

Integrated Catastrophe Risk Modeling

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Editors

Integrated Catastrophe Risk Modeling

Supporting Policy Processes

 Springer

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Preface

This book aims to advance risk management policy and its implementation by demonstrating the application of novel techniques, including integrated catastrophe models, to aid policy decisions on contemporary disaster risk issues.

With the dramatic rise in disaster events across an increasingly populous and interdependent world, people and communities are recognizing the importance of reducing their human and economic toll. Efforts are thus being intensified to manage risk and incorporate risk management principles into policymaking.

Science-based risk management policy is not without its challenges. Given the dynamic demographic, economic, and social context in which most hazards are embedded, including the changing climate, it is not only difficult to assess risk, but standard statistical measures are inappropriate for high-impact, low-probability events with probability distributions characterized by fat tails. In addition, data on rare events are, by definition, very limited and fraught with uncertainties. Beyond the assessment of risk itself, identifying robust policy options in a highly uncertain future world poses equally difficult challenges. Finally, experts alone cannot evaluate policy options, as these depend on the values and preferences of those affected. This raises the challenge of designing and assisting stakeholder processes that can inform risk management decisions.

In this book, we address all these challenges by developing and applying modeling techniques for the assessment and management of catastrophe risk through an integrated “systems” approach. We emphasize integration across natural and social systems, applying models that take account of the intensity and frequency of natural phenomena combined with the exposure and vulnerability of social and economic systems. Integration also means gauging the complex interdependencies of risk across different temporal and spatial scales, which often requires estimates to be made into the distant future and at the local, regional, and even global levels. Integration, too, means taking due consideration of the manifold uncertainties and social constructions of disaster risk. Finally, and perhaps most importantly for the risk management policy process, integration means listening and responding to the plural and competing values and worldviews of stakeholders and policymakers.

Catastrophe models are an important part of integrated assessment, as they explore the drivers of disasters (hazard, exposure, and vulnerability), simulate future events based on historical data and expert judgment, apply appropriate statistical distributions, and take account of future drivers, including climate change. As well as providing risk estimates, as this volume shows, models can be embedded in support systems that can account for conflicting values and for the views of multiple stakeholders. In so doing, they provide useful knowledge and support to risk management policies.

The uniqueness of this book lies in its usefulness to real-world policies on catastrophe risk management and in the novelty of the approaches used for this purpose. The three parts of this volume begin with general discussions of catastrophe models for informing risk management policies, and then turn to the implications of disaster risk for economic growth and socioeconomic development along with associated options for managing risk. Finally, we focus on the Tisza River basin in Hungary, describing the implementation of a model-based stakeholder process for managing flood risk in this area.

Specific applications, among others, include designing insurance strategies for seismic risk in Italy; assessing strategies for managing flood risk in Austria and northern Vietnam; evaluating large infrastructure projects throughout the world; examining the development implications of extreme climate events in Nepal; developing catastrophe bonds for public sector risk management in Mexico; informing the development of the Caribbean Catastrophe Risk Insurance Facility; and implementing a model-based participatory process for managing flood risks in Hungary. The applications break new ground by applying advanced modeling techniques to the policy issues at hand. Methodological innovations include novel stochastic optimization approaches and probabilistic risk estimation taking account of indirect losses and climate change. The applications are also innovative in that they are designed for user-friendly policy support. This, as the research shows, can prove to be instrumental in helping stakeholders holding strongly divergent views reach policy consensus and in helping national policymakers, donors, and development bankers devise risk financing strategies for implementation in highly vulnerable developing countries.

The research was carried out by scientists and their collaborators at the International Institute for Applied Systems Analysis (IIASA), which conducts policy-oriented systems research into problems that are too large or too complex to be solved by a single academic discipline. The research is also linked with other international institutions such as the Intergovernmental Panel on Climate Change, UN development agencies, the European Commission, and international finance institutions such as the Asian Development Bank, Inter-American Development Bank and the World Bank. The researchers represent a wide range of physical and social science disciplines, including mathematics, statistics, systems modeling, geology, meteorology, hydrology, physics, engineering, computer sciences, economics, decision analysis, and sociology. The case studies would have not been feasible without the support and availability of data from the national or local institutions involved, as acknowledged in the relevant chapters. In particular, we are

grateful to the Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS) for providing funding to IIASA for the Hungarian Tisza river project.

It is our hope that this volume will contribute positively to the design and implementation of scientifically grounded and socially acceptable policy options able to reduce the unacceptable human and economic toll of natural hazards, today and in the future.

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Joanne Linnerooth-Bayer
Reinhard Mechler

Contents

Part I Integrated Modeling for Informing Risk Management Policies

- 1 Catastrophe Models for Informing Risk Management Policy:
An Introduction** 3
Aniello Amendola, Tatiana Ermolieva, Joanne Linnerooth-Bayer,
and Reinhard Mechler
- 2 Modeling Risk and Uncertainty: Managing Flash Flood
Risk in Vienna** 13
Keith L. Compton, Tatiana Ermolieva, Joanne Linnerooth-Bayer,
Aniello Amendola, Rudolf Faber, and Hans-Peter Nachtnebel
- 3 Modeling Catastrophe Risk for Designing Insurance Systems** 29
Tatiana Ermolieva and Yuri Ermoliev
- 4 Multiple Criteria Decision Making for Flood
Risk Management** 53
Karin Hansson, Mats Danielson, Love Ekenberg, and Joost Buurman
- 5 Dams and Catastrophe Risk: Discounting in Long
Term Planning** 73
Tatiana Ermolieva, Yuri Ermoliev, Michael Obersteiner,
Marek Makowski, and Günther Fischer

Part II Disasters and Growth: Modeling and Managing Country-Wide Catastrophe Risk

- 6 Modeling Aggregate Economic Risk: An Introduction** 95
Reinhard Mechler
- 7 Economic Growth Under Catastrophes** 103
Yuri Ermoliev and Tatiana Ermolieva

8	Modeling Macro Scale Disaster Risk: The CATSIM Model	119
	Stefan Hochrainer-Stigler, Reinhard Mechler, and Georg Pflug	
9	Managing Indirect Economic Consequences of Disaster Risk: The Case of Nepal	145
	Reinhard Mechler, Stefan Hochrainer-Stigler, and Kazuyoshi Nakano	
Part III Tisza River Basin in Hungary: Flood Risk Management, Multi-stakeholder Processes and Conflict Resolution		
10	Catastrophe Models and Policy Processes: Managing Flood Risk in the Hungarian Tisza River Basin – An Introduction	171
	Joanne Linnerooth-Bayer, Love Ekenberg, and Anna Vári	
11	Social Indicators of Vulnerability to Floods: An Empirical Case Study in Two Upper Tisza Flood Basins	181
	Anna Vári, Zoltan Ferencz, and Stefan Hochrainer-Stigler	
12	Designing a Flood Management and Insurance System in Hungary: A Model-Based Stakeholder Approach	199
	Joanne Linnerooth-Bayer, Anna Vári, and Lisa Brouwers	
13	Consensus by Simulation: a Flood Model for Participatory Policy Making	217
	Lisa Brouwers and Mona Riabacke	
14	A Risk-Based Decision Analytic Approach to Assessing Multi-stakeholder Policy Problems	231
	Mats Danielson and Love Ekenberg	
15	Optimizing Public Private Risk Transfer Systems for Flood Risk Management in the Upper Tisza Region	245
	Yuri Ermoliev, Tatiana Ermolieva, and Istvan Galambos	
16	Flood Risk in a Changing Climate: A Multilevel Approach for Risk Management	263
	Stefan Hochrainer-Stigler, Georg Pflug, and Nicola Luger	
	Index	281