Geophysical Research Abstracts
Vol. 21, EGU2019-5286-2, 2019
EGU General Assembly 2019

Uncertainties of Simulating Debris Avalanches Using RAMMS

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The threat of mass movements has always existed in Norway, but due to climate change, an increase in the frequency of mass movement events is expected. Today, there are over 150.000 people living in areas threatened by mass movements, and the need to map hazard zones is rising.

The use of the numerical software RAMMS (RApid Mass Movement Simulation) as a tool in the elaboration of hazard maps to assist land-use planning at municipal level is increasing. Operational use of this software for hazard mapping is based on recommended settings and typically renders one single simulation per case and, rarely consultants have the time to calibrate the model before its use.

Our motivation here is to investigate the uncertainties of these simulations, associated with uncertainties in regard to field measurements, parameter choices, and model structure. Using the RAMMS::DEBRISFLOW module we investigated the uncertainties due to parameter choice and model structure by analysing a debris avalanche in Oldedalen, Norway.

We performed a sensitivity analysis, where our main focus is the module's sensitivity in regard to the friction parameters μ and ξ, the initiation area, and entrainment. The RAMMS::DEBRISFLOW module is largely dependent on the friction parameters and we observe a compensation effect between the two. We can thus achieve the same result with different combinations of parameter values. We also found that the flow heights are more sensitive to changes in μ, while the velocities and pressures are more controlled by ξ. The uncertainties in regard to the choice of friction parameters can be limited by the use of multi-objective validation, and, with the same analyses for other events, we may find a standard range of friction parameters for debris avalanches in Norway. This effort will ultimately further improve the accuracy of simulations and thus hazard assessment.