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Sensitivity Analysis of Landslide triggering Earthquakes

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Landslides are recognized and mapped worldwide. Natural landslide triggers are predominantly earthquakes or rainfall and soil moisture. In contrast to numerous concepts and methods for rainfall-triggered landslides, techniques for modeling earthquake-triggered landslides are rare. Often research focuses on strong motion earthquakes, which do commonly not occur in Germany. The aim of this study is to analyze if - and to what degree - low motion earthquakes could trigger landslides. The study areas chosen are the 'Lower Rhine Embayment' and the 'Swabian Alb'. Calculations are based on the 'Newmark displacement' method.

The first step was to characterize the relevant earthquakes with a potential to trigger landslides. The relevant data were taken form a historical earthquake catalog of the BGR (Federal Institute for Geosciences and Natural Resources, Hannover). To determine the Arias intensity the intensity values of historical earthquakes were converted to local magnitude (ML) by an unpublished formula of the BGR. To calculate the 'Factor of Safety' for the slopes, a database of all relevant substrates from mud to rock with properties such as friction angle, specific unit weight and cohesion was established. These entries were grouped according to their most common property values in order to simplify the number of calculation with the Newmark displacement method.

The basis for spatial calculations were geological maps of different scales and DEMs ranging from 1m to 75m.

Further the critical acceleration was calculated for different scenarios of all possible slope angles. Newmark displacement was calculated with these values and all resulting displacements > 10 cm were presented in a landslide susceptibility map for respective study areas.

The first results of the study show, that at least the strongest earthquakes which have occurred in the past within or near the study areas had the potential to trigger landslides.

Keywords: Earthquakes, landslides, Newmark displacement, Arias intensity, Lower Rhine Embayment, Swabian Alb