IMPERIAL

Grantham Institute – Climate Change and the Environment
Department of Civil and Environmental Engineering

PhD Post in Environmental Fluid Mechanics (Imperial College, South Kensington campus)
Funding: Home fees only and stipend (3.5 years)
Project title: Laboratory investigation of ocean mixing but stratified turbulence
Supervisor: Dr Adrien Lefauve

Description: Ocean turbulence controls the transport of salt, pollutants, sediments, and nutrients, shaping water quality, erosion, fisheries, and sub-sea infrastructure. Yet turbulence remains one of the last unsolved problems in classical physics. Understanding how it mixes stratified (layered) fluids is key for predicting and managing the impacts of climate change [1].

This PhD will focus on designing and carrying out new laboratory experiments in Imperial's Hydrodynamics Laboratory (see figure 1), using hydraulic flumes and advanced experimental techniques to visualise and accurately measure fluid flow and mixing. A central theme will be the physics of shear instabilities (see [2] and figure 2) and other processes too small to be directly resolved in numerical ocean models.

The scope is quite broad, but experiments will likely be complemented by theory and by analysis of cutting-edge field observations (see [3] and figure 2), providing an opportunity to connect laboratory physics with real-world oceanographic processes. The ultimate aim is to distil new insights into practical models for mixing, advancing both fundamental fluid mechanics and applied climate/ocean prediction. There is also scope for fieldwork with colleagues in the USA.

Skills gained: Valuable multi-disciplinarity skills in fluid mechanics and oceanography, including experimental skills, modelling physical systems (turbulence, numerical models), data science and management (image analysis, handling environmental datasets) and, potentially, fieldwork and training, depending on the student's interests. These skills align with the 'most wanted skills' for environmental science identified by the Natural Environment Research Council, guaranteeing exciting post-PhD career prospects in academia or industry.

Figure 1: One of the many hydraulic flumes in the Hydrodynamics Laboratory in Civil Engineering

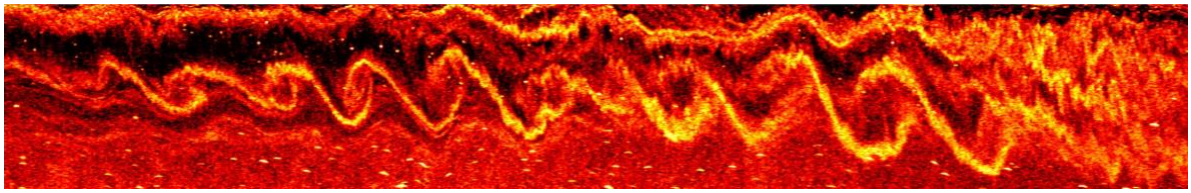

Figure 2: Acoustic measurement in an estuary revealing the structures behind turbulent mixing

Essential:

- First-class or strong 2:1 degree (or international equivalent) in engineering, physics, mathematics, oceanography or closely related, and familiarity with fluid mechanics.
- Masters-level degree
- Good English writing and communication skills (e.g. IELTS 7.0 or TOEFL 100 overall).
- Experience with scientific programming and data analysis (e.g. MATLAB, Python, Julia)
- Evidence of strong critical thinking, organisation, time management and independence.
- Motivation for hands-on laboratory research in a fluids laboratory, mathematical modelling, and physical understanding of environmental flows.

Desired but not essential:

- Research experience and high-quality outputs.
- Knowledge of one or more of the following: hydraulics, waves, turbulence, experimental techniques (software, hardware, acquisition), oceanography, acoustics.

Funding: The studentship will provide funding for tuition fees at the level of Home (UK) students and a tax-free stipend at the standard UKRI London rate (£22,780 pa for 2025/26). The funding can also be used to partially support an international student, combined with other scholarships, although such scholarships have strict deadlines and tend to be extremely competitive.

How to apply:

Enquiries and applications should be made to Dr Adrien Lefauve at **a.lefauve[at]imperial.ac.uk** with the following materials in a single PDF file (under 20 MB):

- Cover Letter explaining your motivation and suitability, including details of prior research
- CV
- Undergraduate and masters transcripts with grades and class rankings (if any)
- If relevant, English testing results, i.e. IELTS or TOFEL
- Details of two academic referees (including name, affiliation, and email address).

Application via the Imperial College Registry is not necessary at this stage.

Review of applications will begin immediately and continue until the position is filled.

References:

[1] Dauxois, T., *et al.* 'Confronting grand challenges in environmental fluid mechanics.' *Physical Review Fluids* **6**, 020501 (2021)

[2] Smyth, W. D., and Moum, J. N. 'Ocean mixing by Kelvin-Helmholtz instability.' *Oceanography* **25**(2):140–149, http://dx.doi.org/10.5670/oceanog.2012.49 (2012)

[3] Geyer, W. R., Lavery, A. C., Scully, M. E. and Trowbridge, J. H. 'Mixing by shear instability at high Reynolds number.' *Geophysical Research Letters* **37**, 2010GL045272 (2010)