

Springer Geography

Shuying Leng et al.

The Geographical Sciences During 1986–2015

From the Classics to the Frontiers



商務印書館
The Commercial Press



Springer

Springer Geography

The Springer Geography series seeks to publish a broad portfolio of scientific books, aiming at researchers, students, and everyone interested in geographical research. The series includes peer-reviewed monographs, edited volumes, textbooks, and conference proceedings. It covers the entire research area of geography including, but not limited to, Economic Geography, Physical Geography, Quantitative Geography, and Regional/Urban Planning.

More information about this series at <http://www.springer.com/series/10180>

Shuying Leng et al.

The Geographical Sciences During 1986–2015

From the Classics to the Frontiers



Shuying Leng
National Natural Science Foundation
of China
Beijing
China

ISSN 2194-315X ISSN 2194-3168 (electronic)
Springer Geography
ISBN 978-981-10-1883-1 ISBN 978-981-10-1884-8 (eBook)
DOI 10.1007/978-981-10-1884-8

Library of Congress Control Number: 2016944324

Translation from the Chinese language edition: 地理科学三十年: 从经典到前沿 by Shuying Leng, © The Commercial Press, Ltd. 2016. All Rights Reserved.

© The Commercial Press, Ltd. and Springer Science+Business Media Singapore 2017

The print edition is not for sale in China Mainland. Customers from China Mainland please order the print book from: The Commercial Press, Ltd.

This work is subject to copyright. All rights are reserved by the Publishers, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publishers, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publishers nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer Science+Business Media Singapore Pte Ltd.

Editorial Board

- Editors in Chief** Shuying Leng, Xizhang Gao, Tao Pei, Guoyou Zhang
- Lead Authors** (In alphabetical order)
Liangfu Chen, Xi Chen, Canfei He, Daming He, Xiaoyan Li,
Chunye Lin, Hongyan Liu, Weidong Liu, Yihe Lü, Shilong Piao,
Qihong Tang, Fulu Tao, Lide Tian, Xiaohua Tong, Cunde Xiao,
Desheng Xue, Linsheng Yang, Linwang Yuan, Yuanming Zheng,
Huiyi Zhu, Liping Zhu
- Copy Editors** Shuying Leng, Xiaoqian Liu, Wenxiang Zhang, Zhonglu Guo,
Fengkui Qian, Gengzhi Huang, Kun Shi, Li Wu, Yang Gao,
Li Wang, Jun Wang, Xiaorong Zhao
- Database Design** (CSCD&NSFC) Xizhang Gao
(SCI/SSCI) Tao Pei
(Geographical Education) Canfei He, Desheng Xue,
Linwang Yuan, Qihong Tang
- Data Analysis** Ci Song, Hua Shu, Jia Zhang, Ting Li
- Artwork** (Excel) Xiaoqian Liu
(CiteSpace) Fengkui Qian, Yafeng Lu

List of Lead Authors and Their Affiliations

Shuying Leng National Natural Science Foundation of China, Beijing, China, e-mail: lengsy@nsfc.gov.cn

Xizhang Gao Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: gaoxz@lreis.ac.cn

Tao Pei Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: peit@lreis.ac.cn

Guoyou Zhang The Geographical Society of China, Beijing, China, e-mail: gyzhang@igsnr.ac.cn

Liangfu Chen Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, China, e-mail: chenlf@radi.ac.cn

Xi Chen Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, Xinjiang, China, e-mail: chenxi@ms.xjb.ac.cn

Canfei He College of Urban and Environmental Sciences, Peking University, Beijing, China, e-mail: hecanfei@urban.pku.edu.cn

Daming He Institute of International Rivers and Eco-security, Yunnan University, Kunming, China, e-mail: dmhe@ynu.edu.cn

Xiaoyan Li College of Resources Science and Technology, Beijing Normal University, Beijing, China, e-mail: xyli@bnu.edu.cn

Chunye Lin School of Environment, Beijing Normal University, Beijing, China, e-mail: c.lin@bnu.edu.cn

Hongyan Liu College of Urban and Environmental Sciences, Peking University, Beijing, China, e-mail: lhy@urban.pku.edu.cn

Weidong Liu Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: liuwd@igsnr.ac.cn

Yihe Lü Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Beijing, China, e-mail: lyh@rcees.ac.cn

Shilong Piao College of Urban and Environmental Sciences, Peking University, Beijing, China, e-mail: slpiao@pku.edu.cn

Qihong Tang Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: tangqh@igsnr.ac.cn

Fulu Tao Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: taofl@igsnr.ac.cn

Lide Tian Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China, e-mail: ldt@itpcas.ac.cn

Xiaohua Tong College of Surveying and Geo-informatics, Tongji University, Shanghai, China, e-mail: xhtong@tongji.edu.cn

Cunde Xiao Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China, e-mail: cdxiao@lzb.ac.cn

Desheng Xue Department of Urban and Regional Planning, Sun Yat-sen University, Guangzhou, China, e-mail: eesxds@mail.sysu.edu.cn

Linsheng Yang Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: yangls@igsnr.ac.cn

Linwang Yuan School of Geography Science, Nanjing Normal University, Nanjing, China, e-mail: yuanlinwang@nynu.edu.cn

Yuanming Zheng National Natural Science Foundation of China, Beijing, China, e-mail: zhengym@nsfc.gov.cn

Huiyi Zhu Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China, e-mail: zhuhy@igsnr.ac.cn

Liping Zhu Institute of Tibetan Plateau Research, Chinese Academy of Sciences, Beijing, China, e-mail: lpzhu@itpcas.ac.cn

Foreword I

The terrestrial system is a perplexing complex, jointly composed of human factors and physical elements, i.e. water, soil, air, etc. The land surface, as a crucial research field of macro-science, has evolved into one of the core areas of geoscience, drawing extensive attention from both academia and society as a whole. Along with constant rapid social and economic development, a series of dramatic changes in human activities have occurred, including more diversified activity modes, more intense activity strength and a wider activity range, giving rise to increasingly acute pressure on the land surface and environment. Meanwhile, a series of social problems have emerged owing to different levels of ecological degradation caused by excessive agricultural exploitation, environmental pollution resulting from extensive industrial production and various onerous challenges to public service provision brought by rapid urbanisation. Integrating natural and social sciences, research relating to the land surface thus finds its motivation in far-flung social needs and has developed into one of the most prominent subjects along with the flourishing earth system sciences.

Over the last few decades, land surface research has made great progress, and Chinese scientists have made numerous achievements in this area, which have received a great deal of attention from the international academia. For a long time, National Natural Science Foundation of China (NSFC) has made major contributions to this field by providing stable funding and paying close attention to the development of research, helping promote high-quality research and significant international cooperation. Issues concerning how to document research progress in a comprehensive and accurate way, how to evaluate the key features and contributions of Chinese terrestrial research, how to capture the driving forces of disciplinary development, how to assess the contribution of a funding agency, and how to identify the opportunities and challenges faced by disciplinary development, have become common components of an appraisal of the evolution of a discipline. In order to increase funding efficiency and support this research field more purposively, it is crucial for NSFC to grasp objectively and accurately the intrinsic nature of these issues to formulate proper development and funding strategies. This book series entitled *Reviews and Prospects of Land Surface Research*, the first volume *The Geographical Sciences During 1986–2015: From the Classics To the Frontiers* have provided some important methods and meaningful conclusions to understand and further explore the above-mentioned questions.

This book series, aiming at demonstrating disciplinary development and research progress, fully explores the multiple factors affecting disciplinary advancement. It pays close attention to the support for talented researchers in the terrestrial research field. It also conducts comparative analysis of representative educational institutions at home and abroad, in terms of their organisational structure, curriculum development, professional background, laying the foundations for a full comprehension of the *status quo* and evolving tendency of interdisciplinary research in this subject area. Besides, focusing on international cooperation, it discusses and delineates the changing role and status of major countries and identifies China's advantages and international standing in different branches of land surface research.

Mainly employing bibliometric analyses, authors of this book series identify the evolving history and achievements acquired at different scales in various research fields. Publications

are the most important outputs of scientific research, while bibliometric analysis is the most effective way to comprehensively review achievements in scientific research. Using a database of publications in both English and Chinese, at home and abroad, as well as NSFC grant applications and funded projects, this book series summarised land surface research's key features and research progress in various stages over the past 30 years. Within the detailed analyses of disciplinary development, land surface studies are divided into assorted sub-disciplines, including Physical Geography, Human Geography, Geographical Information Science, Environmental Geography, Soil Geography, Soil Physics, Soil Chemistry, Soil Biology, etc. Contributors further identify nine strategic issues and 28 research fields, and elaborate on their development and progress, and their development motivations, opportunities and challenges using bibliometric and qualitative analyses. Meanwhile, contributors re-categorise the funding sources for different research outputs, and objectively evaluate NSFC's contributions to the development of land surface studies.

As a complex mega-system and an important research field in geosciences, the land surface has received varied financial support from NSFC. A large cohort of dedicated and courageous researchers have been actively engaging in international cooperation, and showcasing China's academic achievements in the international academic community. Based on publication records, research outputs sponsored by NSFC had increased exponentially in the past three decades. And both the absolute and relative quantity of influential outputs funded by NSFC show a stable yearly increment.

As one of the most important tasks of NSFC, a comprehensive and objective assessment on disciplinary development summarises work efficiency for the previous period, and also lays the foundation for future funding plans. Constantly innovating and refining assessment methods is the only way to achieve effective scientific funding management and bolster basic research and disciplinary development in China.



November 2015

Changqing Song
Chief Editor of Reviews and Prospects of Land Surface Research
Vice Director of Department of Earth Science, NSFC

Foreword II

Geography is devoted to the study of the spatial distribution and pattern of variation, spatial-temporal processes and regional characteristics of geographical elements and geographical complexes. The research foci of geography cover the interaction mechanism and regulatory approaches between the human and epigeosphere. This research involves the coupling of the physical properties of Earth's surface and the functioning of human societies spreading across the earth surface, and makes geography a comprehensive and cross-cutting discipline divulging humanistic substances while probing into the laws of the nature. In recent decades, along with the emergence of pressing issues relating to global population, resources, environment and development, etc., sustainable human development faces great challenges. Geography has played a significant role in the studies of global environmental change and economic integration, while geographical theories, methods and techniques have laid a solid scientific foundation for resolving problems concerning human society's sustainable development. Contemporary geographical research methods have shifted from traditional methods, i.e. survey, observation, recording, and cartography, etc., to spatial statistics, earth observation, geographical information system, indoor and outdoor simulation, modelling, decision support systems, and other modern scientific methods, which tend to be more comprehensive and quantitative. Facing the increasing complexity of research questions, geographical research becomes more diversified and comprehensive, drawing attention from other disciplines. Given that geographical perspectives become more and more important in a wide range of areas, geography is entering a new epoch full of golden opportunities. China is a perfect testing ground for studies of the sustainable development of human society, which meet the strategic needs of the internationalisation of geographical research and national economic and social development, and will therefore create great opportunities for innovative and groundbreaking research.

The development of geography in China is tightly bound up with national development. Chinese geography fully embraces cutting edge international geographical research while closely attending to China's natural environment and social economy condition. Geography in China has hitherto evolved into a systematic and distinctive discipline achieving a series of innovative research outputs and playing an increasingly significant role in China's national economy and social development. Accordingly, geography in China has captured extensive attention from both governments and the society, projecting considerable influence far beyond disciplinary boundaries.

In the last three decades, with the support of National Natural Science Foundation of China (NSFC), Ministry of Science and Technology, Chinese Academy of Sciences and other institutes, Chinese geographers had made more meticulous contributions to the studies of the pattern of natural environment and human economy on epigeosphere. With sufficient data acquired in extensive field observations and empirical socio-economic surveys, along with the development and application of new technologies and new methods such as geographical information system, geography in China has gradually acquired its own distinctive features in physical geography, human geography and regional integration studies. At the time of the 30th anniversary of NSFC and the 33rd International Geographical Union Congress, a group of

young and middle-aged geographers, motivated by enthusiasm and responsibility for the development of geography in China, compiled this book *The Geographical Sciences During 1986-2015: From the Classics To the Frontiers*. Based on rich sources of information and data relating to higher education and scientific research and the outputs of geographically relevant sciences, and using quantitative analysis, international comparisons and synthesis, this book systematically summarised the main strategic research issues and areas in Physical Geography, Human Geography, Geographical Information Science and Environmental Geography in the past 30 years, and pointed out several issues and frontiers that deserve further exploration in future geographical studies.

This book incorporates the following features:

(1) Well-founded arguments

It presents a comprehensive analysis of disciplinary development, higher education, international cooperation and relevant strategic issues for the development of geography in China over the past three decades. Equipped with different perspectives of disciplinary evaluation and supported by analysis of specific database, this book provides ample evidence and abundant information and covers a range of issues.

(2) Variety of methods

Based on published English and Chinese papers, NSFC funding projects, Geography Schools and Departments in higher education institutions, employing bibliometric analysis, statistical analysis, questionnaires and web searches, it vividly demonstrates the disciplinary development trend priorities, frontiers, funding structure and main achievements of scientific research using quantitative methods and providing abundant graphical and textual documentation.

(3) International comparison

Conducting comparative studies by putting the development of China's geography into an international context and summarising the progress and main features of domestic research, this book highlights the unique development path and distinctive outcomes of China's geographical research. Through international comparison, it uncovers the characteristics of China's geography in terms of research, education, international communication and cooperation, key issues and research fields, and identifies main ways in which Chinese geography differs from the international mainstream.

(4) Research prospects

Comprehensively analysing the major issues, areas and progresses in China's geographical research, international trends, and China's national conditions and national demands, it discusses areas where there are prospects of potential breakthroughs and future innovative development. Identification of these prospects has significant reference values for geographical researchers and administrative officers from home and abroad.

This book, which summarises 30 years of development of China's geographical research and sets up a new starting point for it, not only provides a knowledge base for overseas scholars wishing to understand China's geographical research, but also a knowledge base for Chinese domestic geographers to recognise gaps and identify future research directions. Considering a series of realistic demands, such as promoting the new type urbanisation, industrial upgrading and optimisation, reducing the pressure on limited resources and the environment, optimising the use and conservation of land and resources, implementing sustainable development and ecological construction strategy, etc., and facing numerous new challenges, i.e. global environmental change, economic globalisation, and the transformation of global geopolitics, the future development of China's geographical research needs to pay close attention to more synthetic issues and strengthen the understanding of the man-earth complex to realise the coupling of elements, patterns, processes and systems to advance its theoretical and practical capabilities. Chinese scientists should seize these opportunities,

promote innovation, cope with the challenges, actively lead or participate in major international research projects, and strengthen research on global issues to achieve new breakthroughs. By doing so, China can transform itself from a country with a large number of geographers to a country with high quality geographical research. This book attempts to strengthen the geographical sciences in China, improve their capacity to explain geographical phenomena and processes with the help of advanced techniques, and thereby to realise their social service value. These are the high hopes and the vision of the editors.



November 2015

Bojie Fu
President of the Geographical Society of China
Director of Department of Earth Science, NSFC

Preface

Traditional geography mainly focuses on the occurrence and development, as well as regional differentiation patterns of geographical factors on the epigeosphere, paying more attention to the evolving rules and regional differences of a sole geographical element such as soil, hydrology, vegetation, climate or humanity. It thus often employs descriptive research methods. Based on the inheritance of traditional geographical thought, modern geography gradually became more comprehensive and quantitative by borrowing research methods from other disciplines. The aims of modern geography are not only limited to explain the past but also to solve current problems concerning resources, the environment and sustainable regional development and to improve the capability to predict future development trends.

In recent decades, the development of remote sensing, geographical information system and spatial orientation systems technology has greatly improved the possibilities for the visualisation, observation and calculation of geographical phenomena. Ecosystem orientation tests, indoor physics and chemical simulation experiments have significantly deepened the knowledge of geographical processes and dynamics. Earth system model coupling with multi-spherical elements has promoted the development of geographical virtual experiments, and descriptive geography has been transformed into quantitative geography, which plays an indispensable role in promoting the development of earth science.

Geography in China has a long historical tradition, albeit deeply inspired by geographical studies in Western Europe, Northern America and Russia. In post-reform China, motivated by the demands of national economic development and disciplinary development, a team of talented geographical researchers at various levels had emerged and a distinctive geographical disciplinary system had been formed, featuring reasonable organisational structure and abundant research outputs. The development of China's geographical research had experienced different stages, and each stage had pronounced features in terms of research objects, methods and topics.

Similar to the development trajectories of other basic research disciplines, the development of China's geography discipline had benefited immensely from the National Natural Science Foundation of China (NSFC). The year of 2016 marks the 30th anniversary of NSFC and coincidentally the 33rd International Geographical Congress will be held in Beijing in the same year. To celebrate these two great events and summarise three decades' development of geography in China, a group of young and middle-aged geographers formed the editorial board in September 2014 and eventually completed this book on schedule after more than one year's preparation, under guidance of Mr. Changqing Song, Vice Director of Department of Earth Science, NSFC, and academic committee director of the Geographical Society of China, who named this book *The Geographical Sciences During 1986–2015: From the Classics To the Frontiers*.

The debate on “what is geography” has a long history and has provoked various answers and thoughts, which however does not challenge the disciplinary validity and scientific nature of geography at all. All geographers need to think about the discipline's position, research scope and development directions, with a vision to strengthen the role of geography in the scientific community. To quote Academician Bingwei Huang, “All sciences need to be

restructured, the contents of geography should be adjusted accordingly. There is no way out standing still and refusing to make progress". Yet, he also emphasised "Choosing the wrong way will also bring huge losses. Therefore, I urge every geographer in China to further discuss these issues".¹ The geographical society in United States published *Rediscovering Geography: New Relevance for Science and Society*² in 1997 and *Understanding the Changing Planet: Strategic Directions for the Geographical Sciences*³ in 2010 respectively, which showed potential opportunities for future development while reviewing and reflecting on its evolution and subject characteristics. Both books provide a vast number of case studies for readers to gain a better understanding of "what is geography and how it develops". The aim of this book is not to generalise the characteristics, research content and evolution of geography, but to uncover international and domestic changes in the field of geography in the past 30 years. The purpose is to make current research and education in Geography more clear, and offer some inspiration for future geographical studies by using statistical databases and compiling information about numerous publications, projects, questionnaires, etc.

This book includes an introduction and four parts. In order to give readers a better understanding of the authors' research ideas, the introduction details the data assembly, analytical methods and perspectives. The first part outlines the overall development of the geographical sciences, elaborating on development trends and international cooperation, as well as relevant background of China's geographical sciences. The second part mainly focuses on the development conditions of sub-disciplines of geography, examining four geographical sub-disciplines, in terms of publications, evolution of hot research topics, features of NSFC-funded projects and research teams. The third part is about strategic issues in the geographical sciences, explaining the evolution, research situations, research progresses and achievements in relation to nine strategic issues. These nine issues are the common concerns of the international geographical society and have significant implications for the construction of theoretical and methodological systems of comprehensive integration and simulation analysis in geography. The fourth part presents reviews and prospects for several areas of geographical research under NSFC's funding schemes, explaining the evolution, research situations, research progresses, achievements, problems and research prospects in nine research fields. These nine key areas reflect the development commitments of NSFC, covering international frontiers, domestic advantages or highlights, or underdeveloped yet indispensable basic research fields.

This book employs various methods, including bibliometric analysis, statistical analysis of NSFC-funded projects, geographical education questionnaires and geographical distribution analysis, qualitative literature analysis, synthetic judgments from experts, etc., to acquire basic conclusions on disciplinary development rules and trends. Data for bibliometric analysis is from reputable citation index databases including Web of Science, created by the United States of America (USA) Institute for Scientific Information, and the Chinese Science Citation Database (CSCD), initiated by the National Science Library, Chinese Academy of Sciences. The ISI Web of Science database mainly includes publications from Science Citation Index (SCI) and Social Sciences Citation Index (SSCI). The first two parts are based on SCI/SSCI-indexed publications retrieved in July 2015 and CSCD-indexed publications retrieved in May 2015; and the third and fourth parts are based on SCI/SSCI-indexed

¹Editorial board of Collected Works of Bingwei Huang: "Comprehensive Work and Interdisciplinary Research of Geography", In: *Comprehensive Study of Geography: Collected Works of Bingwei Huang*, Page XI. Beijing: The Commercial Press, 2003 (in Chinese).

²Geoscience and Resources Bureau, Environment and resources committee, US National Research Council (NRC), translated by Runhua Huang: *Rediscovering Geography: New Relevance for Science and Society*. Beijing: Academic Press, 2002 (in Chinese).

³The National Research Council of the US National Academies, translated by Yi Liu, Weidong Liu, *Understanding the Changing Planet: Strategic Directions for the Geographical Sciences*. Beijing: Science Press, 2011 (in Chinese).

publications retrieved in November 2014. First, on the basis of expert assessments, we identified publications from SCI/SSCI and CSCD that can well reflect the scientific outputs of geographical sciences. Then we manually handled problems such as authors with the same name, varied expressions for the same institution or different names for one institution at various development stages and manually verified the research funding organisations and project reference numbers extracted by computer programs. Last, we used the literature analysis software CiteSpace and TDA (Thomson Data Analyzer) bought from Thomson Reuters to process and analyse these datasets. Network analysis of authors and corresponding institutes generally adopts the current names of institutes and authors' current affiliations. NSFC project analysis data include all kinds of applications and funded projects in the geographical sciences (application code D01, excluding soil science D0105) from 1986 to 2015. Apart from project leaders, research institutes, project categories and funding amounts, other information including keywords, references, collaborators, case study areas were extracted through computer programming. Geographical education analysis data mainly come from questionnaire surveys and data downloaded from the Internet, containing organisational structure and curriculum development in the geographical sciences in higher education institutions in the USA, the UK, Germany and China, as well as the distribution of geography departments or colleges within China. Geographical distribution analysis uses maps to convey information relating to particular geographical positions, such as the locations of project leaders or research institutes, study areas of funded projects, and the distribution of geographical elements investigated in funded research projects. The basic map information are provided by the National Geomatics Center of China and Nanjing Hydraulic Research Institute. Qualitative literature analysis identifies the major academic contributions for each of the nine strategic issues and the nine research fields, based on specialists' reading and experts' judgment of representative publications.

The bibliometric analysis database comprises selective publications, mainly based on journal classification or keywords extraction. Some disciplinary categories have a good match with journal sorting, which is convenient for obtaining publications by using existing matching relations or constructing corresponding relations. Some research fields can be represented by a small number of explicit keywords; therefore relevant papers can be acquired from journals through searching keywords. For the geography discipline, in which research objects and questions are also shared with other disciplines, and research outputs are extensively published in multidisciplinary journals, there are no clear corresponding relations between disciplines and journals. Publications cannot be extracted by keywords, which is a great challenge for the authors of this book and also a problem that needs to be solved to guarantee the reliability of bibliometric analysis outcomes. According to the research needs and part characteristics, the first and second parts obtain publications mainly from journal and discipline classifications, while the third and fourth parts acquire publications through a combination of keywords and journal classification method and conduct sample evaluations of publication extraction results to ensure that selected papers are comprehensive, representative and interdisciplinary as far as possible. Together, this book selected 307 "mainstream" or "core" SCI/SSCI journals covering four geographical sub-disciplines through many rounds of cross-assessments by more than 30 experts in different research fields. Among them, 118 journals are considered as "comprehensive journals", on the grounds that their research themes are relatively comprehensive. According to our estimation, among the 307 mainstream journals, more than 50 % of papers are closely related to geographical sciences, and authors funded by NSFC account for 38.9 % of all authors from China (first authors or corresponding authors); the overwhelming majority of papers from the 118 comprehensive journals are closely correlated with the geographical sciences, and authors funded by NSFC account for 43.4 % of all authors from China (first authors or corresponding authors). The above results show that the 118 comprehensive journals can totally represent the research directions of geography, but the number of publications in the geographical sciences will be seriously underestimated. On the other hand, the 307 mainstream SCI/SSCI journals contain some

professional journals relating to geographical sciences sub-disciplines, which also publish a lot of multidisciplinary studies. For instance, the *Journal of Quaternary Science* publishes papers from both geomorphology and geology, resulting in the overestimation of geographical publications. For the sake of fully representing the research outputs and development trends of geography and making bibliometric analysis results more accountable, the first and second parts compute the paper amount and total citation frequency according to the 307 mainstream SCI/SSCI journals. In the third and fourth parts the number of journals is increased to satisfy the need to analyse corresponding strategic issues and fields based on the 307 journals and compute the total paper amount and citation frequency in particular areas by retrieving specific terms in titles, keywords and abstracts. Chinese authors in SCI/SSCI journals are extracted if the first author's or corresponding author's address contains "China". Papers from other countries (regions) are calculated in the same way. Non-first and non-corresponding authors' papers are not counted in a country's article number but are used in the construction of co-occurrence network of keywords in Sino-USA (UK or Germany) cooperation articles.

The selection of Chinese geographical journals was first based on the Chinese core periodicals catalogue indexed by CSCD, and then referred to the journal ranking from the *Annual Report for International Citation of Chinese Academic Journals, CAJ-IJCR, 2014*, developed by the International Academic Literature Evaluation Research Center of China and Tsinghua University Library, and published by China Knowledge Resource Integrated Database (CNKI). Most CAJ-IJCR indexed journals are from overseas and are chosen to examine the impact of China's journals from international perspectives. The selection indicator used is the Clout Index (CI), which takes both total citation frequency and impact factors into consideration. Through a consecutive analysis from 2012 to 2014, it was shown that the total international citation frequency of journals ranked in the top 10 % in terms of their international influence had experienced a dramatic increase in three consecutive years since 2012. Considering the authority of CAJ-IJCR, this book chooses the top 10 % of Chinese journals selected by the *Annual Report for International Citation of Chinese Academic Journals, CAJ-IJCR, 2014*. In the light of the widespread geographical research outputs, several important comprehensive Chinese journals and professional Chinese journals which are not within the top 10 % were added, yielding 29 journals altogether.

To solve the problem of overestimating the number of geographical papers caused by contributing researchers with a multidisciplinary background, we identified geography authors by using the reference numbers of NSFC-funded projects and information relating to project leaders' names and corresponding institutes. In this way non-geography researchers were largely removed. Actually for multidisciplinary journals, the research objectives and questions with which different disciplines are concerned are almost the same, so it is nearly impossible to distinguish geographical studies from studies in other disciplines and neither it is possible to recognise authors' disciplinary background one by one. Therefore statistical error cannot be totally avoided, even if NSFC funding information is used. But the clustering results of research directions and themes should be more precise than the statistics of total publications.

The authors of this book are all young and middle-aged Chinese geographers, which makes systematically generalising 30 years development of the geographical sciences a really big challenge. Motivated by the sincere enthusiasm for geography and a strong sense of responsibility for disciplinary development, the authors of this book pay a lot of attention to the data sources, refining the structure of the book, exchanging views on the contents, optimising graphical methods and eventually accomplished the writing with lots of hard work on top of their daily research, teaching and administrative obligations.

Building upon a large volume of literature, finding new methods of data acquisition and developing new analytical methods is the first priority of this book. Fully aware of the unverified conclusions obtaining from previous bibliometric analysis, this book constructs a unified database by strictly controlling data quality at every stage, including methods of data acquisition, conditions of data retrieval, methods of data analysis and graphical representation to guarantee that the conclusions of this book are well-founded. We have applied for a national

invention patent for our approach to accessing literature automatically from the Web of Science. To allow readers to verify the authenticity of our analysis results, we tried to introduce the data source as explicitly as possible.

During the process of writing, the authors of this book also consulted many Chinese geographers for advice. Accordingly, we categorised authors into three groups, i.e. lead authors, authors and contributors, and introduce all of the authors in each chapter to enable readers to further communicate with them. Lead authors are mainly responsible for the conception and major writing tasks, authors are responsible for at least one complete chapter (equivalent to the content under a fourth-level heading) and contributors are those who provide data and empirical materials. Limited by authors' experience, ability and time constraints, mistakes and improper argument are inevitable. We welcome readers' invaluable criticism and comments!

In fact, apart from all the authors listed in the book, there are a lot of geographical institutions and geographers deeply concerned about this book. At the point of publication of this book, we extend our cordial gratitude to all the colleagues who have given us encouragement. The emotional and moral support from them played an important role in the completion of this book! Special thanks go to the Geographical Society of China, Institute of Geographic Sciences and Natural Resources Research of Chinese Academy of Sciences, The Faculty Geography Resource Science of Sichuan Normal University and the Key Laboratory for Virtual Geographical Environments of the Education Ministry of China at Nanjing Normal University, for sponsoring editorial committee working conferences! We also thank the China Knowledge Resource Integrated Database, CNKI and Ms. Junhong Wu, the vice director of the Research Centre for the Quantitative Evaluation of Scientific Papers in China for their significant help! And we would like to express our gratitude to Academician Chenghu Zhou, the director of the State Key Laboratory of Resources and Environmental Information System, Institute of Geographic Sciences and Natural Resources Research of Chinese Academy of Sciences for his support for database management! Thanks also go to Academician Jianyun Zhang and Director Jiufu Liu from Nanjing Hydraulic Research Institute for providing the hydrology and geography database! We are grateful to Mr. Zhigang Li, the chief engineer of the National Administration of Surveying, Mapping and Geoinformation of China, Mr. Jun Chen, chief engineer of the National Geomatics Center of China and Ms. Jie Jiang, director of MapWorld, National Geomatics Center of China for providing the fundamental geographical information database! Last but not least, we wish to present our special thanks to the Commercial Press of China and German Springer Publishing Company for their deep concerns in the development of the discipline of geography!

We dedicate this book to all the people who had contributed to the development of geography in China in the past 30 years and those who make unremitting endeavours to promote the development of geography at international level!

November 2015

Shuying Leng
Division Head of Geography
Department of Earth Science, NSFC
Vice President of the Geographical Society of China

Contents

Part I An Overview of Development in the Geographical Sciences

1	General Trends in the Geographical Sciences	3
1.1	Global Hot Issues Propose New Entry-Points for Research.	3
1.2	RS and GIS Provide Essential Methods and Tools for Area Studies	7
1.3	Simulation and Prediction Become Crucial Aspects of Geographical Science Research.	8
1.4	Field Observation and Experimentation Become Important Methods in Physical Geography.	9
1.5	Higher Education Adapts to the Development of the Geographical Sciences	10
1.5.1	Organisational Structure and Subject/Major Setting	10
1.5.2	Curriculum and Specialisation.	11
1.5.3	Background of Professors.	13
1.5.4	Basic Understanding	14
1.6	Summary	15
2	International Cooperation in the Geographical Sciences	17
2.1	Global Cooperation Network	17
2.2	International Cooperation and Independent Research	19
2.3	Major Research Fields Involving International Cooperation of China. . . .	21
2.4	Summary	27
3	The Background of the Development of the Geographical Sciences in China	29
3.1	Funds for the Geographical Sciences from the NSFC.	30
3.2	Geographical Sciences Education	36
3.3	Universities Involved in Research on Geographical Sciences	39
3.4	The Geographical Society of China	42
3.4.1	The Development of Society Membership	42
3.4.2	Establishment of Secondary Organisations	42
3.4.3	Academic Activities	43
3.4.4	Science and Technology Award	44
3.5	Summary	45

Part II Trends in the Development of the Four Branches of the Geographical Sciences

4	Physical Geography	49
4.1	General Characteristics of the Research Topics Over the Past 30 Years . . .	51
4.2	Change of Research Topics in Various Periods	55
4.2.1	Period of 1986–1995	55

4.2.2	Period of 1996–2000	58
4.2.3	Period of 2001–2005	61
4.2.4	Period of 2006–2010	65
4.2.5	Period of 2011–2015	68
4.2.6	Analysis of Driving Factors for Disciplinary Development over the Past 30 Years	71
4.3	Disciplinary Development and Research Teams in China	73
4.3.1	Numbers and Proportions of NSFC Applications and Funded Projects for Physical Geography	73
4.3.2	Objects of Studies in NSFC-Funded Projects	74
4.3.3	Research Teams	78
4.4	Summary	87
5	Human Geography	89
5.1	General Characteristics of the Research Topics Over the Past 30 Years	91
5.2	Change of Research Topics in Various Periods	93
5.2.1	Period of 1986–1995	93
5.2.2	Period of 1996–2000	95
5.2.3	Period of 2001–2005	99
5.2.4	Period of 2006–2010	103
5.2.5	Period of 2011–2015	104
5.2.6	Analysis of Driving Factors for Disciplinary Development over the Past 30 Years	110
5.3	Disciplinary Development and Research Teams in China	111
5.3.1	Numbers and Proportions of NSFC Applications and Funded Projects for Human Geography	112
5.3.2	Objects of Studies in NSFC-Funded Projects	112
5.3.3	Research Teams	114
5.4	Summary	123
6	Geographical Information Science	127
6.1	General Characteristics of the Research Topics Over the Past 30 Years	130
6.2	Change of Research Topics in Various Periods	134
6.2.1	Period of 1986–1995	134
6.2.2	Period of 1996–2000	136
6.2.3	Period of 2001–2005	139
6.2.4	Period of 2006–2010	144
6.2.5	Period of 2011–2015	148
6.2.6	Analysis of Driving Factors for Disciplinary Development over the Past 30 Years	152
6.3	Disciplinary Development and Research Teams in China	152
6.3.1	Numbers and Proportions of NSFC Applications and Funded Projects for Geographical Information Science	153
6.3.2	Objects of Studies in NSFC-Funded Projects	154
6.3.3	Research Teams	155
6.4	Summary	164
	References	165
7	Environmental Geography	167
7.1	General Characteristics of the Research Topics Over the Past 30 Years	169
7.2	Change of Research Topics in Various Periods	172
7.2.1	Period of 1986–1995	172
7.2.2	Period of 1996–2000	175
7.2.3	Period of 2001–2005	179
7.2.4	Period of 2006–2010	182

7.2.5	Period of 2011–2015	186
7.2.6	Analysis of Driving Factors for Disciplinary Development over the Past 30 Years	189
7.3	Disciplinary Development and Research Teams in China	190
7.3.1	Numbers and Proportions of NSFC Applications and Funded Projects for Environmental Geography	190
7.3.2	Object of Studies in NSFC-Funded Projects	192
7.3.3	Research Teams	193
7.4	Summary	202
	Reference	202

Part III Strategic Research Issues on the Geographical Sciences

8	Global Change and Terrestrial Ecosystems	205
8.1	Overview	205
8.1.1	Development of Research Questions	205
8.1.2	Contributions by Scholars from Different Countries	206
8.1.3	Key Research Topics	208
8.1.4	The Role of NSFC in Supporting the Research on Global Change and Terrestrial Ecosystems	211
8.2	Questions and Research Progress	212
8.2.1	How does Global Change Impact the Patterns and Processes of Terrestrial Ecosystems?	212
8.2.2	How can the Impacts of Global Change on Terrestrial Ecosystems at Different Spatiotemporal Scales be Effectively Observed and Simulated?	220
8.2.3	How may Terrestrial Ecosystems be Sustainably Managed in the Context of Global Change?	223
8.3	Roadmap for Further Research	226
8.4	Summary	228
	References	228
9	Terrestrial Water Cycle and Water Resources	233
9.1	Overview	233
9.1.1	Development of Research Questions	233
9.1.2	Contributions by Scholars from Different Countries	234
9.1.3	Key Research Topics	235
9.1.4	The Role of NSFC in Supporting the Research on Terrestrial Water Cycle and Water Resources	235
9.2	Questions and Research Progress	237
9.2.1	What Has Changed in the Water Cycle and What Changes Could Possibly Occur?	237
9.2.2	How to Improve Simulation and Prediction Capacities in Hydrology and Water Resources?	240
9.2.3	How to Achieve Water Security in a Changing Environment?	241
9.3	Roadmap for Further Research	243
9.4	Summary	244
	References	244
10	Land Change	247
10.1	Overview	247
10.1.1	Development of Research Questions	247
10.1.2	Contributions by Scholars from Different Countries	248
10.1.3	Key Research Topics	248
10.1.4	The Role of NSFC in Supporting the Research on Land Change	250

10.2	Questions and Research Progress	252
10.2.1	What Changes in Land Use and Land Cover Have Occurred at Different Scales?	252
10.2.2	What Kind of Natural and Human Factors Can Lead to Land Change?	255
10.2.3	What are the Negative Environmental Impacts of Land Change?	256
10.3	Roadmap for Further Research	258
10.4	Summary	258
	References	259
11	Global Cryosphere Evolution and Land Surface Processes on the Tibetan Plateau	263
11.1	Overview	263
11.1.1	Development of Research Questions	263
11.1.2	Contributions by Scholars from Different Countries	265
11.1.3	Key Research Topics	265
11.1.4	The Role of NSFC in Supporting the Research on Global Cryosphere Evolution and Land Surface Processes on the Tibetan Plateau	266
11.2	Questions and Research Progress	270
11.2.1	How Has the Climate Changed in the Past on the Tibetan Plateau, and How is the Spatial Pattern Reconstructed from High-Precision Records?	270
11.2.2	How Has the Cryosphere Changed on the Tibetan Plateau in Recent Years and How Have Such Changes Impacted the Ecosystem and Hydrologic Processes?	272
11.2.3	How Has the Polar Cryosphere Changed and How do These Changes Influence the Planet?	274
11.3	Roadmap for Further Research	276
11.4	Summary	277
	References	277
12	Economic Globalization and Local Responses	281
12.1	Overview	281
12.1.1	Development of Research Questions	281
12.1.2	Contributions by Scholars from Different Countries	282
12.1.3	Key Research Topics	282
12.1.4	The Role of NSFC in Supporting the Research on Economic Globalization and Local Responses	283
12.2	Questions and Research Progress	284
12.2.1	How do TNCs Organize Cross-border, Value-adding Networks?	284
12.2.2	How do Capital, Products, Knowledge and Labor Flow across Space?	288
12.2.3	How is the Global Restructuring the Local?	290
12.2.4	How is the Local Responding to the Global?	292
12.3	Roadmap for Further Research	294
12.4	Summary	295
	References	296
13	Regional Sustainable Development	301
13.1	Overview	301
13.1.1	Contributions by Scholars from Different Countries	301
13.1.2	Key Research Topics	302

13.1.3	The Role of NSFC in Supporting the Research on Regional Sustainable Development	302
13.1.4	The Role of the Geographical Sciences in Regional Sustainable Development	305
13.2	Questions and Research Progress	307
13.2.1	How to Understand the Coupling Relationship Between Man and Nature?	307
13.2.2	How to Delineate the Carrying Capacity of the Resource-Environment System for Human Activities?.	310
13.2.3	How to Evaluate the Status of Regional Sustainable Development	312
13.2.4	How to Utilize Natural Resources in a Sustainable Way?.	313
13.2.5	How to Achieve Sustainable Development Through Regional Governance?	315
13.3	Roadmap for Further Research	317
13.4	Summary	318
	References.	318
14	Remote Sensing Modelling and Parameter Inversion	323
14.1	Overview.	323
14.1.1	Development of Research Questions	323
14.1.2	Contributions by Scholars from Different Countries.	324
14.1.3	Key Research Topics.	324
14.1.4	The Role of NSFC in Supporting the Research on Remote Sensing Modelling and Parameter Inversion	326
14.2	Questions and Research Progress	328
14.2.1	How Can the Remote Sensing Model Describe the Surface Parameters More Accurately.	328
14.2.2	How to Improve the Retrieval Accuracy of Surface Parameters?	330
14.2.3	What Is the Role of the Remote Sensing Inversion Parameters in Geoscience Research?	332
14.3	Roadmap for Further Research	333
14.4	Summary	334
	References.	334
15	Spatial Analysis and Simulation.	339
15.1	Overview.	339
15.1.1	Development of Research Questions	339
15.1.2	Contributions by Scholars from Different Countries.	340
15.1.3	Key Research Topics.	340
15.1.4	The Role of NSFC in Supporting the Research on Spatial Analysis and Simulation	341
15.2	Questions and Research Progress	344
15.2.1	What is the Essence of Geo-objects and Their Relationships?.	344
15.2.2	How to Express and Analyze the Spatial Relationship Between Geographic Features?	347
15.2.3	How to Make a More Accurate Spatial Estimation?.	351
15.2.4	How to Simulate Evolutionary Geographical Systems?.	354
15.2.5	How to Display Spatial Information and Realize Human-Computer Interaction?	356
15.3	Roadmap for Further Research	359
15.4	Summary	360
	References.	360

16	Tempo-Spatial Processes and Modelling of Environmental Pollutants	367
16.1	Overview	367
16.1.1	Development of Research Questions	367
16.1.2	Contributions by Scholars from Different Countries	368
16.1.3	Key Research Topics	369
16.1.4	The Role of NSFC in Supporting the Research on Tempo-spatial Processes and Modelling of Environmental Pollutants	371
16.2	Questions and Research Progress	374
16.2.1	How to Identify and Apportion Sources of Environmental Pollutants	374
16.2.2	How to Determine the Behaviors of Environmental Pollutants	378
16.2.3	How to Simulate the Spatial Processes of Environmental Pollutants at the Regional Scale	384
16.3	Roadmap for Further Research	386
16.4	Summary	387
	References	387
Part IV A Review and Outlook of Research Fields on the Geographical Sciences Regarding NSFC		
17	Geomorphology	393
17.1	Overview	393
17.1.1	Development of Research Questions	393
17.1.2	Contributions by Scholars from Different Countries	394
17.1.3	Key Research Topics	395
17.1.4	The Role of NSFC in Supporting the Research on Geomorphology	397
17.2	Research Advances and Problems	399
17.2.1	Bibliometric Analysis of Contemporary Research	399
17.2.2	Contemporary Research	400
17.2.3	Bibliometric Analysis of Contemporary Research in China	401
17.2.4	Contemporary Research in China	401
17.2.5	Contributions by Chinese Scholars and Subsequent Problems	403
17.3	Roadmap for Further Research	403
17.4	Summary	404
	References	404
18	Ecohydrology	407
18.1	Overview	407
18.1.1	Development of Research Questions	407
18.1.2	Contributions by Scholars from Different Countries	408
18.1.3	Key Research Topics	409
18.1.4	The Role of NSFC in Supporting the Research on Ecohydrology	411
18.2	Research Advances and Problems	412
18.2.1	Bibliometric Analysis of Contemporary Research	412
18.2.2	Contemporary Research	413
18.2.3	Bibliometric Analysis of Contemporary Research in China	413
18.2.4	Contemporary Research in China	414
18.2.5	Contributions by Chinese Scholars and Subsequent Problems	414
18.3	Roadmap for Further Research	415
18.4	Summary	416
	References	416

19 Ecosystem Services	419
19.1 Overview	419
19.1.1 Development of Research Questions	419
19.1.2 Contributions by Scholars from Different Countries	420
19.1.3 Key Research Topics	420
19.1.4 The Role of NSFC in Supporting the Research on Ecosystem Services	424
19.2 Research Advances and Problems	425
19.2.1 Bibliometric Analysis of Contemporary Research	425
19.2.2 Contemporary Research	425
19.2.3 Contemporary Research in China	425
19.2.4 Contributions by Chinese Scholars and Subsequent Problems	428
19.3 Roadmap for Further Research	429
19.4 Summary	432
References	432
20 The Urbanization Process and Mechanism	435
20.1 Overview	435
20.1.1 Development of Research Questions	435
20.1.2 Contributions by Scholars from Different Countries	436
20.1.3 Key Research Topics	436
20.1.4 The Role of NSFC in Supporting the Research on the Urbanization Process and Mechanism	440
20.2 Research Advances and Problems	441
20.2.1 Chinese Publications on Urbanization Research	441
20.2.2 Stages of China's Urbanization Research	442
20.2.3 Main Progress of China's Urbanization Research	442
20.2.4 International Comparisons and the Main Problems in China's Research	444
20.3 Roadmap for Further Research	446
20.4 Summary	447
References	447
21 Medical and Health Geography	453
21.1 Overview	453
21.1.1 Development of Research Questions	453
21.1.2 Contributions by Scholars from Different Countries	455
21.1.3 Key Research Topics	455
21.1.4 The Role of NSFC in Supporting the Research on Medical and Health Geography	456
21.2 Research Advances and Problems	460
21.2.1 Bibliometric Analysis of Contemporary Research	460
21.2.2 Contemporary Research	460
21.2.3 Bibliometric Analysis of Contemporary Research in China	461
21.2.4 Contemporary Research in China	462
21.2.5 Contributions by Chinese Scholars and Subsequent Problems	462
21.3 Roadmap for Further Research	463
21.4 Summary	464
References	465
22 International Rivers and Transboundary Environment and Resources	469
22.1 Overview	470
22.1.1 Development of Research Questions	470
22.1.2 Contributions by Scholars from Different Countries	470
22.1.3 Key Research Topics	471

22.1.4	The Role of NSFC in Supporting the Research on International Rivers and Transboundary Environment and Resources	473
22.2	Research Advances and Problems	475
22.2.1	Bibliometric Analysis of Contemporary Research	475
22.2.2	Contemporary Research	476
22.2.3	Bibliometric Analysis of Contemporary Research in China	476
22.2.4	Contemporary Research in China	477
22.2.5	Contributions by Chinese Scholars and Subsequent Problems	477
22.3	Roadmap for Further Research	478
22.4	Summary	479
	References	479
23	Records of Environmental Changes in Physical Geography	481
23.1	Overview	481
23.1.1	Development of Research Questions	481
23.1.2	Contributions by Scholars from Different Countries	482
23.1.3	Key Research Topics	483
23.1.4	The Role of NSFC in Supporting the Research on Records of Environmental Changes in Physical Geography	485
23.2	Research Advances and Problems	487
23.2.1	Bibliometric Analysis of Contemporary Research	487
23.2.2	Contemporary Research	487
23.2.3	Bibliometric Analysis of Contemporary Research in China	488
23.2.4	Contemporary Research in China	488
23.2.5	Contributions by Chinese Scholars and Subsequent Problems	490
23.3	Roadmap for Further Research	491
23.4	Summary	492
	References	492
24	Detection and Attribution of Changes in Land Surface Sensitive Components	495
24.1	Overview	495
24.1.1	Development of Research Questions	495
24.1.2	Contributions by Scholars from Different Countries	496
24.1.3	Key Research Topics	497
24.1.4	The Role of NSFC in Supporting the Research on Detection and Attribution of Changes in Land Surface Sensitive Components	497
24.2	Research Advances and Problems	500
24.2.1	Detection and Attribution of Terrestrial Ecosystem Change	501
24.2.2	Detection and Attribution of Hydrological Cycle Change	503
24.2.3	Detection and Attribution of Agriculture System Change	505
24.3	Roadmap for Further Research	506
24.4	Summary	507
	References	508
25	Uncertainty of Spatial Information and Spatial Analysis	511
25.1	Overview	511
25.1.1	Development of Research Questions	512
25.1.2	Contributions by Scholars from Different Countries	512
25.1.3	Key Research Topics	513
25.1.4	The Role of NSFC in Supporting the Research on Uncertainty of Spatial Information and Spatial Analysis	516
25.2	Research Advances and Problems	517
25.2.1	Bibliometric Analysis of Contemporary Research	517

25.2.2	Contemporary Research	517
25.2.3	Bibliometric Analysis of Contemporary Research in China.	518
25.2.4	Contemporary Research in China	518
25.2.5	Contributions by Chinese Scholars and Subsequent Problems	519
25.3	Roadmap for Further Research	520
25.4	Summary	520
	References.	521
Appendix A: List of 307 Mainstream SCI/SSCI Journals in Geographical Sciences		
		523
Appendix B: Abbreviations of the Funding Agencies in Fig. 1.4.		
		531
Appendix C: List of 29 CSCD and Chinese Core Journals		
		533
Appendix D: List of Institutions in the Collaborative Networks of Chinese Authors in the SCI/SSCI and CSCD (& Chinese Core Journals) Indexed Articles		
		535
Appendix E: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 8 “Global Change and Terrestrial Ecosystems”.		
		539
Appendix F: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 9 “Terrestrial Water Cycle and Water Resources”		
		541
Appendix G: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 10 “Land Change”		
		543
Appendix H: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 11 “Global Cryosphere Evolution and Land Surface Processes on the Tibetan Plateau”		
		551
Appendix I: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 12 “Economic Globalization and Local Responses”		
		555
Appendix J: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 13 “Regional Sustainable Development”		
		557
Appendix K: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 14 “Remote Sensing Modelling and Parameter Inversion”		
		559
Appendix L: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 15 “Spatial Analysis and Simulation”		
		561
Appendix M: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 16 “Tempo-Spatial Processes and Modelling of Environmental Pollutants”		
		563
Appendix N: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 17 “Geomorphology”.		
		569
Appendix O: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 18 “Ecohydrology”		
		571

Appendix P: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 19 “Ecosystem Services”	573
Appendix Q: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 20 “The Urbanization Process and Mechanism”	577
Appendix R: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 21 “Medical and Health Geography”	579
Appendix S: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 22 “International Rivers and Transboundary Environment and Resources”	585
Appendix T: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 23 “Records of Environmental Changes in Physical Geography”	587
Appendix U: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 24 “Detection and Attribution of Changes in Land Surface Sensitive Components”	591
Appendix V: Journals Retrieved with No Less than 15 SCI/SSCI-Indexed Articles in Chap. 25 “Uncertainty of Spatial Information and Spatial Analysis”	595

Authors and Contributors

Table of Author Details

	Lead Authors	Authors	Other Contributors
Introduction	Tao Pei, Xizhang Gao	Shenjing He, Xiaoqian Liu	
Chapter 1	Shuying Leng	Wenxiang Zhang, Siyuan He	<i>Canfei He, Desheng Xue, Linwang Yuan, Qihong Tang</i>
Chapter 2	Shuying Leng	Zhonglu Guo, Siyuan He	
Chapter 3	Shuying Leng Guoyou Zhang	Fengkui Qian, Siyuan He	<i>Linwang Yuan, Zhaoyuan Yu, Wen Luo</i>
Chapter 4	Shuying Leng	Hongyan Liu, Jiawu Zhang, Siyuan He	<i>Xuan Ji, Linshan Liu, Wenxiang Zhang, Huiyi Zhu, Yunlin Zhang, Xianyan Wang</i>
Chapter 5	Shuying Leng	Canfei He, Zhigang Li	<i>Ying Wang, Fengkui Qian, Desheng Xue, Geng Lin, Ye Liu, Yuqi Liu</i>
Chapter 6	Shuying Leng	Liangfu Chen, Linwang Yuan, Xizhang Gao, Yongjun Zhang	<i>Zhigang Liu, Jingchao Jiang, Xiaofeng Zhao, Yongjun Wang</i>
Chapter 7	Shuying Leng	Chunye Lin, Yi Yang	<i>Zhonglu Guo, Yuanming Zheng, Linsheng Yang, Bengang Li</i>
Chapter 8	Shilong Piao, Hongyan Liu	Zehao Shen, Jian Peng, Yangjian Zhang, Shuli Niu, Shiping Wang	<i>Jianguang Tan</i>
Chapter 9	Qihong Tang	Lei Wang, Shaofeng Jia, Dawen Yang, Si'ao Sun	<i>Xingcai Liu, Xuejun Zhang, Jun Xia, Changming Liu</i>
Chapter 10	Huiyi Zhu	Wei Song	
Chapter 11	Cunde Xiao, Lide Tian		<i>Qingbai Wu, Dongqi Zhang, Tingjun Zhang, Tonghua Wu, Tao Che, Fujun Niu, Chaolu Yi, Juzhi Hou, Eryuan Liang, Xiaoping Wang</i>
Chapter 12	Canfei He	Debin Du, Xin Tong, Fenghua Pan	<i>Xiyan Mao, Tianming Chen</i>
Chapter 13	Weidong Liu	Hui Liu, Li Ma, Tao Pan, Zhigao Liu, Mingxing Chen, Qing Tang	
Chapter 14	Liangfu Chen	Jin Chen, Guangjian Yan, Wenjie Fan, Xiaozhou Xin	<i>Chaoyang Wu, Tianjie Zhao, Shenglei Zhang, Xiaoying Li</i>
Chapter 15	Tao Pei	Jun Xu, Jianhua Gong, Xiaoping Liu	<i>Jianghao Wang, Shihong Du, Chengzhi Qin, Lin Yang, You Wan</i>

(continued)

	Lead Authors	Authors	Other Contributors
Chapter 16	Yuanming Zheng, Chunye Lin		
Chapter 17	Liping Zhu	Jinliang Feng, Fangen Hu	<i>Xiaoping Yang, Jiongxin Xu, Changxing Shi</i>
Chapter 18	Xiaoyan Li	Dawen Yang, Chunmiao Zheng	<i>Xinrong Li, Wenzhi Zhao, Mingbin Huang, Yaning Chen, Pengtao Yu</i>
Chapter 19	Yihe Lü	Shuai Wang	
Chapter 20	Desheng Xue	Zhigang Li, Shenjing He, Xianjun Zeng, Wei Li	
Chapter 21	Linsheng Yang		<i>Hairong Li, Yang Cheng, Binggan Wei</i>
Chapter 22	Daming He, Xi Chen	Xuan Ji, Jinming Hu, Anming Bao, Ruisen Zhong	<i>Yan Feng, Yungang Li, Yue Huang, Guli-Jiapaer</i>
Chapter 23	Liping Zhu	Qingfeng Ma, Jifeng Zhang, Yun Guo	<i>Eryuan Liang, Haifeng Zhu, Junbo Wang, Xinmiao Lü, Yong Wang</i>
Chapter 24	Fulu Tao	Shilong Piao, QiuHong Tang	<i>Wenjiao Shi</i>
Chapter 25	Xiaohua Tong	Huan Xie, Shijie Liu, Yanmin Jin	<i>Wenzhong Shi, Jinfeng Wang, Tao Pei, Yong Ge, Changqing Zhu</i>
Copy Editors	Shuying Leng, Xiaoqian Liu, Wenxiang Zhang, Zhonglu Guo, Fengkui Qian, Gengzhi Huang, Kun Shi, Li Wu, Yang Gao, Li Wang, Jun Wang, Xiaorong Zhao		
Database Design	(CSCD&NSFC) Xizhang Gao; (SCI/SSCI) Tao Pei; (Geographical Education) Canfei He, Desheng Xue, Linwang Yuan, QiuHong Tang		
Data analysis	Ci Song, Hua Shu, Jia Zhang, Ting Li		
Artwork	(Excel) Xiaoqian Liu; (CiteSpace) Fengkui Qian, Yafeng Lu		

Contributors

Anming Bao Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, China

Tianming Chen Peking University, Beijing, China

Tao Che Cold and Arid Regions Environmental and Engineering Research Institute, Chinese Academy of Sciences, Lanzhou, China

Jin Chen Beijing Normal University, Beijing, China

Liangfu Chen Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, Beijing, China

Mingxing Chen Institute of Geographic Sciences and Natural Resources Research, Chinese Academy of Sciences, Beijing, China

Xi Chen Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, China

Yaning Chen Xinjiang Institute of Ecology and Geography, Chinese Academy of Sciences, Urumqi, China

Yang Cheng Beijing Normal University, Beijing, China

Debin Du East China Normal University, Shanghai, China