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r.avaflow, the GIS simulation model for avalanche and debris flows: new developments and challenges

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We present the latest developments and discuss some of the key challenges with regard to the novel and unified computational tool r.avaflow, representing an advanced, comprehensive, GIS-based open source simulation environment for two-phase geophysical mass flows such as avalanches of snow or rock, flows of debris or mud, and related process chains. r.avaflow is freely available and adoptable as a raster module of the GRASS GIS software (http://www.avaflow.org). We focus on the following issues:

(1) We back-calculate a laboratory-scale debris flow experiment with r.avaflow and thereby show that different types of drag may govern the evolving flow dynamics, depending on the initial flow configuratiuon. In particular, it appears necessary to consider viscous ambient drag in order to achieve simulation results in line with experimentally measurements.

(2) We employ a set of well-documented rock avalanche events to illustrate the use of a built-in functionality for parameter sensitivity analysis and optimization. To do so, we demonstrate possible strategies going beyond the deficient one-at-a-time simulation approach. They allow us to test three or more parameters at once with a limited number of model runs. Computational times are kept at an acceptable level by multi-core processing strategies and use of the Vienna Scientific Cluster.

We further discuss a number of key issues with regard to (i) arbitrary mountain topography; and (ii) entrainment and deposition of material. Most tests indicate a good model performance when the affected areas predicted for a late stage of the flow simulation are compared with observed affected areas. However, we note that such a validation is not fully justified without the implementation of a physically correct model for the deposition process.

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