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From lake sediments to prehistoric earthquake scenarios: limitations and possibilities from a Swiss perspective

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In regions where deformation rates are low, the recurrence of large earthquakes may exceed the times covered by instrumental and historical observations. In particular for long return periods, earthquake hazard assessment requires information on such large events. Recent studies have shown that lake sediments are suitable for paleoseismological reconstructions by causally linking characteristic sedimentological features to past earthquakes. However, studies on single sites do not allow determining the magnitudes nor the potential epicenter locations. Thus, multiple sites need to be considered.
In this contribution, we present the sedimentary seismological record of Swiss lakes over the last 10,000 years using sublacustrine mass movements and microdeformations that might be seismically induced. In a second step, additional paleoseismological indicators such as rockfalls, small and large-scale deformations, archeological and historical evidences were added to the existing lake dataset. Evidences are clustered in time and space. As dating uncertainties are large, a unique interpretation is not possible. This is demonstrated by analysing the geological record of historical earthquakes. For pre-historical events, both a single large event and multiple earthquakes clustered in time can explain the observations. We therefore analysed periods of potential enhanced paleo-earthquakes in both time and space using intensity prediction equations for the Alpine region. With this approach, we propose paleo-earthquake scenarios with potential magnitudes and epicenters. This will allow us to determine different models for the rates of large earthquakes and compare with the Gutenberg- Richter relationships used recently in the calculation of the probabilistic seismic hazard.