PhD Proposal

Transport of plastic particles by a gravity current in a stratified environment: an Eulerian–Lagrangian approach

Supervision: Mickaël Bourgoin (DR CNRS LPENS de Lyon), Romain Volk (MCF LPENS de Lyon), Yvan Dossmann (MCF LEMTA). Contact : yvan.dossmann@univ-lorraine.fr

Expected start date : Spring 2026

Keywords : Particle transport, stratified flows, turbidity currents, lagrangian tracking, eulerian techniques.

Salary : minimum 2300 €/month gross salary.

Description : Plastic pollution is a major threat to riverine and marine ecosystems. However, only a small fraction of plastic particles entering the oceans remains at the surface. The mechanisms by which they are transported to deeper layers are still poorly understood. Turbidity currents—gravity-driven flows laden with sediments—have been identified as a key vector in this transport process. Understanding the transport properties of these currents is therefore crucial for addressing environmental and public health challenges.

The main objective of this PhD project is to characterize the transport of plastic particles by gravity currents in increasingly realistic configurations, taking into account density stratification (vertical density gradients) and the physical properties (geometry, density) of both sedimentary and plastic particles.

This experimental thesis will be conducted primarily using the facilities dedicated to stratified and particle-laden flows at LEMTA (UMR 7563, Vandoeuvre-lès-Nancy) and at the Physics Laboratory of ENS Lyon (UMR 5672). The scientific originality of the project lies in the study of plastic particle transport in a stratified environment. From a metrological standpoint, the implementation of Eulerian measurement tools (PILAT + PIV) and 3D Lagrangian tracking techniques (Lavision Minishaker) will provide new insights into plastic particle trajectories and their coupling with flow dynamics.

The PhD project will be carried out using two complementary experimental configurations: a turbidity current setup developed at LEMTA, and a stratified turbulent column at LPENSL. This dual-laboratory approach enables a unique combination of Eulerian and Lagrangian measurement techniques, taking advantage of the complementary expertise and instrumentation of both teams. The candidate will benefit from regular exchanges between the two sites and joint supervision across both institutions.

They will also be supported by the national collaboration network of the thesis supervisors offering opportunities to enrich the project through comparisons with field cases and numerical simulations.

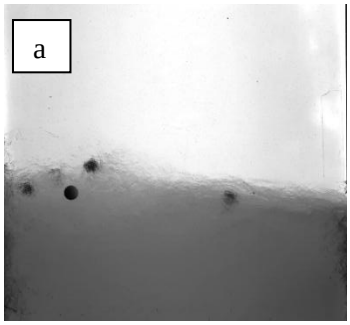
Host laboratories :

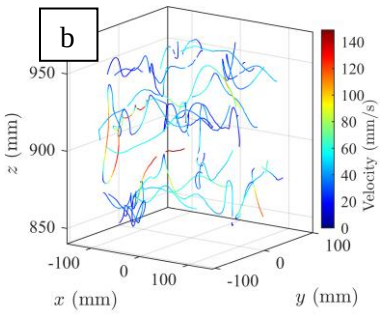
LEMTA (Laboratoire Energies et Mécanique Théorique et Appliquée)
Supervisor: Yvan Dossmann
Location : Vandoeuvre-lès-Nancy, France (Université de Lorraine – ENSEM site)
Research focus:
LEMTA is a joint research unit (UMR 7563) in engineering sciences, with expertise in fluid mechanics, heat and mass transfer, energetics, and complex media mechanics. The laboratory develops both fundamental and applied research, with strong contributions to environmental flow modeling, energy systems, and thermal processes.

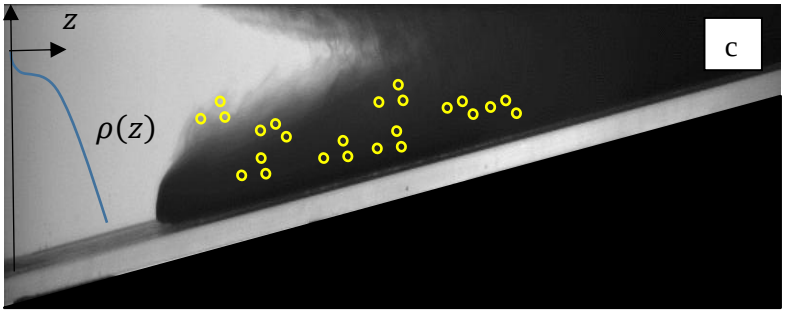
LPENSL (Laboratoire de Physique de l'École Normale Supérieure de Lyon)
Supervision: Romain Volk and Mickaël Bourgoin
Location : Lyon, France (ENS de Lyon, Monod site)
Research focus:
LPENSL is a joint research unit (UMR 5672) recognized for its fundamental research in nonlinear physics, fluid mechanics, statistical physics, condensed matter, and quantum systems. The lab is internationally renowned for its experimental and theoretical work on complex systems, particularly in the areas of geophysical fluid dynamics, turbulence, and hydrodynamic instabilities.

Application :

Via CNRS portal : https://emploi.cnrs.fr/Gestion/Offre/Default.aspx?Ref=UMR7563-YVADOS-002







a. Particles at a density interface (LPENSL).

b. 3D Lagrangian particle tracking (LPENSL).

c. Propagation of a turbidity current in a stratified environment (LEMTA).