

# Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

## Special Report of the Intergovernmental Panel on Climate Change

Extreme weather and climate events, interacting with exposed and vulnerable human and natural systems, can lead to disasters. This Special Report explores the challenge of understanding and managing the risks of climate extremes to advance climate change adaptation. Weather- and climate-related disasters have social as well as physical dimensions. As a result, changes in the frequency and severity of the physical events affect disaster risk, but so do the spatially diverse and temporally dynamic patterns of exposure and vulnerability. Some types of extreme weather and climate events have increased in frequency or magnitude, but populations and assets at risk have also increased, with consequences for disaster risk. Opportunities for managing risks of weather- and climate-related disasters exist or can be developed at any scale, local to international. Some strategies for effectively managing risks and adapting to climate change involve adjustments to current activities. Others require transformation or fundamental change.

The Intergovernmental Panel on Climate Change (IPCC) is the leading international body for the assessment of climate change, including the physical science of climate; impacts, adaptation, and vulnerability; and mitigation of climate change. The IPCC was established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) to provide the world with a comprehensive assessment of the current state of knowledge of climate change and its potential environmental and socioeconomic impacts.

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# Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation

## Special Report of the Intergovernmental Panel on Climate Change

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# Foreword and Preface

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## Foreword

**Foreword**

This Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation (SREX) has been jointly coordinated by Working Groups I (WGI) and II (WGII) of the Intergovernmental Panel on Climate Change (IPCC). The report focuses on the relationship between climate change and extreme weather and climate events, the impacts of such events, and the strategies to manage the associated risks.

The IPCC was jointly established in 1988 by the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), in particular to assess in a comprehensive, objective, and transparent manner all the relevant scientific, technical, and socioeconomic information to contribute in understanding the scientific basis of risk of human-induced climate change, the potential impacts, and the adaptation and mitigation options. Beginning in 1990, the IPCC has produced a series of Assessment Reports, Special Reports, Technical Papers, methodologies, and other key documents which have since become the standard references for policymakers and scientists.

This Special Report, in particular, contributes to frame the challenge of dealing with extreme weather and climate events as an issue in decisionmaking under uncertainty, analyzing response in the context of risk management. The report consists of nine chapters, covering risk management; observed and projected changes in extreme weather and climate events; exposure and vulnerability to as well as losses resulting from such events; adaptation options from the local to the international scale; the role of sustainable development in modulating risks; and insights from specific case studies.

Success in developing this report depended foremost on the knowledge, integrity, enthusiasm, and collaboration of hundreds of experts worldwide, representing a very wide range of disciplines. We would like to express our gratitude to all the Coordinating Lead Authors, Lead Authors, Contributing Authors, Review Editors, and Expert and Government Reviewers who devoted considerable expertise, time, and effort to produce this report. We are extremely grateful for their commitment to the IPCC process and we would also like to thank the staff of the WGI and WGII Technical Support Units and the IPCC Secretariat, for their unrestricted commitment to the development of such an ambitious and highly significant IPCC Special Report.

We are also very grateful to the governments which supported their scientists' participation in this task, as well as to all those that contributed to the IPCC Trust Fund, thereby facilitating the essential participation of experts from the developing world. We would also like to express our appreciation, in particular, to the governments of Australia, Panama, Switzerland, and Vietnam for hosting the drafting sessions in their respective countries, as well as to the government of Uganda for hosting in Kampala the First Joint Session of Working Groups I and II which approved the report. Our thanks are also due to the governments of Switzerland and the United States of America for funding the Technical Support Units for WGI and WGII, respectively. We also wish to acknowledge the collaboration of the government of Norway – which also provided critical support for meetings and outreach – and the United Nations International Strategy for Disaster Reduction (ISDR), in the preparation of the original report proposal.

We would especially wish to thank the IPCC Chairman, Dr. Rajendra Pachauri, for his direction and guidance of the IPCC process, as well as the Co-Chairs of Working Groups II and I, Professors Vicente Barros, Christopher Field, Qin Dahe, and Thomas Stocker, for their leadership throughout the development of this Special Report.



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United Nations Environment Programme



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## Preface

This volume, *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, is a Special Report of the Intergovernmental Panel on Climate Change (IPCC). The report is a collaborative effort of Working Group I (WGI) and Working Group II (WGII). The IPCC leadership team for this report also has responsibility for the IPCC Fifth Assessment Report (AR5), scheduled for completion in 2013 and 2014.

The Special Report brings together scientific communities with expertise in three very different aspects of managing risks of extreme weather and climate events. For this report, specialists in disaster recovery, disaster risk management, and disaster risk reduction, a community mostly new to the IPCC, joined forces with experts in the areas of the physical science basis of climate change (WGI) and climate change impacts, adaptation, and vulnerability (WGII). Over the course of the two-plus years invested in assessing information and writing the report, scientists from these three communities forged shared goals and products.

Extreme weather and climate events have figured prominently in past IPCC assessments. Extremes can contribute to disasters, but disaster risk is influenced by more than just the physical hazards. Disaster risk emerges from the interaction of weather or climate events, the physical contributors to disaster risk, with exposure and vulnerability, the contributors to risk from the human side. The combination of severe consequences, rarity, and human as well as physical determinants makes disasters difficult to study. Only over the last few years has the science of these events, their impacts, and options for dealing with them become mature enough to support a comprehensive assessment. This report provides a careful assessment of scientific, technical, and socioeconomic knowledge as of May 2011, the cut-off date for literature included.

The Special Report introduced some important innovations to the IPCC. One was the integration, in a single Special Report, of skills and perspectives across the disciplines covered by WGI, WGII, and the disaster risk management community. A second important innovation was the report's emphasis on adaptation and disaster risk management. A third innovation was a plan for an ambitious outreach effort. Underlying these innovations and all aspects of the report is a strong commitment to assessing science in a way that is relevant to policy but not policy prescriptive.

### The Process

The Special Report represents the combined efforts of hundreds of leading experts. The Government of Norway and the United Nations International Strategy for Disaster Reduction submitted a proposal for the report to the IPCC in September 2008. This was followed by a scoping meeting to develop a candidate outline in March 2009. Following approval of the outline in April 2009, governments and observer organizations nominated experts for the author team. The team approved by the WGI and WGII Bureaux consisted of 87 Coordinating Lead Authors and Lead Authors, plus 19 Review Editors. In addition, 140 Contributing Authors submitted draft text and information to the author teams. The drafts of the report were circulated twice for formal review, first to experts and second to both experts and governments, resulting in 18,784 review comments. Author teams responded to every comment and, where scientifically appropriate, modified drafts in response to comments, with Review Editors monitoring the process. The revised report was presented for consideration at the First Joint Session of WGI and WGII, from 14 to 17 November 2011. At the joint session, delegates from over 100 countries evaluated and approved, by consensus, the Summary for Policymakers on a line-by-line basis and accepted the full report.

### Structure of the Special Report

This report contains a Summary for Policymakers (SPM) plus nine chapters. References in the SPM point to the supporting sections of the technical chapters that provide a traceable account of every major finding. The first two chapters set the stage for the report. Chapter 1 frames the issue of extreme weather and climate events as a challenge

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in understanding and managing risk. It characterizes risk as emerging from the overlap of a triggering physical event with exposure of people and assets and their vulnerability. Chapter 2 explores the determinants of exposure and vulnerability in detail, concluding that every disaster has social as well as physical dimensions. Chapter 3, the major contribution of WGI, is an assessment of the scientific literature on observed and projected changes in extreme weather and climate events, and their attribution to causes where possible. Chapter 4 assesses observed and projected impacts, considering patterns by sector as well as region. Chapters 5 through 7 assess experience and theory in adaptation to extremes and disasters, focusing on issues and opportunities at the local scale (Chapter 5), the national scale (Chapter 6), and the international scale (Chapter 7). Chapter 8 assesses the interactions among sustainable development, vulnerability reduction, and disaster risk, considering both opportunities and constraints, as well as the kinds of transformations relevant to overcoming the constraints. Chapter 9 develops a series of case studies that illustrate the role of real life complexity but also document examples of important progress in managing risk.

**Acknowledgements**

We wish to express our sincere appreciation to all the Coordinating Lead Authors, Lead Authors, Contributing Authors, Review Editors, and Expert and Government Reviewers. Without their expertise, commitment, and integrity, as well as vast investments of time, a report of this quality could never have been completed. We would also like to thank the members of the WGI and WGII Bureaux for their assistance, wisdom, and good sense throughout the preparation of the report.

We would particularly like to thank the remarkable staffs of the Technical Support Units of WGI and WGII for their professionalism, creativity, and dedication. In WGI, thanks go to Gian-Kasper Plattner, Simon Allen, Pauline Midgley, Melinda Tignor, Vincent Bex, Judith Boschung, and Alexander Nauels. In WGII, which led the logistics and overall coordination, thanks go to Dave Dokken, Kristie Ebi, Michael Mastrandrea, Katharine Mach, Sandy MacCracken, Rob Genova, Yuka Estrada, Eric Kissel, Patricia Mastrandrea, Monalisa Chatterjee, and Kyle Terran. Their tireless and very capable efforts to coordinate the Special Report ensured a final product of high scientific quality, while maintaining an atmosphere of collegiality and respect.

We would also like to thank the staff of the IPCC Secretariat: Renate Christ, Gaetano Leone, Mary Jean Burer, Sophie Schlingemann, Judith Ewa, Jesbin Baidya, Joelle Fernandez, Annie Courtin, Laura Biagioni, and Amy Smith Aasdam. Thanks are also due to Francis Hayes (WMO), Tim Nuthall (European Climate Foundation), and Nick Nutall (UNEP).

Our sincere thanks go to the hosts and organizers of the scoping meeting, the four lead author meetings, and the approval session. We gratefully acknowledge the support from the host countries: Norway, Panama, Vietnam, Switzerland, Australia, and Uganda. It is a pleasure to extend special thanks to the government of Norway, which provided untiring support throughout the Special Report process.

 Christopher Field

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