Wenrui Jiang

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Research Interest

I am broadly interested in understanding the transports and mixing happening in the ocean, especially at high latitude, where ocean circulation plays a critical role in global climate. I use a combination of Lagrangian particle tracking and budget analyses to study the evolution of tracer (heat, salinity, nutrient...) anomalies. I am also interested in submesoscale dynamics. I am currently working on a project about the interaction between submesoscale filaments and inertia-gravity waves with large-eddy simulation.

Education

Johns Hopkins University *Sept 2021 – Dec 2025*
Ph.D. in Physical Oceanography *(expected)*
M.S. in Earth and Planetary Sciences
M.S.E. in Mechanical Engineering (2024)

Fudan University *Sept 2017 - June 2021*
B.S. in Atmospheric Science (2021)
Minor in Data Science (2021)

UCLA *Sept 2019 - Dec 2019*
Exchange student at Department of Atmospheric and Oceanic Sciences

Publications

[1] **Wenrui Jiang**, Gaël Forget, Yuanyuan Song, and Thomas W. N. Haine. Prolonged Marine Heatwave in North-Eastern Pacific Caused by Air-Sea Interaction. *(In Prep)*, 2025.

[2] **Wenrui Jiang** and Thomas W. N. Haine. Generation and Propagation of Eastern Subpolar North Atlantic Salinity Anomalies. *(In Prep)*, 2025.

[3] **Wenrui Jiang** and Thomas W. N. Haine. Tracer Budgets on Lagrangian Trajectories. *ESS Open Archive (Under Review)*, January 2025.

[4] Thomas W. N. Haine, Stephen M Griffies, Geoffrey Gebbie, and **Wenrui Jiang**. A Review of Green's Function Methods for Tracer Timescales and Pathways in Ocean Models. *ESS Open Archive (Under Review)*, August 2024.

[5] **Wenrui Jiang**, Thomas W. N. Haine, and Mattia Almansi. Seaduck: A Python Package for Eulerian and Lagrangian interpolation on ocean datasets. *Journal of Open Source Software*, 8(92):5967, December 2023.

[6] Thomas W. N. Haine, Ali H. Siddiqui, and **Wenrui Jiang**. Arctic Freshwater Impact on the Atlantic Meridional Overturning Circulation: Status and Prospects. *Phil. Trans. R. Soc. Lond. A*, 381(2262), October 2023.

[7] **Wenrui Jiang**, Liguang Wu, and Qingyuan Liu. High-Wind Drag Coefficient Based on the Tropical Cyclone Simulated With the WRF-LES Framework. *Frontiers in Earth Science*, 9, May 2021.

Conference Proceedings

[1] **Wenrui Jiang** and Thomas W.N. Haine. Lagrangian budget on the subpolar north atlantic salinity anomalies (poster). Ocean Sciences Meeting 2024. AGU, 2024

[2] Thomas W.N. Haine and **Wenrui Jiang**. Democratize the Data: A New Way to Analyze Ocean Models (townhall). Ocean Sciences Meeting 2024. AGU, 2024

Invited Talks

[1] Poseidon Viewer: a Visualization Tool for Petabyte-scale Ocean Data, Free and Open Source Software Project Fund (FOSSProF) Summative Event, Oct. 7th, 2024.

[2] Lagrangian Budget Description of Salinity Anomalies in the Eastern Subpolar North Atlantic, MIT SLS seminar, June 18th, 2024.

Open source projects

Seaduck *seaduck*

- A tool for interpolation, Lagrangian particle simulation, and closing tracer budget on Lagrangian trajectories.
- Develop, test, and continuously maintain.
- Documentation: macekuailv.github.io/seaduck/

Poseidon viewer *poseidon-viewer*

- A visualization tool for the LLC4320 ocean dataset.
- Develop the backend interpolator and the documentation.
- Documentation: sciserver.github.io/poseidon-viewer

Oceanspy *oceanspy*

- A Python package to facilitate ocean model data analysis and visualization maintained by Haine's group.
- Maintenance and updates.
- Documentation: oceanspy.readthedocs.io

Current Research Projects

Interaction Between Inertia-Gravity Waves and Submesoscale Filaments in the Upper Ocean
Collaborators: *Thomas W.N. Haine, Peter P. Sullivan, Charles Meneveau*

- We use NCAR-LES to simulate the evolution of upper ocean submesoscale filaments.
- At their mature stage, we introduce compact inertia-gravity wave trains via perturbations to the initial state.
- My focus is on diagnosing energy dissipation and vertical energy transport through analysis of along-filament-averaged turbulent kinetic energy (TKE) budgets. This work contributes to understanding energy pathways in the upper ocean — a key uncertainty in climate modeling.
- Wavelet transform and Generalized Lagrangian Mean (GLM) theory will be used to to quantify pseudomomentum transfer and wave–mean flow interactions.

Air-sea Interaction Sustained the 2014-2015 Intense Marine Heat Wave in the North Pacific (In Prep)
Collaborators: *Gael Forget, Yuanyuan Song, Thomas W.N. Haine*

- We use passive tracers and a Lagrangian budget framework to investigate the three-dimensional evolution of the 2014–2015 marine heatwave.
- The marine heatwave resulted from three distinct surface heating events. Anomalous Ekman transport in the California Current Upwelling Zone and at the North Pacific Current temperature front sustained the warming. During winter, heat loss was reduced due to elevated air temperatures and dew points.
- A persistently strong Aleutian Low decreased Ekman cooling and enhanced poleward transport of heat and moisture, which sustained the marine heat anomaly
- The intensified sea surface low is plausibly linked to the surface warm anomaly, suggesting a positive feedback loop.

Generation and propagation of eastern subpolar North Atlantic salinity anomalies (In Prep)
Collaborators: *Thomas W.N. Haine*

- Using ECCO v4r4 reanalysis and Lagrangian particle tracking, we trace water parcels affecting the eastern Subpolar North Atlantic backward in time. Key transport pathways and their variability are identified.
- A fresh and a salty extreme event are analyzed in detail from the Lagrangian budget perspective. The results reconcile competing explanations of the events by giving a more quantitative description. The importance

of changes in stratification and thus the effect of vertical diffusion is highlighted.

- A large budget analysis equivalent to 100 billion particle years of Lagrangian simulation is conducted, offering a quantitative, mechanistic view of how upstream anomalies shape downstream salinity patterns.

Teaching Experience

Spring 2023	TA and guest lecturer, 'Oceans and Atmospheres', Johns Hopkins University
Fall 2022	TA, 'Introduction to Global Environmental Change', Johns Hopkins University

Awards

2020	The 2nd Conditional Nonlinear Optimum Perturbation (CNOP) method summer school: Outstanding Student
2020	Interdisciplinary Contest in Modeling: Meritorious Winner
2018	First-class Scholarship (2nd out of 80)
2017	Freshman Scholarship (Top 5%)

Leadership and Volunteering

Sept. 2023 - June 2024	Website Manager for Chinese-American Oceanic and Atmospheric Association
Feb. 2023 - July 2023	Host of "Ocean Seminar" among Oceanographers in Maryland
Feb. 2023 - present	Host of "A&O Seminar/Meeting" at JHU, a weekly research exchange among graduate students and faculty
March 2021 - May 2021	Volunteer Teacher, Qingpu, China
Jan. 2019 - Aug. 2019	President of Fudan Astronomy Club