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Reconstructing ~2,200 years of mass movement and tsunami events in a deep fjord-type lake, western Norway

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Rock avalanches are one of the most devastating geohazards in Norway. A recent example can be given by the September 1936 rock fall that released ca. 1 million m3 of gneissic bedrock from the Ramnefjell Mountain, 800 m above Lake Lovatnet in inner Nordfjord, western Norway. The rock fall plunged into the lake causing a tsunami with a maximum run-up of 74 m and causing 74 casualties. This rock failure opened a deep-seated fracture that may serve as a sliding surface threatening for the generation of potential new series of failures.
Lake Lovatnet was surveyed combining simultaneously 1 in3 airgun multi-channel and 3.5 kHz (pinger) single-channel systems. The seismic survey was complemented by piston cores. The general seismic stratigraphy of the lake was reconstructed using the 1 in3 airgun multi-channel survey. The seismic data shows an overall succession of glaciomarine sediments deposited during glacier retreat at the termination of the last ice age and a transition to marine and lacustrine sedimentation, as glacio-isostatic rebound turned the fjord into a land-locked lake. Furthermore, a record of ~2200 years of mass wasting events were identified and dated in the sedimentary record and the events were further mapped in the geophysical data. A specially tailored physically-based numerical simulation was carried out on the 1936 rock fall and related tsunami event in Lake Lovatnet. This model allowed us to reconstruct the effects of such an event on a small lacustrine basin. The outcome of the model has been further validated against historical, marine and terrestrial information.
Results from this study further permit to extend the record of mass wasting events beyond historical times, providing a data set that can be applied to comparable basins at various temporal and geographical scales.