

中国自然灾害风险地图集

Atlas of Natural Disaster Risk of China

主编 史培军

Chief Editor: Shi Peijun



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序 一

中国是世界上自然灾害种类较多、灾情最为严重的少数几个国家之一。几千年来，中国人民与自然灾害展开了卓绝的斗争，取得了显著的成效，诸如世界著名的四川都江堰水利工程等。然而，直至今天，自然灾害仍然是制约中国可持续发展的重大障碍。近20年来，中国每年因自然灾害造成的遇难人员达2000人以上，造成的直接经济损失近2000亿元。近年来巨灾发生频繁，2008年中国南方发生大面积的冰冻雨雪灾害，造成直接经济损失达1500多亿元；2008年的汶川特大地震灾害，造成直接经济损失达8500多亿元，死亡和失踪人员达到8.7万人；2009年初至2010年初华北、东北地区以及西南地区发生大面积旱灾，造成上千万人员和上亿头(只)牲畜饮水困难，直接经济损失千亿元以上；2010年发生在青藏高原东北边缘的玉树地震和舟曲特大山洪泥石流灾害，长江中下游地区和海南岛的特大水灾同样造成了几千人遇难和上千亿元的直接经济损失。

所有这些重特大自然灾害给中国实现建设小康社会的目标带来了巨大挑战。针对与年俱增的自然灾害风险，中国政府加大对综合减灾的研究力度，在国家第十一个五年计划中，部署了多项综合减灾的重大基础研究项目、高技术研发项目和科技支撑项目。其中，由教育部负责组织、北京师范大学等单位共同承担的国家“十一五”科技支撑重点项目——“综合风险防范关键技术与示范”(2006BAD20B00)就是针对中国重大自然灾害风险防范而开展的一项重要的综合减灾研发项目。这一项目经过近五年的努力，已取得多项重要成果，并在国家应对汶川特大地震灾害、南方雨雪冰冻灾害、玉树地震灾害、舟曲山洪泥石流灾害中起到了重要的科技支撑作用，得到了国家和地方政府的高度评价，并引起同行的广泛关注。

编制自然灾害地图是直观展示制图区域自然灾害时空分异规律最为有效的方法之一。北京师范大学在过去20年，组织国内有关力量先后编制出版了《中国自然灾害地图集》(中、英文版，张兰生、刘恩正主编，1992)、《中国自然灾害系统地图集》(中英文对照版，史培军主编，2003)，在综合减灾领域学术界、产业和管理界赢得了良好声誉，得到国内外同行的充分肯定。现在呈现在读者面前的《中国自然灾害风险地图集》(中英文对照版)，则是北京师范大学与国内同行经过近十年努力完成的第三本关于中国综合自然灾害时空分异规律的地图集。与前两本地图集相比，该图集仍然是在“区域自然灾害系统理论”的指导下，着重展示了中国自然灾害系统中综合自然灾害风险和主要自然灾害风险的空间格局、各省区市综合自然灾害风险的空间差异，为中国各级政府和企业制定综合自然灾害风险防范对策提供翔实的科学依据。如果把这三本地图集综合成一个整体，它全面地反映了中国自然灾害系统中自然致灾因子、自然灾害灾情和自然灾害风险的时空格局，也是对由致灾因子、承灾体、孕灾环境和灾情共同组成的中国自然灾害系统的一个完整的科学图解。

该图集的出版为中国开展综合减灾研究和实施综合风险防范奠定了良好基础，对发展灾害风险科学也将起到重要的推动作用。然而，由于中国综合减灾与风险防范科技工作起步较晚，该图集涉及的综合灾害风险评价指标体系、模型等诸多学术问题还有许多不完善之处，请广大同行和读者给予批评指正。在此，对参与该图集编制的广大科技工作者表示热烈的祝贺，并期望中国综合减灾和风险防范研究取得更多新的成就，为提高中国及全世界的综合减灾与风险防范能力作出更大贡献。

徐冠华

全国政协教科文卫体委员会主任，科技部原部长
中国科学院院士、中国科学院遥感应用研究所研究员

2010年12月28日

Foreword I

China is among the few countries in the world with a relatively large variety of highly destructive natural disasters. The Chinese people have been fighting natural disasters for thousands of years. Significant achievements have been made, such as the famous Dujiangyan Irrigation Project in Sichuan Province. However, natural disasters are still major obstacles restricting the sustainable development of China at present. Over the past 20 years, more than 2 000 human lives have been lost annually due to natural disasters, and this number can be over 80 000 in one particularly severe year. The direct annual economic loss typically approaches 200 billion RMB, which can reach as high as 1.1 trillion RMB in one particularly severe year. Catastrophic natural disasters occurred frequently in recent years. In 2008, a large area in southern China was hit by a snow storm and freezing rain disaster with more than 150 billion RMB direct economic loss. In 2008, the devastating Wenchuan Earthquake claimed more than 850 billion RMB direct economic losses, and 87 000 human losses, including casualties and missing. From early 2009 to early 2010, a large-area drought hit the north, northeast, and southwest regions of China, resulting in extreme shortage of drinking water for tens of millions of people and hundreds of millions of livestock, and direct economic losses approaching several hundred billion RMB. In 2010, Yushu earthquake at the northeast edge of the Tibetan Plateau, the serious flash flood and debris flow in Zhouqu, and the devastating floods in Hainan Island and in the middle and lower reaches of Yangtze River regions also killed thousands of people and led to a hundred billion RMB in direct economic losses.

All these major natural disasters have seriously challenged China's goal of achieving a prosperous and harmonious society. In an era of increasing risks of natural disasters, the Chinese government has been increasing research on integrated disaster reduction efforts. In the China National 11th "Five-Year" Plan, a significant number of key fundamental research projects, high-tech R & D projects, and science and technology pillar projects in the field of integrated disaster reduction was initiated. Among them, China National "11th Five-year" Science and Technology Pillar Program "Research and Demonstration on Key Technology of Integrated Risk Governance"(2006BAD20B00), organized by the Ministry of Education and implemented by Beijing Normal University and other institutions, is an important R & D project aimed at better risk governance of major natural disasters in China. A number of important results of this project have played important supporting roles during the emergency response to the devastating Wenchuan earthquake, the snow storm and freezing rain disaster in southern China, the Yushu earthquake, and the Zhouqu flash flood and debris flow disaster. The contributions were highly valued by the state and local governments, and widely recognized in risk research community.

The compilation of natural disaster maps is one of the most effective ways to intuitively display the temporal variation and spatial distribution laws of regional natural disasters. In the past 20 years, Beijing Normal University has published a series of atlases through collaboration, such as *Atlas of Natural Disaster in China* (Chinese-English version; Zhang Lansheng and Liu Enzheng, 1992) and *Atlas of Natural Disaster System of China* (Chinese-English bilingual version; Shi Peijun, 2003). These works have achieved high reputation within the communities of academia, industry and management, and full peer recognition from their domestic and foreign counterparts. Now, after nearly a decade of efforts from Beijing Normal University and its domestic collaborators, the *Atlas of Natural Disaster Risk in China* (Chinese-English bilingual version) are presented, which is the third atlas on the temporal variation and spatial distribution of China's natural disasters. While following the same *regional natural disaster system theory* as in the previous ones, this atlas highlights the integrated natural disaster risks, spatial pattern and regional risk differences of major natural disasters in China. The goal of this atlas is to provide an accurate and detailed scientific basis for the Chinese government and enterprises at all levels to develop integrated natural disaster risk prevention and governance measures. These three atlases integrated into a whole, not only fully reflect the temporal and spatial patterns of the natural hazards, natural disaster, and natural disaster risks, but also provide a complete scientific picture of the natural disaster system in China, with the composition of natural hazards ("hazards-formative factors" in the previous atlas), exposures ("hazard-affected bodies" in the previous atlas), environments ("hazard-formative environments" in the previous atlas), and disasters losses ("disaster effects" in the previous atlas).

The publication of this atlas lays a solid foundation for research into integrated disaster reduction and the implementation of integrated disaster risk governance. It also plays an important role to promote the development of disaster risk science. Nevertheless, since the research of integrated disaster reduction and risk governance in China started just recently, it is expected that there will be academic imperfections in this Atlas, including the index systems and models for integrated disaster risk assessment, etc., and hence comments and suggestions from peers and readers should be highly appreciated. We would like to express our warm congratulations to all the researchers who participated in the compilation of this atlas. We also look forward to the future achievements in China's integrated disaster reduction and risk governance research, and expect to make further contribution to increase the capacity of integrated disaster reduction and risk governance in China and around the world.

Xu Guanhua

Chairman of the Subcommittee of Education, Science, Culture, Health and Sports of the National Committee of the Chinese People's Political Consultative Conference

Former Minister of Science and Technology of China

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Dec. 28, 2010

序 二

世界经济在21世纪头10年里发生了巨大变化。纵然有许多国家已不堪经济危机之重而摇摇欲坠，而中国的经济繁荣却几乎没有受到影响。2010年，中国的经济产出已经超过日本，从而跃居世界第二大经济体，社会和经济财富正以前所未有的速度累积。西方国家经历几个世纪才获得的发展，在中国只不过花了二三十年。

如今，中国被认为是全球经济的主要驱动力之一，但是仍然存在一些因素可能会对其今后增长造成影响，例如中国急速增长的巨灾风险。许多西方国家长期以来的稳定发展一直获益于健康而持续的(再)保险体系。(再)保险已经一再证明其作为一种透明的融资解决方案，可以有效地缓解政府灾后的经济压力，加速灾后重建并促进社会稳定。

对比中国的(再)保险市场与其他成熟市场，中国的自然灾害风险与保险深度之间还存在着巨大的鸿沟。在今天的中国，大部分的灾后保障仍然是由政府和社会捐助提供的。

这并不是说中国的保险市场停滞不前，事实上我们很高兴看到，过去20年里中国的保险市场经历了快速发展。以财产险和意外险为例，从2000年到2009年，保费从600亿人民币增长到2 880亿人民币，其中最近4年的年增长率都在25%左右。然而，这还仅仅是个开始。2010年，中国的人均GDP达到了4 000美金；全球经验显示，当人均GDP达到3 000至10 000美金时保险市场相应发展最快。这就预示着中国将迎来一个保险市场高速发展的时期。

所以我们相信中国风险与保险之间的距离很快就会缩短，但我们也深知中国的保险行业仍然十分年轻，其长期可持续发展有赖于对风险的深入理解以及风险管理的科学化与体系化。中国本土保险公司已经开始面对来自监管机构和股东的压力，管理层也越来越需要注意风险调整以后的资本收益。

要保持持续增长，中国必须抓住机遇以培养并保留足够的全球再保的承保能力，及其对中国市场的承诺和投入。在中国实现未来增长目标的同时，中国市场目前给再保人提供的分散风险的益处很快就会消失。(再)保险公司由于其风险暴露的持续快速增长，将会更加审慎地评估他们的风险并合理地为其定价。

这个过程必须在一个稳定的技术框架里得到可靠的验证。那么，不论是自上而下，还是自下而上，我们都回到了一个焦点，即保险与再保险的风险承保。

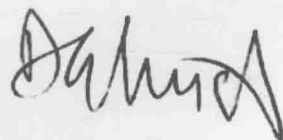
从这个角度出发，怡安奔福全力支持并承诺与中国(再)保险市场建立合作伙伴，帮助市场理解、评估中国的本土风险，并为国内市场提供获取外部承保能力和技术的途径。

我们在全球(再)保险市场的长期经验使得我们能够帮助公众、商业以及政府有效地减轻风险，同时我们也会继续为我们的客户提供基于精准风险分析手段的稳定、可靠的风险转移方案。

所以，我们非常高兴能有这个机会赞助《中国自然灾害风险图集》的出版。在我看来，该图集为所有希望在中国保险市场上发挥积极作用的本土及国际(再)保险公司提供了一项重要的资源。我希望该图集的读者和使用者会像我一样惊叹于图集背后的研究以及中国灾害研究所积累的大量细致、全面的数据。虽然中国灾害模型的开发速度总体来讲还是不错的，但是所有的中国模型都仍然需要更好的校准以反映本地的工程建筑实践以及损失。而且一直以来，缺乏损失数据支持以及中国快速累积的风险都使得风险共识尚未达成。应该说这个图集是解决这些众多问题的第一步，但是最终的挑战还是落在(再)保险行业的肩上，那就是：我们怎样才能最好地利用、转化这些知识和研究成果以开发出最好的保险解决方案？

最后，我向史培军教授及中国相关研究机构的杰出研究者致敬，祝贺他们所取得的成就以及这本图集所展示的成果；同时，我也感谢他们以及我怡安奔福的同事们将这本图集带给全球的(再)保险行业。

多米尼克·克里斯汀



怡安奔福联席CEO

Foreword II

The global economy underwent enormous change in the first decade of the 21st century. While many nations faltered under the weight of the global financial crisis, China's period of prosperity continued virtually unabated, and in 2010 its economic output exceeded that of Japan to become the second largest in the world. Social and economic wealth has never been accumulated at such an unprecedented rate, and what took western countries and markets many decades to achieve has happened in China in just 20 to 30 years.

While China is now considered an important driver of the global economy, there are factors that could jeopardize its future growth, such as the mounting levels of catastrophe risk across the nation. Many western countries have long benefited from healthy and sustainable (re)insurance systems that have played a critical role in ensuring stable growth. Time and time again, (re)insurance has proved its effectiveness as a transparent financing solution that can alleviate governments of post disaster economic stress, and expedite the recovery of disaster zones by facilitating the rebuilding process and stabilizing societies.

When comparing the Chinese (re)insurance market with these more mature markets we see a dramatic discrepancy between the level of natural disaster risks and insurance penetration. Today in China, disaster recovery is still supported mainly by government funds and social donations.

This is not to say China's insurance industry has stagnated; indeed, we are glad to have observed rapid growth in the insurance market in China in the past 20 years. Take the property and casualty market for example: from 2000 to 2009, total written premium grew from RMB 60 billion to RMB 288 billion, with an average annual growth rate of 25% in the past four years. Yet this is only the start: in 2010, China's per capita GDP reached USD 4000, signaling the arrival of an era of above average growth given that a per capita GDP of between USD 3 000 and USD 10 000 contributes the most to growth in the insurance market globally.

We are confident that the gap between risk and insurance will narrow further, but we are also very mindful that China's insurance industry is still young and its long-term sustainability depends on developing an in-depth understanding and sophisticated management of risks. China's domestic insurance companies are already facing increased scrutiny from regulators and shareholders, and senior executives are under pressure to demonstrate a risk-adjusted return on capital.

To achieve continued growth, China should examine opportunities to cultivate and retain adequate global reinsurance capacity and commitment. The diversified risk benefits that the Chinese market currently offers to reinsurers will quickly diminish as the country meets its future growth targets. (Re)insurers' aggregated exposures will become more significant, and they will more closely examine the risks they are taking and rationalize the prices they are offering.

This process will demand sound validation within a solid technical framework, and from top down and bottom up, it will all come down to one vital focal point: risk underwriting, be it original insured risk or reinsurance risk.

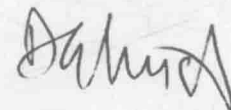
In this regard, Aon Benfield is fully committed to partnering with the Chinese (re)insurance market to help it understand and evaluate its domestic risks, and to provide it with access to external capacity and skills.

Our long-standing experience in the global (re)insurance industry enables us to mitigate the most complex of risks for people, business and governments, and we are continually bringing to our clients robust risk transfer solutions that are borne from sophisticated risk assessment techniques.

We are therefore incredibly proud to have been given the opportunity to sponsor the Atlas of Natural Disaster Risk in China. In my view, the Atlas is an important resource for both domestic and global (re)insurers that are intending to play a meaningful role in China, and I hope readers will be as impressed as I am by the sophisticated research and detailed data available in China on natural disaster risks. Although the pace of catastrophe model development in China has been very encouraging, all China models still require better calibration to reflect local construction practices and loss experience. In addition, due to limited loss data and a fast changing risk landscape, a consensus on the risk outlook is yet to be achieved. The Atlas is the first step in tackling some of these challenges, but the ultimate question will fall upon the (re)insurance industry, as we ask ourselves how we can best leverage such knowledge and research to develop optimum solutions.

Lastly but not least important, I applaud Prof. Shi and other distinguished researchers from the most privileged research institutes throughout China for their great accomplishment in bringing the Atlas to fruition, and would also like to thank them and my Aon Benfield colleagues for making the research accessible to the global (re)insurance market.

Dominic Christian



Co-CEO
Aon Benfield

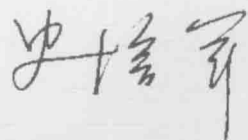
前言

从1989年底开始,伴随联合国组织实施的“国际减轻自然灾害十年活动”(IDNDR,1989~1999)和“国际减灾战略”(ISDR)的实施,全球性的综合减灾研究已走过20个年头。由于减灾与可持续发展密切相关,世界各国和地区都将减灾研究作为国家科技发展战略的重要组成部分。2010年10月中旬召开的中国共产党第十七届五中全会把“综合减轻自然灾害,提高抗风险能力”写入全会决议之中,彰显了中国政府高度重视防灾减灾与综合风险防范工作。北京师范大学高度重视综合减灾研究与人才培养,于1989年在校内设置了“中国自然灾害监测与防治研究室”,并于2006年由民政部和教育部共同在“北京师范大学环境演变与自然灾害教育部重点实验室”和“民政部国家减灾中心”的基础上组建了“民政部-教育部减灾与应急管理研究院”;与联合国开展综合减灾活动同步,北京师范大学开展综合减灾研究,创立“灾害风险科学”也经历了20多年。在这一期间,除承担国际和国内重大减灾研究任务和培养该领域高层次专门人才外,于1992年组织国内相关力量,编制出版了《中国自然灾害地图集》(中、英文版;张兰生、刘恩正主编,1992);2003年编制出版了《中国自然灾害系统地图集》(中英文对照版;史培军主编,2003)。这两本地图集都是在“区域自然灾害系统理论”的指导下,所有参编专家精心研究、综合分析、系统设计而完成的,并都由科学出版社出版。前一本地图集突出了中国自然灾害系统中自然致灾因子空间分异的探究,我们称其为第一代中国综合自然灾害地图集;后一本地图集则突出了对中国自然灾害系统中综合自然灾害和主要自然灾害时空分异规律的认识,我们称其为第二代中国综合自然灾害地图集。

时隔数年之久,中国自然灾害系统发生了重大变化,不仅由于在自然与人文环境变化的驱动下,自然致灾因子与承灾体时空格局发生了明显的变迁,而且中国主要自然致灾因子与其承灾体之间的脆弱性关系也发生了显著的调整,此前出版的两本关于自然灾害时空格局的地图集已不能满足中国综合减灾事业的需求,也不能够全面反映从事中国综合减灾研究领域各方面专家近十年来取得的突出成就。为此,在国家“十一五”科技支撑计划重点项目——“综合风险防范关键技术研究及示范”(2006BAD20B00)的支持下,特别是作为这一项目之第三课题——“综合风险防范技术集成平台研究”(2006BAD20B03)的一个专题内容,并在诸多单位和专家共同努力下,我们组织编制了《中国自然灾害风险地图集》。本图集仍然是在“区域自然灾害系统理论”的指导下,着重展示中国自然灾害系统中综合自然灾害风险和主要自然灾害风险的空间格局,以及各省(区、市)综合自然灾害风险的空间差异,为中国各级政府和企业制定综合自然灾害风险防范对策提供科学依据,我们称其为第三代中国综合自然灾害地图集。如果把这三本地图集综合成一个整体,它较全面地反映了中国自然灾害系统中自然致灾因子、自然灾害灾情和自然灾害风险的时空格局。

在本图集编制过程中,除了得到前述国家“十一五”科技支撑重点项目的支持外,国家自然科学基金委员会资助的“国家杰出青年基金项目”(40425008)、区域可持续发展领域重点项目“快速城市化地区自然灾害综合风险评价及减灾范式研究”(40535024)、国际和地区重要合作项目“巨灾风险防范——IHDP-IRG核心科学计划案例研究”(40821140354)、科技部支持的国际合作重点项目“全球气候变化与巨灾防范”(2008DFA20640)、重点科技支撑项目“长三角地区自然灾害风险等级评估技术研究”(2008BAK50B07),以及教育部和国家外国专家局支持的高等学校学科创新引智计划(111计划)项目“综合灾害风险科学”(J0921009)等科研成果也支撑了本图集的编制。北京师范大学地表过程与资源生态国家重点实验室、环境演变与自然灾害教育部重点实验室、区域地理研究重点实验室共同承担并主持了这项浩繁的地图集编制工作。

在本图集编制和出版过程中,我们得到了中国科学院地理科学与资源研究所、民政部国家减灾中心、中国保险行业协会、北京大学、中国农业大学、武汉大学等单位的大力支持,并共同参与了本图集的编制。我们也得到了科技部农村司、教育部科技司、国家自然科学基金委员会地学部、国家外国专家局科教文司、中国科学院资源环境科学与技术局等部门的全面领导,并为本图集的出版提供了资助。我们还得到了徐冠华院士、秦大河院士、刘昌明院士、林学钰院士、陈颀院士、马宗晋院士、张新时院士、李小文院士、刘燕华教授、陈军教授等著名专家的悉心指导,徐冠华院士还为本图集的出版写了序。科学出版社承担了本图集的编辑出版工作,怡安奔福再保顾问有限公司提供了本图集出版的部分赞助。在此,我们对上述所有单位的领导和专家致以衷心的感谢,并期盼伟大祖国的防灾减灾工作取得更大成就、综合风险防范能力得到显著提高。由于资料所限,香港、澳门和台湾的相关图件没有编制,特表遗憾。



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2010年12月28日

Preface

Since late 1989, with the implementation of the "International Decade for Natural Disaster Reduction" (IDNDR, 1989-1999) and "International Strategy for Disaster Reduction" (ISDR) of the United Nations, two decades of global integrated disaster reduction research have elapsed. With the close relationship between disaster reduction and sustainable development, disaster reduction research is considered as a crucial part of the science and technology development strategy by the worldwide community. In the seventeenth session of the Fifth Plenary Assembly held by the Chinese Communist Party in October 2010, the goals of mitigating natural disasters and increasing capability of risk governance were written into the plenary resolution, reflecting the considerable value the Chinese government places on natural disaster prevention and mitigation and integrated risk governance. Beijing Normal University attaches significant emphasis to both integrated disaster reduction research and personnel training. The "China Natural Disaster Monitoring and Prevention Research Laboratory" was set up on campus in 1989. The "Academy of Disaster Reduction and Emergency Management, Ministry of Civil Affairs and Ministry of Education" was set up by the joint efforts of the Ministry of Civil Affairs and the Ministry of Education in 2006, based on the "Key Laboratory of Environment Change and Natural Disaster of Ministry of Education at Beijing Normal University" and the "National Disaster Reduction Center, the Ministry of Civil Affairs". Throughout the 20 years since the establishment of "Disaster Risk Science", Beijing Normal University's integrated disaster research efforts have evolved in synchronization with the disaster reduction activities at the United Nations. During this period, in addition to undertaking significant research in international and domestic disaster reduction and training of high-level experts in the field, we organized domestic experts in the field to compile and publish the *Atlas of Natural Disaster in China* (Chinese and English version; Zhang Lansheng and Liu Enzheng, Chief Editors, 1992) and *Atlas of Natural Disaster System in China* (Chinese-English bilingual version; Shi Peijun, the Chief Editor, 2003). Using "regional natural disaster system theory" as the guide line, together with thorough research, comprehensive analysis, and systematic planning by all experts involved in the compiling and editing, both Atlases were successfully completed, and subsequently published by Science Press. The first atlas emphasized the spatial distribution and temporal variation of natural hazards in the natural disaster system in China, which we called the first generation atlas of the natural disasters in China. The second atlas highlighted the understanding of integrated natural disasters, and the temporal variation and spatial distribution of major natural disasters in the disaster system in China, which we called the second generation atlas of natural disasters in China.

Several years have passed since then, and major changes have taken place in China's natural disaster system, not only because of the obvious changes in the temporal and spatial pattern of natural hazards and exposure, driven by the natural and human environmental changes, but also the significant adjustment of the vulnerability relationship between natural hazards and the exposure. The two previously published atlases of the temporal and spatial pattern of natural disasters can no longer fully meet the demand for integrated disaster reduction in China, nor can they fully reflect the outstanding achievements in all aspects in the field of integrated disaster reduction over the past decade. Therefore, with the joint efforts of many institutions and experts, we organized the compilation of the *Atlas of Natural Disaster Risk in China*, with the great support of the national "Key Technology and Demonstration of Integrated Risk Governance" — an Eleventh Five-Year Key Pillar Project of Science and Technology (2006BAD20B00), especially the third topic of the project "The Integrating Platform of Technologies for Integrated Risk Governance" (2006BAD20B03). This atlas continues to use the "regional natural disaster system theory" as its guide and emphasizes the integrated risks of major natural disasters in the natural disaster system in China, as well as their spatial patterns and regional risk differences. This atlas provides a scientific basis for the Chinese government and enterprises at all levels to develop integrated natural disaster risk governance measures, which we call the third generation atlas of integrated natural disasters in China. These three atlases as a whole is believed to fully reflect the temporal and spatial patterns of natural hazards, natural disasters and natural disaster risks in the natural disaster system in China.

Other than the great support by the national 11th "Five-Year" plan science and technology pillar project stated above, the compiling of the atlas also received technical contributions from various research projects, including three projects funded by National Natural Science Foundation: the "China National Fund for Distinguished Young Scientists" (40425008), the "Integrated Natural Disaster Risk Evaluation and Disaster Reduction Paradigm Study in Rapid Urbanization Regions" (40535024) — a key project in regional sustainable development, and the "Integrated Risk Governance — Case Study of IHDP-IRG Core Science Plan" (40821140354) — an important international and regional collaboration project; two projects funded by Ministry of Science and Technology: the "Global Climate Change and Large-scale Disaster Governance" (2008DFA20640) — a key international cooperation project, and the "Technology for Evaluating Natural Disaster Risk in Yangtze River Delta" (2008BAK50B07) — a key science and technology pillar project; and the "Integrated Disaster Risk Science — a Project of Innovation and Talent Attraction Program in the Institutes of Higher Education (111 Program) – (J0921009)" supported by the Ministry of Education and the State Administration of Foreign Experts Affairs. The State Key Laboratory of Earth Surface Processes and Resource Ecology, the Key Laboratory of Environment Change and Natural Disaster of Ministry of Education, and Key Laboratory of Regional Geography, all affiliated with Beijing Normal University, shared and presided over the vast and complicated task of compiling the Atlas.

In the preparation and publication of the atlas, we received great support and participation from the Institute of Geographic Sciences and Natural Resources Research of Chinese Academy of Sciences, National Disaster Reduction Center of the Ministry of Civil Affairs, the Insurance Association of China, Peking University, China Agricultural University, Wuhan University and other institutions. We also received overall guidance and financial support from the Department of Rural Science and Technology of the Ministry of Science and Technology, the Department of Science and Technology of Ministry of Education, the Department of Earth Science of the National Natural Science Foundation, the Department of Culture and Educational Experts of the State Administration of Foreign Experts Affairs, the Bureau of Science and Technology for Resources and Environment of Chinese Academy of Sciences and other institutions. We also received guidance from the renowned experts: Academician Xu Guanhua, Academician Qin Dahe, Academician Liu Changming, Academician Lin Xueyu, Academician Chen Yong, Academician Ma Zongjin, Academician Zhang Xinshi, Academician Li Xiaowen, Professor Liu Yanhua and Professor Chen Jun, listed in the editorial board of academic advisors. Academician Xu Guanhua also wrote the foreword for this atlas. The Science Press undertook the work of publishing and editing of the atlas. Aon-Benfield has partially sponsored the publication of this Atlas. Here, we would like to express our sincere appreciation to all of the leaders and experts from the above institutions. At the same time, we are looking forward to a greater achievement of disaster prevention and mitigation of our nation, and a significant improvement of integrated risk governance capability in the near future. It is regrettable that map pieces for Hongkong, Macao, and Taiwan are not compiled due to lack of data.

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序图

Introductory Maps

区域自然灾害风险的大小是区域自然灾害系统各组成要素相互作用的产物。中国自然灾害风险则是由中国自然致灾因子、承灾体与孕灾环境相互作用的结果。为了能够深刻反映中国主要自然灾害和综合自然灾害风险形成的空间格局，本图组精选了对中国自然灾害系统影响突出的孕灾环境(即表征中国地表景观特征的中国卫星影像、中国气候与植被区划、中国地貌与构造分布)、承灾体(即县级行政区划、中国人口、景观城市化、土地利用、交通、国内生产总值分布格局)、致灾因子(即由中国自然灾害多度、相对致灾强度、被灾指数)共同构成的中国综合自然灾害格局及其区划，以及中国农业、城镇自然灾害区划。本图组从宏观角度表征了中国自然灾害系统的空间格局。