TRACKING TORRENTIAL PROCESSES ON ALLUVIAL FANS

ASSESSMENT OF DATING METHODS

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INTRODUCTION

Water-related processes (floods, debris floods, flash floods, debris flows) represent major geomorphic hazards in most mountain areas of the world. However, detailed knowledge on frequency and magnitude of past flood or debris-flow events on alluvial fans and cones remains to be scarce and fragmentary, although it is widely accepted that such knowledge is of crucial importance for the assessment of hazards, mitigation of risks, and land-use planning. (Bollschweiler et al., 2011) In hazard assessment frequently the "*historical method*" is applied which is based on the (qualitative and quantitative) analysis of reports, testimonies and chronicles of past events (catastrophes). (INTERPRAEVENT, 2009) This data provides evidences for the frequency of events, the triggering mechanism and the extension of the process as well as the damages occurred. As a rule, historic sources tend to be fragmentary and distorted due to subjective perception. (Rudolf-Miklau, 2011) Alternatively modern methods of historical dating of past debris-flow and flood events such as *dendrochronology*, *radiocarbon dating*, *lichenometry*, *stratigraphical analysis, cosmogenic nuclides, varves* and many more can provide valuable insights on past process activity and therefore complete historical records. Most of these methods are only applied for scientific purposes but have not yet been implemented in natural hazard engineering.

ASSESSMENT AND TESTING OF DATING METHODS (ASP-PROJECT ADAPT-ALP)

A study was carried out in the framework of the framework of the *ASP-project AdaptAlp* in order to assess and compare available dating methods for tracking of torrential processes on alluvial fans. Modern dating methods include a wide range of different sciences and high-tech procedures. The application of most of these methods was reserved to scientific investigations so far. Only simple and low-cost dating methods (e.g. "*silent witnesses*", *archival records*, *digital images*) have been already implemented in the hazard assessment of engineering purposes. In order to gain a comprehensive over-view and to be able to provide a "state-of-the-art" comparison an *expert poll* was carried out. Leading specialists from Europe and America were invited to contribute to this survey of methods providing a questionnaire and universal criteria for the evaluation of practical applicability of each method. The methods were assessed and compared concerning – among other criteria – their characteristic, the time period covered, the temporal resolution, the assessed type of data (frequency, magnitude, spread of process), the costs, the duration, the general scope of application and the limitations (prerequisites for application). The results of this survey will be provided in a "*state-of-the-art" report* for AdaptAlp, a comprehensive and scientific description of the methods and their application for natural hazard management will be published in Bollschweiler et al. (2011).
The farsighted goal of this study was the provision of reliable methods for event dating in order to enable condensed data sets for accurate prognosis of future catastrophic events. The reduction of uncertainties concerning the frequency of catastrophic events will contribute to a better understanding of the impact of climate change on the triggering mechanisms of water related hazardous processes.

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PILOT STUDIES: DEBRIS-FLOOD RECONSTRUCTION BASED ON TREE-RING ANALYSIS ON SELECTED ALLUVIAL FANS

Some selected methods, particularly the *tree-ring analysis* (dendrogeomorphology), were tested in several pilot investigations (on selected alluvial fans in the Tyrol and Vorarlberg: Gratzentalbach, Reiselehnrinne, Bärenrüfe) for practical application. Growth disturbances in tree-ring series have been regularly used to date debris-flow events in mountain environments. In contrast, no studies were available to date that have reconstructed debris floods by means of dendrogeomorphology so fare. (Mayer et al., 2010)

As snow avalanches and debris flows often occupy the common runout zones, the goal of the study at the Reiselehnrinne, Pitztal, was to (i) a high-resolution history of snow avalanche and debris-flow events on the Reiselehnrinne using dendrogeomorphology and (ii) differentiate between these processes by investigating the intra-annual position of growth disturbances. Due to the rather complete and long event chronology, the case study in St. Leonhard, Pitztal allowed to evaluate iii) the accuracy of the dendrogeomorphic assessment by comparing the reconstructed event frequency with event chronologies available for the investigated area. The analysis showed that dendrogeomorphology has a considerable potential to add substantially to event chronologies especially over periods beyond written records and the data obtained on the lateral spread and reach of past events will serve as a very accurate and valuable basis for hazard analysis and risk assessment.

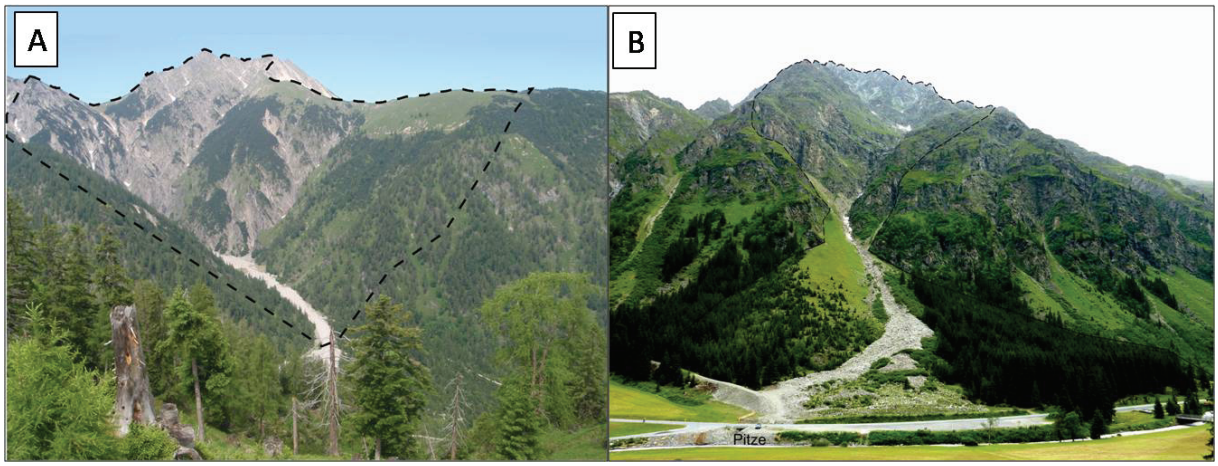

Fig. 1 Overview of the investigated catchments Gratzental (Pertisau) and Reiselehnrinne (Pitz Valley)

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