

## CLIMATE RISK AND SUSTAINABLE WATER MANAGEMENT

Climate change is leading to changing patterns of precipitation and increasingly extreme global weather. There is an urgent need to synthesize our current knowledge on climate risks to water security, which in turn is fundamental for achieving sustainable water management. *Climate Risk and Sustainable Water Management* discusses hydrological extremes, climate variability, climate impact assessment, risk analysis and hydrological modelling. It provides a comprehensive interdisciplinary exploration of climate risks to water security, helping to guide sustainable water management in a changing and uncertain future. The relevant theory is accessibly explained using examples throughout, helping readers to apply the knowledge learned to their own situations and challenges. This textbook is especially valuable to students of hydrology, resource management, climate change and geography, as well as a reference textbook for researchers, civil and environmental engineers and water management professionals concerned with water-related hazards, water cycles and climate change.

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## Contents

<i>List of Contributors</i>	page viii
<i>Preface</i>	xiii
<i>Acknowledgements</i>	xvi
<b>Part I Water-Related Risks under Climate Change</b>	<b>1</b>
1 Pluvial, Fluvial and Coastal Flood Risks and Sustainable Flood Management in the Pearl River Delta under Climate Change JIANFENG LI, XIAOGANG SHI, YONGQIN DAVID CHEN AND YANGCHEN LAI	3
2 Flooding Risk in the Lancang-Mekong River Basin under Global Change XIAOBO YUN, JIE WANG, HUAN WU, BINOD BANIYA, HUI LU, SIAO SUN, XIMENG XU, XINGCAI LIU AND QIUHONG TANG	29
3 Spatial Drought Patterns in East Africa GEBREMEDHIN GEBREMESKEL HAILE, QIUHONG TANG AND BINOD BANIYA	47
4 Assessment of Global Water Erosion Vulnerability under Climate Change MUQI XIONG AND GUOYONG LENG	65
5 Water Erosion and Its Controlling Factors in the Anthropocene XIMENG XU AND QIUHONG TANG	82

vi	<i>Contents</i>	
6	Climate Change Impacts on Saltwater Intrusion into Coastal Aquifers HAN XIAO, HAIMING LI, YIN TANG, QIUHONG TANG AND MARWAN KHEIMI	110
	<b>Part II Climate Risk to Human and Natural Systems</b>	<b>137</b>
7	Observed Urban Effects on Temperature and Precipitation in Southeast China SIAO SUN, GUANGDONG LI AND QIUHONG TANG	139
8	Vegetation Dynamics, Land Use and Ecological Risk in Response to NDVI and Climate Change in Nepal BINOD BANAIYA, QIUHONG TANG, GYAN CHHIPI-SHRESTHA, HOM BAHADUR BANAIYA AND GEBREMEDHIN GEBREMESKEL HAILE	160
9	Climate Warming Induced Frozen Soil Changes and the Corresponding Environmental Effect on the Tibetan Plateau: A Review YUNYUN BAN, QIUHONG TANG AND XIMENG XU	179
10	A Review of the Effects of Climate Extremes on Agriculture Production XIAOMENG YIN AND GUOYONG LENG	198
11	Agricultural Water Use Estimation and Impact Assessment on the Water System in China MENGFEI MU, QIUHONG TANG, XIMING CAI, SIAO SUN AND HUIJUAN CUI	220
12	Impact of Inter-Basin Water Transfer on Water Scarcity in Water-Receiving Area under Global Warming: A Case Study of the South-to-North Water Diversion Project YUANYUAN YIN, QIUHONG TANG AND LEI WANG	240
13	Broadening and Deepening the Rainfall-Induced Landslide Detection: Practices and Perspectives at a Global Scale GUOQIANG JIA, QIUHONG TANG, STEFANO LUIGI GARIANO, MASSIMO MELILLO, XIMENG XU, GUOYONG LENG AND XU LI	267

<i>Contents</i>		vii
14	Estimating Aquifer Depth in Arid and Semi-arid Watersheds using Statistical Modelling of Spectral MODIS Products SEYED RASHID FALLAH SHAMSI, PARISA ANSARI, MASOUD MASOUDI AND HAMID REZA POURGHASEMI	289
<b>Part III Sustainable Water Management under Future Uncertainty</b>		313
15	Managing Urban Flood Risk and Building Resilience in a Changing Climate YUELING WANG, QIUHONG TANG AND NIGEL WRIGHT	315
16	Soft Computing Methods and Water Management MOHAMMAD ZOUNEMAT-KERMANI AND MEYSAM ALIZAMIR	342
17	Rainwater Harvesting for Sustainable Water Resource Management under Climate Change RAM L. RAY, RAJENDRA P. SISHODIA AND TOLULOPE OLUTIMEHIN	374
18	Variability of Runoff Coefficient and Precipitation Elasticity at Watersheds across China YIN TANG, QIUHONG TANG AND ZHONGGEN WANG	401
19	Contribution of Hydrological Model Calibration Uncertainty to Future Hydrological Projections over Various Temporal Scales: A Case Study in the Boulder Creek Watershed QINGHUAN ZHANG, QIUHONG TANG, GUOYONG LENG AND SEYED-MOHAMMAD HOSSEINI-MOGHARI	420
20	Future Water Scarcity over the Yellow River Basin and the Effects of Adaptive Measures ZHONGWEI HUANG, QIUHONG TANG AND YUANYUAN YIN	445
21	Shrinking Lake Urmia: Causes, Future Projection and Implications SEYED-MOHAMMAD HOSSEINI-MOGHARI, QIUHONG TANG, GUOYONG LENG AND XIMENG XU	465
	<i>Index</i>	483

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ix

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xi

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## Preface

As anthropogenic disturbance has reached unprecedented levels, the terrestrial water cycle is undergoing rapid changes, threatening water scarcity and raising new challenges for sustainable water management. In order to achieve the Sustainable Development Goals (SDGs) set by the United Nations General Assembly, water management will have to be improved by reducing climate risks and building climate resilience. Water stress and water-related hazards such as drought, flood, landslide, storm surge and saltwater intrusion have caused huge impacts to the social-economy and the environment. Such water risks are projected to grow under future socioeconomic scenarios and climate scenarios characterized with rising temperature, changing precipitation patterns and increasing extreme weathers. There is an urgent need to synthesize current state-of-art knowledge on climate risks facing the water sector, especially given that professionals in water management agencies are often not well updated with scientific progress. Therefore, it is time to write a book on Climate Risk and Sustainable Water Management using ordinary-language explanations and examples throughout, such that it can be used as a textbook for training courses as well.

This book covers various topics including hydrological extremes, climate variability and climate, climate impact assessment, risk analysis, hydrological modelling, etc. The inter-disciplinary and multi-disciplinary feature of this book could provide a comprehensive knowledge on climate risks to water security, thus guiding sustainable water management in an uncertain future. This book provides relevant theory step-by-step using ordinary-language explanations and examples throughout, making the theory accessible to readers without specialized training in science. The information and advice are conveyed in such an efficient and realistic way that readers can apply the knowledge learned from this book to their own situation and problems.

This book is organized into three closely connected parts. Part I focuses on the interactions between water-related hazards and climate change. It starts with two

chapters on the modelling and analysis of flood risk, followed by droughts, soil erosion and saltwater intrusion. Specifically, Chapter 1 investigates various types of flood risk in a delta area, while Chapter 2 assesses the flood risk in a transboundary river basin impacted by both climate change and reservoir operations. Projection of future drought change patterns in East Africa is presented in Chapter 3. Chapters 4 and 5 focus on the changes in global water erosion vulnerability under climate change and the driving factors behind the changing water erosions, respectively. The last chapter in Part I, Chapter 6 investigates climate change impacts on saltwater intrusion into coastal aquifers.

Part II covers various climate risks to the human and natural systems. Chapter 7 evaluates the impacts of urbanization on local climate in Southeast China, which could further feedback to the spatial-temporal variation of water-related hazards. Chapter 8 investigates the impact of climate change on vegetation dynamics, land cover change and ecological risk in Nepal, followed by Chapters 9 and 10 reviewing the effects of climate change on frozen soil on the Tibetan Plateau and global agriculture production, respectively. Chapter 11 focuses on the impacts of human water use on the terrestrial water cycle, while Chapter 12 assesses the benefits of China's South-to-North Water Diversion project in regulating water scarcity in a water-receiving area under climate change. Chapter 13 focuses on the detection and monitoring of rainfall-induced landslide at global scale, while Chapter 14 introduces the methodology of estimating aquifer depth using satellite remote sensing data.

Part III provides an overview of recent advances in theory and practice towards sustainable water management under future uncertainty. It starts with Chapter 15, on how to manage urban flood risk in a changing climate, followed by Chapter 16, on the application of soft computing techniques for water management. Chapter 17 introduces the benefits of rainwater harvesting for enhancing the resilience to climate risks. Chapter 18 focuses on the variations of runoff coefficient and precipitation elasticity at watershed scale, while the uncertainties from model calibration for future hydrological projections are explored in Chapter 19. Chapters 20 and 21 present two case studies for water risk management under future uncertainty, with one focusing on water scarcity and the other on the shrinking inland lake.

Some of the chapters included in this book are based on discussions with scientists and practitioners at regular conferences organized by the International Association of Chinese Youth in Water Sciences (CYWater). Parts of the chapters are also used for graduate courses at the University of Chinese Academy of Sciences (UCAS) as well as the international training workshop by the Chinese Academy of Sciences (CAS).

*Preface*

xv

We hope this book can facilitate multi-disciplinary and transdisciplinary discussions and exchange between scientists and practitioners for sustainable water management under deep uncertainty, and serve as a textbook for graduate and postgraduate courses in climate change, hydrology, water management, risk analysis and geography.

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