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Controls on turbidity current flow modes: New insights from direct measurements worldwide

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New technology now enables high-resolution measurement of turbidity currents. New data can answer key questions, such as what flow types exist for field-scale turbidity currents? How important is the trigger in controlling flow behaviour compared to grain size? We analyse direct measurements of turbidity currents from eight locations worldwide (water depths: 65-2300 m). We test whether commonalities in flow mode exist, independent of location, thickness, velocity and duration. Normalised time-velocity plots reveal three distinct flow modes. Type 1 is a rapid temporal increase in velocity (first 5-10% of the flow) followed by an exponential deceleration. Type 2 is a steady increase in velocity (first 30-50% of the flow), followed by a similar rapid waning decline. Like Type 1, Type 3 exhibits a rapid peak in velocity; however, the exponential decline is interrupted by a period of near-constant velocity for c.80% of the flow, followed by declining velocities in the final c.20% of the duration of the flow.
Canyons with coarse axial sediments (<10% mud) and oceanographic-triggers feature Type 1 flows. Canyons directly linked to hyperpycnal rivers feature Type 2 flows, where sediments comprise c.10-40% mud. Type 3 flows are also linked to rivers, but are not directly fed by sediment-laden river water. Unlike Type 1 and 2 flows which are <22 hours long, Type 3 flows last for several days. High mud contents (>60%) permit Type 3 flows to sustain themselves at low velocities (0.2-0.8 m/s). We suggest that triggers and grain size are equally important controls on flow mode, but that the latter is more significant further away from the source.