Master 2 - Internship proposal
2022-2023

Sedimentation of microplastics in the ocean mixed layer:
numerical study of a model system

Laboratory: Unité de Mécanique de Lille J. Boussinesq, Univ. Lille Villeneuve d'Ascq, Cité Scientifique
Supervisors: Enrico Calzavarini et Stefano Berti (Univ. Lille, ULR 7512 - Unité de Mécanique de Lille - Joseph Boussinesq (UML))
Duration: 6 months (from february/march 2023)

Context: Most plastics in the ocean break up into very small particles. These tiny plastic bits, that can be quite different in shape and weight, are collectively called *microplastics*. Scientists believe microplastics are present in oceans around the world, but unlike larger plastics which can be easily seen, microplastics are harder to find. Ocean currents and circulation patterns move microplastics around like pollens in air, making them difficult to track. Presently, it is challenging to provide a quantitative description of the depth concentration profiles of microplastics or to quantify the time they spend within the ocean upper mixed layer before descending into the calmer deep-ocean. In this internship we plan to address these questions by means of a theoretical model system based on a representation of evolving particles and flow fields (a so called Lagrangian-Eulerian model) which can be studied by means of numerical simulations.
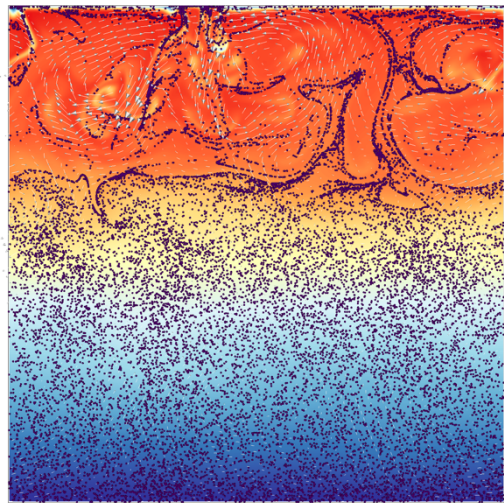

Figure: Test simulation of particles dispersed by inhomogeneous turbulence in the model system of ocean mixed layer

Objectives:
1) Perform numerical simulations of sinking particles with different material properties in a model system of the ocean mixed layer
2) Analyze the produced datasets focusing on microplastics mean vertical profiles, on the formation of long-lived clusters and residence times. We will adopt the statistical methods used in the context of turbulent flows.
3) Interpretation of results by means of theoretical approaches.

Methods: The candidate will learn state of the art computational fluid dynamics techniques for particle laden flows and will perform computationally intensive data analysis. This position will be based at the *Unité de Mécanique de Lille J. Boussinesq (UML) ULR 7512* of Lille University (France) https://uml.univ-lille.fr . The candidate will integrate a team of researcher in mechanics, fluid dynamics and its applications, where he/she will be supervised by Enrico Calzavarini and Stefano Berti.

Required skills: We are looking for an enthusiast candidate with basic knowledge of fluid-dynamics and an intermediate-level in programming (C and Python preferred languages).

How to apply: Please send an email to Enrico Calzavarini (enrico.calzavarini@polytech-lille.fr) with the subject line: **M2_microplastics**, and include the following documents: (i) Cover letter of 1 page with a brief summary of the candidate's academic experiences and research goals (ii) Curriculum vitae (please include at least the name of one academic mentor/teacher that we might contact for a recommendation).