33rd Scottish Fluid Mechanics Meeting

Experimental modelling of the flow processes and deposits produced by turbidity currents in base-of-slope settings

Jonathan Wilkin[1], Alan Cuthbertson[1], James Wilkes[1], Sue Dawson[2], Dorrik Stow[3], Karl Stephen[3], Uisdean Nicholson[3], Nadia Penna[4]

[1] School of Science and Engineering, University of Dundee, UK
email: jzwilkin@dundee.ac.uk, a.j.s.cuthbertson@dundee.ac.uk
[2]School of Social Science, University of Dundee, UK
email: s.dawson@dundee.ac.uk
[3]Institute of GeoEnergy Engineering, Heriot-Watt University, UK
email: d.stow@hw.ac.uk, k.stephen@hw.ac.uk, u.nicholson@hw.ac.uk
[4]Department of Civil Engineering, University of Calabria, Italy
email: nadia.penna@unical.it

28th May 2020

Abstract

Results are presented from a recent experimental study that investigated the impact of sediment concentration on the dynamics and resulting deposits of turbidity currents as they transition between a confined slope environment to an unconfined basin (Figure 1). These currents are scaled using dimensionless parameters representing prevalent flow conditions and associated sedimentary processes. A total of six concentration conditions were tested that increased incrementally between 6% (regarded as a 'true' turbidity current) and 16% (regarded as a 'high-density' turbidity current). In each case, supercritical turbidity currents with a 45 second duration were generated along the confined channel before being subjected to an abrupt loss of lateral confinement and a severe change in slope angle (~10 degrees). Flows were initially net depletive (i.e. depositional), accelerating down the confined channel slope and reaching speeds up to 0.60m/sec. At the base of the slope, all currents underwent a rapid radial expansion into the basin that was accompanied by the formation of an internal hydraulic jump that produced an elongate scour feature in the bed deposit. The depth, width and length of this scour was primarily controlled by the initial sediment concentration of the parental flow. The results presented herein combine observations and measurements of the confined turbidity currents, with ultrasonic velocity profiling UVP and video image analysis showing the impact of concentration on current structure, as well as its downslope evolution. Observations from the resulting deposits both within the confined channel and the unconfined basin are also presented and discussed.

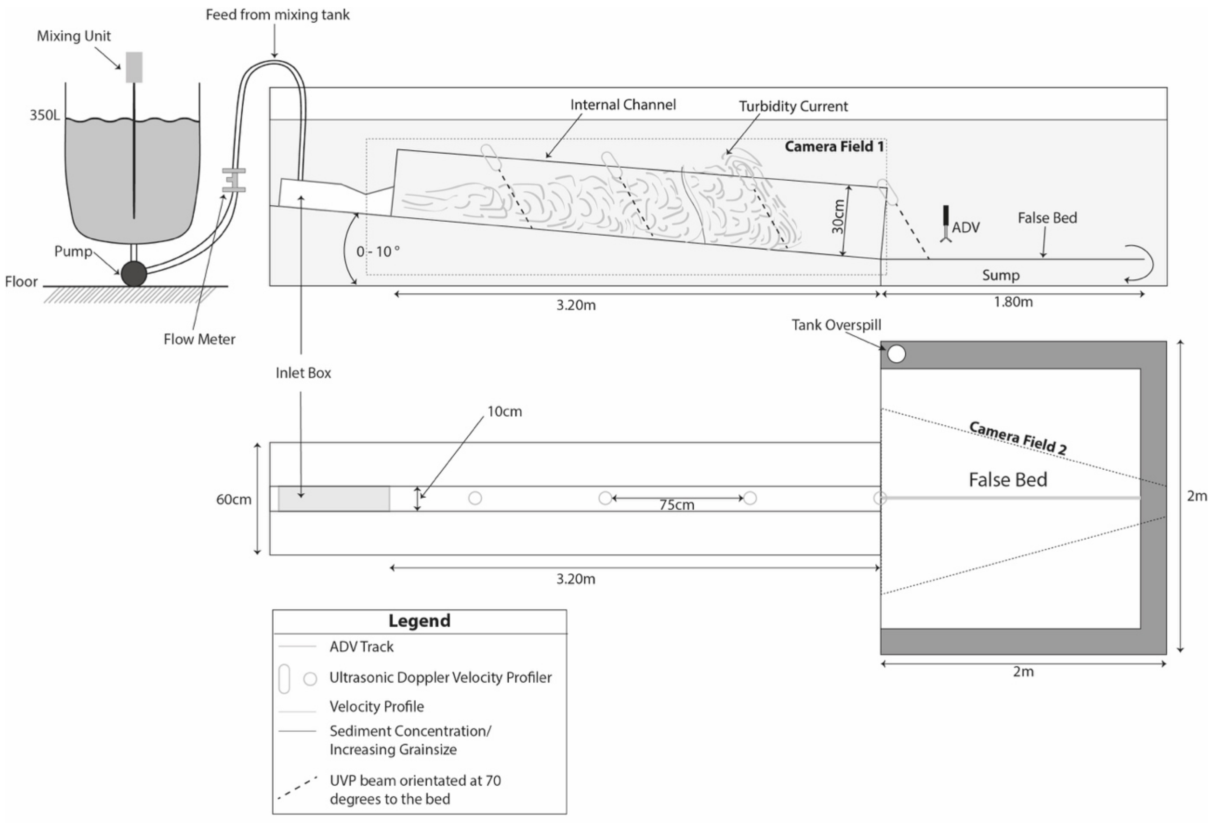

Figure 1: Schematic of the laboratory facility used in this study. *N.B. image not to scale.*