Integrated Catastrophe Risk Modeling

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Integrated Catastrophe Risk Modeling

Supporting Policy Processes

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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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Contents