An indicator-based methodology for vulnerability assessment in Alpine areas

Papathoma Köhle M., Kappes M., Keiler M.
Department of Geography and Regional Research
University of Vienna
AUSTRIA

1. INTRODUCTION AND OBJECTIVE

Alpine communities are threatened by a series of natural hazards.The aim of this study is the development of an approach to assess physical vulnerability towards multiple hazards. A pilot case study in the Municipality of Faucon, France, is presented.

2. METHODOLOGY

Our approach is based on a vulnerability assessment methodology for tsunami, the PTVA (Papathoma Tsunami Vulnerability Assessment) model (Papathoma and Dominey Howes 2003) and it includes the following steps:

Step 1: Identification of the study area and the relevant hazards
Step 2: Selection of vulnerability indicators and data collection (**Table 1**)
Step 3: Weighting of indicators and Relative Vulnerability Index (RVI) assignement for every building (**Figure 1**).

The RVI is applied according to the following formula:

$$RVI = \sum_{1}^{m} w_m \cdot I_m s_n$$

With the weights w_1-w_m for the vulnerability score $I_m s_n$ (s_1-s_n) for each indicator I_1-I_m.

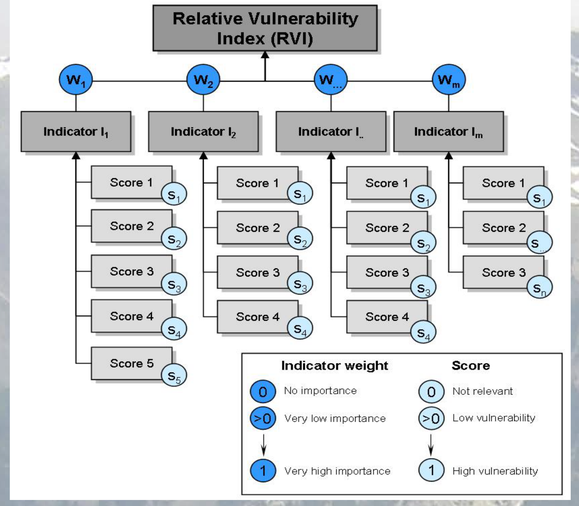

Figure 1. Vulnerability computation framework

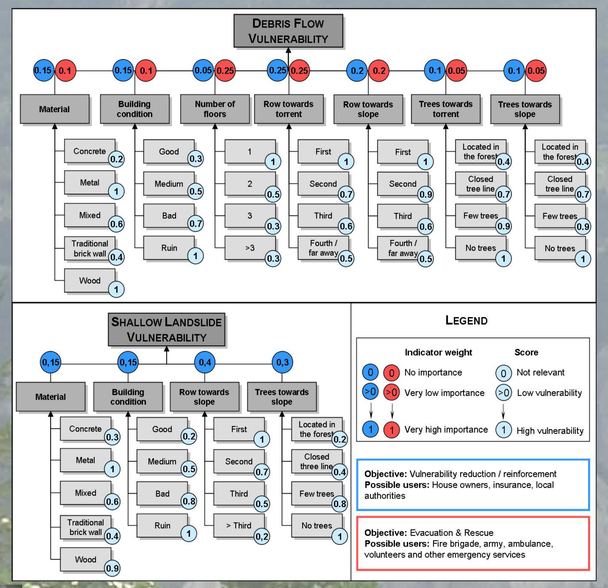

Figure 2. Vulnerability indicators for different processes and users

3. CASE STUDY

The "Commune de Faucon de Barcelonnette" (Municipality of Faucon) located in the Barcelonette basin in the South French Alps, was chosen as a pilot case study (**Figure 3**). In **Figure 2** the indicators for each hazard on basis of expert appraisal and their weighting for different users is shown. In **Figure 4** the maps showing the spatial pattern of the physical vulnerability for debris flow (**4a and 4b**), river flood (**4c and 4d**) and landslide (**Figure 4e**) for two purposes (emergency management and building reinforcement) are demonstrated.

	AV	RF	FL	SL	DF	FF
Building-specific information						
Material						
Floors						
Condition						
Openings towards slope (size and condition)						
Height of lowest opening						
Presence of warning signs of landslides (jammed doors, cracks, broken utility lines, etc.)						
Basement						
Roof material						
Foundation type						
Building surroundings						
Building row (towards slope)						
Building row (towards river)						
Protection by vegetation						
Protection measures						
Movable objects that can be carried away by water or snow						
Human-related characteristics						
Use						
Vulnerable pop. (hospitals/schools etc.)						
Population density (winter/day)						
Population density (winter/night)						
Population density (summer/day)						
Population density (summer/night)						

Table 1. Selection of vulnerability indicators for alpine hazards and their importance (AV: avalanche, RF: Rock fall, FL: Flood, SL: Shallow Landslide, DF: Debris flow, FF: Flash Flood, Light blue: Less important, Middle Blue: Important, Dark Blue: Very Important)

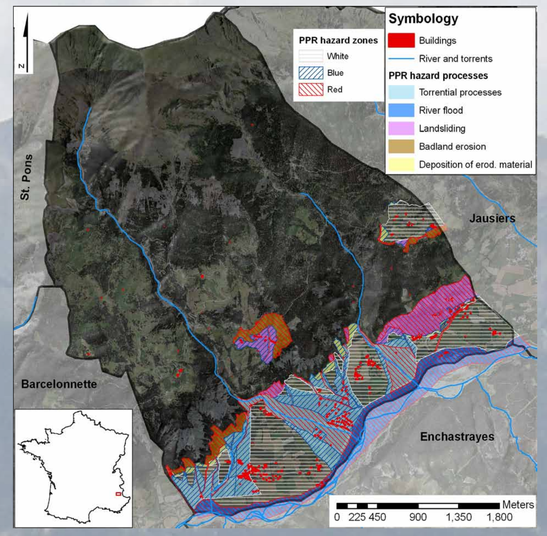

Figure 3. The case study area: Municipality of Faucon

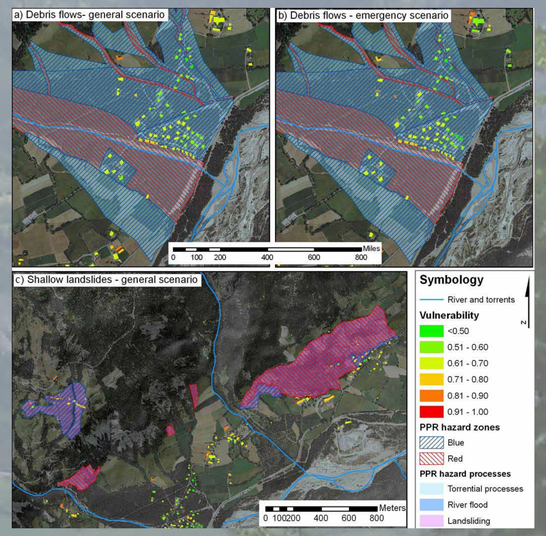

Figure 4. Vulnerability assessment in Faucon

4. CONCLUSIONS

We present an indicator based vulnerability assessment approach for multi-hazards. The innovative aspect of the methodology is its flexibility.We consider not only vulnerability "to" different hazards but also vulnerability "for" a range of users according to their objectives. The results show that the methodology can provide information to different stakeholders in order to identify hotspots and focus their efforts in specific buildings and areas, however, it also demonstrates the need for more data regarding the indicators themselves and better documentation of damage assessment.

Acknowledgements: The authors thank the European Union for funding the Marie Curie Reserach and training Network "Mountain Risks"(2007-2010) and Anne Puissant and Jean Philippe Malet (CNRS, Strasbourg, France) for their support and the provision of data and information.

References:
Papathoma M, Dominey-Howes D (2003) Tsunami vulnerability assessment and its implications for coastal hazard analysis and disaster management planning, Gulf of Corinth, Greece. Natural Hazards and Earth System Sciences 3:733–747

universität wien

AUSTRIA GEOMORPHOLOGY ENVIRONMENTAL CHANGE

ENGAGE Geomorphological Systems & Risk Research