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Iterative method for regional prediction of shallow slope failure volumes.

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Models for prediction of regional slope failure hazard are an important tool in hazard and risk assessment. Slope failures cause large amounts of damage throughout mountainous regions around the globe. However, existing models are frequently limited to stability assessment and cannot predict failure volumes or spatial patterns in failure depth. In this presentation we present a novel method for physically-based estimation of shallow slope failures. The model predicts spatial failure and failure depth patterns. The equation in the model are based on a traditional safety factor, which is extended with a spatial sub-surface force simulation. The slope angle is assumed parallel to the surface slope initially. Then, in case of instability, the material depth is iteratively remove, altering the slope and material depth. The removal depth is based on the required amount of material that needs to be removed to gain stability. During the iterations, the changes subsurface force patterns and slope values propagate both up and down-slope. Finally, the iterative process finds a final state where enough slope material is removed to gain stability. The model performance was tested on a real case study and compared to the performance of the infinite slope model, and a random ellipsoid sampling model. During a 2009 convective storm, over 390 shallow landslides were triggered in the 6 m2 coastal Scaletta catchment in the Eastern part of Sicily. The results show that the model is able to predict failure patterns and volumes with relatively high accuracy when compared to other models. Particularly, the failure patterns are similar in locations and shapes as the random ellipsoid sampling results. However, while this method is limited to ellipsoid shapes, the iterative method shapes organically fit to the elevation model. Furthermore, while random ellipsoid sampling provides detailed insights into stability estimates, it requires large amounts of computations, and is not useful in combination with real-time hydrological modelling. The developed method is computationally efficient, allow for integration in a hydrological model, where hydrological processes can act as real-time triggers for the slope failure.