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2D application of a friction-limited model for debris flow propagation

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Debris flows are each year responsible of severe infrastructure damages and human losses. Accurate simulation of this phenomenon allows for prevention of risks related to such events and can help for a sustainable territorial planning.

A simple and intuitive 2-D debris flow model is developed using MatLab. It is based on the coupling of a mass point motion along the slope and the flattening of a volume linked to this mass point. Three main parameters have to be tuned in order to obtain a realistic prediction: the basal friction angle, the flattening coefficient and the debris flow maximum velocity. The model enables to simulate the location of the debris as a function of time and thus predict an important parameter of debris flow events, the runout distance. This tool allows for rapid calculations and has the advantage to use parameters that are easily assessable, such as the thickness of the debris flow deposit.

The model is applied and compared to a debris flow event that occurred in Switzerland (Fully, VS) in October 2000. Following heavy rainfall and a hydroelectric pipe failure, a morainic deposit failed and propagated as a debris flow, reaching human-occupied areas (vineyards and roads). The event is well documented, with the initiation point, the flow velocity and runout distance known.

A good agreement is found between the model prediction and the data from the debris flow event described above. This shows that the developed simple model can be an efficient tool to predict important debris flow characteristics, such as the runout distance. A further development would be to implement a 3-D model based on this approach