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Application of a fast and efficient algorithm to detect areas with prerequisites for landslide in sensitive clays, Göta Älv, Sweden

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In Sweden, landslide stability maps are based on the recognition of topographical and soil conditions. The topographical criterion is based on the ratio between height of the slope and its length. The calculation of this cross-sectional angle is straight forward in one dimension, but slightly more complicated in two dimensions and very computationally expensive in a GIS environment. We present an application of a fast and efficient computer algorithm based on slope and soil criteria in Göta Älv, southwest Sweden. The algorithm, compared to other software implementations of the cross-sectional angle criterion, guarantees a fast execution, the possibility to insert several threshold values of the cross-sectional angle and the use of information on bedrock elevation.
As input maps we used a 1:50000 Quaternary soil map, a DEM at 2x2 m pixel resolution, and a bedrock elevation map. We used two sets of cross-sectional angle thresholds, the first one derived from stability calculation and the second one assessed through the relationship between QCSI (i.e. estimated value of the sensitivity) and the cross-sectional angle calculated from the landslide scar database. A comparison between the results of the algorithm using or not using the bedrock information was also performed. The produced maps were validated by using the landslide scar database and a hazard map.
The results show that the use of bedrock information decreases the calculated areas with prerequisites for landslides, whereas not decreasing the performance of the algorithm. The maps produced by using the two different sets of cross-angle thresholds are very similar and show similar results in the validation. This means that it would be possible to extent this methodology in areas without geotechnical information by using less expensive data such as the QCSI. Moreover, the use of several cross-sectional angle thresholds is not possible in other software implementations available at the moment. This means that the presented algorithm is the best candidate to assess landslide prerequisites in Sweden.