

Duncan Watson-Parris

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<https://climate-analytics-lab.github.io/>

My research focusses on the role of aerosol on our climate from their microscopic interactions with clouds to their global radiative effects [6]. I was a lead author on a recent, influential review paper [27], leading the sections regarding aerosol direct and semi-direct forcing (4, 5 and 7). As a co-chair for the AerChemMIP2 contribution to CMIP7 and AeroCom committee member, I also have an intimate knowledge of aerosol climate modelling, and its associated uncertainties [1]. My lab is harnessing machine learning (ML) to accelerate climate research [16] and improve the ML emulators [2,3,13] that are being increasingly used to link IPCC WG1 outputs with WG2 and WG3, as in e.g. my recent ClimateBench paper [8]. I also use these ML techniques to distill new process understanding from extensive remote sensing observations, as demonstrated in my recent paper exploring the change in cloud perturbations following the IMO ship fuel emissions changes in 2020 [7].

Research Experience

2023 – Present Assistant Professor, University of California San Diego
2023 – Present Faculty Fellow, San Diego Supercomputing Centre, UCSD
2020 – 2023 Senior Research Associate and Course Director, University of Oxford
2015 – 2020 Post-doctoral Research Associate, University of Oxford

Professional Experience and Education

2020 – 2021 Independent Consultant, Oxford University Innovation, Oxford
2011 – 2015 Data Analytics Consultant, Tessella Ltd., Abingdon
2007 – 2011 PhD Theoretical Physics, University of Manchester
2003 – 2007 First Class BSc. (Hons.) Theoretical and Computational Physics, Cardiff University

Awards, Fellowships, and Grants

2025 *PI*: CAREER: The large-scale buffering of shallow cloud perturbations: \$1m (NSF)
2024 *PI*: Combining top-down and bottom-up constraints for improved projections (submitted to DOE BER)
2024 *PI*: ClimateBench v2.0 ...: \$270,000 (Google Academic Research Award)
2024 *Co-PI*: GENIE: generative foundation model for automated climate science: \$1m (DARPA)
2024 *Co-PI*: Identification of clouds microphysical seedability in an actionable manner: \$1.5m (UAEREP)
2021 *Named Researcher*: “ML4CLOUDS”, Natural Environment Research Council: ~£800k total
2017 *Researcher Co-I*: “access to EnVironmental Analytics for Developing countriEs”, UK STFC: £50,399

Selected Invited Presentations

Selected from 45 invited talks, including 16 departmental seminars

2024 AAAS 2024 Annual Meeting, Denver
2024 Berkeley Atmospheric Science Symposium, UC Berkeley
2023 AGU Fall Meeting (A033 and A086 sessions), San Francisco
2023 Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles
2023 Department of Environmental Science and Engineering, Caltech
2022 AGU Fall Meeting (A073 - Models, In situ, and Remote sensing of Aerosols), Chicago
2022 Rosenstiel School of Marine, Atmospheric, and Earth Science, University of Miami
2022 Transformers in Environmental Science (keynote), Magdeburg, Germany
2022 Department of Geosciences, University of Oslo
2022 Institute for Climate and Atmospheric Science, University of Leeds
2022 UN AI for Good ‘Accelerating Climate Science with AI’, Virtual
2021 International Aerosol Modeling Algorithms Conference, Virtual
2021 Institute for Atmospheric and Climate Science, ETH Zurich
2021 Department of Atmospheric, Oceanic and Planetary Physics, University of Oxford
2018 World Climate Research Programme workshop, Ringberg

Selected Publications

*(Co-)supervised

ORCID: [0000-0002-5312-4950](https://orcid.org/0000-0002-5312-4950); [Google Scholar](#)

Published peer-reviewed papers: 49; First author: 12. Currently > 2900 citations; h-index 28.

- [1] Fiedler, S., Naik, V., O'Connor, F. M., Smith, ..., **Watson-Parris, D.**, ... , A., Collins, W. J., Schulz, M., Myhre, G., and Forster, P. M. *Interactions between atmospheric composition and climate change – progress in understanding and future opportunities from AerChemMIP, PDRMIP, and RFMIP*. Geosci. Model Dev., 17, 2387–2417, [10.5194/gmd-17-2387-2024](https://doi.org/10.5194/gmd-17-2387-2024), 2024
- [2] Niu, R., Wu, D., Kim, K., Ma, Y.-A., **Watson-Parris, D.**, and Yu, R.: *Multi-Fidelity Residual Neural Processes for Scalable Surrogate Modeling*, ICML 2024, [arXiv](#), 2024
- [3] *Bouabid, S., Sejdinovic, D., and **Watson-Parris, D.** *FaIRGP: A Bayesian Energy Balance Model for Surface Temperatures Emulation*. Accepted at Journal of Advances in Modeling Earth Systems: [10.22541/essoar.169008319.96252512/v1](https://doi.org/10.22541/essoar.169008319.96252512/v1), 2024
- [4] *Manshausen, P., **Watson-Parris, D.**, Christensen, M. W., Jalkanen, J.-P., and Stier, P. *Rapid saturation of cloud water adjustments to shipping emissions*. Atmos. Chem. Phys., 23, 12545–12555, [10.5194/acp-23-12545-2023](https://doi.org/10.5194/acp-23-12545-2023), 2023
- [5] *Williams, A., **Watson-Parris, D.**, Dagan, G., Stier, P. *Dependence of fast changes in global and local precipitation on the geographical location of absorbing aerosol*. Journal of Climate: [10.1175/JCLI-D-23-0022.1](https://doi.org/10.1175/JCLI-D-23-0022.1), 2023
- [6] **Watson-Parris, D.** & Smith, C. J. *Large uncertainty in future warming due to aerosol forcing*. Nature Climate Change 12 (12): [10.1038/s41558-022-01516-0](https://doi.org/10.1038/s41558-022-01516-0), 2022
- [7] **Watson-Parris, D.**, Christensen, M., Laurenson, A., Clewley, D., Gryspeerdt, E., Stier, P. *Shipping regulations lead to large reduction in cloud perturbations*. Proceedings of the National Academy of Sciences 119 (41): [10.1073/pnas.2206885119](https://doi.org/10.1073/pnas.2206885119), 2022
Highlight: We're changing the clouds' An unforeseen test of geoengineering is fueling record ocean warmth in Science [10.1126/science.adk1022](https://doi.org/10.1126/science.adk1022)
- [8] **Watson-Parris, D.**, Rao, Y., Olivie, D., Seland, Ø., ... *ClimateBench: A benchmark dataset for data-driven climate projections*. Journal of Advances in Modeling Earth Systems 14: [10.1029/2021MS002954](https://doi.org/10.1029/2021MS002954), 2022
Highlight: How AI is improving climate forecasts in Nature [10.1038/d41586-024-00780-8](https://doi.org/10.1038/d41586-024-00780-8)
- [9] *Manshausen, P., **Watson-Parris, D.**, Christensen, M., Jalkanen, J.P., Stier, P. *Invisible Ship Tracks Show Strong Cloud Sensitivity to Aerosol*. Nature 610: [10.1038/s41586-022-05122-0](https://doi.org/10.1038/s41586-022-05122-0), 2022
- [10] *Williams, A., Stier, P., Dagan, G., **Watson-Parris, D.** *Strong control of effective radiative forcing by the spatial pattern of absorbing aerosol*. Nat. Clim. Change. 12 (8): [10.1038/s41558-022-01415-4](https://doi.org/10.1038/s41558-022-01415-4), 2022
- [11] Salzmann, M., ..., **Watson-Parris, D.**, ..., Tegen, I. *The global atmosphere-aerosol model ICON-A-HAM2.3*. Journal of Advances in Modeling Earth Systems: [10.1029/2021MS002699](https://doi.org/10.1029/2021MS002699), 2022
- [12] Christensen, M., Gettelman, A., ..., **Watson-Parris, D.**, ... *Opportunistic Experiments to Constrain Aerosol Effective Radiative Forcing*. Atmospheric Chemistry and Physics, 22: [10.5194/acp-22-641-2022](https://doi.org/10.5194/acp-22-641-2022), 2022
- [13] **Watson-Parris, D.**, Williams, A., Deaconu, L., Stier, P. *Model calibration using ESEm v1.1.0 – an open, scalable Earth System Emulator*. Geoscientific Model Development, 14: [10.5194/gmd-14-7659-2021](https://doi.org/10.5194/gmd-14-7659-2021), 2021
- [14] Kasim, M. F., **Watson-Parris, D.**, Deaconu, L., Topp-Mugglestone, ..., Vinko S. M. *Building high accuracy emulators for scientific simulations with deep neural architecture search*. Machine Learning: Science and Technology, 3: [10.1088/2632-2153/ac3ffa](https://doi.org/10.1088/2632-2153/ac3ffa), 2021
Highlight: From models of galaxies to atoms, simple AI shortcuts speed up simulations by billions of times. Science [10.1126/science.abb2769](https://doi.org/10.1126/science.abb2769)
- [15] Sand, M., Samset, B. H., Myhre, G., Gllß, J., ..., and **Watson-Parris, D.** *Aerosol absorption in global models from AeroCom Phase III*. Atmospheric Chemistry and Physics, 21: [10.5194/acp-21-15929-2021](https://doi.org/10.5194/acp-21-15929-2021), 2021
- [16] **Watson-Parris, D.** *Machine learning for climate and weather are worlds apart*. Philosophical Transactions of the Royal Society A, 379: [10.1098/rsta.2020.0098](https://doi.org/10.1098/rsta.2020.0098), 2021
- [17] Dagan, G., Stier, P. & **Watson-Parris, D.** *An energetic view on the geographical dependence of the fast aerosol radiative effects on precipitation*. Journal of Geophysical Research: Atmospheres, 126: [10.1029/2020JD033045](https://doi.org/10.1029/2020JD033045), 2021

- [18] **Watson-Parris, D.**, Sutherland, S. A., Christensen, M. W. & Stier, P. *A large-scale analysis of pockets of open cells and their radiative impact*. Geophysical Research Letters, 48: [10.1029/2020GL092213](https://doi.org/10.1029/2020GL092213), 2021
- [19] Gettelman, A., ..., **Watson-Parris, D.** *Climate Impacts of COVID-19 Induced Emission Changes*. Geophysical Research Letters, 48: [10.1029/2020GL091805](https://doi.org/10.1029/2020GL091805), 2020
Highlight: COVID-19 lockdowns temporarily raised global temperatures <https://bit.ly/3p20zc8>
- [20] Haywood, J. M., Abel, S., ..., **Watson-Parris, D.**, ... Zuidema, P. *Overview: The CLOUD-Aerosol-Radiation Interaction and Forcing: Year-2017 (CLARIFY-2017) measurement campaign*. Atmospheric Chemistry and Physics: 21: [10.5194/acp-21-1049-2021](https://doi.org/10.5194/acp-21-1049-2021), 2020
- [21] McCoy, I. L., McCoy, D. T., Wood, R., Regayre, L., **Watson-Parris, D.**, Grosvenor, D. P., Mulcahy, J., Hu, Y., Bender, F. A. M., Field, P. R., Carslaw, K., Gordon, H. *The hemispheric contrast in cloud microphysical properties constrains aerosol forcing*. Proceedings of the National Academy of Sciences 117 (32): [10.1073/pnas.1922502117](https://doi.org/10.1073/pnas.1922502117), 2020
- [22] **Watson-Parris, D.**, Bellouin, N., Deaconu, L., Schutgens, N., Yoshioka, M., Regayre, L. A., Pringle, K. J., Johnson, J. S., Carslaw, K. S. & Stier, P. *Constraining uncertainty in aerosol direct forcing*. Geophysical Research Letters, 47: [10.1029/2020GL087141](https://doi.org/10.1029/2020GL087141), 2020
- [23] Richardson, T. B., Forster, P. M., Smith, C. J., Maycock, A. C., Wood, T., Andrews, T., Boucher, ..., **Watson-Parris, D.** *Efficacy of Climate Forcings in PDRMIP Models*. Journal of Geophysical Research: Atmospheres, 124: [10.1029/2019JD030581](https://doi.org/10.1029/2019JD030581), 2019
Editors' Highlight: How Does Climate Respond to Different Forcings? <https://eos.org/editor-highlights/how-does-climate-respond-to-different-forcings>
- [24] Tegen, I., Neubauer, D., Ferrachat, S., ..., **Watson-Parris, D.**, ..., Heinold, B., & Lohmann, U. *The global aerosol-climate model ECHAM6.3–HAM2.3 Part 1: Aerosol evaluation*. Geoscientific Model Development, 12(4): [10.5194/gmd-12-3609-2019](https://doi.org/10.5194/gmd-12-3609-2019), 2019
- [25] **Watson-Parris, D.**, Schutgens, N., Reddington, C., Pringle, K. J., Liu, D., Allan, J. D., Coe, H., Carslaw, K. S., & Stier, P. *In situ constraints on the vertical distribution of global aerosol*. Atmospheric Chemistry and Physics, 19(18): [10.5194/acp-19-11765-2019](https://doi.org/10.5194/acp-19-11765-2019), 2019
- [26] **Watson-Parris, D.**, Sutherland, S., Christensen, M., Caterini, A., Sejdinovic, D., Stier, P. *Detecting anthropogenic cloud perturbations with deep learning*. Climate Change: How Can AI Help? workshop at the ICML 2019: [arxiv:1911.13061](https://arxiv.org/abs/1911.13061), 2019
Highlight: Chosen for 'best paper' award
- [27] Bellouin, N., Quaas, J., Gryspeerdt, E., Kinne, S., Stier, P., **Watson-Parris, D.**, ..., Stevens, B. *Bounding global aerosol radiative forcing of climate change*. Reviews of Geophysics, 2019RG000660: [10.1029/2019RG000660](https://doi.org/10.1029/2019RG000660), 2020
Editors' Highlight: Effects of Particles on Climate Remain Unsettled <https://eos.org/editor-highlights/effects-of-particles-on-climate-remain-unsettled>
Clarivate ESI 'Highly Cited' and 'Hot' paper: Top 0.1% of Geosciences papers 2020
- [28] Myhre, G., Kramer, R. J., Smith, C. J., Hodnebrog, Ø., Forster, P., Soden, B. J., Samset, B. H., Stjern, ..., **Watson-Parris, D.** *Quantifying the Importance of Rapid Adjustments for Global Precipitation Changes*. Geophysical Research Letters, 45(20): [10.1029/2018GL079474](https://doi.org/10.1029/2018GL079474), 2018
- [29] **Watson-Parris, D.**, Schutgens, N., Winker, D., Burton, S. P., Ferrare, R. A., & Stier, P. *On the Limits of CALIOP for Constraining Modeled Free Tropospheric Aerosol*. Geophysical Research Letters, 45(17): [10.1029/2018GL078195](https://doi.org/10.1029/2018GL078195), 2018
- [30] Smith, C. J., Kramer, R. J., Myhre, G., Forster, P. M., Soden, B. J., Andrews, T., Boucher, O., ... **Watson-Parris, D.** *Understanding Rapid Adjustments to Diverse Forcing Agents*. Geophysical Research Letters, 45(21): [10.1029/2018GL079826](https://doi.org/10.1029/2018GL079826), 2018

Other contributions

- [31] Allan, J. and **Watson-Parris, D.** *Measurements of Ambient Aerosol Properties*. In "Aerosols and Climate", Edited by Ken Carslaw. Elsevier, 2022
- [32] Contributed to *Modelling of short-lived climate forcers*. In AMAP Assessment 2021: Impacts of Short-lived Climate Forcers on Arctic Climate, Air Quality, and Human Health. Tromsø, Norway, 2022

Contributed Presentations

>35 oral presentations and 6 posters

Teaching Experience

- SIO(C) 209 – Deep Learning for Geo and Environmental Sciences, Spring 2024
- DSC 200 – Data Science Programming, Fall 2022
- 2nd iMIRACLI summer school, Stockholm, September 2022
- 1st iMIRACLI summer school, Virtual, September 2020
- Physics of the Atmosphere and Oceans October 2016 – May 2017

Mentoring

- 6 Phd Students: Sophie Wynn (2023-); Jawahar Madan (2023-); Giorgia Nicolaou (2023-); Peter Manshausen (2020-); Andrew Williams (2019-2023); Shipeng Zhang (2018-2020).
- 7 MPhys projects: Harsha Gangala (2023); Harin Radha-Krishnan (2023); Jesse Wang (2022); Matthew Wan (2021); Thomas Matthews (2019); Robin Gan (2019); Sam Sutherland (2018).
- Climate Change Faculty for Stanford [AI for Climate Change Bootcamp](#) (2020-present)

Service and Outreach

Committee memberships

- Co-chair of “AerChemMIP2” CMIP7 modelling exercise
- Steering committee Member of CLIVAR Micro2Macro program
- Steering committee member of the AeroCom international modelling consortium
- Steering committee member of “Composition Air quality Climate inTeractions Initiative”

Editorial

Editor for Atmospheric Chemistry and Physics; Editor for Environmental Data Science

Peer review

NeurIPS '24; Proceedings of the National Academy of Sciences; Geophysical Research Letters; Journal of Geophysical Research - Machine Learning and Computation; Journal of Geophysical Research – Atmospheres; Nature; Atmospheric Chemistry and Physics (Letters); Geoscientific Model Development; Journal of Advances in Modelling Earth Systems; Atmospheric Environment; International Journal of Climatology; AGU Books; IEEE Transactions on Geoscience and Remote Sensing; Science Advances; Reviews of Geophysics.

Proposal review

Panelist for NSF Site Visit of NSF AI Institute; ETH Zurich Research Commission; Swiss Data Science Center (SDSC) Collaborative Data Science Projects; Research Council of Norway for Chinese-Norwegian Collaboration Projects within Climate Systems; Climate Change AI Innovation Grants (meta-reviewer).

Conference and workshop organisation

- Lead Convener of “Machine Learning for Climate Science” session at EGU 2022-present
- Co-chair of the UN AI for Good - Accelerating Climate Science with AI series 2021-present
- Co-Convener, “Aerosols as Drivers of Climate Risk”, “Deep Learning for Climate Science and Weather Prediction” and “Developments in impacts-relevant physical model emulation”, AGU 2023
- Chair of “Machine Learning” session at UK Atmospheric Science Conference 2021
- Co-chair of 10th “Climate Informatics” international conference (2020)
- Co-host of the 1st “Oxford Machine Learning in Climate Science” workshop (2018)

Outreach

- “Generative AI in Science” in [ACM](#) (2024)
- “How AI is improving climate forecasts” in [Nature](#) (2024)
- “We’re changing the clouds’ An unforeseen test of geoengineering is fueling record ocean warmth” in [Science magazine](#) (2023)
- “Tiny Aerosols Pose a Big Predicament in a Warming World” in [Wired magazine](#) (2023)
- “Air pollution cools climate more than expected – this makes cutting carbon emissions more urgent” [The Conversation](#) (2022)
- “Tiny aerosols present a big challenge for global warming” in the [National Observer](#) (2022)
- [AGU News](#) article “COVID-19 lockdowns temporarily raised global temperatures” (2021)

Professional Memberships

American Geosciences Union; European Geosciences Union; Institute of Physics