



Calculating Factor of Safety for Regional Slope Stability Maps

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Landslides are recognized and mapped worldwide. However, the trigger mechanism and the processes, which finally lead to the failure of a slope, are not well understood. Commonly, analysis are based on the 'Factor of Safety' (FOS) and express the slope conditions as unstable ($FOS < 1$), marginal ($1.0 < FOS < 1.5$) and stable ($FOS > 1.5$). Within this study, the FOS is calculated using the formula introduced by Newmark (1965) and modified by Miles & Keefer (2003). This formula considers different material properties (e.g. cohesion, unit weight, friction angle), soil moisture and the slope angle. This equation is applied in a regional analysis leading to a spatial hazard map.

Because it is difficult to measure all relevant substrate data for the whole region, a sensitivity analysis was performed to determine the relevance of the different substrate properties required for the calculations. If a value change of a specific property does not affect significantly the result, an average value was used. For all other cases a more precise value was inserted. To obtain the required values, a database on substrate properties was created. Most of the data had to be taken from literature due to a lack of measured values for the study areas (Swabian Alb and Lower Rhine Embayment, Germany). The database gives the range of values for the different substrate data. Soil moisture is very difficult to determine for a larger region. Based on previous sensitivity analysis, different soil moisture conditions were applied within the calculations.

Finally, regional maps for different scenarios were calculated with these input data showing the FOS for different conditions. Comparing the areas with a $FOS < 1.0$ with known landslide areas, there is a nearly 100% fit. Thus it can be concluded, that this method is suitable for delimiting landslide prone areas based on specific regionalized substrate conditions.