A comprehensive approach to remote sensing, climate science and geosciences”. Editors: Gustau Camps-Valls, Xiao Xiang Zhu, Devis Tuia, Markus Reichstein. *Wiley & Sons, inc., 2021*.
- [55] Couldrey, Gregory, Dias, Dobrohotoff, Domingues, Garuba, Griffies, Haak, Hu, Ishii, Jungclaus, Köhl, Marsland, Ojha, Saenko, Savita, Shao, Stammer, Suzuki, Todd, Zanna. What causes the spread of model projections of sea level change in response to greenhouse gas forcing? *Clim. Dyn.*, doi.org/10.1007/s00382-020-05471-4.
- 2020**
- [54] Hewitt, et al.: Resolving and Parameterising the Ocean Mesoscale in Earth System Models. *Current Climate Change Reports*, doi.org/10.1007/s40641-020-00164-w.
- [53]** Newsom, Zanna, Khatiwala, Gregory: The influence of warming patterns on passive Ocean Heat Uptake. *GRL*, doi.org/10.1029/2020GL088429.
- [52]** Byrne, Zanna: Radiative effects of clouds and water vapor on an axisymmetric monsoon. *J. Climate*, doi.org/10.1175/JCLI-D-19-0974.1.
- [51] Zanna, Bolton: Data-driven Equation Discovery of Ocean Mesoscale Closures. *GRL*, doi.org/10.1029/2020GL088376; *some coverage in Quanta Magazine*.
- [50]** Todd, Zanna, et al. Ocean-only FAFMIP: Understanding Regional Patterns of Ocean Heat Uptake and Dynamic Sea Level Change. *JAMES*, <https://doi.org/10.1029/2019MS002027>
- [49] Frederikse, Landerer, Caron, Adhikari, Parkes, Humphrey, Dangendorf, Hogarth, Zanna, Cheng, Wu. The causes of sea-level rise since 1900. *Nature*, <https://doi.org/10.1038/s41586-020-2591-3>.
- [48]* Bronselaer, Zanna: Heat and carbon coupling reveals ocean warming patterns due to circulation changes. *Nature*, <https://doi.org/10.1038/s41586-020-2573-5>.
- [47] Chemke, Zanna, Polvani. Attribution of North Atlantic surface temperature. *Nature Comms*, 10.1038/s41467-020-15285-x.
- [46] Yin, Griffies, Winton, Zhao, Zanna, 2020: Response of Storm-related Extreme Sea Level along the US Atlantic Coast to Combined Weather and Climate Forcing. *J. of Climate*, <https://doi.org/10.1175/JCLI-D-19-0551.1>.

[45] Sun, Eisenman, [Zanna](#), Stewart, 2020. Surface constraints on the depth of the Atlantic Meridional Overturning Circulation: Southern Ocean vs North Atlantic. *J. of Climate*, <https://doi.org/10.1175/JCLI-D-19-0546.1>.

2019

- [44]** [O'Reilly](#), [Woollings](#), [Zanna](#), 2019. Assessing external and internal sources of Atlantic Multidecadal Variability using models, proxy data and early instrumental indices. *J. of Climate*, doi:10.1175/JCLI-D-19-0177.1.
- [43]** [O'Reilly](#), [Woollings](#), [Zanna](#) and [Weisheimer](#), 2019. An interdecadal shift of the extratropical ENSO teleconnection during boreal summer. *GRL*, doi:10.1029/2019GL084079.
- [42] Carson, Lyu, Richter, Becker, Domingues, Han, Little, [Zanna](#). Climate model uncertainty and trend detection of regional sea level projections in the open ocean and coastal zone. *Surveys in Geophysics*, doi:10.1007/s10712-019-09559-3.
- [41] Ponte, [et al](#): Ocean Obs' 2019: Towards comprehensive observing and modeling systems for monitoring and predicting regional to coastal sea level. *Frontiers in Marine Science*, doi: 10.3389/fmars.2019.00437.
- [40]* [Bolton](#), [Abernathey](#), [Zanna](#), 2019: Regional and temporal variability of lateral mixing in the North Atlantic. *JPO*, 49(10), 2601-2614, doi:10.1175/JPO-D-19-0042.1
- [39]* [Fraser](#), [Palmer](#), [Roberts](#), [Wilson](#), [Zanna](#), 2019: Predictability of Interannual Sea Level Variability in the North Atlantic. *Climate Dynamics*, doi:10.1007/s00382-019-04814-0.
- [38] [Rodrigues](#), [Subramanian](#), [Zanna](#), [Berner](#), 2019. ENSO bimodality and extremes. *GRL*, DOI:10.1029/2019GL082270.
- [37] [Zanna](#), [Khatiwala](#), [Gregory](#), [Ison](#), [Heimbach](#), 2019: Global reconstruction of historical ocean heat storage and transport. *Proc. of the National Academy of Sciences*, 116 (4) 1126-1131, doi: 10.1073/pnas.1808838115. [Link to press coverage](#).
- [36]* [Bolton](#), [Zanna](#), 2019: Applications of Deep Learning to Ocean Data Inference and Sub-Grid Parameterisation. *JAMES*, 11, doi: 10.1029/2018MS001472.

2018

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