

Natural Hazards – Nonlinearities and Assessment

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Marin Drinov Academic Publishing
House, Sofia, Bulgaria

ISBN 978-954-322-419-7 (soft cover)

ISBN 978-954-322-420-3 (hard cover)

327 pp

Geosciences are developing and applying a wide range of methodologies to assess natural hazards. Significant advances in the site characterization and models development have been achieved in the last decade, but many challenges still remain. Several disastrous earthquakes in the past decade accompanied with tsunamis have required a rapid assessment of the underlying causes of the tragic loss of life and property. Natural disasters risk reduction and control as a crucial criterion for sustainable development and minimizing social and economic loss and disruption due to earthquakes, tsunamis and other hazards requires reliable assessment of the seismic and tsunami hazard, as well as mitigation actions of the vulnerability of the built environment and risk. All of these provide the critical basis for improved building codes and construction emergency response plans for the people and infrastructure safety and protection. The European practice needs such approach due to the increased risk which is definitely dominated by the increase urbanization and the improved quality of life. There is not very much books published viewing to the natural hazards from the nonlinear point of view. In this respect the new edited book – *Natural hazards – nonlinearities and assessment* is one of the first publications in the European Research Area related to the natural hazards studies and mitigation of their negative consequences.

The book is devoted to natural hazard studies, their nonlinear properties and influences related to triggering, development and consequences of the natural hazards to the environment and society.

The theoretical part covers several important issues related to the content of this book: i. introduction of the nonlinear approach to the seismic hazard assessment and stochastic earthquake prediction. Among the methods used are fractal analysis of the seismotectonic models, mono- and poly-modal statistical distributions of the space, time and magnitude

determination of the expected earthquakes, applications of the stochastic models of earthquake prediction in different regions of the world – Balkans, Mexico coast, Chile coast, Australia, etc.; ii. pioneering investigations about the approximations of the losses and needed recovery funds by deterministic function – called *loss-recovery function* – about the primary and secondary damages of the natural disasters of different type. This gives a possibility of fast and reliable integrated assessment of the losses and estimations of the needed financial and organizational resources for the recovery of the assessed damages; iii. introduction of the nonlinear functional graphics giving image of the people's behavior during the extreme situations are presented. These functions (called like *panic, media, enthusiasm, rumors*, etc.) are investigated and their properties (interruption, manageable assessment, time duration, influences of the following disastrous events – aftershocks in case of earthquakes, for example, etc.) and limitations disclosed; iv. the nonlinear elastic plate rebound in case of strong earthquakes is a rather new phenomenon established after strong earthquakes in Sumatra (2004), Chile (2010) and Japan (2011) by the GPS measurements. It can provoke deeper geology and geophysics investigations to discover such effects during the past geological times, when the geodynamics has been much more active; v. the destructive potential concept is introduced and developed about the space and time limitations of the natural hazards. Such approach gives possibilities about comparison of the different hazards using unified scale of the destructive potential. This parameter shows also nonlinear properties useful about the differentiation of the local, regional and global influences of the different disasters; vi. the complex risk assessment in case of the multi-hazard simultaneous actions of several hazards (for example earthquakes, tsunamis and landslides) is a big challenge to the risk management practice and was developed in some models related to the Black Sea coast. Many examples with risk quantitative values are presented.

Special part of the book is devoted to the tsunami investigations in the Black Sea. Models of seismic and nonseismic (meteorological and submarine turbidities) tsunami sources are developed and the tsunami propagation and coast-wave interactions calculated. Several examples with a lot of illustrations are

on focus in this chapter.

The first and the last part of the book are much more pragmatic. They deal with the measures and useful practices about natural hazards and risk mitigation with a lot of practical issues addressed to the specialized authorities – Civil Defense, local and regional administrations, financial and insurance companies, etc. Simple classifications of the physical properties and possible negative consequences of the natural hazards of different types, measures and practices of the applying institutions, price list and responsible authorities are among the presented issues in these chapters: i) the modern development of the early warning systems as promising tool about human life safety and society sustainability is essential. In case of the large natural disasters (such as earthquakes, tsunamis, volcanic eruptions, etc.) these systems can protect and safe human lives and preserve natural environment. Many examples of the existing and future early warning systems are presented including as well as the systems for rapid loss assessment; ii) The systematization and data base creation about different useful practices and measures against the negative influence of the different natural hazards is a real way to mitigate the consequences. The cost-benefit analysis in every specific case can help a lot the decision makers with the selection and implementation of the most effective measure in every single case.

Most of the materials incorporated in the book are results of the previously published common investigations together with a lot of teams participated in various EU Projects – TRANSFER, SCHEMA, etc. All illustrations are in black and white, but in all chapters the references where the original colored pictures are published have been included to make easier access for anybody interested to see them.

The book could be a useful tool of the everyday practice of the urban planners and the Civil Protection authorities and might be of interest not only to scientists, researchers, students, but also to the wide public.

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