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## **Sediment resuspension and transport from near-shore zones towards the deep interior of Lake Geneva caused by winter cascading**

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Coastal regions accumulate particulate matter, including pollutants, that are brought into the lake from surrounding watersheds. In order to assess dispersion of these substances into the lake interior, it is important to understand the near-shore hydrodynamics and resuspension processes. In winter, cascading of near-shore cold water, caused by differential cooling, induces relatively intense density currents down the sloping bottom lake boundary. Previous field measurements in Lake Geneva have shown signs of resuspension in this cascading flow, which transports near-shore water towards the deep lake interior. However, the importance of sediment resuspension and transport could not be determined because hydrodynamic studies of those cross-shore flows were lacking the necessary resolution. With the recent advances in instrument capabilities, we were able to collect detailed field data in the near-shore bottom boundary layer in Lake Geneva. Using a unique high spatial and temporal resolution dataset, we present results on the hydrodynamics of winter cascading and their implications for sediment resuspension and transport.

Acoustic Doppler Current Profilers (ADCPs) and vertical thermistor lines were deployed during winter on the northern shore of Lake Geneva on the shallow shelf and along the sloping lakebed. In addition, CTD (Conductivity-Temperature-Depth) profiles were taken during periods of strong cooling in order to obtain a broader view of the temperature field along a cross-shore transect. After a cold, calm night, strong differential cooling develops between the shallow shelf and the open lake, initiating the flow of cold dense water from the shelf as pulses down the sloping lakebed. Analysis shows that the maximum in the velocity profile is relatively close to the bed, as expected for a density current. During large and intense pulses, the flow is thick enough to reveal details of the velocity profiles close to the boundary. As expected for a boundary flow, the measured profiles are logarithmic. From the profile shape, the bottom shear stress can be estimated by applying the law of the wall, thus assessing the potential of sediment resuspension with the classic incipient motion approach from Shields.

We find that within the cascading flow, favorable conditions for resuspension are intermittent which is supported by ADCP backscattering. At 30-m depth, sediment transport towards the lake interior is more likely to occur during cascading flow events than under other flow conditions

during winter, including those linked to strong wind events. Indeed, during the measurement period (mid-December to March), highest near-bottom cross-shore currents with bottom shear stresses exceeding the threshold of motion were recorded during cascading flows. They are also more frequent than cross-shore currents induced by wind-driven events. Results of this study suggest that winter cascading is very efficient in renewing near-shore waters and that during weakly-stratified periods, near-shore sediment could be transported into the deep interior by strong cascading events.