A. Shields, "Application of similarity principles and turbulence research to bed-load movement," California Institute of Technology, Pasadena.

References

Systematic numerical simulations will be performed to support model developments and validation.

Particle interactions. As mentioned in a recent review [7], the development of modelling approaches for remobilization in complex beds is still ongoing due to the intricate role of multilayer bed morphology. Extension may also account the situation of remobilisation in multilayer beds by accounting for the bed morphology as well as inter-particle interactions. 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. 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.

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 scare.

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 doctoral research is to develop a new model for the 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 $\mu$m). The doctoral student will participate to the development of state-of-the-art numerical tools, perform simulations, analyze and validate results.

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]. Extension of the model may address situation of neutrally buoyant particles in the millimeter range. Extension may also account the situation of remobilisation in multilayer beds by accounting for the bed morphology as well as inter-particle interactions. As mentioned in a recent review [7], the development of modelling approaches for remobilization in complex beds is still ongoing due to the intricate role of multilayer bed morphology.

Systematic numerical simulations will be performed to support model developments and validation.

References

from German), 1936.


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
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- Social, cultural and sports events and activities
- Access to vocational training
- Social security coverage

Rémunération

Duration: 36 months
Location: Sophia Antipolis, France
Gross Salary per month: 1982€ brut per month (year 1 & 2) and 2085€ brut/month (year 3)

Informations générales

- Thème/Domaine : Approches stochastiques
- Ville : Sophia Antipolis
- Centre Inria : CRI Sophia Antipolis - Méditerranée
- Date de prise de fonction souhaitée : 2019-10-01
- Durée de contrat : 3 ans
- Date limite pour postuler : 2019-05-05

Contacts

- Equipe Inria : TOSCA
- Directeur de thèse : Bossy Mireille / mireille.bossy@inria.fr

A propos d'Inria

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

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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.

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