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Lake Tsunamis: Causes, Consequences and Hazard investigated in a multidisciplinary project

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Tsunamis can occur in lacustrine environments, similar to marine settings. In lake settings, these tsunamis are mainly generated by mass-movement processes displacing large volumes of water, and triggered by seismic or aseismic phenomena. In Swiss lakes, several historical tsunamis are reported. Some of the most prominent examples are: the 563 AD Lake Geneva tsunami presumably caused by a rockfall-induced delta failure, the 1601 AD Lake Lucerne tsunami caused by earthquake-triggered sublacustrine mass movements, and the 1687 AD Lake Lucerne tsunami that was caused by a delta failure.

Nowadays, the shorelines of many Swiss lakes are densely populated and host important infrastructures. The occurrence of lake tsunamis in Switzerland is known, however, we still miss a workflow to assess the hazard related to tsunamis. Within the framework of a multidisciplinary project (Lake Tsunamis: Causes, Consequences and Hazard), funded by the Swiss National Science Foundation and the Federal Office for the Environment, we aim towards better understanding lake-tsunami processes using Swiss lakes as laboratories.

The major objectives of this project are to investigate a) the diverse causes of lake tsunamis, b) the geotechnical and sedimentological properties of unstable slope sediment, c) the potentially unstable sediment volumes on charged slopes, d) the wave generation, propagation and shore run-up, e) the onshore and shallow offshore tsunami deposits and d) their related hazard.

Since 2018, extensive field work using ocean bottom seismometers and cone penetration tests, as well as laboratory tests on sediment sample have been performed to assess the slope stability

during seismic shaking on Lake Lucerne. Tsunami waves have been reproduced at laboratory scale to benchmark the numerical simulations of generation, propagation and run-up of tsunamis in lakes. To characterize and date historical and prehistorical tsunami deposits, on and off-shore sediment cores have been retrieved at Lake Lucerne, Geneva, Zurich and Sils. A first work-flow to assess the tsunami hazard related to earthquake-triggered sublacustrine mass movements is proposed. In this contribution, we will summarise the current status of this project.