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Sensitivity analysis of landslide triggering earthquakes

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Earthquakes are often mentioned as a trigger for landslides. Often research focus on strong motion earthquakes only. In this study different mechanisms and combinations of earthquake strength and depth for Germany as well as different substrate properties are analyzed by applying the 'Newmark Displacement' method.

The first step was to characterize the relevant earthquakes with known strength and depth. For most historical earthquakes the strength is noted in terms of intensity, but values are needed in magnitude (Ml). An unpublished formula of the BGR (Bundesamt für Geologie und Rohstoffe, Hannover, Germany) was applied to converted intensity data into magnitude values. Secondly, a database of all relevant substrates from mud to rock and their properties such as friction angle, specific unit-weight and cohesion was created. These entries were grouped according to their most common property values in order to simplify the number of calculations within the 'Newmark Displacement' method. Thirdly, the spatial distributed 'ARIAS-Intensity' was calculated by applying the formula of Wilson & Keefer (1993). Minimum and maximum values for reasonable combinations of magnitude and depth of earthquakes within their influence areas were delineated. Fourthly, the 'Newmark Displacement' was calculated by the formula of Jibson (1998) for slope angles from 0° to 90° using the determined values of 'ARIAS-Intensity'. The 15cm movement value defined by Keefer (2002) was chosen as the criteria landslides displacement.

This study is performed for the Bonn and Swabian Alb regions, both located in Germany. Results determine a large group of substrates with similar behavior under stress and therefore with a high potential to trigger future landslides. In contrast, there are also quite a number of substrates of higher or lower resistance to stress caused by earthquakes. Sensitivity analysis demonstrate the influence and weight of some variables used in these calculations for the results. For example, changes in friction angle

and moisture has more influences on results than specific unit weight.