Engineering and Physical Sciences Research Council Doctoral Landscape Award

PROJECT TITLE: Predicting climate change impacts on UK river instability and flood hazard

Lead Supervisor: Professor Andrew Nicholas

Co-Supervisors:
Diego Panici (D.Panici@exeter.ac.uk)
Steve Palmer (S.J.Palmer@exeter.ac.uk)

Webpage: https://experts.exeter.ac.uk/102-andrew-nicholas

Project details: Flooding has the greatest socio-economic impact of all natural hazards and is expected to worsen in future due to anthropogenic climate change, in addition to factors such as population growth, the increased economic value of assets, and the encroachment of people and assets into flood-prone areas. In this context, the availability of accurate models to understand changing flood risk and flood inundation hazards is a critically important prerequisite for adaptive flood management. However, existing projections of future flood risk rely on flood models that treat rivers as static conduits with fixed morphology and flow conveyance capacity. It is well known that this assumption is not valid. During floods, the erosion, transport and deposition of sediment can lead to substantial changes in river morphology and flow conveyance capacity, hence models that neglect these processes may generate unrealistic predictions of flood water levels and floodplain inundation. Moreover, the expected shift to larger and/or more frequent floods under climate change will likely increase the frequency and intensity of sediment transport events that drive river instability, widening of river channels and destruction of floodplain land and infrastructure.

This PhD studentship will exploit recent advances in modelling of flood-driven river dynamics in order to develop effective tools for predicting the impacts of climate change on flood frequency and river-floodplain instability across the UK. In doing this it will address the following research questions:

(1) How large is the potential contribution of river morphodynamics to changes in UK flooding under future climate change?
(2) Will climate change promote significant increases in river width and/or changes in the occurrence of periods of river and floodplain instability?
(3) How are the morphodynamic responses of rivers to climate change (and associated flood impacts) likely to vary across the UK?
(4) How can these changes best be predicted?

The PhD will answer these questions by employing a multi-disciplinary approach that combines fieldwork, remote sensing and numerical modelling at multiple scales. Field surveys (of topography and channel bed material) and remote sensing datasets (aerial photography, satellite and drone-based) will be used to calibrate and validate physics-based morphodynamic models of river evolution, for contrasting rivers over multi-decadal periods, and then to predict future river channel changes up to 2100 for a range of climate change scenarios.

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These high-resolution empirical and model datasets quantifying evolving river morphology and flood conveyance capacity will be used to develop and evaluate a low-complexity predictive tool for modelling: (1) the evolution of river width and cross-section shape through time (e.g., due to bank erosion and river bed erosion or sedimentation); (2) the associated evolution of river channel flow conveyance capacity (channel bankfull discharge) and hence flood frequency; and (3) future changes in the probability (and frequency) of hydrological events likely to trigger major channel changes (e.g., periods of high bank erosion and floodplain instability). This low-complexity tool will be driven and evaluated using existing national datasets for river hydrology and geomorphology, to facilitate its implementation across the UK.

Project specific entry requirements: Degree in relevant field

Potential PhD programme of study: PhD in Geography

Department: Geography

Location: Amory, Streatham

Please direct project specific enquiries to: Andrew Nicholas (a.p.nicholas@exeter.ac.uk)

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

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