LEO MIDDLETON

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SUMMARY

Physical Oceanographer interested in ocean mixing, stirring and transport in the polar oceans. Process-based research using observations, theory, and simulations. Looking for a collaborative work environment that encourages me to develop new skills and tackle new challenges.

SKILL SET

- Ocean observation processing and analysis
- Ocean data collection
- Geophysical fluid dynamics
- Large-Eddy-Simulations
- Scientific computing (MATLAB, Python, Julia, Fortran)

EDUCATION

Ph.D, Physical Oceanography and Fluid Dynamics *October 2017 - September 2021*
DAMTP, University of Cambridge and *British Antarctic Survey (BAS)*

- **Thesis:** Unmixing the Ocean: Double Diffusion and Turbulence in Polar Oceans
- **Supervisors:** Dr. John Taylor (primary), Dr. Paul Holland and Dr. Keith Nicholls (co-supervisors)

M.Sci, Mathematics, First Class with Honours *October 2013 - June 2017*
University College London (with 1 year at *University of British Columbia*)

- **Thesis:** Perturbation Dynamics of a Thermally Forced Vortex in a Deep Rapidly-Rotating Fluid
- **Supervisor:** Prof. Ted Johnson

Undergraduate Research Project, London Mathematical Society
University College London *July 2015- August 2015*

- **Thesis:** Point vortex equilibria: Solutions of the Sinh-Poisson equation - from low to high energy
- **Supervisor:** Dr. Gavin Esler

EMPLOYMENT

Postdoctoral Investigator *November 2021 - July 2023*
Woods Hole Oceanographic Institute, Grant Funding

- **Supervisor:** Amala Mahadevan
- **Topic:** Submesoscale dynamics
- **Responsibilities:** Data collection, data calibration and analysis, preparing manuscripts, CALYPSO and S-MODE projects.

Build-The-Base Fellow *July 2023 - December 2024*
Woods Hole Oceanographic Institute, Independent Funding

- **Supervisors:** J. Thomas Farrar, Isabela Le Bras
- **Topic:** Connecting turbulence with submesoscales in the Arctic via high-resolution measurements
- **Responsibilities:** Cruise planning, funding acquisition, data collection, data calibration and analysis, preparing manuscripts, NORSE project.

Postdoctoral Researcher *December 2024 - Current*
Gothenburg University

- **Supervisor:** Anna Wåhlin
- **Topic:** Antarctic ice melt
- **Responsibilities:** Data collection, data calibration and analysis, preparing manuscripts, COSMUS, GOAT and iQ2300 Projects

FIELDWORK

Continental Shelf Multidisciplinary Flux Study II (COSMUS II)
Weddell Sea, Antarctica : *R/V Polarstern, AWI* *December 2024 - March 2025*

- **Principal Scientific Officer:** Dr. Olaf Boebel
- **Responsibilities:** Seal CTD tagging; mooring design, deployment and recovery; data processing and instrument calibration

Northern Ocean Rapid Surface Evolution (NORSE) IOP2 (https://www.mod.ucsd.edu/norse)
Jan Mayen, Norwegian Sea : *R/V Kronprins Haakon, NPI* *November 2023*

- **Principal Scientific Officer:** Prof. Jennifer Mackinnon
- **Responsibilities:** Towed-chain profiling lead; air-sea flux buoy preparation; data processing.

Sub-Mesoscale Ocean Dynamics Experiment (S-MODE) IOP2 (https://smode.whoi.edu/)
California Current, USA : *R/V Sally Ride, Scripps* *April 2023 - May 2023*

- **Principal Scientific Officer:** Dr. Andrey Scherbina
- **Responsibilities:** Night watch lead; EcoCTD profiling; data processing; data management.

Sub-Mesoscale Ocean Dynamics Experiment (S-MODE) IOP1 (https://smode.whoi.edu/)
California Current, USA : *M/V Bold Horizon, Eclipse Group* *October 2022 - November 2022*

- **Principal Scientific Officer:** Dr. Andrey Scherbina
- **Responsibilities:** EcoCTD profiling; data processing; data management; Nitrate sampling.

Coherent Lagrangian Pathways from Surface Ocean to Interior (CALYPSO) IOP2
Balearic Sea, Mediterranean : *R/V Pourquoi Pas? IFREMER* *February 2022 - March 2022*

- **Principal Scientific Officers:** Dr. Amala Mahadevan, Dr. Eric D'Asaro
- **Responsibilities:** Cruise organisation; drifter & float deployment; underway profiling; data processing; data management.

Ocean Regulation of Climate by Heat and Carbon Sequestration and Transports (ORCHESTRA)
January 2019 - February 2019
Orkney Passage, Southern Ocean : *RSS James Clark Ross, British Antarctic Survey*

- **Principal Scientific Officer:** Dr. Alexander Brearley,
- **Responsibilities:** Mooring recovery; CTD casts; glider & float deployment; salinometry.

Left-Right Asymmetry in Flowers
Cederberg, South Africa *August 2022*
Missouri, USA *August 2023*

- **Principal Scientific Officer:** Dr. Alice Fairnie,
- **Responsibilities:** Flower population counts; pollinator observations; data processing.

PAPERS

1. **Middleton, L.**, Wåhlin, A., Losch, M. (2025). Abyssal recipes in a warming ocean, *in revision* `https://mitgcm.org/~mlosch/middelton-etal_submitted.pdf`
2. **Middleton, L.**, Wu, W., D'Asaro E. A., Johnston, S., Rudnick, D., Tarry, D., Poulain, P. M., Farrar, J. T., Berta, M., Shcheribina, A., Mahadevan, A. (2025). Observations of a splitting ocean cyclone resulting in subduction of surface waters, *Science Advances*
3. **Middleton, L.**, Brown, J., and Taylor, J.R. (2025). Reconciling layering mechanisms in double-diffusive and single-diffusive fluids *, Journal of Fluid Mechanics: Rapids*
4. Wu, W., **Middleton, L.**, Tarry, D. R., D'Asaro, E. A., Mahadevan, A. (2025). Curvature-induced subduction in a cyclonic eddy. *Journal of Physical Oceanography*.
5. Donnet, S., Huntley, H. S., Berta, M., Centurioni, L., **Middleton, L.**, Özgökmen, T., ... Griffa, A. (2025). Surface evolution and wind effects during a cyclonic eddy splitting event in the Balearic Sea. *EGUsphere*

6. Zhou, S., Dutrieux, P., Giulivi, C.F., Jenkins, A., Silvano, A., Auckland, C., Abrahamsen, E.P., Meredith, M.P., Vaňková, I., Nicholls, K.W., **Middleton, L.** and Davis, P.E. (2025). The OCEAN ICE mooring compilation: a standardised, pan-Antarctic database of ocean hydrography and current time series, 2025, *Earth System Science Data*
7. Pružina, P., Zhou, Q., **Middleton, L.**, Taylor, J. R. (2025). Layer formation in double-diffusive convection diagnosed in sorted buoyancy coordinates. *Journal of Fluid Mechanics*
8. Gentil, M., Pallàs-Sanz, E., **Middleton, L.**, Ruiz-Angulo, A., Meunier, T., Durante, G., Tenreiro, M., Estrada-Allis, S.N. and Sheinbaum Pardo, J. (2024). Distribution, Mixing, and Transformation of a Loop Current Ring Waters: The Case of Gulf of Mexico , *Geophysical Research Letters*
9. Farrar, J.T., D'Asaro, E., Rodriguez, E., Shcherbina, A., Lenain, L., Omand, M., Wineteer, A., Bhuyan, P., Bingham, F., Villas Boas, A. B., Czech, E., D'Addezio, J., Freilich, M., Grare, L., Hypolite, D., Jacobs, G., Klein, P., Lang, S., Leyba, I., Mahadevan, A., McWilliams, J., Menemenlis, D, **Middleton, L.**, Molemaker, J., O'Neill, L., Perkovic-Martin, D., Pizzo, N., Rainville, L., Rocha, C., Samelson, R. M., Simoes-Sousa, I., Statom, N., Thompson, A., Thompson, D., Torres, H., Uchoa, I., Wenegrat, J., Westbrook, E.(2024). S-MODE: the Sub-Mesoscale Ocean Dynamics Experiment. *Bulletin of the American Meteorological Society (BAMS)*
10. **Middleton, L.**, Davis, P.E., Nicholls, K.W., and Taylor, J.R. (2022). Double-Diffusion as a Driver of Turbulence in the Stratified Boundary Layer under George VI Ice Shelf, *Geophysical Research Letters*
11. Fine, E. C., MacKinnon, J. A., Alford, M. H., **Middleton, L.**, Taylor, J., Mickett, J. B., and Peacock, T. (2021). Double diffusion, shear instabilities, and heat impacts of a Pacific Summer Water intrusion in the Beaufort Sea, *Journal of Physical Oceanography (JPO)*
12. **Middleton, L.**, Fine, E., Alford, M., Mackinnon, J. and Taylor, J.R. (2021). Estimating Dissipation Rates Associated with Double-Diffusion, *Geophysical Research Letters*
13. **Middleton, L.**, Vreugdenhil, C.E., Holland, P.R. and Taylor, J.R. (2021). Numerical Simulations of Melt-Driven Double-Diffusive Fluxes in a Turbulent Boundary Layer beneath an Ice Shelf, *Journal of Physical Oceanography*
14. **Middleton, L.** and Taylor J.R. (2020). A general criterion for the release of background potential energy through double diffusion, *Journal of Fluid Mechanics: Rapids*

PAPERS : IN-PREP

1. **Middleton, L.**, and Farrar, J. T., Statistics of curvature-modified frontogenesis in submesoscale flows
2. **Middleton, L.**, Mackinnon, J., Sanchez-Rios, A. and Farrar, J. T., Resolving vertical transport via finescale plume-like features in the Arctic Ocean

DATASETS

1. **Middleton, L.**, Johnston, S., Rudnick, D., Tarry, D., Poulain, P. M., Farrar, J. T., Berta, M., Shcheribina, D'Asaro E. A., A., Mahadevan, A. (2025). CALYPSO 2022 Cruise Data, https://doi.org/10.26025/1912/71856
2. **Middleton, L.**, and S-MODE Team (2024). S-MODE IOP1 Shipboard uCTD and EcoCTD Measurements Version 1. Ver. 1. PO.DAAC, CA, USA.https://doi.org/10.5067/SMODE-RVECT
3. **Middleton, L.**, and S-MODE Team (2023). S-MODE IOP2 Shipboard uCTD and EcoCTD Measurements Version 1. Ver. 1. PO.DAAC, CA, USA.https://doi.org/10.5067/SMODE-RVECT
4. **Middleton, L.**, Davis, P., and Nicholls, K. (2021). Borehole data from George VI Ice Shelf (Version 1.0). NERC EDS UK Polar Data Centre. https://doi.org/10.5285/c4a8ad33-2c09-44e9-b4ea-2923bb4b85f1,
5. **Middleton, L.**, Thunherr, A. (2024). Lowered acoustic Doppler current profiler (LADCP) data from cruise JR18004. NERC EDS UK Polar Data Centre. https://doi.org/10. 5285/1fbb7874-5433-3b07-e063-7086abcobee9,

FUNDED AWARDS

Build-the-base Fellowship Award: 18 month independant fellowship at WHOI, 2,000,000 kr *2023-2024*
NERC Ph.D Studentship: Full fee and maintenance award, 1,600,000 kr *2017-2021*
London Mathematical Society Research Bursary: Funding for summer research project, 50,000 kr *2015*

International Meteorological Institute Visitors Funding: Month visit to Gothenberg, 40,000 kr *2023*
Consiglio Nazionale della Richerche Visitors Funding: Two-week visit to CNR, Venice, 20,000 kr *2024*
International Meteorological Institute Visitors Funding: Two-week visit to Gothenberg, 20,000 kr *2024*
INI Visitors Funding: Funding for invited attendees to the Isaac Newton Institute program, 20,000 kr *2022*
GRC Funding: Funding for invited speakers to attend the Gordon Research Conference, 20,000 kr *2024*

PRIZES

NASA Group Achievement Award: for S-MODE Field Campaign *2023*
Smith-Rayleigh and Knight-Rayleigh Prize: First year Ph.D essay award *2019*
Susan N. Brown Prize: Best fourth-year undergraduate in Applied Mathematics *2016*
Dean's List: A commendation for undergraduates excelling in their chosen field *2016*
Andrew Rosen Prize: Awarded for excellence in second year Applied Mathematics *2014*
Jefferey Sessional Prize: Best results in first year B.Sc/M.Sci *2013*

SELECTED PRESENTATIONS

1. **Double Diffusion in the Global Oceans**
   Gordon Research Conference, 2024
2. **Ocean Cyclone Splitting Ventilates the Upper Ocean**
   Ocean Sciences Meeting, 2024; WHOI Seminar, 2023; VEPOSSSS Conference, 2023
3. **Un-mixing the Ocean: Double-Diffusion and Turbulence in Polar Oceans**
   Gordon Research Conference, 2024; VEPOSSSS Seminar,2022; MIT PAOC Seminar, 2022; OSU Seminar, 2022; Leeds Seminar, 2022; Cambridge GEP Seminar, 2021
4. **Melt-driven convection as a driver of under-ice turbulence**
   Maths on Ice Seminar, 2021; Forum for Research into Ice Shelf Processes, 2019; Atmospheric and Oceanic Fluid Dynamics Meeting, 2019; EGU General Assembly, 2020
5. **An introduction to layering beneath ice**
   KITP Layering Conference, 2021
6. **A general criterion for the release of background potential energy by double diffusion**
   UCL Seminar Series, 2019; Cambridge Seminar Series, 2019

TEACHING AND PUBLIC SCIENCE OUTREACH

Guest lecturer:
- Waves and Instabilities course for WHOI graduate students *2022, 2023*
- Combined Ocean Mixing Course, Experiments, and Practices for Turbulence Sampling (COMCEPTS) summer school *2025*

Supervision:
- Masters student on double-diffusive turbulence in polar observations
- Masters student on Getz Ice Shelf mooring data *2025*
- Geophysical Fluid Dynamics Summer School project supervision on simulations of doubly diffusive Kolmogorov flow *2024*
- Summer student on ADCP data taken during CALYPSO *2022*
- Summer student on mooring data beneath Filchner-Ronne Ice Shelf *2021*

Teaching assistant:
- Fluid Dynamics, final year undergraduate course *2020*
- FDSE summer school on numerical simulation *2019*
- Mathematics for Natural Sciences, first year undergraduate course *2019*

Outreach presentations:
- West-coast sea week, tall ship exhibition *2025*
- COP26 London Exhibition on behalf of BAS *2019*
- Bluedot festival on behalf of BAS *2021*
- Fluid dynamics lab experiments open day *2019*

ADDITIONAL ROLES

Reviewer:	GRL (4), JFM (6), JAMES (1), JPO (6), PRFluids (1), Cryosphere (1), JGR (6)	*2021-2025*
Convener:	• WHOI DEI working group on post-cruise surveys	*2022-2024*
	• CALYPSO working group on submesoscale dynamics	*2023*
	• WHOI Physical Oceanography retreat for strategic planning	*2023*
	• KITP Layering Workshop session on Layering Beneath Ice	*2021*
	• EGU session on Ice-Ocean Boundary Layers	*2020*
Organiser:	• Forum of Research into Ice Shelf Processes (FRISP)	*2026*
	• Polar heat workshop	*2026*
	• WHOI Physical Oceanography seminar series	*2023-2024*
	• CALYPSO symposium	*2022*
	• Ice Shelf-Ocean Boundary Layers group meeting	*2017-2020*
	• G.K.Batchelor Laboratory seminar series	*2018-2019*
	• British Antarctic Survey student symposium	*2018*
Member:	• CLIVAR Northern Oceans Regional Panel	*2025*
	• WHOI Fieldwork Climate working group	*2023-2024*
	• WHOI Strategic Planning working group	*2023*