Geophysical Research Abstracts
Vol. 21, EGU2019-8485, 2019
EGU General Assembly 2019

Computational modeling of rapid landslides in the presence of DEM uncertainty – random field methods vs sequential Gaussian simulations

Hu Zhao and Julia Kowalski

AICES Graduate School, RWTH Aachen University, Aachen, Germany (zhao@aices.rwth-aachen.de)

The essential input for a simulation-based impact assessment of rapid landslides is a digital elevation model (DEM) that represents the underlying terrain surface. Being an approximation of the real-world topography, it inevitably contains errors introduced by its generating procedures, or a resolution that is too coarse to reflect topographic features such as terrain steps at high spatial-frequencies. The errors are often unknown at most locations in the DEM and thus give rise to DEM uncertainty. To date many methods have been proposed to represent DEM uncertainty. For run-out simulations of rapid landslides, however, the DEM is still mostly used as ground truth, despite the fact that DEM uncertainty may heavily influence the mobilized material's flow path and its deposition area. This may increase the uncertainty of computational landslide models and thus decreases the reliability at which we can predict the area affected by the landslide, its deposit structure and overall destructiveness.

In this contribution, we present results of a study that addressed the impact of DEM uncertainty on rapid landslide simulations. In particular, we investigate how DEM uncertainty propagates through computational landslide models using stochastic simulations. First, we describe a python-based workflow that is designed to ultimately automate procedures of stochastic simulations. It integrates existing software for representing DEM uncertainty, rapid landslide process simulations and visualization, as well as self-written python scripts for post-processing of the simulation data. A brief example will show the capabilities of our workflow based on a realistic rapid landslide scenario.

Next, we describe our approach to account for the DEM uncertainty in the landslide simulations. Depending on the available information about the DEM errors, we have to distinguish two situations: 1) one global DEM error indicator (root mean square error, RMSE) is available, and 2) high accuracy reference data are available (DEM error map). Unconditional simulation with a random field method (Wechsler and Kroll, 2006) is utilized in the first case. Conditional simulation with a sequential Gaussian method (Holmes et al., 2000) is adopted in the latter. Both methods will be introduced. Finally, simulation results for a selected landslide scenario are compared and discussed.

References

Holmes, K.W., et al. (2000). Error in a USGS 30-meter digital elevation and its impact on terrain modeling. Journal of Hydrology, 154-173.

Wechsler, S.P. and Kroll, C.N. (2006). Quantifying DEM uncertainty and its effect on topographic parameters. Photogrammetric Engineering and Remote Sensing, 1081-1090.