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Predicting the reactivation of a landslide from precipitation data. The example of a confidential landslide (Switzerland)

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The return period is widely used to characterise the statistical time between two occurrences of a natural event of a given intensity. It is the case for precipitation, thanks to a long recording time (over 160 years in Switzerland). But for landslides, especially for a single case study, the history is generally insufficient. Thus, the prediction of brusque reactivation of existing slides is still hard to quantify and are crucial information for risk assessment. In this context, the return period of studied landslides can be linked with the one of the precipitation of the same region.

The case study, a landslide in an undisclosed location is mainly composed by Würmian deglaciation deposits and intramorainic deposits. It is a partially submerged landslide and contains two water tables. One is associated with the level of the water body and the other is perched. The landslide has a sliding rate of about 2 cm per year and its motion is controlled by the perched water table level and thus, by the precipitations.

This study aims to provide a reliable numerical model that permits the estimation of return periods for water-triggered landslides.

The model takes into account an infiltration function, the porosity, the permeability, the underground flow and the surface runoff. Inputting the precipitation intensity, it gives the cumulative duration and vice versa. The intersection of these two outputs into an Intensity-Duration-Frequency (IDF) chart lead to a matching return period. As this process is performed for various water table levels, and particularly the one that corresponds to a safety factor smaller than one, the return period of the reactivation of the slide is obtained.

In our case study, the parameters of the models are both determined by available data and in situ measurements. Nine different water table levels are investigated and the return period, based on the safety factors calibrated on the worst precipitation scenario, obtained for the sudden reactivation is superior to 500 years.

In conclusion, our code permits to predict the occurrence of a sudden reactivation of a known landslide, using the statistical concept of return period. It consequently helps for a reliable risk assessment.