CERFACS

JOB OFFER – STAGE

Suspension modeling for hydrological models

OFFER INFORMATION

Reference: Globc-2025-LC-1 **Location:** 42 Avenue Gaspard Coriolis – 31057 Toulouse
Team: GLOBC

Supervisors:

- Ludovic CASSAN
- Hélène ROUX (Institut de mécanique des fluides de Toulouse)

Gratification: 700€ net per month - M2 level or last year at engineering school

Period: 6 months - from: 03/02/2025

Key words: Hydrology, solid transport, modelling

CERFACS

Cerfacs is a private research, development, transfer and training center for modeling, simulation and high-performance computing. Cerfacs designs, develops and proposes innovative software methods and solutions to meet the needs of its partners in the aeronautics, space, climate, environment and energy sectors. Cerfacs trains students, researchers and engineers in simulation and high-performance computing.
Cerfacs works closely with its seven partners: Airbus, Cnes, EDF, Météo France, Onera, Safran et TotalEnergies.

HOSTING TEAM - GLOBC

The Cerfacs GlobC team is made up of senior and early-career researchers, and is supported by a team of highly qualified research engineers with extensive expertise in climate and environmental models, high-performance computing (HPC), simulation workflows and data management. We conduct cutting-edge research into climate variability and prediction, oceanography and polar science, air-sea interaction, detection and attribution of climate change and its impacts, extreme events, and environmental hazards. We use a wide range of numerical models, from large-scale simulation to global earth system models, and associated algorithms (data assimilation, uncertainty quantification, machine learning, code coupling) to meet our scientific challenges.

CONTEXT

Knowledge and modelling of solid transport on a catchment scale are essential for several aspects of water management in upstream catchments. Sediment transport, particularly during extreme events, impacts the management of structures designed for hydroelectric production, and also modifies the natural habitats of aquatic species. These two aspects are present in the notion of sediment continuity of watercourses (regulated in particular by article L214-17 of the French Environment Code), which obliges all stakeholders to better mitigate impacts while guaranteeing optimal allocation of the resource, particularly for the energy transition and the development of renewable energy production.
To make the link between precipitation, runoff and solid transport, it is necessary to model the physics of the phenomena (Roux et al. (2011), Travert et al, (2022)). On this basis, a coupling between hydrodynamics and solid transport on a catchment scale has been set up using the physics-based hydrological model MARINE. This work

began with the CrueSim project (RTRA-STAE) and continued with 2 theses (Occitanie/OFB and ministerial grant) to develop the code and validate this approach on several watersheds.

Objective

Using hydrological variables from a distributed hydrological model or in-situ measurements, it is possible to estimate soil losses using empirical models from the USLE (Universal Soil Loss Erosion) family. These methods have been set up at IMFT for comparison with a physically-based approach (Hosseinzadeh et al., 2024). During this work, post-processing modules for hydrological quantities such as runoff or flow rates were developed to apply the sediment transport equations (GAIA) to a MARINE hydrological model. The aim of the internship is to implement the suspension transport equations in these Python-coded scripts and compare them with the MARINE calculations. The aim is to obtain a sediment calculation that can be coupled with various hydrological models (SMASH, MORDOR, etc.).

MISSION

Tasks :

We propose to structure the work with the following steps:

1. Literature review of solid transport models in hydrology
2. Development of the advection-diffusion formula (or approximation) in existing scripts for bedload transport.
3. Application to a real case already modeled (Claduègne watershed). Comparison with the MARINE/USLE model.
4. Analysis of results (model sensitivity, advantages/disadvantages of coupling).

DESIRED PROFILE

- Master 2 or engineering student in hydraulics or the environment
- Knowledge of hydrology, possibly solid transport
- Programming in Python

WHAT WE OFFER AT CERFACS

- Broad access to technology, a rich interpersonal environment, in-house skills recognized nationally and internationally.
- An inclusive and equitable work environment.
- A structure accessible to people with disabilities.
- Possibility of benefiting from 1.83 days of reduced working hours per month, linked to your choice of a 39-hour rather than 35-hour working week.
- 50% reimbursement of public transport costs.

HOW TO APPLY ?

To apply, please send your CV and covering letter to cassan@cerfacs.fr , applications are open until 20/12/2024.

See you soon at CERFACS!