
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!

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The Geographical Sciences During 1986—2015

From the Classics To the Frontiers

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