Stan Thorez: Evidence and possible causes of velocity pulsing in a turbidity current in Lake Geneva

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Negatively buoyant riverine inflows plunge when entering lakes or reservoirs and form gravity-driven currents near the bed. These currents can supply momentum, heat, oxygen, sediments, nutrients and contaminants to deep lake/reservoir basins. Even with steady inflow, gravity currents have been observed to exhibit regularly pulsing velocity patterns, which likely enhance mixing between the inflowing and ambient waters. In literature, hypotheses linking this pulsing to several mechanisms, including Kelvin-Helmholtz and Rayleigh-Taylor instabilities in the plunge zone, exist. However, to our knowledge, field measurements confirming these links have not been reported.

In the present study, field measurements of the plunging inflow of the negatively buoyant Rhône River into Lake Geneva (Switzerland/France) were carried out. Vessel-mounted ADCP measurements of the flow field of the plunging flow and the subsequent gravity current were combined with remote time-lapse imagery capturing related surface patterns.

The ADCP measurements reveal the presence of pulsing velocity patterns in the gravity current. Simultaneously taken remote time-lapse images show that at the surface, the inflowing sediment-rich water forms a distinct plume that exhibits intermittently shifting lobes at its edge. The periodicities of the velocity pulsing and these shifting lobes are of the same order of magnitude, suggesting a possible causal relationship.