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Is Turbidity Current Activity Predictable?

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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 important. 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, robust statistical analysis of triggers has been problematic due to the small numbers of flows recorded. Here we show direct monitoring data from a fjord-head delta in Bute Inlet, British Columbia acquired during the spring and summer of 2016 and 2018. This unusually detailed monitoring dataset allows comparison of high resolution, direct measurements of more than 100 turbidity currents with potential triggering mechanisms, such as river discharge and tidal elevation. Not all peaks in river discharge result in turbidity currents. Powerful long-runout flows can initiate without a clear trigger. The increased river discharge during the spring and summer freshet does appear to create a system ‘switch on’. Flows are triggered when sufficient sediment load is attained in the river plume and, almost exclusively, at low tides when the delta-top channel width is restricted. Our findings are significant for hazard assessment. Through detailed understanding of turbidity current triggering we can calculate the likelihood of an event under given conditions. Additionally, these 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.