**PROPOSITION DE STAGE – MASTER 2 DET**
Dynamique des fluides, Energétique et transferts
Université Toulouse 3 Paul Sabatier - Toulouse INP - INSA Toulouse - ISAE SUPAERO – IMT Mines Albi

**Titre :** Modélisation de laboratoire des courants de turbidité -- Laboratory modelling of turbidity currents

Responsable(s) : Cyril Gadal, Post-Doctorant – cyril.gadal@imft.fr
Matthieu Mercier, Chargé de Recherche CNRS - 05.34.32.28.64 - matthieu.mercier@imft.fr .
Laurent Lacaze, Directeur de Recheche CNRS - laurent.lacaze@imft.fr .

Lieu du stage : Institut de mécanique des fluides de Toulouse (IMFT). 2 allée Pr. Camille Soula, 31400 Toulouse.

Durée / période : 5-6 mois à partir de Février, flexible selon exigence formation Master 2.

Candidature [CV, lettre de motivation, références] à envoyer à : matthieu.mercier@imft.fr

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## Sujet

Gravity currents are buoyancy-driven-flows observed in a wide range of applications. In geophysical situations, gravity currents often involve dense particles suspensions as: pyroclastic flows, sandstorms, snow avalanches, turbidity currents or blowing snow in katabatic winds [1], as shown in Figure 1(a,b). Then, these gravity currents which includes or even are driven by solid particles will be referred to as Particle Laden Gravity Currents (PLGCs). A major difference between compositional currents and PLGCs is the existence of typical length and time scales associated with the particles dynamics leading to complex interactions between turbulence and particles denoted as turbulence-particle interactions [2,3].

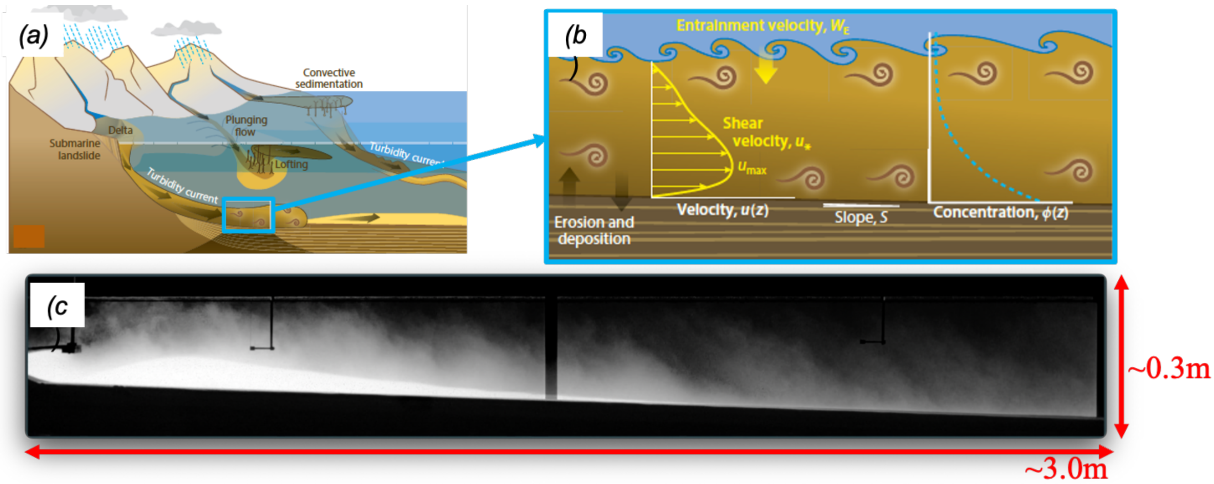


***Figure 1:*** (a) Examples of geophysical situations leading to the generation of turbidity currents, and (b) zoom on the inner structure of such a flow (from [3]). (c) Image of a turbidity current and its deposit in the experimental facility at IMFT.

This training opportunity is part of the ANR project PALAGRAM which investigates the connections between the local processes and the global dynamics of PLGCs, from the interaction of particles near the bed or in the bulk of the current to the scale of the current and of the topographic features it encounters. The main ambition is to provide models for the equivalent flow dynamics based on physical processes at the particle scale, over a large range of values for relevant parameters characterizing the PLGC. One can consider for instance the slope of the topography, the concentration of the particles and their settling velocity compared to the one of the current. Recently, the team at

IMFT characterized the slumping regime of PLGC (when the PLGC moves at a constant front velocity), in the case of a lock-release configuration [3].

The main objective of this training program is to investigate the erosion / deposition processes occurring in the case of turbidity currents originating from a continuous injection of a particles into a fluid at rest (different from the lock-release configuration). Preliminary studies have already been done in the experimental facility available at IMFT: a 500L suspension of particles can be injected at various inflow rates, over an inclined slope into a 1000L water tank at rest with outlets mimicking open boundary conditions. An example of data obtained from shadowgraph imaging of the experiment is presented in Figure 1(c). The particles are injected from the left-side of the image, some are transported across the image while other can deposit at the bottom. The global dynamics of PLGC in this context will be investigated with a parametric study over varying inflow and slope properties mainly.

During the training program, the person recruited will have the opportunity to run experiments into this unique facility, and to make measurements with various optical and acoustic techniques commonly used at IMFT. The analysis of the dataset obtained, as well as other available dataset, will be an important part of the program.
We seek candidates motivated by laboratory studies, and with some interest into data analysis. Skills in programming with Python will be appreciated, although not mandatory.

## Références

[1] Simpson, J. E., Gravity currents in the environment and the laboratory. Cambridge Univ. Press. (1997).
[2] Chassignet E., Cenedese C. & Verron, J. Buoyancy-Driven Flows. Cambridge Univ. Press (2012).
[3] Wells M. G. & Dorrell R. M., Turbulence Processes within Turbidity Currents, Annual Review of Fluid Mechanics, 53:59-83 (2021).
[4] Gadal C., Mercier M. J., Rastello M., Lacaze L., Slumping regime in lock-release turbidity currents. Journal of Fluid Mechanics, Journal of Fluid Mechanics, 974, A4 (2023) - https://arxiv.org/abs/2301.00192