

Quantifying the effects of slump blocks on bank erosion rates across a range of flow stages

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Background

River bank erosion is primarily controlled by the rate of hydraulic action at the bank toe. Previous research has suggested that blocks of failed material (henceforth 'slump blocks') reduce hydraulic action at the bank toe through the delivery of protective material base of the bank resulting in the deflection high velocity flow away from the near-bank region. However, recent field observations have shown that when fully submerged, slump blocks may deflect flow up, over and toward the bank, enhancing rates of bank erosion. Understanding how varying flow stage affects the impact of slump blocks on the 3D flow field is vital for robustly predicting and thus managing river bank erosion rates. Yet, observations of the full 3D flow field around blocks at varying flow stages is currently lacking.

Methods and preliminary results

An ECR grant from the BSG in 2016 has enabled the collection of a series of repeat flow and topographic surveys of an actively eroding outer-bank of the River Severn, Shropshire, UK (Figure 1) across a range of flow stages (bank full flow, mean flow and low flow). Repeat acoustic Doppler current profiler data highlights how the near-bank flow field changes with both discharge and the interaction with submerged topographic features (Figure 2). High-resolution terrestrial laser scanning of the bank reveals loci of bank erosion as well as the residence time and life-cycle of failed slump blocks at the toe of the bank. Links between variations in bed and bank shear stresses and morphological change on the bank and blocks can now be identified, highlighting new interactions between toe material, flow stage and rates of bank erosion. This work is currently being written up for publication and a huge thanks to the BSG is required for enabling this work to be undertaken. Data and more information is available by contacting Chris Hackney on the email listed above.



Figure 1: Collecting ADCP transects of near-bank flow velocities at low flow in March 2017.

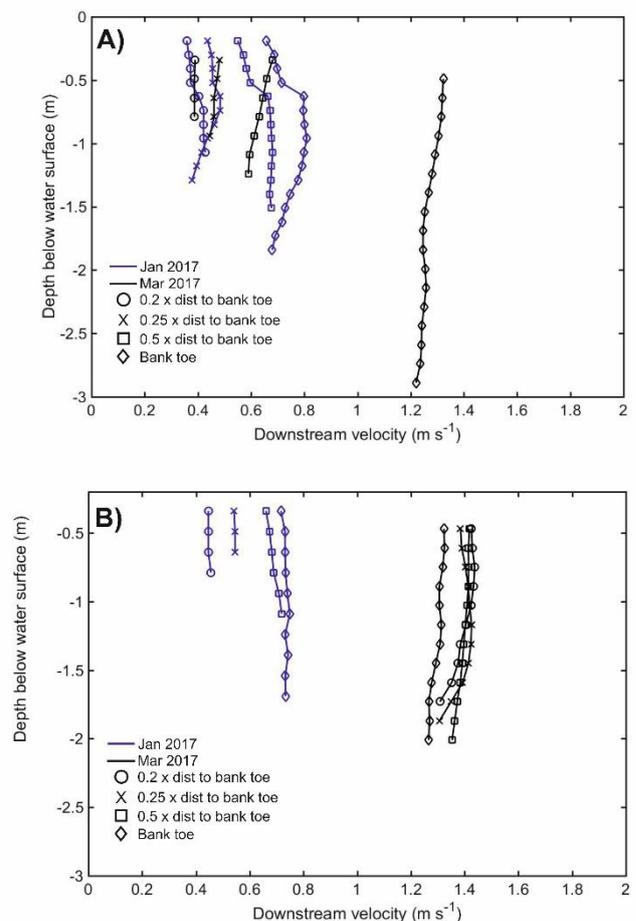


Figure 2: Velocity profiles for January 2017 (blue lines) and March 2017 (black lines) for different transects: **A)** furthest upstream and **B)** furthest downstream.

