Fully funded 3yr PhD Project / Call for candidate

Impact of climate change on the dynamics of mountain streams in the European Alps

Host dept : UMR 6118 Géosciences Rennes, CNRS / Rennes University, France & Institute of Environmental Science and Geography, Universität Potsdam, Germany

Supervisor: Dimitri Lague (Senior Researcher, CNRS, Rennes)

Co-supervisor: Wolfgang Schwanghart (Associate Professor, Potsdam University), **Boris Gailleton** (Post-doc Researcher, Rennes University)

Keywords : floods ; LiDAR; erosion ; natural hazards ; numerical modelling; GIS

English summary

Global warming is intensifying the hydrological cycle, leading to more intense rainfall and increasing the frequency and impact of extreme floods, particularly in the Alps. Disasters such as storm Alex (2020), storm La Bérarde (2024) and storm Boris (2024) illustrate these impacts. In mountains, these extreme floods trigger sediment transport and bank erosion, which dramatically increases the damage to infrastructure. Understanding the thresholds for sediment mobilisation and bank destabilisation is therefore crucial to adapting to climate change. Steep, small torrential streams are particularly affected by these issues. There are many of them, but they are very poorly documented owing to limited accessibility and forest cover, limiting our capability to predict floods and sediment transport.

The French Alps (and other European countries) have very recently been covered by high-resolution 3D lidar data that accurately describe the geometry of small torrential streams, even under vegetation. This new data offers unprecedented prospects for studying the geometry and predicting the dynamics of small torrential streams. This joint PhD thesis between the Universities of Rennes (France) and Potsdam (Germany), aims to use this new data and high-resolution hydraulic models to identify areas at risk from future increases in extreme hydrological events. The work involves developing a processing chain that can automatically extract lidar data and predict flood levels for different flow rates, complemented by an analysis of the relationships between flood intensity and frequency in different sectors. Based on this catalogue of simulations, the objective is to estimate the frequency with which debris transport and bank erosion thresholds are exceeded, to identify the sectors likely to experience a significant increase in hydrosedimentary hazards and to understand the environmental factors controlling the spatial distribution of these hazards.

Profile required:

- Master's degree in one of the following disciplines: Hydrology, Geomorphology or Remote Sensing
- Very good programming skills (Python or matlab)
- Very goog experience in 2D GIS data processing
- Proficient in English to communicate easily with supervisors in Potsdam and Rennes
- Preliminary experience in processing and using LiDAR data would be a plus

Although this thesis subject is mainly based on the use of numerical models and tools for processing large volumes of data, contributions to certain field missions and collective projects of the Rennes RIVER team are expected. Collaborations are planned in Rennes with Philippe Steer, Christoff Andermann, Laure Guerit, Pierre Brigode and Ron Nativ, and with Bodo Bookhagen and Oliver Korup (Potsdam University).

This thesis project is one of the first joint PhD (co-tutelle) to be set up between the University of Rennes and the University of Potsdam. It is expected to lead to the award of a joint doctorate from both universities, or a doctorate from each university (agreement currently being negotiated between the two universities).

Contact : Dimitri Lague, **dimitri.lague@univ-rennes.fr**

Deadline for application 30th may 2025

Expected start of the contract : as soon as possible after the 1st of July 2025