Will Gregory

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Profile

My research combines large-scale observational data, climate models, and artificial intelligence (AI) to better understand the polar climate system. My past work includes the first application of AI to real-time Arctic sea ice forecasts; I have also pioneered the development of AI tools for optimally combining data from different satellite altimeters, to dramatically improve observational coverage over sea ice. More recently, my work has leveraged satellite data and AI to make advances in "hybrid" sea ice modeling, in which AI is used overcome deficiencies in sea ice physics parameterizations. Through this work I have independently steered research outcomes into how data assimilation and AI can derive state-dependent model error representations and also improve online generalization of AI-based parameterizations. Looking ahead, I am keen to explore how state-of-the-art remote-sensing data and AI can continue to drive progress in hybrid climate modeling and coupled climate emulation. I am now leading the development of an AI-based sea-ice emulator, with the aim of improving coupled ocean-sea-ice interactions within climate model emulators. Finally, I am passionate about open science and strive to make all my data and code publicly available—see my GitHub for implementations ranging from data assimilation to principal component analysis, complex networks, and other machine learning (ML) methods.

Education

2017-2021	PhD in Polar Climate Science and ML, *Pass (no corrections)*	University College London (UCL)
2013-2014	MSc in Petroleum Geophysics, *Distinction*	Imperial College London
2010-2013	BSc in Geology with Geophysics, *1st class*	University of Leicester

Employment

2022-present — **Postdoctoral Researcher | Princeton University & Geophysical Fluid Dynamics Lab**

Funded by Multi-scale Machine Learning In coupled Earth System modeling (M^2LInES) initiative
Current/Past Responsibilities:
- Leading sea-ice emulation development through M^2LInES–AI2 partnership
- Leading hybrid sea ice modeling development in M^2LInES and GFDL
- Co-organiser of the 2025 M^2LInES annual meeting
- Co-organiser of biweekly project meetings

2014-2017 — **Depth-imaging Geophysicist | Petroleum Geo-Services Ltd**

Client-facing role in the private sector, delivering geophysical services to oil and gas companies
Past Responsibilities:
- Develop sub-surface seismic velocity models using tomographic inversion techniques
- Deliver project presentations and lead data visualisation sessions with clients
- Develop and maintain Gantt charts, status reports, and end-of-project reports.
- Train new staff in sub-surface imaging theory and in-house software

Research Funding Applications

2025	NERC AI for Environmental Science (Co-I)	Submitted December 2025, outcome pending
2025	Royal Society University Research Fellowship (PI)	Submitted September 2025, outcome pending
2025	Marie Curie Postdoctoral Fellowship (PI)	Submitted September 2025, outcome pending
2025	Schmidt AI in Science Postdoctoral Fellowship (PI)	Unsuccessful
2024	NERC Independent Research Fellowship (PI)	Unsuccesful: score 6/10
2024	Marie Curie Postdoctoral Fellowship (PI)	Unsuccessful: score 93% and awarded European Commission Seal of Excellence
2023	NERC Independent Research Fellowship (PI)	Unsuccessful: score 7/10

Selected Honours

Scientific Contributions

Pre-prints

J Duncan, ..., **W Gregory** et al, "SamudrACE: Fast and Accurate Coupled Climate Modeling with 3D Ocean and Atmosphere Emulators," *arXiv* [in review at *Geophysical Research Letters*] (2025)

L Zanna, **W Gregory** et al, "A framework for hybrid physics-AI coupled ocean models," *arXiv* [in review at *Science Advances*] (2025)

YF Zhang, M Bushuk, M Winton, **W Gregory**, W Hurlin, L Jia, F Lu, "Subseasonal forecast improvements from sea ice concentration data assimilation in the Antarctic," *EGUsphere* [in review at The Cryosphere] (2025)

Peer-reviewed

W Gregory, M Bushuk, YF Zhang, A Adcroft, L Zanna, C McHugh, L Jia, "Advancing global sea ice prediction capabilities using a fully-coupled climate model with integrated machine learning," *Science Advances* (12), 1 (2026)

D Balwada, ..., **W Gregory** et al, "Learning machine learning with Lorenz-96," *Journal of Open Source Education* (7), 241 (2024)

W Gregory, R MacEachern, S Takao, IR Lawrence, C Nab, M Deisenroth, M Tsamados, "Scalable interpolation of satellite altimetry data with probabilistic machine learning," *Nature Communications* (15), 7453 (2024)

M Bushuk, ..., **W Gregory** et al, "Predicting September Arctic sea ice: a multi-model seasonal skill comparison," *Bulletin of the American Meteorological Society* (15), E1170-E1203 (2024)

W Gregory, M Bushuk, YF Zhang, A Adcroft, L Zanna, "Machine learning for online sea ice bias correction within global ice-ocean simulations," *Geophysical Research Letters* (51), e2023GL106776 (2024)

YF Zhang, M Bushuk, M Winton, W Hurlin, **W Gregory**, JC Landy, L Jia, "Improvements in September Arctic sea ice predictions via assimilation of summer CryoSat-2 sea ice thickness observations," *Geophysical Research Letters* (50), e2023GL105672 (2023)

W Gregory, M Bushuk, A Adcroft, YF Zhang, L Zanna, "Deep learning of systematic sea ice model errors from data assimilation increments," *Journal of Advances in Modeling Earth Systems* (15), e2023MS003757 (2023)

C Nab, R Mallett, **W Gregory**, JC Landy, IR Lawrence, R Willatt, J Stroeve, M Tsamados, "Synoptic variability in satellite altimeter-derived radar freeboard of Arctic sea ice," *Geophysical Research Letters* (50), e2022GL100696 (2023)

W Gregory, J Stroeve, M Tsamados, "Network connectivity between the winter Arctic Oscillation and summer sea ice in CMIP6 models and observations," *The Cryosphere* (16), 1653–1673 (2022)

W Gregory, IR Lawrence, M Tsamados, "A Bayesian approach towards daily pan-Arctic sea ice freeboard estimates from combined CryoSat-2 and Sentinel-3 satellite observations," *The Cryosphere* (15), 2857–287. (2021)

W Gregory, M Tsamados, J Stroeve, P Sollich, "Regional September sea ice forecasting with complex networks and Gaussian processes," *Weather and Forecasting* (35), 793–806. (2020)

Invited Talks	"How is AI shaping sea ice modeling and prediction research?" Polar Research Board, Fall Meeting, Virtual (2025)

"Fortran-integrated machine learning in SIS2 and SPEAR", GFDL AI workshop, GFDL (2025)

"How is AI shaping Arctic climate modeling and observational research?" US Interagency Arctic Research Policy Committee (IARPC) Webinar, Virtual (2025)

"Bridging AI, remote sensing, and climate modeling to understand polar climate variability and change," Institute for Advanced Computational Science (IACS) Seminar, Stony Brook University (2025)

"From component to coupled: evaluating the performance of a machine-learned sea ice bias correction scheme in fully-coupled seasonal predictions," Nansen SuperIce Webinar Series, Virtual (2024)

"Towards improving numerical sea ice predictions with data assimilation and machine learning," NOAA Arctic All Hands, Vitual (2024)

"Applications of machine learning to sea ice data assimilation," 10th US Climate modeling summit, Geophysical Fluid Dynamics Laboratory, Princeton, NJ (2024)

"Towards a machine-learned sea ice model parameterization from data assimilation increments," Euro-Mediterranean Center on Climate Change (CMCC) Seminar, Bologna, Italy (2024)

"Deep learning of systematic sea ice model errors from data assimilation incremenets," Courant Institute of Mathematical Sciences Guest Seminar Series, New York City, NY (2022)

"Machine learning tools for pattern recognition in polar climate science," EGU General Assembly, Vienna, Austria (2021)

"Machine learning in climate science," Government Digital Service, London, UK (2020)

Selected Conference Talks	**W Gregory**, M Bushuk, YF Zhang, A Adcroft, L Zanna. "Machine-leaned sea ice bias correction in a global fully-coupled climate model," CESM Polar Working Group Meeting, Boulder, CO (2025)

W Gregory, M Bushuk, YF Zhang, A Adcroft, L Zanna. "Towards improving numerical sea ice predictions with data assimilation and machine learning," Cross-VESRI Convening, Cambridge, UK (2024)

W Gregory, M Bushuk, YF Zhang, A Adcroft, L Zanna. "Towards improving numerical sea ice predictions with data assimilation and machine learning, EGU General Assembly, Vienna, Austria (2024)

W Gregory, M Bushuk, YF Zhang, A Adcroft, L Zanna. "Machine learning for online sea ice bias correction within global ice-ocean simulations, AGU Ocean Sciences Meeting, New Orleans, LA (2024)

R MacEachern, M Tsamados, **W Gregory**, IR Lawrence, S Takao. "Fast interpolation of satellite altimetry data with probabilistic machine learning and GPU," EGU General Assembly, Vienna, Austria (2023)

W Gregory, M Bushuk, A Adcroft, YF Zhang, L Zanna. "Deep learning of systematic sea ice model errors from data assimilation increments," EGU General Assembly, Vienna, Austria (2023)

W Gregory, M Bushuk, A Adcroft, YF Zhang, L Zanna. "Deep learning of systematic sea ice model errors from data assimilation increments," EGU General Assembly, Vienna, Austria (2023)

W Gregory, M Bushuk, A Adcroft, YF Zhang, L Zanna. "Using deep learning to predict systematic model error from sea ice data assimilation increments in a fully-coupled climate model," AGU Fall Meeting, Chicago, IL (2022)

W Gregory, IR Lawrence, M Tsamados. "A Bayesian approach towards daily pan-Arctic sea ice freeboard estimates from combined CryoSat-2 and Sentinel-3 satellite observations," EGU General Assembly, Vienna, Austria (2021)

Teaching & Mentoring

2020	TA in BSc Geodynamics, UCL | Class size: 15-20. Format: Tutorials
2020	TA in BSc Ocean Physics, UCL | Class size: 15. Format: Tutorials
2019	TA in BSc Principles of Climate, UCL | Class size: 10-15. Format: Tutorials
2018-2019	TA in BSc Foundations of Physical Geoscience, UCL | Class size: 10-12. Format: Lectures and Tutorials
2018-2020	TA in BSc Introduction to Matlab, UCL | Class size: 15-20. Format: Lectures and Tutorials

2024-2025	Mentored Surya Dheeshjith, a laboratory associate within the Courant Institute for Mathematical Sciences at New York University. Surya was tasked with building a data-driven 3D ocean emulator, with Prof. Laure Zanna. My responsibilities were to guide Surya in the understanding of climate physics and the manifestation of ocean biases in coupled models.
2022	With Marc Deisinroth, co-supervised Ronald MacEachern, a postgraduate student undertaking the MSc Machine Learning course within the Department of Computer Science at UCL. I designed the MSc dissertation project, which was titled "Sea Ice Freeboard Interpolation using Gaussian Process Regression". Ronald achieved a thesis grade of Distinction. I then led an international collaboration to build Ronald's work into an open-source Python library, GPSat, along with the *Nature Communications* paper Gregory et al 2024.

Public engagement & Outreach

2025	Early-career panelist at the Science Philanthropy Alliance meeting, titled "The Next Generation"
2023	"AI is transforming climate forecasts for melting sea ice," *Advanced Science News Article*
2023-2024	Project development chair for the Climatematch academy outreach program | Responsible for managing individuals developing material for student projects
2022-2023	Curriculum content reviewer for the Climatematch Academy outreach program | Responsible for reviewing all content relating to fundamentals of climate science
2022	Presented on EDI progress within NOAA and GFDL, Princeton University and GFDL, NJ
2016	Delivered science outreach presentations to years 10-12, King Solomon Academy school, London UK
2021	"A new approach towards daily pan-Arctic sea ice freeboard estimates," *ESA, EO for Society*
2012-2013	Assisted in the Department of Geology open days at the University of Leicester | Responsible for welcoming members of the public to the department and also talking to prospective students about the Geology with Geophysics BSc program

Service

2024	AGU Fall Meeting 2024 Outstanding Student Presentation Award (OSPA) judge
2024	Reviewer for National Science Foundation (NSF) Arctic Natural Sciences program
2019-present	Peer reviewer for numerous international journals, including: The Cryosphere, JAMES, AMS Journal of Climate, Climate Dynamics, Quarterly Journal of the Royal Meteorological Society, AMS AI for Earth Systems, npj Climate and Atmospheric Science
2024	AGU Fall Meeting 2024 convener and chair for session: "NG011-II. Data Driven Science: Developments in Machine Learning Subgrid-Scale Parameterizations and in Reanalyses across Earth System Modeling"

Technical Skills & tools

- Ocean-sea-ice models: Modular Ocean Model version 6 (MOM6), Sea Ice Simulator version 2 (SIS2)
- Coupled climate models: Seamless system for Prediction and EArth system Research (SPEAR)
- AI techniques: Gaussian processes, deep neural networks (U-Net, Graph neural nets), principal component analysis, relevance vector machines, complex networks, data assimilation