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# Runout modeling of hillslope debris flows and small surficial landslides

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Small surficial landslides and hillslope debris flows (small unchannelized debris flows) are a common problem in the Alps during large rainfall events. Here we explore the possibility of modeling the runout of this type of event. Ten recent well-documented unchannelized hillslope debris flows from Switzerland were selected. Event volumes range from a few hundred up to a few thousand cubic meters. The model (RAMMS) is a 2D finite-volume solution to the shallow water equations for granular flows. The flow friction here was described using a simple Voellmy relationship. For the ten cases presented herein, calculations were made using a high-resolution elevation model (DTM-AV) of the topography, with the starting volume estimated from the field data. For nine of the test cases we found the range of friction coefficients that were capable of matching the measured runout distance, and we compare the coefficients with observed parameters such as hillslope angle and event volume. For one case it was not possible to achieve reasonable results with constant coefficients. The range of the Voellmy friction coefficients is large, with the turbulent and Coulomb coefficients spanning many orders of magnitude and indicating that some flows are dominated by one term (e.g. Coulomb friction). While it is possible to model the runout of hillslope debris flows using a Voellmy relationship to describe the flow resistance, the large degree of variability of the coefficients among events—even within the same region and during the same storm event—indicates that the predictive capability of this approach is limited.