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Using average velocities of deep-seated landslides to develop intensity-frequency scenarios

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In Switzerland, hazard maps qualify the potential of destruction of events according to their intensity and their return period, usually set at 30, 100 and 300 years. This refers to the degrees of danger. For permanent landslides, intensities correspond to the average of the annual displacement velocities. In most cases these velocities are estimated based on expert opinion, because most of the landslides are not monitored. This information does not provide enough information to establish scenarios for different return periods. Consequently, we develop a method, which allows to infer the intensities based on a negative exponential distribution used to deduce the velocities of landslides for the three return periods.

For this study, we choose the differential movement as intensity scale. To estimate the deformation rate we need a shear deformation quantification calculated using a distance and a velocity. The distance is defined by the half with of a rectangular idealized landslide shape 2/1 which corresponds to the square root of the surface A/2 divided by two. Using the average displacement velocity (v) and A the differential strain e cm / (m $\times$ an) is given by e = 2 v (1/sqrt(A/2)).

Based on that average deformation, it is possible to extrapolate average deformations for longer period of time based on Poisson distribution. This leads to three scenarios which are used for risk analysis. These risk calculations are implemented in a WEBGIS platform, which automatically calculates the risks using the buildings register, including their values and assignments, and an inventory of landslides as polygons including their average velocities.
Therefore, e is a characteristic of each landslide polygon (in a GIS). To define the intensity we assume that a building of width w = 10 m is affected by a deformation during a period of time dt. The damage degree thresholds (hazard intensities) used for the building are 10, 50 and 100 cm/m. This method applied to the region of les Diablerets (CH) provided encouraging results.