

# **RISK ASSESSMENT IN THE BAVARIAN ALPS – THE VALUE OF HISTORICAL DATA**

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## **INTRODUCTION**

The project HANG (Historische Analyse von NaturGefahren/Historical analysis of natural hazards) of the Bavarian State Agency for the Environment and the Catholic University of Eichstätt-Ingolstadt deals with the analysis of historical data to assess the hazard potential in the Bavarian Alps. The research focuses on the whole range of natural hazards, yet concentrating on hydrological and geomorphic hazard types, from floods and debris-flows to avalanches and mass movements. For this purpose mainly governmental and municipal archives were examined for written documents, photographs and maps providing information on hazardous events of the past. By this means more than 10.000 different sources were detected, giving valuable facts on the regional differentiation of natural hazards in the research area. The data allows reconstructing extreme events of many “hot spots” to better assess the hazard potential of certain areas. The uniqueness of HANG is due to its aim to analyse a wide range of hazard types in a huge geographical unit, like the Bavarian Alps, yet taking into consideration that the research area is not a consistent geological, climatologic and hydrological unit. Therefore the study was made on a local scale, examining small catchment areas, valleys and even single torrents.

The data retrieved by HANG are already used by experts for water management and Geologists to plan measures of protection.

## **DATA COLLECTION**

The collection of data was realised in the archives of the four State Agencies for Water Management, located in the alpine region. In these archives more than 8500 references on past events were found. A first evaluation of the data showed certain areas especially liable to natural hazards. On this basis further investigation was performed in 25 municipal archives, situated in these areas. About 1500 sources of these archives contributed additional information on single hot spots. The findings were collected in a specially designed data base, which, part from basic information, such as place, time and type of event, allows recording the original wording of sources to better understand and interpret their essential information in a later analysis. In addition, original descriptions of the sources made it less difficult to locate the places mentioned, so that x/y-coordinates and catchment areas were attributed to each data set. At a final stage of data revision, duplicates were deleted and similar information was combined. To visualize the recordings, all datasets were integrated into a GIS.

## **ANALYSIS**

First analysis of the data showed that more than 80% of the data described floods and debris-flows, 10.7 % deal with geomorphic hazards, and the rest were miscellaneous events like ava-

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lanches, thunderstorms or were not determinable. The data covers a time span between 781 and 2005, with the bulk of it referring to the last 200 years. The quality of information ranges from passing mention to detailed descriptions. Since the majority of the data deals with hydrological events, this report concentrates on the analysis of floods. For some areas, the multitude of information and quality of descriptions made it possible to classify the hazardous potential of torrents. For this purpose, every single event was analyzed as accurately as possible, not only relating to the whole area that was affected but with regard to every single torrent. In consideration of the typical information given by historical documents, six categories have been developed to classify a particular flood at a certain torrent:

1) not classifiable, 2) swollen torrent, 3) light flood, 4) moderately severe flood, 5) severe flood, 6) catastrophic flood

By means of these classes, every event verified at a torrent was rated. As a next step, to distinguish torrents by their activity, the number and severity of floods of a torrent were related, so that the classification of torrents is based upon the following principles:

- frequency
- amplitude

However, a categorization of torrents on the basis of historical documents is unprecedented, so that categories had to be developed. In this context it must be stressed that any classification seems to be arbitrary, and should therefore be regarded as a first approach. The following classification of torrents turned out to be most feasible, because it combines the frequency and amplitude of events and limits potential misinterpretations by requiring a minimum occurrence of events per category:

- Very high activity: at least ten events, among them at least one severe or catastrophic flood
- High activity: at least five events, among them at least three moderately severe or one severe or catastrophic flood
- Medium activity: at least three events or at least one moderately severe event
- Low activity: all further torrents

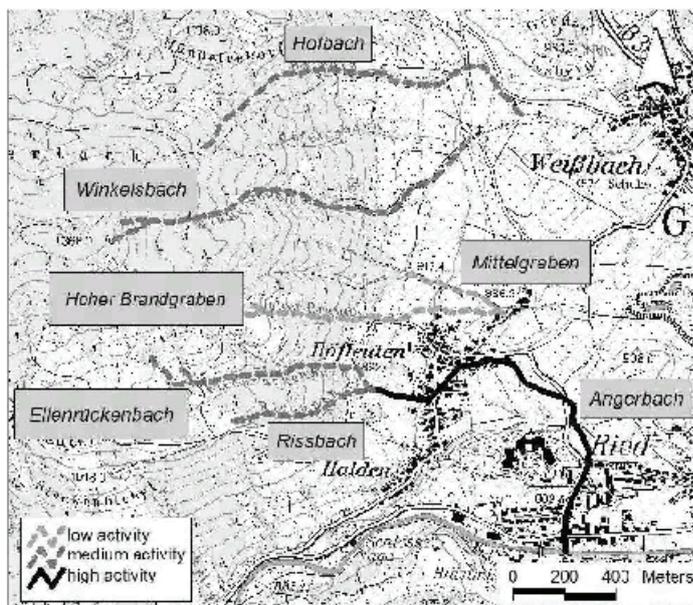


Fig. 1: Torrents near Pfronten (Allgäu)

As an example, all torrents of a small catchment area near Pfronten in the Allgäu part of Bavaria were classified (cf. fig. 1)

## CONCLUSION

The analysis of historical data has proved to be a precious contribution to risk assessment in the Bavarian Alps. At least with regard to floods the number of documents allows well-grounded conclusions on the frequency and amplitude of hazardous events.

**Keywords:** Natural hazards, historical data, risk assessment