Engineering and Physical Sciences Research Council Doctoral Landscape Award

PROJECT TITLE: Monitoring the stability of large wood structures and their influence on sediment and wood transport with novel sensor networks

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Project details: Large wood structures are an increasingly popular natural flood management (NFM) measure in upland regions of the UK, effectively attenuating flood peaks, increasing lag time, and overall reducing flood risk (Bagheri-Gavkosh et al., 2025). However, the stability of these structures is not widely monitored. This is particularly pertinent given the threat posed to downstream infrastructure by woody debris carried in flood waters (Panici & de Almeida, 2018). There is also a lack of research into how effective dams are at holding back large wood and sediment and reducing the impact of flood debris on downstream infrastructure. This project will use innovative sensor technology to assess stability of different large wood structures and build an evidence base to inform policy on this NFM practice nationally. It will also investigate how effective dams are at trapping and retaining large wood debris and sediment.

The PhD project will analyse data collected on the SENSUM research project between 2021 and 2024 at sites in Cumbria and Dartmoor that exemplify a range of large wood structures. Data consist primarily of Inertial Measurement Unit (IMU) with 9 degrees of freedom data from sensors embedded in wood and river sediment that detect tilting and rotational movements. This device was first applied to monitoring boulder transport in landslides (Dini et al., 2019) but has subsequently been adapted to monitor large wood. The device communicates in real time via the Long Range Wireless Area Network (LoRaWAN), through a gateway, giving alerts of instability and movement. Data recorded on movement and/or instability of large wood structures will inform the physical relationship between hydrodynamic actions and incipient wood movement and transport, that will also be dependent on the structure type and complexity.

This PhD project will also monitor large wood structures installed as part of river restoration projects on the rivers Feshie and Muick in Scotland by partners SEPA and River Dee Trust to enrich the dataset collected on SENSUM with high-energy, highly active geomorphic sites. The student will be based in Geography at the University of Exeter, where they will receive training in environmental sensors and in earth and water systems from the Sustainable Hydrological Systems group and Centre for Resilience in Environment, Water and Waste (CREWW). They can be involved in fieldwork in Scottish river sites in collaboration with University of Edinburgh and will benefit from being part of the research team on NERC funded project on use of large wood in river restoration. There is additional funding to attend national and international conferences and workshops.

References

Dini, B., Bennett, G. L., et al. (2021) Development of smart boulders to monitor mass movements via the Internet of Things: a pilot study in Nepal, ESurf, 9, 295–315, https://doi.org/10.5194/esurf-9-295-2021.

Bagheri-Gavkosh, M., Panici, D., et al. (2025) Hydrological Analysis and Impacts of Natural Flood Management Strategies: A Systematic Review, Journal of Flood Risk Management, 18, https://doi.org/10.1111/jfr3.70112

Panici, D., & de Almeida, G. A. M. (2018). Formation, growth, and failure of debris jams at bridge piers. WRR, 54. https://doi.org/10.1029/2017WR022177

Project specific entry requirements: The applicant should have at least a Bachelor degree in Physical Geography, Engineering or a related subject. They should be motivated to conduct fieldwork and to learn and advance the use of inertial measurement unit (IMU) sensors for monitoring hydrogeomorphic processes. A grounding in fluvial geomorphology and/or computational fluid dynamics would be helpful.

Potential PhD programme of study: PhD in Physical Geography

Department: Geography

Location: CREWW building, Streatham Campus

Please direct project specific enquiries to: Please contact g.l.bennett@exeter.ac.uk or d.panici@exeter.ac.uk with any queries. Diego Panici already supervises an EPSRC DLA student so can answer questions about the PhD programme. Both Georgie and Diego can answer questions about the project.

Please ensure you read the entry requirements for the potential programme you are applying for.

To Apply for this project please click on the following link - **APPLY HERE**