INTEGRAL HAZARD MANAGEMENT USING UNIFIED SOFTWARE ENVIRONMENTS

NUMERICAL SIMULATION TOOL "RAMMS" FOR GRAVITATIONAL NATURAL HAZARDS

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INTRODUCTION

In the field of natural hazards there is a strong need for process models or tools, in which both the process and interaction with proposed mitigation measures can be evaluated. We have developed a unified software package, for both research and practice, in which flow avalanches (see Fig. 1), debris flows, shallow landslides and rockfall are combined in one tool. The program has been verified using WSL's field installations and data from field case studies. Integrating different process models in one tool, exploitation of dynamics similarities in the processes is possible. Additionally, because many mitigation measures also protect against hazards for which they were not originally intended, the common interface allows for a comprehensive evaluation of mitigation measures in the sense of integral risk management.

UNIFIED MODELLING OF NATURAL HAZARDS

Today's computational capabilities and advances in software engineering are changing how natural hazard problems are solved. However, many different applications require time and resources to learn and to reliably use. "Quick and dirty" simulations, quick results and reports are not uncommon in practice. If it were possible to use the same software to analyse different natural hazards much time could be saved and – even more important – the risk of mistakes due to an insufficient knowledge of various different software products is reduced significantly. Furthermore, money could be saved because of a possibly attractive licensing system and a reduced number support/service contacts helps as well.

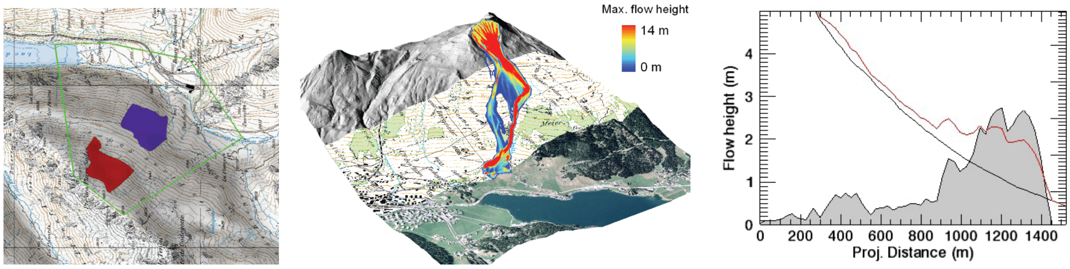

Fig. 1 RAMMS::GUI – input of investigated area and simulation parameters (left) and output of avalanche simulation in 3D (middle) and along avalanche path (right)

LINKING RESEARCH WITH PRACTICE

Each software product sold and used requires continuous support and updates, e.g. due to changes in the underlying operating system. Ideally, the software is also developed further not only for its

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capabilities and user-friendliness but also with regard to its theoretical basis and the numerical algorithms, etc. This is usually the case if the underlying numerical procedures are a topic of current research at universities or research institutes. Here, the motivation is normally not profit-oriented and therefore free of commercial pressure (with the drawback of sometimes longer lasting development times than in industry). However, it guarantees numerically up-to-date software and any helps the public-funded institutions to get some third-party money to co-finance their research.
The continuing developments, on the one hand, might also change the simulation results compared to earlier software versions. However, and in general, the numerical models improve over time and therefore also the results.
Finally, engineering practice invests only a small amount of time and money in testing and verifying complex numerical simulations. Therefore, "ground truthing", i.e. a proper verification, by one organisation is unavoidable. This requires field data sets as well as empirical methods on how to verify such a code.

REQUIRED CAPABILITIES FOR UNIFIED MODELLING IN THE FIELD OF NATURAL HAZARDS

The main tasks in the field of natural hazards are the definition and evaluation of the different hazards, their influence on the landscape, humans, buildings and the infrastructure and possible prevention measures. For software, this means the need to automatically detect a hazard's source areas and magnitudes, simulate the process's evolution (hazard map), calculate and combine with the potential damage (risk map) and finally to consider protection measures. Right now, there are still a lot of gaps in this process that are currently and most probably also in future will be filled by hazard experts. However, where possible actual numerically transferable knowledge should be concentrated in – preferably – a compact software package. Future developments can then be added.

THE SOFTWARE PACKAGE "RAMMS"

The software package "RAMMS" ("Rapid Mass MovementS", http://ramms.slf.ch) forms part of some current research at the Swiss Federal Institute for Forest, Snow and Landscape Research WSL and follows the concept of a unified modelling tool. Its structure is modular enabling a continuing further development and enhancement. The user works with a single graphical user interface (GUI) with 3D landscape modelling conforming to GIS standards. In it the investigated areas as well as the source areas are placed and the hazard properties and input parameters for the single numerical simulations (see Table 1) are defined. Subsequently, the relevant output results are visualized in the same GUI as energy distributions, velocities, flow heights, trajectories, etc. (see Fig. 1). The actual status of the software and the theory and models behind will be presented at the conference.

Tab. 1 Modules of software package RAMMS

Software module	Status	Comment
RAMMS::GUI	Released	Graphical pre- and post processor based on GIS standard and using typical digital elevation models (DEM)
RAMMS::avalanche	Released	2D simulation (areal distribution with flow height and velocity) with numerics based on Voellmy-fluid friction model
RAMMS::debris	Beta	2D debris flow modelling similar avalanche module (based on Voellmy-fluid friction model); two-phase modelling planned
RAMMS::landslide	Beta	2D simulation of shallow landslides based on Voellmy-fluid friction model; tests on different models such as "Random Kinetic Energy" model
RAMMS::rockfall	In development	Fully 3D rigid body simulation, terrain/topography and boulder shape freely formable; implementation of new hard contact model
RAMMS::protect	In development / planned	Dams, basins and ditches already capable of modelling by modifying the DEM. Also planned is to deal in future with forests, fences, galleries.

Keywords: numerical models, simulations, hazards maps, rockfall, debris flow, avalanche, rockslide, shallow landslide, RAMMS