Geophysical Research Abstracts
Vol. 21, EGU2019-5635, 2019
EGU General Assembly 2019

First field measurements of an erosive turbidity current triggered by a dilute river plume

Sophie Hage (1,2), Matthieu Cartigny (3), Esther Sumner (1), Michael Clare (2), John Hughes Clarke (4), Mark Vardy (2), Peter Talling (3), Gwyn Lintern (5), Steve Simmons (6), Age Vellinga (1), Ricardo Silva Jacinto (7), Joshua Allin (1), Maria Azpiroz Zabala (8), Jamie Hizzett (1), James Hunt (2), Daniel Parsons (6), Edward Pope (3), Cooper Stacey (5), William Symons (1), and Millie Watts (1)

(1) School of Ocean and Earth Sciences, University of Southampton, European Way, Southampton SO14 3ZH, UK, , (2) National Oceanography Centre Southampton, European Way Southampton SO14 3ZH, UK, (3) Department of Geography, Durham University, South Road Durham DH1 3LE, UK , (4) Centre for Coastal and Ocean mapping, University of New Hampshire, Durham, New Hampshire USA, (5) Natural Resources Canada, Geological Survey of Canada, 9860 W Saanich Road Sidney, BC, Canada , (6) Department of Geography, Environment and Earth Sciences, University of Hull, HU6 7RX, UK, (7) Marine Geosciences Unit, IFREMER, Centre de Brest, CS10070, 29280 Plouzané, France, (8) Faculty of Civil Engineering and Geosciences, 2628 CN Delft University, The Netherlands, (9) CGG Robertson, Llandudno, North Wales, LL30 1SA, UK

Turbidity currents generated downstream of rivers are the primary agent to transport land particles (e.g. nutrients, organic carbon, microplastics) to the deep sea. Turbidity currents can erode the seafloor by entraining seabed sediment, which can cause a hazard to seafloor infrastructures. It is thus important to understand how erosive turbidity currents are triggered off river deltas. Sediment settling from dilute (<40g/L) river plumes have been shown to be the most frequent trigger on some deltas and to be capable of generating long run-out erosive turbidity currents. Yet the processes by which dilute river plume lead to turbidity currents are still unclear. Turbidity currents have been produced by 'dilute river plumes' in laboratory experiments and numerical models when sediment density is able to overcome the density difference with saline water, settling out slowly from the surface plume. However, in natural river plumes such conditions do not always trigger turbidity currents, suggesting that the mechanism is more complicated than experiments and numerical models suggest. There is thus a need for field observations to understand the processes by which slow sediment settling from dilute river plumes will and will not initiate an erosive turbidity current.

Here we provide the first observations of a dilute (∼0.05g/L) river plume which generated one erosive turbidity current during 5 days of continuous measurements. Our measurements took place during the freshet period in the Squamish River Plume which enters Howe Sound, a saline fjord in British Columbia (Canada). We assessed density differences between the freshwater river plume and the saline ambient water using measurements of temperature, salinity and suspended sediment concentration through water depth. 12-min repetitive maps revealed that the turbidity current was erosive. This turbidity current was triggered at low tide when the river plume touched the seabed. However our 5-day long measurements reveal that the river plume may 'touch down' on the seabed without generating a turbidity current. We demonstrate that dilute river plumes require several preconditions to trigger erosive turbidity currents on the Squamish delta. First the river discharge must be high enough to bring sediment into the fjord. Second, the river plume must reach hyperpycnal conditions (i.e. overcome the ambient saline water) close to the bed during falling and low tide under high (4 to 5 m) tidal range. Third, we suggest that fine sediment needs to be available at the seabed in order to generate an erosive turbidity current from a dilute river plume. Understanding the triggering mechanisms of erosive turbidity currents from dilute river plumes is important because dilute river plumes are ubiquitous worldwide.