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Extended Abstract**

***Development of Flood Risk in Mountain Catchments  
and Related Perception - RISKATCH***

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## **1 Introduction**

The RISKATCH project aims to deliver new, practical and viable solutions for an integrated risk-assessment-based management of natural hazards in Alpine environments and related forelands.

A special focus is on the interaction of technical and non-technical measures during recent flood events in catchment areas. Comparing the status quo and historical development of risk and forecasting possible future developments based on scenarios, necessary action will be derived and efficiency of non-technical measures of flood defence will be evaluated.

Based on the assessment of historical and possible future development of hazard, values at risk and vulnerability, non-technical measures will be evaluated from an economic and technical point of view using scenario technique, cost-benefit analysis and cost comparison method. With respect to different scenarios of the temporal development of risk, maps will be generated and assessed with respect to its perception, using the method of graphic semiology. Graphic semiology is an innovative tool to evaluate such information, and is based on the statistical analysis of eye movements of test persons exposed to visual information.

## 2 Methods

In WP 1, the respective hydrological process characteristics were analysed on a regional and temporal scale. Data of synthetic floods derived from hydrological models in combination with stream routing was linked with data of real flood and debris flow events to analyse the relations between precipitation and the development of hazards in the river systems. The test site in the upper part of alpine catchments were the Wartschenbach, the Enterbach and the Vorderbergerbach catchment in Austria, the lower part of alpine catchments were represented by the rivers Rott and Vils.

Based on the modelling results and the proxies from recent events, an analysis and valuation of damage potential was carried out, focussing on spatial characteristics and possible implementations within GIS (WP 2). To meet the requirements given by the risk equation, process intensities (flow depth and velocities) were linked to exposed values at risk. For the Austrian catchments, values at risk were defined by the expected economic loss of buildings, while in the German catchments the focus was laid at potentially affected persons. In a second set of calculations, the economic damage was also evaluated.

In WP 3, risk maps were generated based on the equation (1). Since vulnerability is still hardly quantifiable, preliminary results from an ongoing project have been used for calibrating the data (Fuchs et al. 2007).

$$R_{i,j} = f(p_{Si}, A_{Oj}, v_{Oj, Si}, p_{Oj, Si}) \quad (1)$$

$R$	=	risk
$p_{Si}$	=	probability of scenario $i$
$A_{Oj}$	=	value at risk of object $j$
$p_{Oj, Si}$	=	probability of exposure of object $j$ to scenario $i$
$v_{Oj, Si}$	=	vulnerability of object $j$ , dependent on scenario $i$

With respect to the perception of the information included in these risk maps, the research programme on graphic semiology was developed (WP 4), including a project-specific survey to be carried out by the test persons. A list of representative test persons from Austria, Germany and France was compiled, and the travel to and stay in Tours was organised. Risk maps were developed and improved according to results from the previous French study "Sémiologie Graphique Experimentale". The test is scheduled for October 19<sup>th</sup> and 20<sup>th</sup> in the Hospital of Tours, France, and the results will be analysed subsequently.

## Results and Discussion

### *Most important scientific results and important events*

The temporal development of risk was assessed using different but complementary methods in Austria and Germany. Data from the Lower Vils region in Germany with respect to a 100-year and a 1000-year design event is presented in Figure 1. The comparison of the time periods since 1850 showed an increase in affected values at risk by a factor of ten and twenty, respectively, with an assumed resulting equal increase in risk. However, due to the lack of historical data, a precise quantification is not possible at the present stage of the project.

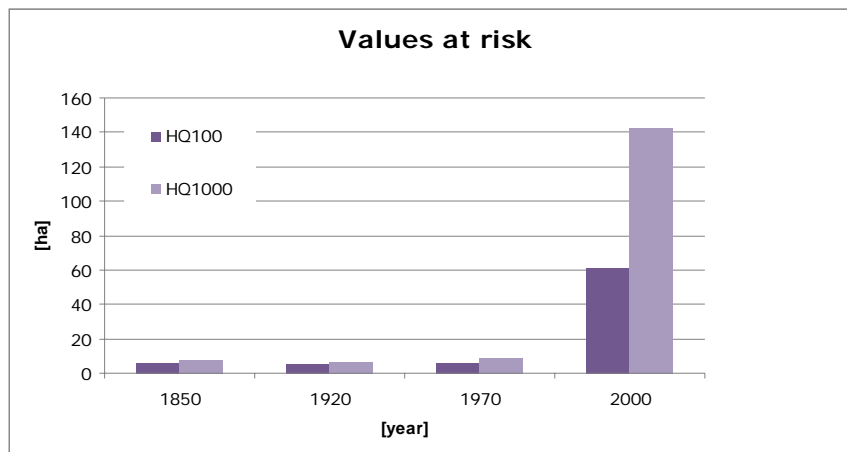


Figure 1. Affected values at risk for a 100-year and a 1000-year design event in the Lower Vils region.

In contrast, an evaluation of damaging torrent events between 1973 and 2004 in Austria had shown no significant trend in a possible increase of losses. Three major storm events causing extraordinary losses are represented by peaks in Figure 2. Considering the increase in settlement area during the same period, this might be attributed to the implementation of technical mitigation measures. However, the impact of land-use regulations as a non-technical mitigation measure is not yet quantified satisfyingly.

Based on the modelling results risk maps were generated for the test sites described in the previous section. Examples for torrent catchments are shown in Figure 3 and an example for catchments in the alpine foreland is shown in Figure 4. Since such maps are an important input for the planned study on graphic semiology, the layout was adopted in close collaboration with the French project

partner to ensure the best possible success with respect to the project aims (Figure 5).

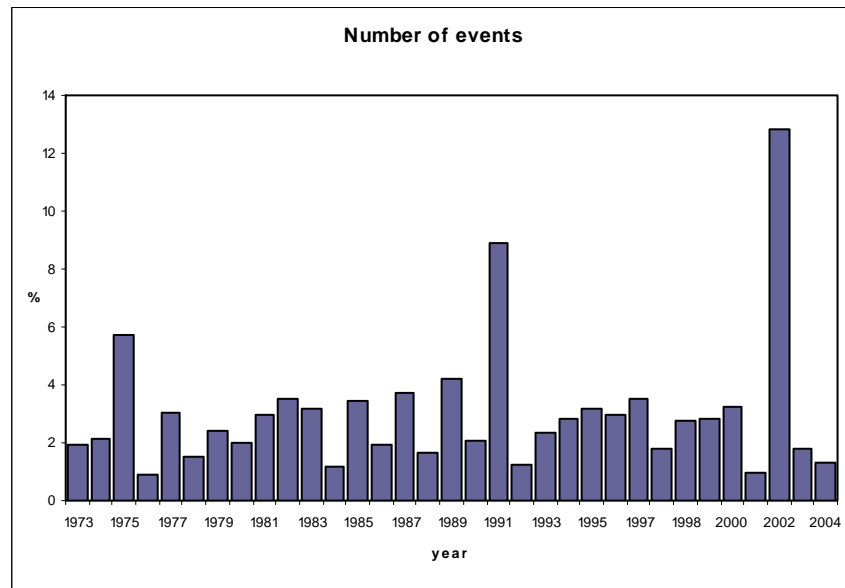
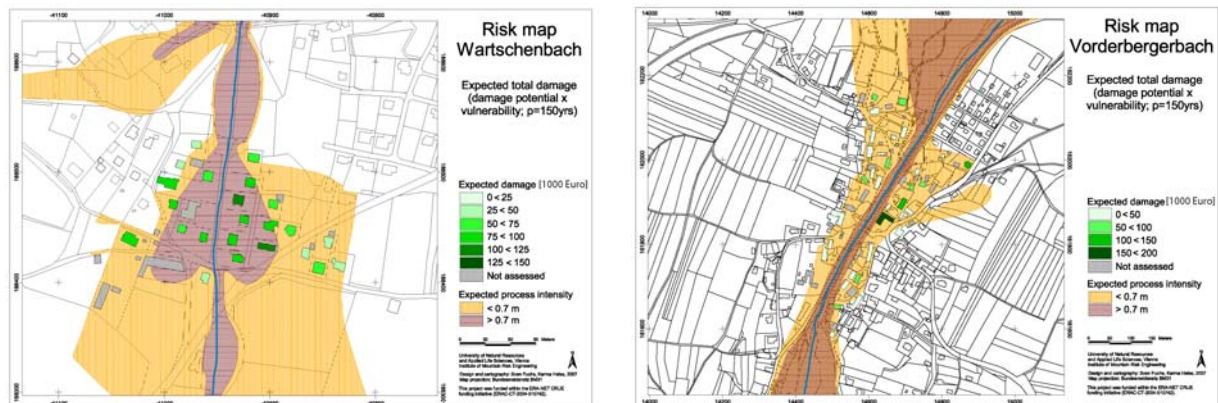


Figure 2. Development of torrent events between 1973 and 2004 in Austria.



a) Wartschenbach

b) Vorderbergerbach

Figure 3. Selected risk maps from Austrian test sites (torrent fans).

The methodologies to link data on the intensity and magnitude of flood and torrent events to exposed values at risk is relatively well established, in particular in Switzerland where legal regulations require the compilation of risk maps. Hence, a major aim of the RISKATCH project was to adopt these methods to the availability of data in Austria and Germany, and to evaluate the method with respect to efficiency of non-technical protection measures.

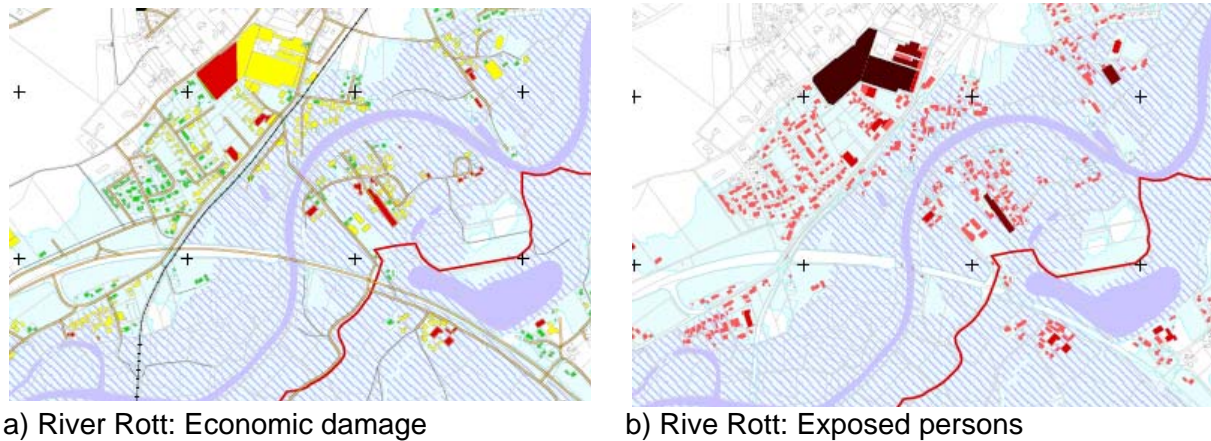


Figure 4. Selected risk map from the German test site (foreland river).

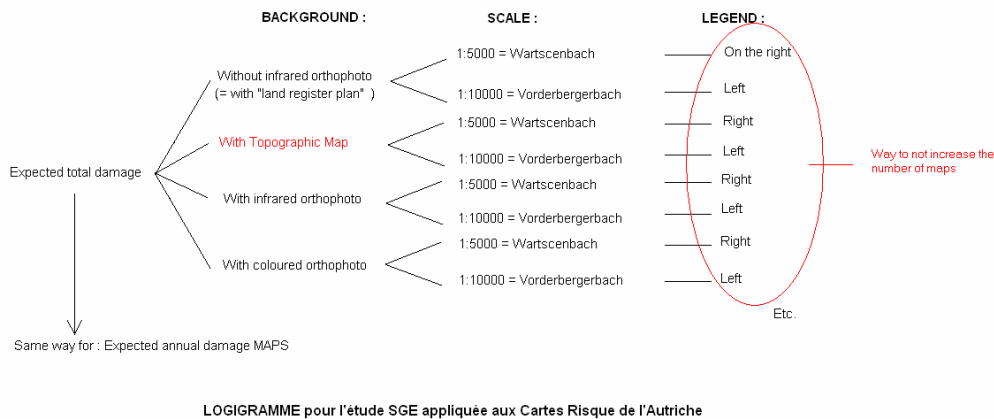


Figure 5. Example for a flowchart produced for a complete set of maps.

### Comparison work plan – progress

Compared to the initial work plan the RISKATCH project is in due time. The major findings related to risk in mountain as well as foreland test sites are compiled in the form of maps. These maps were adopted in close collaboration between all involved partners for use in the study related to risk perception. A careful selection of test persons had been performed to mirror multiple stakeholders' interest in risk information.

Dissemination, communication and education as well internal knowledge management need to be regarded as a major issue of the project.

Communicating and disseminating state-of-the-art research to society in a target-group specific manner is an efficient attempt to bridge the constantly widening gap between research community and the general public. In addition to involving stakeholders and experts, strategies (e.g. environmental education

approaches) for externally disseminating information can be further developed for various target-groups and different scales.

### **Presentations**

EGU 2007, Vienna, Austria: Fuchs, S., Dorner, W., Serrhini, K.: Development of flood risk in mountain catchments and related perception. Geophysical Research Abstracts 9: 01631

EGU 2007, Vienna, Austria: Fuchs, S., Oberndorfer, S., Heiss, K.: Application of the vulnerability concept to torrent events in Austria. Geophysical Research Abstracts 9: 01630

EGU 2007, Vienna, Austria: Spachinger, K.; Dorner, W.; Metzka, R.: Economic aspects of flood protection enhancements. Geophysical Research Abstracts 9: 09634

ANHM 2007, Brisbane, Australia: Dorner, W.; Spachinger, K.; Metzka, R.; Fuchs, S. & Serrhini, K.: Development of land use and flood risk - analysis, assessment, measures.

### **Webspace**

[www.riskcatch.info](http://www.riskcatch.info)

## **3 Contact Details of Authors**

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## **4 References**

Fuchs, S.; Heiss, K. & J. Hübl (2007): Towards an empirical vulnerability function for use in debris flow risk assessment. Natural Hazards and Earth System Sciences 7 (5): 495-506