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What determines the evolution of turbidity currents?

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Turbidity currents, underwater avalanches of sediments, are one of the principle mechanisms of moving sediment across our planet. Only rivers transport comparable sediment volumes. However, turbidity currents are fundamentally different to rivers because they are driven by the weight of sediment they carry, which cause unstable behaviour. Faster flows could pick up more sediment, and self-accelerate (ignite). Slower flows might deposit sediment, and dissipate.

Previously, turbidity currents are notoriously difficult to directly monitor, due to their location, episodic occurrence and ability to damage instruments placed in their path. Therefore, the fundamental ignition theories of how erosion and deposition control the evolution of turbidity currents are poorly constrained.

Here we analyse the most detailed measurements yet from turbidity current evolution over tens of kilometres. Seven moorings measuring velocity were placed in Monterey Canyon, offshore California, over 18 months. These moorings captured 13 separate flows, and include the fastest flows yet measured by moorings, with some flows that ran out for over 50 km.

Using the data from seven different locations, we analyse temporal and spatial patterns of flow behaviour. We test existing ignition models against our data, and propose a new general model of turbidity current evolution.