

Preface

This book offers a cross-disciplinary coverage for the rapidly growing field of integrated approaches in risk assessment in mountain areas. It considers all the aspects related to hazard and risk assessment, risk management and governance, all illustrated with a wide range of case studies. The book associates (1) technical chapters on the state-of-the-art methods for the understanding of mountain processes and quantitative hazard and risk forecasts and (2) case study chapters detailing the integration of natural, engineering and human sciences within multi-scale methodologies for risk management and prevention planning.

Long-term cohabitation of the social, economic and environmental systems in mountain areas necessitates (1) to reflect the ‘chain of safety’ (e.g. pro-action, prevention, preparation, response and follow-up) and (2) to cover the chain of the ‘living with risk’ process, from quantitative risk assessment to coping strategies including socio-economic and political decision-making. The observed increase in disastrous events over the last decades, associated with an often low perception of most natural risks by the local communities, along with the lack of efficient, socially accepted and environmentally sound remedial measures are amongst the drivers behind the increasing effects of mountain risks.

Landslides and rockfalls on mountain slopes, debris flows within torrential streams and flooding on river valleys, driven by climatic and anthropogenic factors as well as land mismanagement, all cost the economy dearly, especially in mountain areas. Even today, development is still taking place in many hazardous zones, and even more development is taking place in future hazard zones where planning and predictive assessment are at odds. Growing attention has to be paid also to the impact of climatic and non-climatic changes that will result in changing hazard risk patterns over Europe. The development of viable livelihoods on the long-term also endorses the task of governing the risk assessment process at all levels of spatial planning, and for several spatial and temporal scales.

The assessments of natural hazards and risks are generally carried out by natural scientists from fields such as engineering geology, geomorphology, geophysics, hydrology, soil science and geography; however, while the physical problems associated with risk assessment need continual science and engineering attention

(e.g. development of monitoring techniques, alert systems and protection measures), some of the ongoing questions need to be addressed by other disciplines including social and economic science, cognition science, civil and public law, planning and politics.

Most text books deal with some aspects related to hazard and risk assessments (Turner and Schuster 1996; Lee and Jones 2004; Glade et al. 2005; Landslide Committee – National Research Council 2008; Sassa and Canuti 2008). This book focuses on comparative multi-disciplinary case studies and gives a complete picture of all the aspects related to hazards and risks.

The book provides valuable insights, guidance and advice to research scientists, engineers, people in charge of local and regional risk management, planners and policy makers and all those who share a common interest of effective risk reduction to show them the importance of an integrated approach of all aspects of risks in mountainous areas. It is envisaged that the presented cross-disciplinary approach may extend their vision, add to their understanding and possibly, facilitate their work.

The first part of the book is focusing on new techniques for assessing mass movement and flood hazards. It describes the state-of-the-art techniques for the morphological characterization and the monitoring of displacements. Computational advances are described to understand the physical processes, the interactions within the systems and to quantify the hazard.

In the introduction, *Greiving et al.* (Chap. 1) discuss key issues related to aspects of hazards and risks of natural processes in mountain areas and set up the framework of risk governance, which aims to integrate these elements. *Lu et al.* (Chap. 2) introduce several innovative remote-sensing techniques to monitor and analyse the kinematics of slow moving to moderately moving landslides. These are illustrated in three case studies in Italy and France. *Kniess et al.* (Chap. 3) highlight the interest of combining different techniques obtained from numerous developments in remote-sensing, near-surface geophysics, field instrumentation and data processing. In a number of case studies, they show significant advances in characterizing the landslide morphology and internal structure. *Ferrari et al.* (Chap. 4) give an overview of the recent developments of numerical models to describe the complex behaviour of slow and rapid mass movements which form the basis for hazard and risk assessment and the development of reliable Early-Warning Systems (EWS). Special attention is given to the complex hydrological system of landslides, which controls their dynamic behaviour. Case studies are presented to illustrate the performance of the numerical models detailed in this chapter.

The second part of the book is focusing on methodologies to assess the impact of the natural hazards on the society in terms of risks. It presents methods and tools for a quantitative risk assessment of dangerous rapid mass movements using run-out models and the characterization of the vulnerability of the elements at risk.

Luna et al. (Chap. 5) evaluate several dynamic process-based models able to simulate the propagation of rapid mass flows and forecast the hazard (e.g. delineation of the zones where the elements-at-risk will suffer an impact of a certain level of intensity) and the risk through the application of fragility and

vulnerability curves and the generation of risk curves based on economic losses. *Mavrouli et al.* (Chap. 6) give a review on the current methodologies that are used for the assessment of rockfall susceptibility, hazard and risk. The authors present advances involving the consideration of the magnitude of the events and the intensity of the phenomena at selected locations as well as the incorporation of a quantitative vulnerability into the risk equation. *van Westen et al.* (Chap. 7) discuss the analysis of multi-hazards, especially in terms of their interaction, in mountainous environments at a medium scale (1:25,000). They give an overview of the problem of multi-hazard risk assessment illustrated through a case study for the Barcelonnette area (French Alps). *Sterlacchini et al.* (Chap. 8) discuss how vulnerability assessment plays a crucial role in ‘translating’ the estimated hazard level into an estimated level of risk. They stated that it is impossible to address risk assessment without assessing vulnerability first, and it appears unquestionable that a multi-disciplinary approach is requested in vulnerability assessment studies. *Garcia et al.* (Chap. 9) present a quantitative survey to evaluate the response capacity of the population in the mountainous environment of the Italian Central Alps, in order to assess the levels of preparedness and the perceived risk. The outcome of the enquiry showed that, in this case study, a gap between the occurred disasters and the possible lessons to be learnt still exist and that an effective method to share and disseminate knowledge is missing.

The third part of the book is focusing on the response of the Society towards the problems of hazard and risk. It highlights the role of spatial planning, Early-Warning Systems and evacuation plans for risk management. It establishes practical thresholds for acceptable and tolerable risks and emphasizes the validity of education and communication towards the Society.

Greiving and Angignard (Chap. 10) discuss options for mitigating risk by spatial planning and highlight the effectiveness of such measures by analysing the example of the municipality of Barcelonnette (French Alps). *Mavrouli et al.* (Chap. 11) distinguish two different strategies for corrective and protective measures for the mitigation of landslide risk, namely stabilization/interception measures and control measures. A variety of mitigation measures are presented for three different landslide types: rockfalls, debris flows and shallow to deep seated slope movements. *Angignard et al.* (Chap. 12) discuss the interconnection of factors that determine risk perception through a series of social variables and by concentrating on the relevance of legal frameworks and insurance possibilities. The theoretical implications of risk culture on risk assessment and management in practice are explained by the example of the case study of the region of Valtellina (Italian Central Alps). *Garcia et al.* (Chap. 13) analyse different types of Early-Warning Systems with the aim to connect scientific advances in hazard/risk assessment with local management strategies and practical demands of stakeholders/end-users. An Integrated People-Centred Early Warning System (IEWs) is presented, which is mainly based on prevention as a key element for disaster risk reduction. *Peters-Guarin and Greiving* (Chap. 14) give an analysis about risk acceptability and tolerance, which greatly depend on the existing social, economic, political, cultural, technical and environmental conditions of the society at a given moment in time.

Frigerio et al. (Chap. 15) propose interactive tools by means of a WebGIS service architecture to inform stakeholders about the different stages of risk management, especially the preparation phase and emergency management. Different cases are set up using a common open source environment: multi-hazard risk assessment, risk management with interoperability on spatial data and metadata, collection of information on historical natural events and visualisation of outcomes of multi-hazard risk analyses.

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