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Measuring the suspended sediment concentration structure of powerful turbidity currents in the deep-sea

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Turbidity currents transport significant amounts of material globally, and their deposits form some of the largest sediment accumulations on Earth. Our current understanding of the structure and evolution of these episodic, energetic flows is largely derived from small-scale laboratory studies. However, recent deployments of instruments at water depths ranging from tens to thousands of metres have demonstrated that flows can be successfully monitored in the field. Acoustic Doppler Current Profilers (ADCP) have proved particularly useful in revealing the flow structure of turbidity currents at high temporal resolutions, but to fully understand the forces that drive the flows we need to also determine the concentration structure of sediment within the flows.

Here we present the concentration structure of oceanic turbidity currents derived using novel methods developed to invert the acoustic backscatter from ADCPs deployed in the Monterey and Congo submarine canyons, offshore California (USA), and Angola (Africa), respectively, at water depths of up to ∼2,000m. Deployment strategies and inversion methods are described which combine multiple-frequency ADCPs and sediment grain size information from mid-water sediment traps and post-event seabed push-cores to constrain and validate the acoustic inversions. We discuss the parameters that affect the performance of these novel acoustic methods, which is of particular relevance to the growing number studies that use ADCPs to monitor turbidity currents.