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Stability assessment of submerged lateral and deltaic slopes in Lake Lucerne

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Numerous studies indicate that tsunamis do not only occur in oceans but also in lakes. Lake Tsunamis are mainly caused by sublacustrine and subaerial mass movements that can be triggered by seismic or aseismic processes (Schnellmann et al. 2002, Strasser et al. 2007, Kremer at al. 2012, Hilbe and Anselmetti 2015). Such tsunamis can have devastating effects on the surrounding population and infrastructure.

To assess the tsunami hazard triggered by sublacustrine mass movements, the stability of the lake slopes needs to be examined. As a part of the SNSF funded SINERGIA project “Lake Tsunamis: Causes, Controls and Hazard”, we perform the slope stability analysis based on the comprehensive geotechnical in situ and laboratory dataset for the selected sites of Lake Lucerne, Central Switzerland.

During 2018-2019 dense geotechnical investigations were carried out along slope-perpendicular profiles at 10 sites where the slopes have failed in the past or are susceptible to failure and included more than 130 in-situ free-fall cone penetration tests with pore pressure measurement (CPTu) and laboratory analysis of 30 short sediment cores. Already existing reflection seismic dataset complements these data and provides the thickness of different sediment layers.

1D undrained, infinite slope stability analysis following Morgenstern and Price (1965) is used to define the Factor of Safety and critical conditions for deltaic and lateral slopes, where different triggers can be responsible for the failure. Based on the conducted analysis, static and dynamic stability together with critical failure conditions for different slopes in Lake Lucerne can be compared.

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