Flume experiment for sustaining turbidity currents

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The turbidity current is a kind of density flow, which is one of the main processes to transport sediments from shallow to deep regions in submarine environments. Turbidity currents are often sustained and flow down along their pathways several hundreds of kilometres. It has been suggested that this sustainability of turbidity currents is achieved when the flow becomes self-sustaining. This consists in the acceleration of turbidity currents while increasing their own density due to sediments eroded from the substrate. Thus, these unique non-depositional turbidity currents can be sustained for long periods of time. Although self-sustaining turbidity currents have been predicted theoretically, all turbidity currents that have ever been produced in the experiments were depositional decelerating flows.

Here, a series of experiments were conducted in a flume to produce sustained turbidity currents and reveal their properties such as distribution of sediment concentration and grain-size sorting in the flows. In order to produce non-depositional flows, we employed plastic particles as sediment with a density lower (1.3 g/cm^3) than that of siliciclastic sands (2.65 g/cm^3). The flume is 15 m long, 1.4 m high, and 0.45 m wide, and the bed slope is 5%. After creating an antecedent bed profile, a mixture of sediment and water was injected upstream to produce the turbidity current.

The behaviour of the turbidity currents varied depending on their initial concentration and velocity, some of the currents did not decelerate but were sustained and partially accelerated. Measurements using siphons revealed that sediment concentration of basal interval of the flow increased downstream in some sustained turbidity currents. This implies that the exchange of sediments between the flow and substrate might have influenced the flow behaviour.