GFD Newsletter 2025

Faculty of Walsh Cottage

The 2025 GFD photograph with the 12 fellows in the front

Summer Lectures

The 2025 Geophysical Fluid Dynamics Summer Study Program started on June 16th and the topic this year was *Instabilities and Bifurcations in GFD*. The principal lectures were given by Professors Joseph Pedlosky (WHOI) and Laurette Tuckerman (ESPCI Paris), with additional tutorials from Glenn Flierl and Keaton Burns. Joe's lectures covered various aspects of the baroclinic instability, while Laurette's lectures explored the notion of bifurcations through dynamical systems theory.

Pascale Garaud (UC Santa Cruz) and David Goluskin (University of Victoria) were co-directors. They took turns to welcome many long- and short-term visitors, and to ensure that the 12 fellows they had selected were working hard (but not too hard). Almost all of the long-term visitors were able to advise fellows, either individually or in groups. As an added feature this year, the co-directors offered a lecture on 'How to Give Talks' to the fellows, which seemed to have paid off as the quality of the final week's presentations was outstanding.

As usual, laboratory experiments were facilitated by able support from Anders Jensen. Janet Fields and Julie Hildebrandt made sure that the administrative side of the summer ran smoothly. We continue to be indebted to the WHOI Academic Programs Office, who once more provided a perfect atmosphere.

Schedule of Principal Lectures

Week 1: Joseph Pedlosky

Monday, June 16: *Discussion of Quasi Geostrophy, Quasi Geostrophic Potential Vorticity, Conditions for Instability and Physical Interpretation*

Tuesday, June 17: *Weakly Nonlinear Theory: The 2-layer Model, Critical Shears for Instability, Multiple Time Scales for Supercritical Flows, Chaos*

Wednesday, June 18: *The Role of Topography and Radiation, an Example of Radiation-induced Instability*

Friday, June 20: *Instabilities Evolving in Space and Time: The Role of Chaos and Chaotic Shocks*; *Giants: A History. Eady and Charney, Their Contributions and the History of the Charney/Burger Problem*

Week 2: Laurette Tuckerman

Monday, June 23: *Dynamical Systems and Bifurcations*

Tuesday, June 24: *Symmetry via Taylor–Couette Flow and Rayleigh–Bénard Convection*

Wednesday, June 25: *Applications to the Eckhaus Instability, D4 Scenario, and Others*

Thursday, June 26: *Transition to Turbulence and the Self-sustaining Process*

Friday, June 27: *Codimension-two Bifurcations*

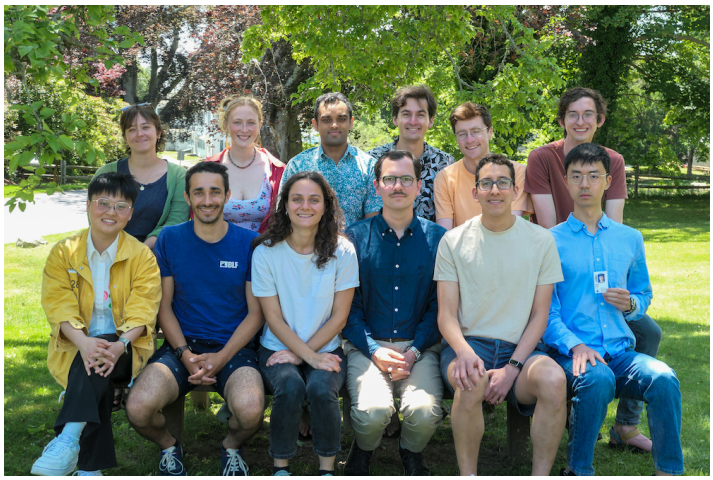
Joe Pedlosky and Laurette Tuckerman

Fellows' Projects

To make up for the post-COVID 2022 GFD program, where only 8 fellows were invited, this year we hosted 12 fellows. Despite uncertainties about international visas, everyone made it to Woods Hole.

The GFD faculty spent the summer advising the GFD Fellows on their summer research projects. As usual, the fellows are strongly encouraged to work in areas unrelated to their PhD thesis topics and to engage with as many of the faculty and visitors as possible. The reward for all involved is the final week of the summer when the fellows give lectures on their projects, which are as widely varied as the fellows' backgrounds.

Emma, Edoardo, Dave and Marion in their office.



2025 Fellows

2025 GFD Fellows and their research projects:

Edoardo Bellincioni, University of Twente
Effect of Burger Number on Two Rotating Currents

Emma Bouckley, University of Cambridge
Secondary Shear Instabilities on Kelvin-Helmholtz Braids

Marion Cocusse, École Polytechnique
The Interaction of a Gravity Wave with an Unstable Horizontal Shear at Low Froude Number

Isabela Conde, University of New South Wales
Upslope and Downslope Flow Along Ocean Bottom

David Darrow, MIT
Global Stability Beyond the Energy Method

Theo Lewy, University of Cambridge
Optimal Heat Transport in Steady Rayleigh–Bénard Convection

Kyle McKee, MIT
Pattern Transitions in Faraday Waves: From Hexagons to Beaded Stripes

Andrés Posada, Queen's University
Submarine Waterfalls: Dynamics of Gravity Currents over Stepped Slopes

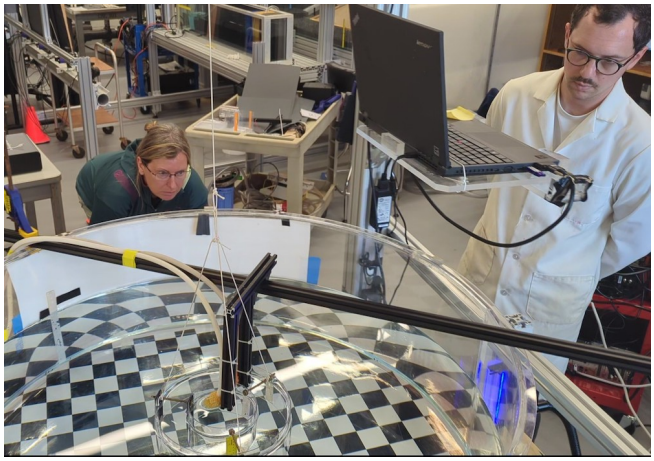
Heng Quan, Princeton University
Linear Waves vs. Nonlinear Potential Vorticity Mixing—Which Determines the Equatorial Jet Direction in Planetary Atmospheres?

Farid Rajkotia-Zaheer, University of Victoria
Ray Theory for Rotating Hyperbolic "Instabilities"

Alexandre Tlili, CEA Saclay
Weakly Nonlinear Dynamics of Vorticity Patches from Hamiltonian Contour Theory

Lin Yao, University of Chicago
Baroclinic Instability as a Driver of Polar Vortices on Giant Planets

Pictured on the left: Top row: Bella, Emma, Farid, Theo, Kyle and David. Bottom row: Lin, Alexander, Marion, Edoardo, Andrés, Heng.

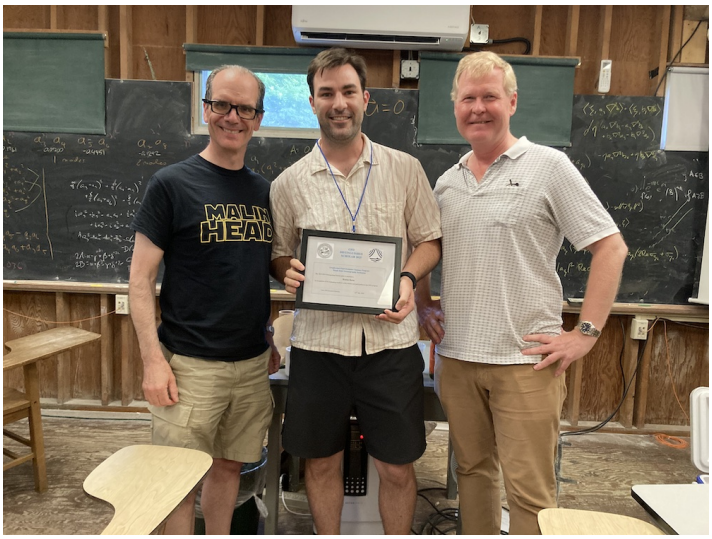


Left: Kyle, Laurette,Theo and Marion on the porch; Right: Edoardo and Claudia in the lab.

Karaoke and volleyball have become a new tradition at GFD.

The Distinguished Scholar award

During a particularly delightful GFD awards ceremony hosted as usual by Colm-cille Caulfield and Bruce Sutherland, this year's Distinguished Scholar Award was presented to Keaton Burns, for his academic excellence, service to the GFD community supporting use of the Dedalus code, and dedication to mentoring the next generation of fellows. Congratulations Keaton!



Keaton Burns (middle) receiving his award from awards night hosts Colm-cille Caulfield (left) and Bruce Sutherland (right)

Softball Report (by team captain Emma Bouckley)

As always, softball formed a pivotal part of the summer for us fellows. As the democratically appointed team captain of the GFD dynamos, I, Emma, have the honour of reporting back the trials and triumphs of the season.

After a long lesson in the theory of softball by Greg, we had a brief practice before diving into our first game against MBL. It was a tremendous win for the Dynamos: 40-12. It looked like a promising summer for the team! Unfortunately, the rest of the summer continued on a downwards trajectory with no further wins. We would like to claim an additional three technical victories on the grounds that the opposing teams had insufficient players. Sadly, two of these teams still beat us after we accidentally donated our best players, Daniel and Keaton, to them (oops!). The final technical win came from the cancelled staff vs. students match, which was replaced by a volleyball match at Jim and Claudia's — won by the staff. These matches were survived with beers (thank you to our beer sponsors) and the promise of a post-softball Pie in the Sky.

While we may not have found success on the field, the team was hailed by many as the best team in years. Special recognition goes to Farid, our star pitcher, who caught the most outs and played brilliantly alongside our infield dream team of Kyle (1st), Dave (2nd), Edoardo (3rd) and Alex (SS). Alex's endless energy kept us all motivated — even if it did result in a dog-biting incident (he bit the dog, not the other way round). No one will forget Theo's two miracle catches in the final game, which more than made up for a less than stellar batting reputation. And a shout-out to Sam for committing so hard to the game that he ended up with many injuries for not much reward.

First game of the season 2025 was a win!

The Sears Public Lecture

The 2025 Sears Public Lecture was delivered by Professor Jennifer MacKinnon, of the Scripps Institution of Oceanography at UC San Diego, on "Fresh, Salty or Spicy: How Layering of Different Types of Water Controls Heat, Hurricanes, and Habitats in the Gulf of Mexico." Jen's talk was an unforgettable public lecture. It blended her experience as a physical oceanographer at sea, public advocacy for sustained scientific research on climate change, and explanations of her latest research that were made accessible through outstanding pedagogy and audience participation.

Next summer program

The 2026 GFD summer program will start on June 15th, 2026, on the topic of *Oceanic Internal Gravity Waves*. The principal lecturers are Jennifer MacKinnon (Scripps) and Bruce Sutherland (University of Alberta). Please email the program directors, Megan Davies Wykes (msd38@cam.ac.uk) and Stefan Llewellyn Smith (sgls@ucsd.edu), if you are interested in participating.

The GFD Website

The lectures notes and reports are available online at gfd.whoi.edu. The GFD website also contains:

- lecture and seminar schedules
- electronic versions of proceedings and newsletters
- lists of alumni and visitors
- application materials
- picture galleries of life at GFD

The GFD Faculty

Oliver Buhler, *New York University*
Keaton Burns, *MIT*
Colm-cille Caulfield, *University of Cambridge*
Claudia Cenedese, *WHOI*
Eric Chassignet, *Florida State University*
Greg Chini, *University of New Hampshire*
Raffaele Ferrari, *MIT*
Glenn Flierl, *MIT*
Pascale Garaud, *UC Santa Cruz*
Renske Gelderloos, *Delft University of Technology*
David Goluskin, *University of Victoria*
Alexis Kaminski, *UC Berkeley*
Wanying Kang, *MIT*
Stefan Llewellyn Smith, *UC San Diego*
James McElwaine, *WHOI*
Colin Meyers, *Dartmouth University*
Philip Morrison, *University of Texas at Austin*
Joseph Pedlosky, *WHOI*
Tiffany Shaw, *University of Chicago*
Bruce Sutherland, *University of Alberta*
Jean-Luc Thiffeault, *University of Wisconsin*
Geoff Vallis, *University of Exeter*
John Wettlaufer, *University of Oxford*
Jack Whitehead, *WHOI*
Megan Davies Wykes, *University of Cambridge*

The GFD Faculty handles the scientific and administrative duties of the school. This group is made up of members of the scientific community, across several disciplines, united by their interest in GFD. These are the faces to be seen at GFD over future summers, and their varied research interests help to define the scientific direction and flavor of the Program. GFD faculty must commit to spending at least one full summer every 5 years at the GFD program, and are encouraged to step down if they cannot continue to do so.

New GFD faculty are nominated and elected every year by the current GFD faculty. In 2025, we welcomed **Keaton Burns** from MIT to the faculty.

The current executive committee of the GFD faculty is composed of **Claudia Cenedese, Greg Chini, Pascale Garaud, Stefan Llewellyn Smith**, and **Bruce Sutherland**. The executive committee is in charge of topic selection, fundraising, and overall programmatic oversight.

Contributions

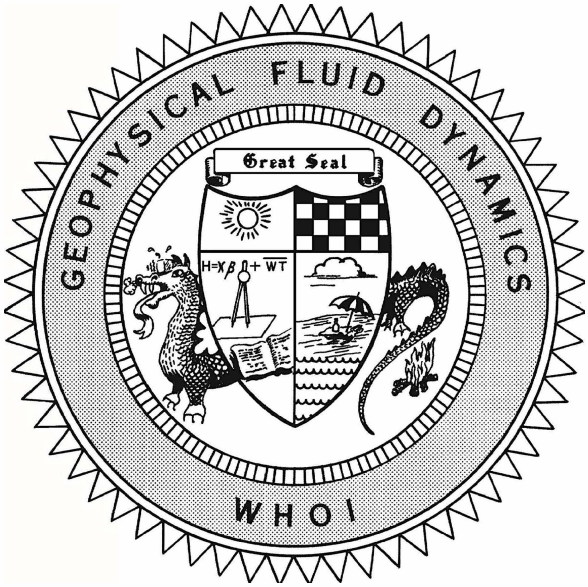
As of now, the GFD program does not have NSF funding for summer 2026 onward. Any contributions to the GFD Program endowment fund will help support the continuation of the Program in the future. The fund is administered at WHOI under the guidance of Claudia Cenedese. If you would like to contribute, please send your check (made payable to WHOI) to

Woods Hole Oceanographic Institution
GFD Fund, MS 40
Woods Hole, MA 02543

Donations can also be made by credit card by calling the Development office at 508-289-4895.

Please send comments or suggestions about this newsletter or the GFD Program to `ccenedese@whoi.edu`.

The GFD Program thanks the National Science Foundation for many years of financial support. The Woods Hole Oceanographic Institution also provides support, including the use of the historic Walsh Cottage.


GEOPHYSICAL FLUID DYNAMICS
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