2020-02308 - Internship position 2020 in Applied Mathematics and Engineering Sciences. Particles in the environment: dynamics and statistics of re-mobilization (Possibility to pursue with a PhD)

Type de contrat : Convention de stage
Niveau de diplôme exigé : Bac + 5 ou équivalent
Fonction : Stagiaire de la recherche

A propos du centre ou de la direction fonctionnelle

The Inria Sophia Antipolis - Méditerranée center counts 34 research teams as well as 8 support departments. The center's staff (about 900 people including 320 Inria employees) is made up of scientists of different nationalities (250 foreigners of 50 nationalities), engineers, technicians and administrative staff. 1/3 of the staff are civil servants, the others are contractual agents. The majority of the center's research teams are located in Sophia Antipolis and Nice in the Alpes-Maritimes. Four teams are based in Montpellier and two teams are hosted in Bologna in Italy and Athens. The Center is a founding member of Université Côte d’Azur and partner of the i-Site MUSE supported by the University of Montpellier.

Contexte et atouts du poste

The internship is offered within the Calisto team, under creation at Inria Sophia Antipolis, who invested and develop the topic of complex SDEs and stochastic particle modeling, in collaborations with researchers that share interest in environmental applications (including meteorologists, hydrophysicists, physicists specialized in turbulence and two-phase flows modeling).

http://www-sop.inria.fr/members/Mireille.Bossy/Calisto/

Mission confiée

Internship position 2020 in Applied Mathematics and Engineering Sciences (Possibility to pursue with a PhD)

Particles in the environment: dynamics and statistics of re-mobilization

Scientific context of the subject

Particles are omnipresent in the environment, such as in atmospheric sciences (pollutant dispersion) or in marine sciences (plastic contamination in oceans). These particles can accumulate on surfaces (pollutant deposit on the ground, plastic debris on riverbanks). Due to the action of the flow, such particles can be detached from surfaces and brought back into the flow: this process is often referred to as resuspension in multiphase flows.

Remobilization of micro-plastic (MP) debris that previously accumulated in sediment beds and riverbanks is a typical situation that calls for new models to perform simulations in realistic multilayer beds. Plastic contamination is a major concern in a number of marine habitats where it has spread globally to even the most remote areas. Rivers alone contribute to 10-20% of the yearly release of micro-plastic (MP) debris in oceans. Yet, this release is highly seasonal, with measured emissions up to ten times higher after heavy rainfalls. These intense emission peaks are attributed to the remobilization of MP debris. Particle remobilization from homogeneous beds has been extensively studied, especially by aerosol and turbulence flow communities. Bed erosion has also been studied by the hydrological community.

Research on remobilization of MP debris from sediment beds caused by a sudden water flow intake emerged only some years ago and literature data on remobilization of MP debris are still scarce.

State of art on particle remobilization in turbulent flows

One of the first fundamental investigations on the remobilization of solid and dense particles probably dates back to the 1930s, when Shields [1] reported the existence of a threshold shear velocity $U_{\tau}$, beyond which remobilization occurred. Multiple empirical studies have since been performed and various estimates of this threshold shear velocity are now available [2]. By the 1970s, statistical studies by Cleaver and Yates [3] provided new insights by revealing the key role played by episodic turbulent bursts in particle remobilization. They had showed that a direct particle lift-off occurred when the balance between removal forces and adhesive forces was ruptured. Turbulent bursts, similar in behavior to miniature tornadoes, were found to trigger instantaneous remobilization. But, the particle lift-off model formerly suggested by Cleaver and Yates [3] did not provide all the ingredients necessary for a complete description of the remobilization process.

At that time, only the lift and adhesion forces were considered. Continuous developments of numerical and experimental techniques have led to significant improvements in modelling of this process. Remobilization is sensitive to a number of parameters, including mainly the turbulent nature of the flow (turbulent structures in the boundary layer), the substrate properties (surface roughness), as well as the particle properties (in particular particle size).

Principales activités

Main objectives and activities

The aim of this research internship is to work on the modeling of re-mobilization of particles. For that purpose, the student will extend a recent approach that has been developed for small colloidal particles (i.e. smaller than a few micro meters). The candidate will participate to the development of state-of-the-art numerical tools, perform simulations, analyze and validate results.

Informations générales

- Ville: Sophia Antipolis
- Centre Inria: CRI Sophia Antipolis - Méditerranée
- Date de prise de fonction souhaitée : 2020-04-01
- Durée de contrat : 4 mois
- Date limite pour postuler : 2020-04-01

Contacts

- Equipe Inria : AT-SOP AE
- Recruteur : Bossy Mireille / Mireille.Bossy@inria.fr

A propos d’Inria

Inria, est l’institut national de recherche dédié aux sciences et technologies du numérique. Il emploie 2600 personnes. Ses 200 équipes projets agiles, en général communées avec des partenaires académiques, impliquent plus de 3500 chercheurs et ingénieurs pour relever les défis du numérique, souvent à l’interface d’autres disciplines. L’institut fait appel à de nombreux talents dans plus d’une quinzaine de métiers différents. 900 personnels d’appui à la recherche contribuent à faire émerger et grandir des projets scientifiques ou entrepreneuriaux qui impactent le monde.

L’essentiel pour réussir

When you apply, please send also an email to: christophe.henry@inria.fr and mireille.bossy@inria.fr

Applicants are required to send a cover letter a CV, and at least one recommendation letter to the above address.

Consignes pour postuler

Sécurité défense : Ce poste est susceptible d'être affecté dans une zone à régime restrictif (ZRR), telle que définie dans le décret n°2011-1425 relatif à la protection du potentiel scientifique et technique de la nation (PPST). L'autorisation d'accès à une zone est délivrée par le chef d'établissement, après avis ministériel favorable, tel que défini dans l’arrêté du 03 juillet 2012, relatif à la PPST. Un avis ministériel défavorable pour un poste affecté dans une ZRR aurait pour conséquence l'annulation du recrutement.

Politique de recrutement : Dans le cadre de sa politique diversité, tous les postes Inria sont accessibles aux personnes en situation de handicap.

Attention Les candidatures doivent être déposées en ligne sur le site Inria.

Le traitement des candidatures adressées par d'autres canaux n'est pas garanti.
As a starting point one will consider the resolved remobilization model, brought to fruition by C. Henry, that already predicted accurately the remobilization rate of sub-millimeter particles in turbulent air flows [5, 6].

References


Compétences

- Candidates should have a solid background in one or more of the following topics: physics, applied mathematics, or mechanical engineering
- Strong competence and taste for code development. In particular knowledge of python/ C / C++ programming languages;
- Fluent in English

Optional competences

- Knowledge in fluid dynamics
- Knowledge in statistical physics
- Rigorous, autonomous and creative thinking
- Interest in environmental applications
- HPC skills will be appreciated

Avantages

- Subsidized meals
- Partial reimbursement of public transport costs
- Leave: 7 weeks of annual leave + 10 extra days off due to RTT (statutory reduction in working hours) + possibility of exceptional leave (sick children, moving home, etc.)
- Possibility of teleworking (after 6 months of employment) and flexible organization of working hours
- Professional equipment available (videoconferencing, loan of computer equipment, etc.)
- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage