VARIABILITY IN VALUES AT RISK – METHODOLOGICAL ISSUES FOR NATURAL HAZARDS RISK MANAGEMENT

Margreth Keiler[1] and Sven Fuchs[2]

INTRODUCTION

Due to global change processes facing both, the natural and the cultural environment, variability became a key issue in the framework of natural hazard risk management. Changes in process behaviour, vulnerability and values at risk can not only be observed within the alpine environments, but also on a national and European level.
Risk is defined as a function of the probability of occurrence of a potentially hazardous process, the exposed values at risk, and the related vulnerability due to the exposure of the values at risk to this hazardous process. The procedure of hazard assessment is methodologically reliable in determining the hazard potential and the related probability of occurrence by studying, modelling, and assessing individual processes and defined design events. So far, little attention has been given to the damage potential affected by hazard processes, particularly concerning spatial patterns and temporal shifts. Studies related to the probability of exposure of an object to a defined scenario and the appropriate vulnerability of the object have predominantly been carried out so far as proposals to determine the risk of property and human life with the focus on risk within a specific location and a specific point in time.
However, risk changes over time; thus, the temporal variability of damage potential is a key variable in the consideration of risk. GIS-based studies related to the temporal variability of damage potential have been carried out, focussing both, the long-term and the short-term temporal development of damage potential. Based on these studies, the multi-temporal development of values at risk is presented with respect to alpine natural hazards. This multi-temporal approach aims to demonstrate the different superimposed temporal scales in the development of damage potential complementing each another. Furthermore, the methodology presented is independent from the individual hazardous process and can provide the basis for a standardised approach within natural hazards risk management.

METHODS

Methodological approaches for determining the temporal and spatial development of values at risk including buildings, infrastructure and persons were developed GIS-based with respect to different scales. In doing so, the choice of scale is not only determined by the purpose but also by the availability and quality of data. Furthermore, the analysis of values at risk and the analysis of hazard have to be carried out on a similar scale.
On a local scale, the analyses were carried out object-based. The values at risk were obtained analysing the zoning plan with respect to location and perimeter of every building. Additional information, such as building type, year of construction and replacement value, as well as the number of residents were provided by the official authorities and joint using a GIS. Data on the object (geographic location and extent, number of temporary and permanent persons) were

[1] Department of Geography and Regional Research, University of Vienna, Universitätsstrasse 7, A-1010 Wien, margreth.keiler@univie.ac.at
[2] Institute of Mountain Risk Engineering, University of Natural Resources and Applied Life Sciences, Peter Jordan Strasse 82, A-1190 Wien, sven.fuchs@boku.ac.at

analysed and economically valuated. Due to the variability in data, single object values were obtained using statistical average value per object category, and original values per object, respectively. For infrastructure facilities, average values were used per metre exposed.
On a regional scale, in a first step, the analyses were undertaken aggregating the values of the local scale spatially. In doing so, the local values were statistically calculated for different object categories and different comparable regions. As a result, average values for different categories of damage potential were developed and applied within the GIS-based risk analysis model, and a sensitivity study of the results was carried out.

RESULTS

The development of a methodology for the analysis of values at risk on different scales had shown considerable results with respect to the temporal and spatial variability of damage potential exposed. Concerning the long-term development, a general shift in damage potential resulted from the development of mountain areas from traditionally agricultural societies to tourism centres within the 20th century. This shift is for the most part attributed to immobile values and infrastructure. Thereby, different mountain regions had shown different developments in values at risk. This long-term increase was superimposed by short-term fluctuations on a seasonal, monthly, diurnal, and hourly level. Those fluctuations resulted from mobile values and persons at risk, and lead to substantial peaks in the resulting risk.

CONCLUSION

Information on the temporal variability of values at risk both from a long-term as well as from a short-term point of view provide in combination with process knowledge the basis for a dynamic risk visualisation. Such information may help to recognise high risk situations more easily and enables a situation-oriented and risk-based decision-making. The variability of values at risk has considerable influence on the resulting risk, and thus on the management of natural hazards risk. The methodology presented aims at a comparable and reproducible assessment of the values at risk.
Long-term changes in values at risk could be considered as basic disposition. To reduce the risk resulting from this basic disposition, permanent constructive mitigation measures could be constructed and land-use regulations implemented. As a consequence, the basic risk could be reduced due to a spatial reduction of the process area. Short-term fluctuations in damage potential supplement this continuing development of damage potential within a remarkable range. Thus, they have to be considered as variable disposition. To mitigate those fluctuations, temporal measures could be applied, such as evacuations or temporary road closures, and complement the permanent measures to achieve an efficient and effective risk reduction.
The methodology presented is independent from the individual hazard process and can provide the basis for a standardised approach within natural hazards risk management. However, since values at risk have almost been neglected within natural hazards research, there is still a considerable lack of data related to a spatial application.

Keywords: risk management, values at risk, variability