Geophysical Research Abstracts
Vol. 19, EGU2017-6088, 2017
EGU General Assembly 2017

Application and optimization of input parameter spaces in mass flow modelling: a case study with r.randomwalk and r.ranger

Julia Krenn (1,2), Christian Zangerl (1), Martin Mergili (1,3)

(1) University of Natural Resources and Life Sciences (BOKU), Institute of Applied Geology, Vienna, Austria (martin.mergili@boku.ac.at), (2) Government of Lower Austria, Group Roads, St. Pölten, Austria, (3) University of Vienna, Department of Geography and Regional Research, Vienna, Austria

r.randomwalk is a GIS-based, multi-functional, conceptual open source model application for forward and backward analyses of the propagation of mass flows. It relies on a set of empirically derived, uncertain input parameters. In contrast to many other tools, r.randomwalk accepts input parameter ranges (or, in case of two or more parameters, spaces) in order to directly account for these uncertainties. Parameter spaces represent a possibility to withdraw from discrete input values which in most cases are likely to be off target. r.randomwalk automatically performs multiple calculations with various parameter combinations in a given parameter space, resulting in the impact indicator index (III) which denotes the fraction of parameter value combinations predicting an impact on a given pixel.

Still, there is a need to constrain the parameter space used for a certain process type or magnitude prior to performing forward calculations. This can be done by optimizing the parameter space in terms of bringing the model results in line with well-documented past events. As most existing parameter optimization algorithms are designed for discrete values rather than for ranges or spaces, the necessity for a new and innovative technique arises. The present study aims at developing such a technique and at applying it to derive guiding parameter spaces for the forward calculation of rock avalanches through back-calculation of multiple events.

In order to automatize the work flow we have designed r.ranger, an optimization and sensitivity analysis tool for parameter spaces which can be directly coupled to r.randomwalk. With r.ranger we apply a nested approach where the total value range of each parameter is divided into various levels of subranges. All possible combinations of subranges of all parameters are tested for the performance of the associated pattern of III. Performance indicators are the area under the ROC curve (AUROC) and the factor of conservativeness (FoC). This strategy is best demonstrated for two input parameters, but can be extended arbitrarily.

We use a set of small rock avalanches from western Austria, and some larger ones from Canada and New Zealand, to optimize the basal friction coefficient and the mass-to-drag ratio of the two-parameter friction model implemented with r.randomwalk. Thereby we repeat the optimization procedure with conservative and non-conservative assumptions of a set of complementary parameters and with different raster cell sizes.

Our preliminary results indicate that the model performance in terms of AUROC achieved with broad parameter spaces is hardly surpassed by the performance achieved with narrow parameter spaces. However, broad spaces may result in very conservative or very non-conservative predictions. Therefore, guiding parameter spaces have to be (i) broad enough to avoid the risk of being off target; and (ii) narrow enough to ensure a reasonable level of conservativeness of the results.

The next steps will consist in (i) extending the study to other types of mass flow processes in order to support forward calculations using r.randomwalk; and (ii) in applying the same strategy to the more complex, dynamic model r.avaflow.