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Experimental modelling of outburst flood - bed interactions

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Outburst floods are a sudden release and advancing wave of water and sediment, with a peak discharge that is often several orders of magnitude greater than perennial flows. Common outburst floods from natural sources include those from glacial and moraine-impounded lakes, freshwater dyke and levee bursts, volcanic debris dams, landslides, avalanches, coastal bay-bars, and those from tree or vegetation dams. Outburst flood hazards are regularly incorporated into risk assessments for urban, coastal and mountainous areas, for example. Outburst flood hazards are primarily due to direct impacts, caused by a frontal surge wave, from debris within a flow body, and from the mass and consistency of the flows. A number of secondary impacts also pose hazards, including widespread deposition of sediment and blocked tributary streams. It is rapid landscape change, which is achieved the mobilization and redistribution of sediment that causes one of the greatest hazards due to outburst floods.

The aim of this project is therefore to parameterise hydrodynamic - sedimentary interactions in experimental outburst floods. Specifically, this project applies laboratory flume modelling, which offers a hitherto untapped opportunity for examining complex interactions between water and sediment within outburst floods.

The experimental set-up is of a tradition lock-gate design with a straight 4 m long tank. Hydraulics are scaled at 1:20 froude scale and the following controls on frontal wave flow-bed interactions and hence on rapid landscape change are being investigated: 1. Pre-existing mobile sediment effects, fixed bed roughness effects, sediment concentration effects, mobile bed effects. An emphasis is being maintained on examining the downstream temporal and spatial change in physical character of the water / sediment frontal wave. Facilities are state-of-the-art with a fully-automated laser bed-profiler to measure bed elevation after a run, Seatek arrays to measure transient flow depths, 0.5 Hz Ultrasonic Velocimeter Profiling to measure within-flow velocities, and Ultrasonic High-Concentration Meter (UHCM) to measure sediment concentrations, for example, all at increments of space and time. These instruments can only be used without a mobile sediment bed and some could be rendered as a source of error because they are intrusive to the flow. Digital video and automated still photography is therefore also important for recording hydraulic and bedform changes through time in flows with freely-moving sediment. This paper will report initial results.