ERC FEASIBLe – 2 years Post-doctoral Fellowship

The impact of a single large storm event on river evolution and sediment transport: combining unique repeated Lidar data with 2D hydro-sedimentary simulations

Scientific context – It is well established that discharge variability is a major ingredient of river dynamics (e.g. Lague et al., 2005). In particular, large storms can lead to high discharge and to river basal shear stresses exceeding the thresholds for sediment mobility and bedrock erosion, in turn leading to accelerated sediment transport and riverbed erosion. Despite this, very few data have been able to constrain the impact of a single storm event on the morphological evolution of a river. This is mostly due to the difficulty of monitoring river bathymetry at high temporal and spatial resolution. Rivers in the South of France are frequently subjected to intense Mediterranean storms, while experiencing an expected rather low background geomorphological activity otherwise. In 2021, two airborne topo-bathymetric Lidar surveys occurred just before and after a major storm (up to 400 m of rainfall in one day) covering about 30 km of the bathymetry and topography of the gorges of the Ardèche river. This unique dataset offers a rare opportunity to investigate the morphodynamic and sedimentary response of the Ardèche river to this storm. Moreover, fast hydrodynamic models solving for shallow water equations are available in Rennes (Bernard et al., 2022; Steer et al., 2022) enabling to compare model predictions (e.g., water height, shear stress, sediment transport) with observations. These models will also be used to assess the long-term topographic and morphodynamic role of these rare and major storms compared to more frequent but less intense events. This fellowhsip will be part of the FEASIBLe (Finding how Earthquakes And Storms Impact the Building of Landscapes) project led by Philippe Steer (University of Rennes) and funded by the European Research Council, in close collaboration with members of a French consortium of researchers (ANR Topo-Extreme - involving the Universities of Montpellier and Aix-Marseille). The candidate will be part of an international and dynamic group of scientisits in a team including geomorphologists, hydro(-geo)logists, geologists and modellers working on surface processes and landscape dynamics.

The main steps of the scientific work - These questions will be investigated using a combination of remote sensing and numerical modelling. The work will consist in several main sub-tasks:

- Analyzing the repeated topo-bathymetric Lidar data (acquired by the University of Rennes) to assess the morphologic changes of the Ardèche river induced by the 2021 Mediteranean storm.
- Acquiring and aggregating complementary data on grain-size distributions, water discharge and height, sediment transport and erosion markers along the Ardèche river by combining field missions and data search.
- Modelling the water height, shear stresses and discharges before, during and after this major storm using fast 2D hydrodynamic models solving for the shallow water equation (GraphFlood or Eros model). Using these hydrodynamic solutions to predict sediment transport and morphodynamic changes induced by the storm, and compare them with observations.
- Exploiting these modelling results to explore the long-term impact of storms on river and landscape evolution over timescales of 0.1 to 100 kyr.

The ability of the candidate to work with different and up-to-date methods will be pivotal. The use of numerical model will represent an important part of the work, as well as the ability to efficiently exploit topo-bathymetric Lidar and remote sensing data. Some field missions along the Ardèche river will occur during the course of this post-doctoral fellowship.

Scientific and technical skills required by the candidate - Candidates are expected to be trained in Earth Sciences and/or in (Geo)physics with preferably a solid background in Geomorphology,

Numerical Modelling and Remote Sensing. Ability to work in an international and collaborative environment, to communicate and to write scientific papers are expected. Although prior knowledge of French is not mandatory, spoken and written English proficiency is needed. Visits to the partner univeristies (Montpellier and Aix-Marseille) are expected.

Context - Rennes, the capital of Brittany, is a very lively, green human-scale city, recognized as one the best city to live in France, and is located just 1,5 hour away from Paris and less than 1 hour from sunny beaches. University Rennes is amongst the ten main universities in France. It is a multidisciplinary university, famous for its excellence and dynamic research. The Geosciences department is a large and multidisciplinary research centre which is internationally recognized for its quality in environmental research, in particular in hydro(geo)logy, geomorphology and numerical modelling.

Practical considerations:

- Employment period: 01/06/2023 – 31/05/2025
- Location: Univeristy of Rennes (France)
- Main advisors: Philippe Steer, Dimitri Lague, Laure Guerit and Philippe Davy (Rennes)
- Collaborators: Boris Gailleton (Rennes), Paul Leroy (Rennes), Rodolphe Cattin (Montpellier), Vincent Godard (Aix-Marseille)
- Net salary: 2000-2500 € (funded by the ERC FEASBILe project)

Questions - How to apply? – Please contact philippe.steer@univ-rennes.fr for questions regarding the position. Applications should be sent by email to philippe.steer@univ-rennes.fr with your CV, a motivation letter and contact for two references. Review of applications will start **beginning of April 2023** and will be continued until the position is filled.