

# FRASER WILLIAM GOLDSWORTH

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## RESEARCH EXPERIENCE

### **Post-doctoral research scientist, Climate Energetics group; Max Planck Institute for Meteorology, Hamburg (2023 — 2026)**

Work on the EU funded EERIE project, examining the ocean mesoscale in high-resolution (5 km) climate simulations on multi-decadal to centennial timescales. Co-lead of work package “mesoscale impacts on air-sea interactions”. Experience of running the ICON model at high-resolutions. Experience of analysing terra- to peta- scale datasets. Interests include the fate of freshwater in the North Atlantic, the AMOC, the impact of eddies on ventilation and anthropogenic carbon uptake. (*Supervisor: Professor Jin-Song Von Storch.*)

### **DPhil Student, Ocean Physics group; University of Oxford (2018 — 2022)**

*Symmetric instability in the Atlantic Meridional Overturning Circulation:* Investigated symmetric instability in the the cross-equatorial North Brazil Current and Deep Western Boundary Current, and the high latitude Irminger Current. Ran extremely high resolution experiments in the MITgcm to explore symmetric instabilities and their effects on density structure and water mass transformations. (*Supervisors: Professor David Marshall, Professor Helen Johnson. Thesis: <https://doi.org/10.5287/ora-xogpmrvzd>.*)

### **Junior scientist, RAPID AMOC expedition; National Oceanography Centre, Southampton (2020)**

Took part in a research cruise to service and deploy moorings which form part of the RAPID array. Was responsible for monitoring the quality of meteorological observations taken by on board instruments, as well as assisting in mooring operations. Produced a three dimensional map of the ship for use in outreach and training settings. (*Supervisor: Dr Ben Moat.*)

### **MSci research project, SPAT group; Imperial College London (2017 — 2018)**

*Understanding ocean carbon-cycle model sensitivities to prescribed forcings:* Investigated sensitivity of Ocean CO<sub>2</sub> uptake to atmospheric CO<sub>2</sub> concentrations and wind speed products, using the Transport Matrix Method for modelling tracer transport. (*Supervisor: Dr Heather Graven.*)

### **Summer research project, SPAT group; Imperial College London (2017)**

Investigated correlations between ship derived aerosol concentrations and aerosol concentrations in the clouds above them. Created a piece of semi-automated software that identifies ship-tracks in satellite imagery. (*Supervisor: Dr Edward Gryspeerdt.*)

### **Summer research project, Centre for Environmental Policy; Imperial College London (2016)**

Aided in literature search and review, extracting and summarising data on air pollution exposures of commuters from various studies. (*Supervisor: Dr Audrey de Nazelle.*)

## EDUCATION

### University of Oxford, Oxford, UK (2018 — 2022)

DPhil Physics (physical oceanography)

### Imperial College London, London, UK (2014 — 2018)

MSci Physics (1st class honours)

## RESEARCH INTERESTS

- Freshwater processes around Greenland.
- AMOC stability.
- The sub-polar North Atlantic.
- Symmetric instability & sub-mesoscale dynamics.
- The impact of the mesoscale and smaller on ocean ventilation.
- The impact of the mesoscale on air-sea fluxes and water mass transformation.
- High-resolution modelling from idealised models to coupled climate models.
- Climate change impacts on regional ocean dynamics.
- Dynamics of cross-equatorial flows.

## RELEVANT RESEARCH SKILLS & EXPERIENCES

- Co-lead of work package on large multi-institution EU project (EERIE).
- Co-convener of session “*Earth system models at km-scale and beyond: Benefits and challenges of resolving smaller scale processes*” at EGU26.
- PhD co-supervisor of Andrea Mosso (University of Hamburg). Supervised Masters internship of Hayat Nasirova (University of Bremen).
- Founder and lead of the *Hamburg sub-polar forum* at the University of Hamburg and the Max Planck Institute for Meteorology. We have monthly discussion meetings on topics related to sub-polar science with a membership of ~15 people from masters students to professors.
- Co-founder of the *Interface seminar* series at the Max Planck Institute for Meteorology. The monthly seminar encourages inter-departmental cooperation and collaboration.
- Strong background in theories of physical oceanography, AMOC science and submesoscale dynamics.
- Numerical modelling of geophysical flows using MITgcm & ICON.
- Data analysis in python including the handling of terra- to peta- scale datasets.
- Effective use of tier 1 HPC systems. Helped to test the UK’s ARCHER2 super computing system before it came online.
- Writing documentation for software & HPC systems.
- Open source software development, including use of git and automated testing.
- Experience of sea-going oceanography.
- Ability to conduct research independently.
- Have an international network of collaborators.

## PEER REVIEWED PUBLICATIONS

- Goldsworth, F. W.** (2026). A novel framework for studying oceanic freshwater transports, and its application in discerning the modelled fate of freshwater around the coast of Greenland. *Journal of Ocean Modelling*, 199, 102599. <https://doi.org/10.1016/j.ocemod.2025.102599>.
- Goldsworth, F. W.**, Johnson, H. L., Marshall, D. P., Le Bras, I. A. (2024). Destratifying and Restratifying Instabilities During Down-Front Wind Events: A Case Study in the Irminger Sea. *JGR: Oceans*, 129, e2023JC020365. <https://doi.org/10.1029/2023JC020365>.
- Goldsworth, F. W.**, Johnson, H. L., Marshall, D. P. (2022). Density staircases generated by symmetric instability in a cross-equatorial deep western boundary current. *Geophysical Research Letters*, 49, e2022GL100961. <https://doi.org/10.1029/2022GL100961>
- Goldsworth, F. W.**, Marshall, D. P., Johnson, H. L. (2021). Symmetric Instability in Cross-Equatorial Western Boundary Currents. *Journal of Physical Oceanography*, 51(6), 2049– 2067. <https://doi.org/10.1175/JPO-D-20-0273.1>.
- Wilson, J.D., **et al.** (2022) Carbon Sequestration by the Biological Carbon Pump in CMIP6 models: 21st century trends and uncertainties. *PNAS*, 119(29). <https://doi.org/10.1073/pnas.2204369119>
- Gryspeerdt, E., Smith, T. W. P., O'Keeffe, E., Christensen, M. W., **Goldsworth, F. W.** (2019). The impact of ship emission controls recorded by cloud properties. *Geophysical Research Letters*, 46, 12547– 12555. <https://doi.org/10.1029/2019GL084700>.
- Reviewing activities for Nature: Communications Earth & Environment, *Journal of Physical Oceanography*, *Geophysical Research Letters*, *JGR: Oceans*.

## SUBMITTED PUBLICATIONS

- Martin-Martinez, E., Moreno-Chamarro E., **Goldsworth, F. W.**, von Storch, J.-S., Arumí-Planas, C., Kuznetsova, D., Loosveldt-Thomas, S., Bretonnière, P.-A., Ortega, P. (Under revision, 2026). North Atlantic response to a quasi-realistic Greenland meltwater forcing in eddy-rich EC-Earth3P-VHR hosing simulations. *Ocean Science*. <https://doi.org/10.5194/egusphere-2025-5882>.

## PLANNED PUBLICATIONS

- Goldsworth, F. W.**, von Storch, J.-S., Brüggemann, N., Haak, H. (Outline only). Ventilation by mesoscale eddies has a negligible impact on the rate at which anthropogenic carbon is sequestered within the global ocean.
- Duyck, E., **Goldsworth, F. W.** (Early draft). Pathways and impacts of increased Greenland and Arctic freshwater fluxes to the Sub-polar North Atlantic.
- Mosso, A., **Goldsworth, F. W.**, von Storch, J.-S. (Outline only). The resolution dependence of water mass transformation budgets in the sub-polar North Atlantic.

## AWARDS

### **ARCHER2 image competition (2020)**

Winner of the best video category in scientific image competition run by UK's national supercomputer provider (£150).

### **St Anne's College graduate travel grant (2022)**

Awarded funding to attend Ocean Mixing GRC in Massachusetts, USA (£500).

### **NERC studentship (2018 — 2022)**

Awarded fully funded place on NERC environmental research DTP at the University of Oxford, covering tuition, stipend and research support grant (Approx. £100,000).

### **Ogden Trust summer internship (2016 & 2017)**

Received funding to carry out summer research projects at Imperial College London (Approx. £5,000).

## SUPERVISION, TEACHING & OUTREACH

### **Video publication on freshwater mixing around Greenland (2026)**

Produced a soon to be released "video publication" with the organisation *Latest Thinking*.

### **PhD co-supervisor, International Max Planck Research School (2024 — present)**

Co-supervising Andrea Mosso, a PhD student examining the sensitivity of the AMOC to diapycnal and isopycnal mixing parameterisations in coupled configurations of the ICON model.

### **HiWi supervisor, Max Planck Institute for Meteorology (2024)**

Supervised Hayat Nasirova, a masters student looking at how cross-equatorial symmetric instability manifests itself in high-resolution configurations of the ICON-Ocean model.

### **Tutor, University of Oxford (2021 — 2022)**

Ran tutorials and problems classes for several small groups of students, for a third year undergraduate fluids course. Responsible for the setting and marking of mock exams.

### **Demonstrator, University of Oxford (2019 — 2022)**

Demonstrated for three years on the advanced quantitative methods course for first year PhD students. Course covers numerical methods and scientific computing. Also demonstrated for undergraduate laboratory experiments.

### **Lead instructor, Oxford University Yacht Club (2022)**

Designed and taught the introduction to navigational theory course run by Oxford University Yacht Club. Topics covered include tidal calculations and theory, meteorology, and mathematics for navigation.

### **Outreach Talk, Trent Valley Sailing Club (2022)**

Gave an after dinner talk focussing on the drivers of the Atlantic Meridional Overturning Circulation, its impact on weather & climate, and the importance of net-zero.

### **Summer school coordinator, University of Oxford (2019)**

Planned and ran sessions at a two day summer school on "environmental research", aimed at penultimate year undergraduate students. Role involved administrative tasks such as managing registration and arranging accommodation, as well as organising science sessions.

## ADDITIONAL SKILLS AND COURSES

- Supervision: completed University of Hamburg “certified supervisor” training (2025).
- Coding: extensive experience with Python, bash & CDO, very good Matlab & Fortran, some experience of C.
- Use of Microsoft office suite of applications.
- Use of LaTeX for typesetting reports and manuscripts.
- *Effective oceanographic data analysis with Python*, Challenger Society for Marine Science (2022).
- *Ocean circulation*, graduate level course, University of Oxford (2020).
- *HPC: Introduction to advanced research computing & effective cluster use*, one day course, University of Oxford (2019).
- *Scientific computing for DPhils*, graduate level course, University of Oxford (2019 — 2020).
- *Scientific writing*, graduate level course, University of Oxford (2019).
- *Advanced quantitative methods*, graduate level course, University of Oxford (2018).
- Sea survival — STCW95 personal survival skills (2019), RYA MCA sea survival & World sailing.

## SOFTWARE CONTRIBUTIONS

*ICON* — *ICOsohedral Non-hydrostatic GCM*. Implemented a suite of passive tracers in the *ICON* model.

*ICONSPy* — *ICON Sections in Python*. Author of a package for analysing sections on an unstructured GCM grid.

*pyicon* — Frequent contributor to package which aids in the analysis of *ICON* model data on its native grid.

Abernathy et al. (2021). *xmitgcm* v0.5.2 (software). <https://doi.org/10.5281/zenodo.5139886>.

## INVITED TALKS

- National Oceanography Centre, Southampton, UK (November 2022).
- Universität Hamburg, Center for Earth System Research and Sustainability, Germany (June 2022).
- Met Office, Exeter, UK (May 2022).
- University of Cambridge, Department of Applied Maths and Theoretical Physics, UK (June 2020).

## CONFERENCE PRESENTATIONS & POSTERS

### **EGU General Assembly 2026 (submitted, Vienna)**

Ventilation by mesoscale eddies has a negligible impact on the rate at which anthropogenic carbon is sequestered within the global ocean.

### **Ocean Sciences Meeting 2026 (poster, Glasgow)**

Spatial and seasonal variability of diahaline mixing in the sub-polar North Atlantic and its role in freshwater transformation.

### **Cello 2025 (poster, Hamburg)**

Where and when does diahaline mixing destroy fresh waters around Greenland?

**EGU General Assembly 2025 (poster, Vienna)**

Exploring the mixing of freshwater around Greenland in a high-resolution climate model using the freshwater transformation framework.

**AMOC workshop 2024 (talk, Exeter)**

The fate of freshwater around Greenland: insights from an eddying coupled general circulation model.

**Ocean Sciences Meeting 2024 (talk, New Orleans)**

Eddy Transports of Freshwater from the Greenland Coastal Shelf to the Ocean Interior: New Perspectives from an Eddy Resolving Model.

**EGU General Assembly 2023 (talk, Vienna)**

Water mass transformation following instability in the mixed layer of the East Greenland Current.

**TRR181 meeting 2023 (poster, Hamburg)**

Water mass transformation by symmetric instability in the East Greenland Current.

**Physical Oceanography dissertation symposium XII 2022 (talk, Hawaii)**

Symmetric instability in the Atlantic Meridional Overturning Circulation.

**Challenger Conference 2022 (talk, London)**

Symmetric instability in components of the Atlantic Meridional Overturning Circulation.

**Gordon Research conference 2022 (poster, Springfield, MA)**

Density staircases and mixing barriers generated by symmetric instability in a deep western boundary current.

**EGU General Assembly 2022 (talk, Vienna)**

Symmetric instability in the surface and deep components of the Atlantic Meridional Overturning Circulation close to the equator.

**US CLIVAR AMOC meeting 2022 (poster, Woods Hole, MA)**

Symmetric Density staircases and mixing barriers generated by symmetric instability in a deep western boundary current.

**Ocean Sciences Meeting 2022 (talk, virtual)**

Symmetric instability in cross-equatorial western boundary currents.

**Challenger ocean modelling meeting 2021 (talk, virtual)**

Modelling symmetric instability in the Atlantic MOC.

**Pirata 24-TAV workshop 2021 (talk, virtual)**

Symmetric instability in cross-equatorial western boundary currents.

**TRR181 meeting 2021 (talk, virtual)**

Symmetric instability in cross equatorial western boundary currents.

**EGU General Assembly 2021 (poster, virtual)**

Symmetric (inertial) instability in cross-equatorial western boundary currents.

**Challenger ocean modelling group 2020 (talk, virtual)**

Symmetric instability in the cross-equatorial North Brazil Current.

## **LANGUAGES**

- English — native speaker.
- German — CEFR B1.
- French — CEFR A2.

## **REFEREES**

Professor Jin-Song von Storch, Max Planck Institut für Meteorologie, Hamburg, Germany.

Professor David P. Marshall, Atmospheric Oceanic and Planetary Physics, University of Oxford, UK.

Professor Helen L. Johnson, Department of Earth Sciences, University of Oxford, UK.