



## **The ‘Mountain Risks’ research project: challenges in vulnerability analysis and quantitative risk assessment.**

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The ‘Mountain Risks’ Project intends to develop an advanced understanding of how mountain hydro-geomorphological processes behave and to apply this knowledge to long-term cohabitation with such hazards. The objective of this poster is to present the issues addressed by the project on mountain vulnerability analysis and quantitative risk assessment (QRA).

Vulnerability analysis has to be understood as an important part of risk assessment. Ideally, risk assessment requires that both hazard and vulnerability of the elements at risk be defined as independent probabilities (of occurrence, and of damage, respectively). In practice, it is rarely possible to obtain such probabilities and apply the generally accepted risk definition. Therefore, for many years, a qualitative or semi-qualitative evaluation of consequences, based on expert judgement and interviews with private households, firms and land owners, has been preferred as the more convenient method in terms of application. Subsequently, statistics of detailed historical records, matrices or mathematical frameworks have become more commonly used. A recent literature review has demonstrated that within quantitative risk research there is a serious lack of studies related to vulnerability, especially concerning both the social and economic aspects. In effect, an entire risk assessment requires the combination of different techniques and methodologies, and the interplays of various experts. Thus, a more rigorous quantitative ‘cause-effect’ correlation has to be investigated in order to develop a systematic approach to multi-risk problems. This should be incorporated into a QRA, which robustness depends upon (1) a quantitative evaluation of multi-hazards consequences through the collection of relevant data on past phenomena, (2) a translation of the damage assessment into economic direct and indirect losses (3) an

analysis of the trends acting in the study area in order to translate the physical effects into economic and social losses and (4) an understanding of the importance that society attaches to the level of hazards. As a function of these, the ‘vulnerability analysis and QRA’ theme of the project will address the following actions:

- Inventory of the elements at risk, their attributes and their ‘historical propensity’ to be damaged at both local and regional scales. Estimation of vulnerability functions for the definition of the prospective physical effects;
- Quantify the level of social, economic, and environmental losses, considering the period of occurrence of the damaging phenomenon (e.g. seasons);
- Define a procedure to translate societal perception of risk into a QRA;
- Identify and quantify the source of uncertainties in the analyses;
- Estimate a number of risk scenarios considering the status and evolution of the natural, economic and social systems.

These actions will be applied on highly documented case studies, located in five European countries (France, Italy, Swiss, Germany and Spain) where mountain hazards are currently evident.