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This book series, entitled “IHDP/Future Earth—Integrated Risk Governance Project Series” for the International Human Dimensions Programme on Global Environmental Change—Integrated Risk Governance Project (IHDP/Future Earth—IRG Project), is intended to present in monograph form the most recent scientific achievements in the identification, evaluation and management of emerging global large-scale risks. Future Earth is a flagship initiative of the Science and Technology Alliance for Global Sustainability. It aims to provide critical knowledge required for societies to understand and address challenges posed by global environmental change (GEC) and to seize opportunities for transitions to global sustainability. Future Earth identifies three research themes, i.e., Dynamic Planet, Global Development and Transition toward Sustainability in its plan and adopts a new approach of “Co-designing and co-producing” to incorporate GEC researchers with stakeholders in governments, industry and business, international or intergovernmental organizations, and civil society.

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Atlas of Environmental Risks Facing China Under Climate Change

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Preface

Climate change is one of the most serious threats and the greatest challenges facing human society today. According to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change (IPCC), each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850. The unequivocal warming in the climate system has caused impacts on natural and human systems over the world and is bringing environmental risks having important implications for sustainable development. The environmental risk induced by climate change could be highly regional or even local. Although the IPCC reports have assessed the future impacts of climate change and risks at the global scale and/or from a regional perspective, it is not sufficient for decision-making due to its deficiency in risk assessment at regional and local scales. Assessment of regional environmental risks under climate change is urgently needed to support climate change adaptation at the regional scale. China is a developing country with relatively high level of agricultural population and relatively low level of urbanization but rapid rural-to-urban migration. There are several modernized cities and relatively less developed rural areas in China. Having a tremendously large territory, China has a complex and diverse terrain and a variety of ecosystems ranging from alpine tundra to evergreen tropics and from desert to forest. The climate of China is also diverse, wide-ranging from tropical climate in the south to subarctic climate in the north. With respect to these differences, regional vulnerabilities to climate change are different. Thus, different regions would face environmental risks differently under climate change. Understanding the different regional risks is essential for climate change adaptation in China.

In order to assess the risk of future climate change impacts, the most common means is to use climate-impact models driven by various climate change projections from the general circulation models (GCMs). The model-run scenarios for the IPCC AR5, collected by the Coupled Model Intercomparison Project Phase 5 (CMIP5) archive, are widely used as input forcing data for the climate-impact models. The Inter-Sectoral Impact Model Intercomparison Project (ISI-MIP), which is a community-driven climate-impact modeling initiative aimed to provide a quantitative and cross-sectoral synthesis of the differential impacts of climate change, has offered a framework for modeling of the impacts of climate change by sharing a daily-resolution, downscaled, and bias-corrected climate data from the CMIP5 archive. Many ISI-MIP outcomes have been used by or cited in the IPCC AR5. This atlas leverages the ISI-MIP framework to assess the environmental risks faced by China under climate change. While the common climate change projections provided by ISI-MIP are adopted, the vulnerabilities are assessed using the region-specific information in China. Uncertainty of the assessment is rooted in many aspects of the modeling framework. The spreads of both climate and impact models are large, in particular at the regional and local scales. Despite the irreducible model spread, the uncertainties should not prevent decision-making from using the assessment to support climate change adaptation actions. Indeed, many decisions, for example in insurance industry, have been made with huge uncertainty in future prediction. The multi-model ensembles, including multiple-impact model-runs driven by climate change projections from multiple climate models, are used to estimate future risks and to provide the

basis for uncertainty estimation. The atlas illustrates many multi-model ensembles, which allow decision-makers to know the implications of a wide range of future projections so they can manage the uncertainty and make adaptation policy arguments bearing the uncertainties.

The objective of the atlas is to provide the most comprehensive and accurate illustrations of environmental risks relating to climate change vulnerability and adaptation in China. It addresses the agricultural, ecosystem, and heat wave-related human health risk posed by climate change and presents the projected environmental risks in the twenty-first century under various climate change and socioeconomic scenarios. The detailed and concise risk assessments are mapped in grid units, allowing easy identification of the environmental risk for specific locations. The atlas contains six chapters. Chapter 1 presents the geographic, social, demographic and economic features in China. Chapter 2 illustrates the geographical distribution of temperature and precipitation and their long-term changes in the twenty-first century. Chapters 3–5 demonstrate the risks posed by climate change in the human health, agricultural, and ecosystem sectors with a focus on mortality due to heat wave, food production, and ecosystem shift over naturally vegetated land, respectively. Chapter 6 addresses the integrated environmental risk posed by climate change, which is a combined risk evaluation of climate change impacts on the basis of the risk assessments in the human health, agricultural, and ecosystem sectors. The maps in the atlas are with No. of licensed maps: JS(2016)01-143 (Star Map Press).

I would like to thank Dr. Ge who agreed to be listed as a co-editor of this atlas. Thanks also go to the National Basic Research Program of China (Grant No. 2012CB955403), the National Natural Science Foundation of China (Grant No. 41425002), and the National Youth Top-notch Talent Support Program that supported funding to make this atlas a reality. I would like to extend my thanks to the staff of the Star Map Press (Beijing) and Springer-Verlag Berlin Heidelberg, for smoothly and professionally handling all aspects of the production processes.

I hope this atlas would provide the reader clear pictures of the environmental risks across different sectors posed by climate change and their evolution in the twenty-first century over China. I further hope that the atlas will contribute to the knowledge base for climate change adaptation in China and provide a valuable resource for students and professionals in the fields of geographic sciences and climate change.

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Contents

1	Geography of China	1
	Qihong Tang, Yuanyuan Yin, Xuexia Zhang, Tong Zhu, Jingyao Zhao and Wei Yang	
2	Climate Change Projections in the Twenty-First Century	21
	Wenxiang Wu, Chenchen Xu and Xingcai Liu	
3	Heat Health Risks	51
	Xinchuang Xu, Quansheng Ge and Xingcai Liu	
4	Agricultural Risks	109
	Yuanyuan Yin, Qihong Tang, Xingcai Liu and Huijuan Cui	
5	Ecological Risks	157
	Yuanyuan Yin, Qihong Tang, Xingcai Liu and Huijuan Cui	
6	Integrated Environmental Risks	205
	Xingcai Liu, Yuanyuan Yin, Xinchuang Xu, Qihong Tang and Huijuan Cui	
	Appendix	225
	Further Readings	229

List of Maps

Chapter 1 Geography of China

Topography of China	5
Annual Mean Precipitation (1981-2010)	6
Mean Temperature (1981-2010)	6
Mean Daily Minimum Temperature (1981-2010)	7
Mean Daily Maximum Temperature (1981-2010)	7
Climatic Regionalization of China	8
Climatic Change Regionalization of China	9
River Systems and Drainage Basins of China	10
Annual Runoff Depth	11
Annual Runoff Coefficient	11
Soil Types	12
Soil Regionalization of China	13
Vegetation Types	14
Vegetation Regionalization of China	15
Land Uses and Land Covers	16
Eco-geographical Regionalization of China	17
Population Density in 2010	18
Gross Domestic Product in 2010	18
Products of Farming, Forestry, Animal Husbandry and Fishery in 2010	19
Grain Production in 2010	19

Chapter 2 Climate Change Projections in the Twenty-First Century

Change in Daily Minimum Temperature for RCP2.6 (1981-2010 to 2011-2040)	23
Change in Daily Maximum Temperature for RCP2.6 (1981-2010 to 2011-2040)	23
Change in Mean Temperature for RCP2.6 (1981-2010 to 2011-2040)	24
Change in Annual Precipitation for RCP2.6 (1981-2010 to 2011-2040)	24
Change in Daily Minimum Temperature for RCP2.6 (1981-2010 to 2041-2070)	25
Change in Daily Maximum Temperature for RCP2.6 (1981-2010 to 2041-2070)	25
Change in Mean Temperature for RCP2.6 (1981-2010 to 2041-2070)	26
Change in Annual Precipitation for RCP2.6 (1981-2010 to 2041-2070)	26
Change in Daily Minimum Temperature for RCP2.6 (1981-2010 to 2071-2100)	27
Change in Daily Maximum Temperature for RCP2.6 (1981-2010 to 2071-2100)	27
Change in Mean Temperature for RCP2.6 (1981-2010 to 2071-2100)	28
Change in Annual Precipitation for RCP2.6 (1981-2010 to 2071-2100)	28
Change in Daily Minimum Temperature for RCP4.5 (1981-2010 to 2011-2040)	29
Change in Daily Maximum Temperature for RCP4.5 (1981-2010 to 2011-2040)	29
Change in Mean Temperature for RCP4.5 (1981-2010 to 2011-2040)	30
Change in Annual Precipitation for RCP4.5 (1981-2010 to 2011-2040)	30
Change in Daily Minimum Temperature for RCP4.5 (1981-2010 to 2041-2070)	31
Change in Daily Maximum Temperature for RCP4.5 (1981-2010 to 2041-2070)	31

Change in Mean Temperature for RCP4.5 (1981-2010 to 2041-2070)	32
Change in Annual Precipitation for RCP4.5 (1981-2010 to 2041-2070)	32
Change in Daily Minimum Temperature for RCP4.5 (1981-2010 to 2071-2100)	33
Change in Daily Maximum Temperature for RCP4.5 (1981-2010 to 2071-2100)	33
Change in Mean Temperature for RCP4.5 (1981-2010 to 2071-2100)	34
Change in Annual Precipitation for RCP4.5 (1981-2010 to 2071-2100)	34
Change in Daily Minimum Temperature for RCP6.0 (1981-2010 to 2011-2040)	35
Change in Daily Maximum Temperature for RCP6.0 (1981-2010 to 2011-2040)	35
Change in Mean Temperature for RCP6.0 (1981-2010 to 2011-2040)	36
Change in Annual Precipitation for RCP6.0 (1981-2010 to 2011-2040)	36
Change in Daily Minimum Temperature for RCP6.0 (1981-2010 to 2041-2070)	37
Change in Daily Maximum Temperature for RCP6.0 (1981-2010 to 2041-2070)	37
Change in Mean Temperature for RCP6.0 (1981-2010 to 2041-2070)	38
Change in Annual Precipitation for RCP6.0 (1981-2010 to 2041-2070)	38
Change in Daily Minimum Temperature for RCP6.0 (1981-2010 to 2071-2100)	39
Change in Daily Maximum Temperature for RCP6.0 (1981-2010 to 2071-2100)	39
Change in Mean Temperature for RCP6.0 (1981-2010 to 2071-2100)	40
Change in Annual Precipitation for RCP6.0 (1981-2010 to 2071-2100)	40
Change in Daily Minimum Temperature for RCP8.5 (1981-2010 to 2011-2040)	41
Change in Daily Maximum Temperature for RCP8.5 (1981-2010 to 2011-2040)	41
Change in Mean Temperature for RCP8.5 (1981-2010 to 2011-2040)	42
Change in Annual Precipitation for RCP8.5 (1981-2010 to 2011-2040)	42
Change in Daily Minimum Temperature for RCP8.5 (1981-2010 to 2041-2070)	43
Change in Daily Maximum Temperature for RCP8.5 (1981-2010 to 2041-2070)	43
Change in Mean Temperature for RCP8.5 (1981-2010 to 2041-2070)	44
Change in Annual Precipitation for RCP8.5 (1981-2010 to 2041-2070)	44
Change in Daily Minimum Temperature for RCP8.5 (1981-2010 to 2071-2100)	45
Change in Daily Maximum Temperature for RCP8.5 (1981-2010 to 2071-2100)	45
Change in Mean Temperature for RCP8.5 (1981-2010 to 2071-2100)	46
Change in Annual Precipitation for RCP8.5 (1981-2010 to 2071-2100)	46
Intermodel Spread in Changes in Daily Minimum Temperature for RCP8.5 (1981-2010 to 2071-2100)	47
Intermodel Spread in Changes in Daily Maximum Temperature for RCP8.5 (1981-2010 to 2071-2100)	47
Intermodel Spread in Changes in Mean Temperature for RCP8.5 (1981-2010 to 2071-2100)	48
Intermodel Spread in Changes in Annual Precipitation for RCP8.5 (1981-2010 to 2071-2100)	48

Chapter 3 Heat Health Risks

The Number of Days with Daily Maximum Temperature over 35°C in 1981-2010 . . .	54
The Number of Days with Daily Maximum Temperature over 40°C in 1981-2010 . . .	54
Maximum Temperature of a year over 1981-2010	55
The Annual Mean Number of Days of Heat Waves over 1981-2010	55
Population Vulnerable to High Temperature over 1981-2010	56
The Number of Days with Daily Maximum Temperature over 35°C in 2011-2040 for RCP2.6	57
The Number of Days with Daily Maximum Temperature over 40°C in 2011-2040 for RCP2.6	57
Maximum Temperature of a year over 2011-2040 for RCP2.6	58
The Number of Days of Heat Waves over 2011-2040 for RCP2.6	58
Hazard of Mortality to High Temperature over 2011-2040 for RCP2.6	59
Risk of Mortality to High Temperature over 2011-2040 for RCP2.6	60

The Number of Days with Daily Maximum Temperature over 35°C in 2041-2070 for RCP2.6	61
The Number of Days with Daily Maximum Temperature over 40°C in 2041-2070 for RCP2.6	61
Maximum Temperature of a year over 2041-2070 for RCP2.6	62
The Number of Days of Heat Waves over 2041-2070 for RCP2.6	62
Hazard of Mortality to High Temperature over 2041-2070 for RCP2.6	63
Risk of Mortality to High Temperature over 2041-2070 for RCP2.6	64
The Number of Days with Daily Maximum Temperature over 35°C in 2071-2099 for RCP2.6	65
The Number of Days with Daily Maximum Temperature over 40°C in 2071-2099 for RCP2.6	65
Maximum Temperature of a year over 2071-2099 for RCP2.6	66
The Number of Days of Heat Waves over 2071-2099 for RCP2.6	66
Hazard of Mortality to High Temperature over 2071-2099 for RCP2.6	67
Risk of Mortality to High Temperature over 2071-2099 for RCP2.6	68
The Number of Days with Daily Maximum Temperature over 35°C in 2011-2040 for RCP4.5	69
The Number of Days with Daily Maximum Temperature over 40°C in 2011-2040 for RCP4.5	69
Maximum Temperature of a year over 2011-2040 for RCP4.5	70
The Number of Days of Heat Waves over 2011-2040 for RCP4.5	70
Hazard of Mortality to High Temperature over 2011-2040 for RCP4.5	71
Risk of Mortality to High Temperature over 2011-2040 for RCP4.5	72
The Number of Days with Daily Maximum Temperature over 35°C in 2041-2070 for RCP4.5	73
The Number of Days with Daily Maximum Temperature over 40°C in 2041-2070 for RCP4.5	73
Maximum Temperature of a year over 2041-2070 for RCP4.5	74
The Number of Days of Heat Waves over 2041-2070 for RCP4.5	74
Hazard of Mortality to High Temperature over 2041-2070 for RCP4.5	75
Risk of Mortality to High Temperature over 2041-2070 for RCP4.5	76
The Number of Days with Daily Maximum Temperature over 35°C in 2071-2099 for RCP4.5	77
The Number of Days with Daily Maximum Temperature over 40°C in 2071-2099 for RCP4.5	77
Maximum Temperature of a year over 2071-2099 for RCP4.5	78
The Number of Days of Heat Waves over 2071-2099 for RCP4.5	78
Hazard of Mortality to High Temperature over 2071-2099 for RCP4.5	79
Risk of Mortality to High Temperature over 2071-2099 for RCP4.5	80
The Number of Days with Daily Maximum Temperature over 35°C in 2011-2040 for RCP6.0	81
The Number of Days with Daily Maximum Temperature over 40°C in 2011-2040 for RCP6.0	81
Maximum Temperature of a year over 2011-2040 for RCP6.0	82
The Number of Days of Heat Waves over 2011-2040 for RCP6.0	82
Hazard of Mortality to High Temperature over 2011-2040 for RCP6.0	83
Risk of Mortality to High Temperature over 2011-2040 for RCP6.0	84
The Number of Days with Daily Maximum Temperature over 35°C in 2041-2070 for RCP6.0	85
The Number of Days with Daily Maximum Temperature over 40°C in 2041-2070 for RCP6.0	85
Maximum Temperature of a year over 2041-2070 for RCP6.0	86
The Number of Days of Heat Waves over 2041-2070 for RCP6.0	86
Hazard of Mortality to High Temperature over 2041-2070 for RCP6.0	87

Risk of Mortality to High Temperature over 2041-2070 for RCP6.0	88
The Number of Days with Daily Maximum Temperature over 35°C in 2071-2099 for RCP6.0	89
The Number of Days with Daily Maximum Temperature over 40°C in 2071-2099 for RCP6.0	89
Maximum Temperature of a year over 2071-2099 for RCP6.0	90
The Number of Days of Heat Waves over 2071-2099 for RCP6.0	90
Hazard of Mortality to High Temperature over 2071-2099 for RCP6.0	91
Risk of Mortality to High Temperature over 2071-2099 for RCP6.0	92
The Number of Days with Daily Maximum Temperature over 35°C in 2011-2040 for RCP8.5	93
The Number of Days with Daily Maximum Temperature over 40°C in 2011-2040 for RCP8.5	93
Maximum Temperature of a year over 2011-2040 for RCP8.5	94
The Number of Days of Heat Waves over 2011-2040 for RCP8.5	94
Hazard of Mortality to High Temperature over 2011-2040 for RCP8.5	95
Risk of Mortality to High Temperature over 2011-2040 for RCP8.5	96
The Number of Days with Daily Maximum Temperature over 35°C in 2041-2070 for RCP8.5	97
The Number of Days with Daily Maximum Temperature over 40°C in 2041-2070 for RCP8.5	97
Maximum Temperature of a year over 2041-2070 for RCP8.5	98
The Number of Days of Heat Waves over 2041-2070 for RCP8.5	98
Hazard of Mortality to High Temperature over 2041-2070 for RCP8.5	99
Risk of Mortality to High Temperature over 2041-2070 for RCP8.5	100
The Number of Days with Daily Maximum Temperature over 35°C in 2071-2099 for RCP8.5	101
The Number of Days with Daily Maximum Temperature over 40°C in 2071-2099 for RCP8.5	101
Maximum Temperature of a year over 2071-2099 for RCP8.5	102
The Number of Days of Heat Waves over 2071-2099 for RCP8.5	102
Hazard of Mortality to High Temperature over 2071-2099 for RCP8.5	103
Risk of Mortality to High Temperature over 2071-2099 for RCP8.5	104
Intermodel Spread in Number of Days with Daily Maximum Temperature over 35 °C in 2071-2099 for RCP8.5	105
Intermodel Spread in Number of Days with Daily Maximum Temperature over 40 °C in 2071-2099 for RCP8.5	105
Intermodel Spread in Daily Maximum Temperature over 2071-2099 for RCP8.5	106
Intermodel Spread in Number of Days of Heat Waves over 2071-2099 for RCP8.5	106
Intermodel Spread in Hazard of Mortality to High Temperature over 2071-2099 for RCP8.5	107
Intermodel Spread in Risk of Mortality to High Temperature over 2071-2099 for RCP8.5	107

Chapter 4 Agricultural Risks .

Maize Growing Areas	112
Wheat Growing Areas	112
Rice Growing Areas	113
Soybean Growing Areas	113
Annual Mean Yield of Maize over 1981-2010	114
Annual Mean Yield of Wheat over 1981-2010	114
Annual Mean Yield of Rice over 1981-2010	115
Annual Mean Yield of Soybean over 1981-2010	115

Annual Mean Agricultural Production over 1981-2010	116
Risk Levels of Maize Yield over 2011-2040 for RCP2.6	117
Risk Levels of Wheat Yield over 2011-2040 for RCP2.6	117
Risk Levels of Rice Yield over 2011-2040 for RCP2.6	118
Risk Levels of Soybean Yield over 2011-2040 for RCP2.6	118
Risk Levels of Agricultural Production over 2011-2040 for RCP2.6	119
Risk Levels of Maize Yield over 2041-2070 for RCP2.6	120
Risk Levels of Wheat Yield over 2041-2070 for RCP2.6	120
Risk Levels of Rice Yield over 2041-2070 for RCP2.6	121
Risk Levels of Soybean Yield over 2041-2070 for RCP2.6	121
Risk Levels of Agricultural Production over 2041-2070 for RCP2.6	122
Risk Levels of Maize Yield over 2071-2099 for RCP2.6	123
Risk Levels of Wheat Yield over 2071-2099 for RCP2.6	123
Risk Levels of Rice Yield over 2071-2099 for RCP2.6	124
Risk Levels of Soybean Yield over 2071-2099 for RCP2.6	124
Risk Levels of Agricultural Production over 2071-2099 for RCP2.6	125
Risk Levels of Maize Yield over 2011-2040 for RCP4.5	126
Risk Levels of Wheat Yield over 2011-2040 for RCP4.5	126
Risk Levels of Rice Yield over 2011-2040 for RCP4.5	127
Risk Levels of Soybean Yield over 2011-2040 for RCP4.5	127
Risk Levels of Agricultural Production over 2011-2040 for RCP4.5	128
Risk Levels of Maize Yield over 2041-2070 for RCP4.5	129
Risk Levels of Wheat Yield over 2041-2070 for RCP4.5	129
Risk Levels of Rice Yield over 2041-2070 for RCP4.5	130
Risk Levels of Soybean Yield over 2041-2070 for RCP4.5	130
Risk Levels of Agricultural Production over 2041-2070 for RCP4.5	131
Risk Levels of Maize Yield over 2071-2099 for RCP4.5	132
Risk Levels of Wheat Yield over 2071-2099 for RCP4.5	132
Risk Levels of Rice Yield over 2071-2099 for RCP4.5	133
Risk Levels of Soybean Yield over 2071-2099 for RCP4.5	133
Risk Levels of Agricultural Production over 2071-2099 for RCP4.5	134
Risk Levels of Maize Yield over 2011-2040 for RCP6.0	135
Risk Levels of Wheat Yield over 2011-2040 for RCP6.0	135
Risk Levels of Rice Yield over 2011-2040 for RCP6.0	136
Risk Levels of Soybean Yield over 2011-2040 for RCP6.0	136
Risk Levels of Agricultural Production over 2011-2040 for RCP6.0	137
Risk Levels of Maize Yield over 2041-2070 for RCP6.0	138
Risk Levels of Wheat Yield over 2041-2070 for RCP6.0	138
Risk Levels of Rice Yield over 2041-2070 for RCP6.0	139
Risk Levels of Soybean Yield over 2041-2070 for RCP6.0	139
Risk Levels of Agricultural Production over 2041-2070 for RCP6.0	140
Risk Levels of Maize Yield over 2071-2099 for RCP6.0	141
Risk Levels of Wheat Yield over 2071-2099 for RCP6.0	141
Risk Levels of Rice Yield over 2071-2099 for RCP6.0	142
Risk Levels of Soybean Yield over 2071-2099 for RCP6.0	142
Risk Levels of Agricultural Production over 2071-2099 for RCP6.0	143
Risk Levels of Maize Yield over 2011-2040 for RCP8.5	144
Risk Levels of Wheat Yield over 2011-2040 for RCP8.5	144
Risk Levels of Rice Yield over 2011-2040 for RCP8.5	145
Risk Levels of Soybean Yield over 2011-2040 for RCP8.5	145
Risk Levels of Agricultural Production over 2011-2040 for RCP8.5	146
Risk Levels of Maize Yield over 2041-2070 for RCP8.5	147
Risk Levels of Wheat Yield over 2041-2070 for RCP8.5	147
Risk Levels of Rice Yield over 2041-2070 for RCP8.5	148
Risk Levels of Soybean Yield over 2041-2070 for RCP8.5	148

Risk Levels of Agricultural Production over 2041-2070 for RCP8.5	149
Risk Levels of Maize Yield over 2071-2099 for RCP8.5	150
Risk Levels of Wheat Yield over 2071-2099 for RCP8.5	150
Risk Levels of Rice Yield over 2071-2099 for RCP8.5	151
Risk Levels of Soybean Yield over 2071-2099 for RCP8.5	151
Risk Levels of Agricultural Production over 2071-2099 for RCP8.5	153
Intermodel Spread in Relative Changes of Maize Yield over 2071-2099 for RCP8.5	153
Intermodel Spread in Relative Changes of Wheat Yield over 2071-2099 for RCP8.5	153
Intermodel Spread in Relative Changes of Rice Yield over 2071-2099 for RCP8.5	154
Intermodel Spread in Relative Changes of Soybean Yield over 2071-2099 for RCP8.5	154
Intermodel Spread in Relative Changes of Agricultural Production over 2071-2099 for RCP8.5	155

Chapter 5 Ecosystem Risks

Net Primary Productivity over 1981-2010	160
Fire Carbon over 1981-2010	160
Carbon Contained in Vegetation over 1981-2010	161
Carbon Contained in Soil over 1981-2010	161
Transpiration over 1981-2010	162
Evaporation over 1981-2010	162
Runoff over 1981-2010	163
Soil Water Content over 1981-2010	163
Relative Change of Net Primary Productivity over 2011-2040 for RCP2.6	164
Risk Levels of Carbon Fluxes over 2011-2040 for RCP2.6	164
Risk Levels of Carbon Stocks over 2011-2040 for RCP2.6	165
Risk Levels of Water Fluxes over 2011-2040 for RCP2.6	165
Risk Levels of Natural Ecosystems over 2011-2040 for RCP2.6	166
Relative Change of Net Primary Productivity over 2041-2070 for RCP2.6	167
Risk Levels of Carbon Fluxes over 2041-2070 for RCP2.6	167
Risk Levels of Carbon Stocks over 2041-2070 for RCP2.6	168
Risk Levels of Water Fluxes over 2041-2070 for RCP2.6	168
Risk Levels of Natural Ecosystems over 2041-2070 for RCP2.6	169
Relative Change of Net Primary Productivity over 2071-2099 for RCP2.6	170
Risk Levels of Carbon Fluxes over 2071-2099 for RCP2.6	170
Risk Levels of Carbon Stocks over 2071-2099 for RCP2.6	171
Risk Levels of Water Fluxes over 2071-2099 for RCP2.6	171
Risk Levels of Natural Ecosystems over 2071-2099 for RCP2.6	172
Relative Change of Net Primary Productivity over 2011-2040 for RCP4.5	173
Risk Levels of Carbon Fluxes over 2011-2040 for RCP4.5	173
Risk Levels of Carbon Stocks over 2011-2040 for RCP4.5	174
Risk Levels of Water Fluxes over 2011-2040 for RCP4.5	174
Risk Levels of Natural Ecosystems over 2011-2040 for RCP4.5	175
Relative Change of Net Primary Productivity over 2041-2070 for RCP4.5	176
Risk Levels of Carbon Fluxes over 2041-2070 for RCP4.5	176
Risk Levels of Carbon Stocks over 2041-2070 for RCP4.5	177
Risk Levels of Water Fluxes over 2041-2070 for RCP4.5	177
Risk Levels of Natural Ecosystems over 2041-2070 for RCP4.5	178
Relative Change of Net Primary Productivity over 2071-2099 for RCP4.5	179
Risk Levels of Carbon Fluxes over 2071-2099 for RCP4.5	179
Risk Levels of Carbon Stocks over 2071-2099 for RCP4.5	180

Risk Levels of Water Fluxes over 2071-2099 for RCP4.5.	180
Risk Levels of Natural Ecosystems over 2071-2099 for RCP4.5.	181
Relative Change of Net Primary Productivity over 2011-2040 for RCP6.0.	182
Risk Levels of Carbon Fluxes over 2011-2040 for RCP6.0.	182
Risk Levels of Carbon Stocks over 2011-2040 for RCP6.0.	183
Risk Levels of Water Fluxes over 2011-2040 for RCP6.0.	183
Risk Levels of Natural Ecosystems over 2011-2040 for RCP6.0.	184
Relative Change of Net Primary Productivity over 2041-2070 for RCP6.0.	185
Risk Levels of Carbon Fluxes over 2041-2070 for RCP6.0.	185
Risk Levels of Carbon Stocks over 2041-2070 for RCP6.0.	186
Risk Levels of Water Fluxes over 2041-2070 for RCP6.0.	186
Risk Levels of Natural Ecosystems over 2041-2070 for RCP6.0.	187
Relative Change of Net Primary Productivity over 2071-2099 for RCP6.0.	188
Risk Levels of Carbon Fluxes over 2071-2099 for RCP6.0.	188
Risk Levels of Carbon Stocks over 2071-2099 for RCP6.0.	189
Risk Levels of Water Fluxes over 2071-2099 for RCP6.0.	189
Risk Levels of Natural Ecosystems over 2071-2099 for RCP6.0.	190
Relative Change of Net Primary Productivity over 2011-2040 for RCP8.5.	191
Risk Levels of Carbon Fluxes over 2011-2040 for RCP8.5.	191
Risk Levels of Carbon Stocks over 2011-2040 for RCP8.5.	192
Risk Levels of Water Fluxes over 2011-2040 for RCP8.5.	192
Risk Levels of Natural Ecosystems over 2011-2040 for RCP8.5.	193
Relative Change of Net Primary Productivity over 2041-2070 for RCP8.5.	194
Risk Levels of Carbon Fluxes over 2041-2070 for RCP8.5.	194
Risk Levels of Carbon Stocks over 2041-2070 for RCP8.5.	195
Risk Levels of Water Fluxes over 2041-2070 for RCP8.5.	195
Risk Levels of Natural Ecosystems over 2041-2070 for RCP8.5.	196
Relative Change of Net Primary Productivity over 2071-2099 for RCP8.5.	197
Risk Levels of Carbon Fluxes over 2071-2099 for RCP8.5.	197
Risk Levels of Carbon Stocks over 2071-2099 for RCP8.5.	198
Risk Levels of Water Fluxes over 2071-2099 for RCP8.5.	198
Risk Levels of Natural Ecosystems over 2071-2099 for RCP8.5.	199
Intermodel Spread in Risk of Net Primary Productivity over 2071-2099 for RCP8.5	200
Intermodel Spread in Risk of Carbon Fluxes over 2071-2099 for RCP8.5	200
Intermodel Spread in Risk of Carbon Stocks over 2071-2099 for RCP8.5	201
Intermodel Spread in Risk of Water Fluxes over 2071-2099 for RCP8.5	201
Intermodel Spread in Risk of Natural Ecosystems over 2071-2099 for RCP8.5	202

Chapter 6 Integrated Environmental Risks

Integrated Environmental Risk over 2011-2040 for RCP2.6	207
Integrated Environmental Risk over 2041-2070 for RCP2.6	208
Integrated Environmental Risk over 2071-2099 for RCP2.6	209
Integrated Environmental Risk over 2011-2040 for RCP4.5	210
Integrated Environmental Risk over 2041-2070 for RCP4.5	211
Integrated Environmental Risk over 2071-2099 for RCP4.5	212
Integrated Environmental Risk over 2011-2040 for RCP6.0	213
Integrated Environmental Risk over 2041-2070 for RCP6.0	214
Integrated Environmental Risk over 2071-2099 for RCP6.0	215
Integrated Environmental Risk over 2011-2040 for RCP8.5	216
Integrated Environmental Risk over 2041-2070 for RCP8.5	217
Integrated Environmental Risk over 2071-2099 for RCP8.5	218
Regionalization of Integrated Environmental Risk over 2071-2099 for RCP6.0	219
Regionalization of Integrated Environmental Risk over 2071-2099 for RCP8.5	220

Intermodel Spread in Integrated Environmental Risk over 2071-2099 for RCP2.6	221
Intermodel Spread in Integrated Environmental Risk over 2071-2099 for RCP4.5	221
Intermodel Spread in Integrated Environmental Risk over 2071-2099 for RCP6.0	222
Intermodel Spread in Integrated Environmental Risk over 2071-2099 for RCP8.5	222