DEBRIS FLOW PROCESSES IN AN ALPINE CATCHMENT IN ANTHOLZ VALLEY (SOUTH TYROL)

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INTRODUCTION

Debris flows are frequent natural hazards in mountain regions, which seriously can threat human lives and economic values. In the European Alps, the occurrence of debris flows might even increase with respect to climate change, including permafrost degradation, glacier retreat and variable precipitation patterns (Damm and Felderer, 2008; Mair et al., 2008). Thus, detailed understanding of process parameters and spatial distribution of debris flows is necessary for risk assessment and to take appropriate protection measures.

Fig. 1 View of the eastern part of the catchment

STUDY AREA

The south-orientated catchment of the Klammbach creek comprises an area of 6.5 km³. It is located in the central Eastern Alps as a part of the Rieserferner Mountains. Altitudes reach from 1310 up to 3270 m on a horizontal distance of 3000 m. The main precipitation period is during summer with mainly convective rainfall. The study area is geologically located in the Ostalpin with metamorphic rocks (mainly Gneiss) and the plutonic rocks of the Rieserferner Tonalit.

BACKGROUND

In summer 2005, a series of three debris flows occurred in the Klammbach creek. In total, about 140 000 m³ of debris was deposited on the debris fan in the Antholz valley. Agricultural area was inundated and the Antholz creek was dammed and displaced. The events were triggered by local intense rainfall in the upper parts of the catchment. The major event in August 2005 originated from a steep, sparsely vegetated debris cone, located below a rock wall, which conducted the water rapidly into the sediment. As a response to the events, a retention basin with a capacity of 100 000 m³ was constructed on the fan in 2007.

Tab. 1 The debris flow events of 2005

	18 July	25 July	1 August
Volume deposited on the fan	30 000m³	8000m³	100 000m³
Precipitation (on 2800m)	35mm/15min	unknown	30mm/60min
Runtime	30min	unknown	20-30min

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OBJECTIVES

To evaluate the disposition of the Klammbach creek for the occurrence of debris flow events, the following questions are addressed:

- How is the process history of the investigated area?
- What amount of sediment exists in the catchment; how is it composed; how is it consolidated and where is it located?
- Where are the potential starting and deposition areas of debris flows? How much material could be mobilized by future events?

METHODS

To gain a general understanding of debris flow processes in the area, a detailed geomorphological map, including also relevant geomorphodynamical and sedimentological contents was created. In addition, the grain size distribution of sediment samples from the catchment were analysed to evaluate the sediment potential in the catchment. By means of the geomorphological mapping and the analysis of sedimentological samples, potential starting areas for debris flows could be identified. They were used for modelling potential debris flow processes in the catchment. For this purpose, the model framework 'r.debrisflow' based on GRASS GIS was applied (Mergili, 2008). The mapped debris flow forms were used for model calibration.

RESULTS

Evidence for past and recent debris flow processes, like levees, debris flow lobes or scars and scour marks could be found over the whole catchment. Besides the already known event, a second recent event could be identified in the eastern part of the catchment. Large areas are covered by sediments, particularly debris cones and moraine material of Late Glacial and Holocene glaciations. According to their grain size distribution, all sediments are potential source material for debris flows. In general, the material is sparsely consolidated, as erosion can be observed on many slopes, especially on moraines, and most of the material is not or only sparsely vegetated. The GIS-model revealed that relocation of channels is an important factor for debris flow processes in the catchment. Deposition patterns, however, could not be modelled successfully.

DISCUSSION

Geomorphological mapping in combination with sedimentological analysis was found a useful approach for the evaluation of debris flow processes in the catchment. It showed that regarding process history, topography and sediment potential, future debris flows in the catchment could even exceed the events of 2005. In this study, the GIS-analysis gained few additional information. Field observation, geomorphological mapping and expert knowledge remain an essential tool in risk assessment.

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