Using unprecedented, direct measurements of turbidity currents to understand flow front speed evolution

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Turbidity currents, often compared to seafloor avalanches of sediment, are one of the most important processes for moving sediment across our planet. Only rivers carry comparable amounts of sediment across such large areas. Here we present some of the first detailed monitoring of these underwater flows that is being undertaken at two different test sites. We seek to understand the factors that determine flow front speed, and how that speed varies with distance. This frontal speed is particularly important for predicting flow runout, and how the power of these hazardous flows varies with distance.

First, we analyse unusually detailed measurements of flow front speed, defined by transit times between moorings in Monterey Canyon, offshore California. These flow front speed measurements are then compared to flow front speeds measured in Bute Inlet, British Columbia from 2016. Next, we consider how flow front velocity is related to external parameters, such as seafloor gradient, canyon width or sinuosity, as well as internal parameters, including flow thickness and density. It appears that spatial trends of increasing and decreasing frontal speed are similar in multiple flows in each submarine system, although their peak frontal velocities vary. For Monterey Canyon, flow front velocity tends to increase initially before declining rather gradually over tens of kilometres. In Bute Inlet however, the flow front velocity gradually declines from the onset of the flow. It has been proposed that submarine flows will exist in one of two states; either eroding and accelerating, or depositing sediment and dissipating. We conclude by discussing the implications of this global compilation of flow front velocities for understanding basic submarine flow behaviour.