SIMULATION OF SHALLOW LANDSLIDE BASED ON DETAILED ELEVATION MODELS

Serena Liener[1], Gabi Hunziker[1]

INTRODUCTION

Recent storm events in Switzerland (2002, 2005) showed, that shallow landslides can occur on many slopes and are responsible for a lot of damage. Therefore the assessment of such phenomena is an important part of hazard prevention. The availability of more detailed elevation models together with new simulation models improves the assessment of shallow landslides.

SIMULATION OF STARTING AREAS OF SHALLOW LANDSLIDES

The procedure SLIDISP (Liener 2000) combines the method 'infinite slope analysis' with a geographic information system to generate a hazard-index map for landslides. The model can process digital elevation models and other spatial data sets. The model parameters such as slope angle, shear parameters, water saturation, and thickness of the soil material must be known for all points within the considered area. For determining the spatial distribution of the water saturation the topoindex is applied (Quinn et al. 1995). Additionally, the model uses a Monte Carlo simulation for representing the natural variability of the shear parameters (cohesion, angle of friction). The results are presented in maps showing the local probability of landslide occurrence (see Fig. 1).

SIMULATION OF SHALLOW LANDSLIDE TRAJECTORIES

Based on the starting areas the trajectories of shallow landslides were simulated with the model SLIDESIM. This model is a further development of the model MGSIM/dfwalk (Gamma 2000), which is used for debris flow assessment. The dispersion of shallow landslide trajectories is simulated with a random walk procedure. The range of the landslide trajectories is calculated according to a friction model (Voellmy 1955) with 2 friction parameters. The parameters were calibrated on the storm event of 2002 in the Napf area (BWG, WSL 2003).

DETAILED ELEVATION MODEL

For most areas in Switzerland a detailed elevation model based on Airborne-Laser-Scanning-Data (DTM-AV) is available. The elevation model can be used in a resolution of at least 1 or 2 meters. The altitude is represented in a precision of ± 50 cm. The use of DTM-AV data for simulation of shallow landslides improves the precision of shallow landslide hazard assessment, because the slope angle calculated from the elevation model is a very sensitive parameter. Fig. 1 shows that the DTM AV represents detailed topographic structures (e.g. narrow slopes, topographic situation around settlements and infrastructure), where shallow

---

1 Geo7 AG, Geowissenschaftliches Büro, Neufeldstrasse 3, 3012 Bern, Switzerland,
email: serena.liener@geo7.ch , email. Gabi.hunziker@geo7.ch

landslides often occur. This means that the use of detailed elevation models such as DTM AV leads to a much more detailed assessment of shallow landslides. Especially the situation around settlements and infrastructure can be simulated much more precise.

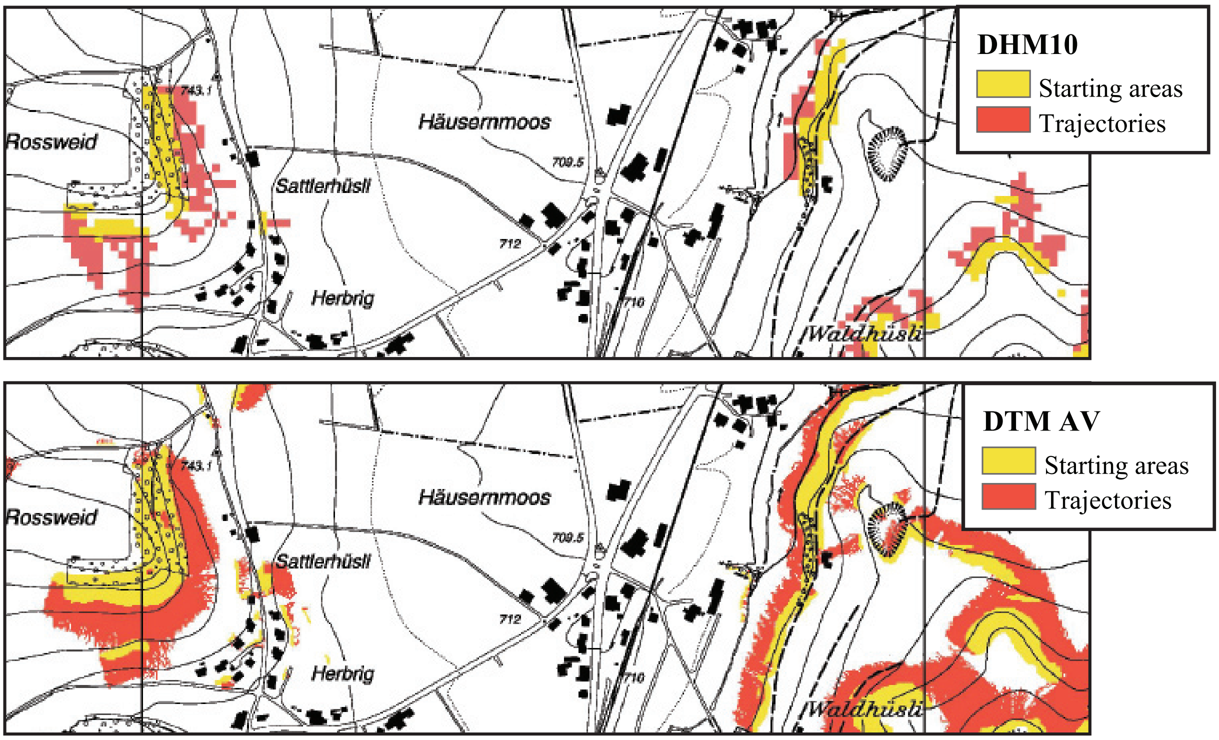

Fig. 1: Comparison of simulation results based on digital elevation model with a resolution of 10 meters (DHM10) above and based on 2 meter resolution DTM-AV below. Both simulations have been done with the same parameters based on different digital elevation models.

APPLICATION FOR HAZARD ASSESSMENT

Such simulations based on DTM AV are a good basis for shallow landslide hazard assessment. They serve as background for detailed hazard assessment and have already been used for developing several hazard maps in Switzerland.

LITERATUR

BWG, WSL 2003: Oberflächennahe Rutschungen, ausgelöst durch die Unwetter vom 15.-16.7.2002 im Napfgebiet und vom 31.8.-1.9.2002 im Gebiet Appenzell.

GAMMA, P. 2000: dfwalk – Ein Murgang-Simulationsprogramm zur Gefahrenzonierung, Geographica Bernensia G66, Universität Bern.

LIENER S. 2000: Zur Feststofflieferung in Wildbächen, Geographica Bernensia G64, Universität Bern.

QUINN, P.F., BEVEN, K.J., LAMB, R., 1995: The ln(a/tan β)index: How to calculate it and how to use it within the topmodel framework. Hydrological Processes, Vol. 9.

VOELLMY, A. 1955: Über die Zerstörungskraft von Lawinen. Schweizerische Bauzeitung, Jahrgang 73, Heft 12, 15, 17 und 19.

Keywords: Simulation model, shallow landslide, hazard prevention