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Can Powerful Turbidity Currents Initiate Without a Major Trigger? New insights from detailed measurements in Monterey Canyon

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Individual turbidity currents can reach velocities up to 20 ms-1 and may transport globally significant quantities of sediment. These flows pose a threat to subsea infrastructure such as hydrocarbon pipelines and seafloor cables, which underpin our daily lives. Avoidance of areas prone to turbidity current activity is not always possible, therefore determining the tempo and triggering mechanisms of turbidity currents is integral.

It is generally thought that turbidity currents are triggered by large events, such as storm waves, earthquakes or river floods. Directly linking turbidity currents with a trigger is challenging due to uncertainties in age dating of deposits left by past flows. In recent years, advances in technology have enabled direct monitoring of turbidity currents so their precise timing can be determined; however, statistical analysis of triggers has been problematic due to the small numbers of flows that were recorded. Here, we show data from the Coordinated Canyon Experiment in Monterey Canyon, offshore California, where both turbidity currents and background oceanographic conditions have been monitored at unprecedented detail. During the 18-months of instrument deployment 17 turbidity currents were detected, with velocities of >8 ms-1 and runouts up to 50 km down-canyon. We show that turbidity currents do not require a major event for their initiation.

Throughout this monitoring period no clear or consistent triggering mechanism was identified. Instead, events cluster within a window of heightened sediment delivery to the canyon head during the winter months. We propose this sediment delivery preconditions the upper canyon slopes to failure, enabling relatively minor perturbations in oceanographic or other conditions to trigger failure. Our results indicate that caution should be applied when using turbidite deposits to extend historical catalogues of natural hazards, as event trigger magnitude does not appear to correlate with turbidity current run-out distance or velocity.