



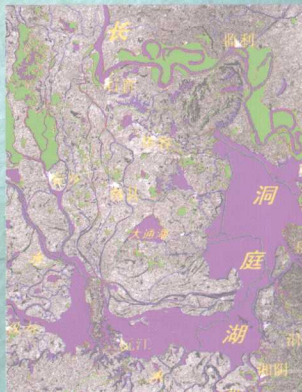
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摄影测量与遥感在中国

Photogrammetry and Remote Sensing in China

本书编委会 编



测绘出版社

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内 容 简 介

改革开放以来,中国摄影测量与遥感的科学研究、技术发展、教育普及、产业化应用等方面取得了长足进步,在国家经济建设、社会发展、资源研究、环境保护、防灾减灾、国防建设、国家安全、人民生活等方面有着十分广泛的应用,同时在积极参与摄影测量与遥感的国际学术交流与合作活动方面做出了应有的努力。本书采用中英文对照方式,介绍中国在摄影测量、遥感与空间信息系统领域取得的主要成就。

全书共分9章。第1章简要介绍了中国摄影测量与遥感的发展历程,第2章介绍了我国对地观测领域的民用系列卫星遥感系统和航空遥感系统,第3章介绍了中国在解析摄影测量、数字摄影测量、遥感图像处理、数字化测图与更新方面的主要技术成就,第4章介绍了在空间信息科学理论研究、国产地理信息系统软件平台、国家地理空间数据基础设施建设等方面取得的成就,第5章介绍了摄影测量与遥感在测图、农业、林业、水利等十个领域的典型应用案例,第6章介绍了中国摄影测量与遥感的产业规模、分布、产品与服务概况,第7章介绍了相关教育机构、招生规模,课程与教材建设等,第8章介绍了中国参加国际、区域相关组织及活动情况,第9章介绍了今后中国本领域的若干重点发展方向。

该书内容丰富翔实,是国内外同行了解中国在该领域的进展及和平利用空间信息技术成就的重要读物,对国内本领域及相关学科的科技人员、管理人员和广大读者有着重要的参考价值。

Abstract

Since the reform and opening up to the world, China has made great progress in photogrammetry, remote sensing and spatial information science. They have been widely applied in social economic development, resource investigation, environmental protection, disaster prevention and reduction, national security and people's life. And China has also been active in academic exchange and international cooperation. The book provides an overview in both Chinese and English about the major achievements of China in this field.

This book includes 9 chapters. Chapter 1 introduces the long history of surveying and mapping in China. Chapter 2 summarizes civil applications of air-borne and space-borne remote sensing systems for Earth observation in China. Chapter 3 describes key technological achievements in analytical photogrammetry, digital photogrammetry, remote sensing image processing, digital mapping and data updating in China. Chapter 4 presents the research on spatial information science, such as multi-dimensional spatio-temporal data modeling, uncertainty in spatial data and analysis, GIS-based process analysis and simulation, geo-information Tupu. Chapter 5 reviews key applications of photogrammetry and remote sensing in topographic mapping, forestry, agriculture, etc. . Chapter 6 describes the industrialization of mapping, remote sensing, GIS, and satellite-based navigation. An introduction is given to the scale, distribution, products, and services of photogrammetry and remote sensing in China. The education and international cooperation in this field are briefly summarized respectively in Chapter 7 and 8. An outlook about the future developments in photogrammetry and remote sensing in China is given in Chapter 9.

The contents of this book are full and informative. It is a useful reading book for domestic and foreign counterparts to know about the progress and the accomplishments in peacefully applying spatial information technology.

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序 一

在过去一个多世纪中,全球变化导致了地球环境的急剧恶化,极端气候频发,人类正面临着全球变化造成的各种自然灾害的不断侵袭。全球变化不仅对地球系统产生作用,而且对人类文明也造成影响。人类不仅面临着自然环境恶化的严重挑战,资源短缺、人口膨胀等也是人类正在面临的重大难题,应对这双重挑战是当前社会发展的重大历史使命。而掌握地球环境等空间信息对未来有效的、可持续的管理地球显得越发重要。地球空间信息可以被各国政府和国际组织用来作为全球管理和决策的有效信息源,以保证人类生存空间的可持续发展。

摄影测量和遥感技术的发展为全球监测、分析和模拟地球系统的变化提供了可能。以人造卫星为标志的空间信息时代的到来,在人类历史上第一次提供了从大气、海洋到陆地,从赤道到南北两极,覆盖整个地球的信息和它们的连续变化。到目前为止,大约有两千多颗人造卫星在天空中遨游,连续不断地获取地球变化的空间信息。

近几年来,世界各国都十分重视摄影测量与遥感技术在全球变化中的应用。欧洲航天局、美国国家航空航天局、日本宇宙航空研究开发机构等,协调各自发射的一系列对地观测卫星,建立对地观测系统以获得长期覆盖全球的对地观测数据,并将对地观测数据应用于全球气候、大气成分、水循环、植被变迁、海洋现象、自然灾害等地球空间环境变化的监测。中国也加入了国际地球观测组织(GEO)等诸多国际和区域合作组织,进入了卫星对地观测国际合作的大格局。

在过去的二十年里,摄影测量与遥感和地理信息系统技术与应用在中国得到了很大发展。经过政府的大力推动,以重大应用为导向,与国家科技计划紧密结合,初步形成了中国遥感、地理信息系统的技术创新体系框架,建成了一大批应用业务系统,在规划管理、灾害监测、环境

保护等社会可持续发展领域发挥着越来越重要的作用。

中国政府一贯鼓励和支持中国摄影测量、遥感和地理空间信息科技工作者积极参与国际摄影测量与遥感学会的各项活动,作出中国科技工作者应有的贡献。国际摄影测量与遥感学会在促进全球范围内摄影测量、遥感和地理信息系统科学研究、学术交流和国际合作方面作出了不懈努力与突出贡献。第21届国际摄影测量与遥感大会在中国召开,将进一步增强我国该领域科技工作者与国内外同行的相互了解与合作。

为了进一步促进国内外同行的交流与合作,《摄影测量与遥感在中国》一书,从空间数据获取、空间数据处理、空间信息管理与分析、空间信息典型应用、地理信息产业发展、学科与教育、国际合作七大方面介绍了我国在摄影测量与遥感领域的发展进步及和平利用空间信息技术的成就。该书不仅为国际同行了解中国在该领域的进展提供了丰富翔实的材料,也对国内各级管理人员、科技人员和广大读者有着重要的参考价值。

中国科学院院士

全国政协科教文卫体委员会主任

第21届国际摄影测量与遥感大会国家指导委员会主席

杨子宁

二〇〇八年六月十二日

Foreword I

In the past century, global change has caused rapid deterioration of the earth environment and frequent occurrence of extreme weather. Human beings are constantly threatened by natural hazards. Indeed, global change has great influences not only on the earth system, but also on human civilization. Human beings are faced with the challenge not only from environmental deterioration but also with the serious problems of resources shortage and over population. To deal with this double challenge is currently a great historical mission for the social development. Access to geospatial information (e. g. about the environment) has become increasingly important for effective and sustainable management of the earth. Geospatial information can be utilized by governments and international organizations as an effective source for global management and decision-making so as to ensure sustainable development of our living space.

The development of photogrammetry and remote sensing technology has made it possible to monitor, analyze and simulate the changes of the earth system. With the advent of spatial information era which is marked by satellite, human beings for the first time in the history are able to acquire information about the earth from the atmosphere to oceans and to lands, and from the equator to the north and south poles and about the continuous changes of the atmosphere, oceans and lands. Currently there are about two thousand satellites roaming in the space to continuously acquire the spatial information of the change of the earth.

In recent years, more and more countries have paid great attention to the applications of photogrammetry and remote sensing technology in dealing with global change. European Space Agency (ESA), US National Aeronautics and Space Administration (NASA) and Japan Aerospace Exploration Agency (JAXA) are collaborating in their earth observation systems to continuously acquire earth observation data with global coverage and then to utilize such data for monitoring the changes of the climate, atmospheric composition, water cycle, vegetation, oceanic phenomena, and natural hazards. A number of international organizations have also been formed for a similar purpose, such as the intergovernmental Group on Earth Observations (GEO). China has also become a member of GEO and other international and regional organizations, and is taking an active part in the international cooperation in earth observation.

In the past 20 years, remarkable progress has been achieved in China in the development of photogrammetry, remote sensing and geographic information system and

their applications. Under the promotion of the government, a technical innovation framework has been formed which is application-oriented and tightened with the national scientific and technical programs. A large number of operational application systems have been established and they have played an important role in various fields such as planning, hazard mitigation, environmental protection, and social sustainable development.

Through its unremitting efforts, ISPRS has made outstanding contributions in promoting the research, exchange, and international cooperation in the field of photogrammetry, remote sensing and geospatial information. Chinese Government has always encouraged and supported Chinese scientists in the fields of photogrammetry, remote sensing and geospatial information to actively participate in and make contributions to all the activities of ISPRS. The convening of the 21st ISPRS Congress in China will further strengthen the understanding and collaboration between Chinese scientists and their international colleagues.

To further promote international exchange and collaboration, this book 'Photogrammetry and Remote Sensing in China' is edited. It provides an introduction to China's achievements in photogrammetry and remote sensing and peaceful use of spatial information technology. It covers the range from spatial data capture, spatial data processing, spatial information management and analysis, spatial information application, development of geo-information industry, training and educational development, to international cooperation. This book not only provides rich and substantial contents to enable international colleagues better understand the advances in these areas in China but also offers a valuable reference to Chinese professional readers working in this field.

XU Guanhua

Academician, Chinese Academy of Sciences

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Co-Chairman, National Steering Committee of ISPRS 2008 Beijing

序 二

测绘是经济社会发展和国防建设的一项基础性工作,是准确掌握国情国力、提高管理决策水平的重要手段。摄影测量与遥感技术是重要的测绘技术。自 20 世纪 70 年代原武汉测绘科技大学名誉校长王之卓院士率先提出全数字自动化测图的构想以来,国家测绘局一直致力于推动中国测绘技术的现代化变革。经过广大测绘科技工作者的不懈努力,我国自行研发了数字摄影测量工作站、数字制图系统、数字航空摄影仪、地理信息系统软件等一大批具有自主知识产权的测绘科研成果,“十五”期间,测绘部门全面实现了由传统测绘技术体系向数字化测绘技术体系的历史性跨越。

与此同时,测绘工作者充分利用摄影测量与遥感技术、全球卫星导航定位技术、地理信息系统技术等现代测绘技术,加快基础地理信息资源建设,加强测绘成果和技术的推广应用。相继建立了全国 1:100 万、1:25 万、1:5 万基础地理信息数据库、部分省(自治区、直辖市)的 1:1 万基础地理数据库和一大批城镇大比例尺基础地理信息数据库。测绘高新技术和基础测绘成果在加强和改善宏观调控、促进区域协调发展、构建资源节约型和环境友好型社会、建设创新型国家等方面发挥了重要作用。

在最近发生的四川汶川大地震抗震救灾工作中,国家测绘局紧急建立了航天、航空、低空三位一体的灾区观测和遥感影像获取体系,快速获取和加工处理灾区遥感影像,快速整合集成灾区地震前后的各类基础地理信息、灾情信息和经济社会信息,尽最快的速度加工制作各类抗震救灾专用地图、正射影像图、影像地形图和三维地理信息服务系统,及时满足了灾情评估、抢险救灾、灾害监测、恢复重建等方面的急需,得到广泛肯定与好评。

随着我国信息化进程的不断加快,以及人口、资源、环境、灾害等问题的日益突出,必须大力加强我国测绘能力建设,全面提升服务我国现代化建设的测绘保障服务水平。当前,国家测绘局正抓紧实施国家西部 1:5 万地形图空白区测绘、“资源三号”测绘卫星、各级基础地理数据库建设与更新等重大测绘工程,加快实现我国基础地理信息资源的数量增加、质量提高和结构优化;大力推进信息化测绘体系建设,促进地理信息获取实时化、处理自动化、服务网络化和应用社会化。

国际摄影测量与遥感学会成立以来,为加强地理空间信息科学基础研究,推进摄影测量与遥感技术的发展、应用和交流,发挥了积极作用。国家测绘局历来高度重视与国际摄影测量与遥感同行的交流与合作。在中国举办第 21 届国际摄影测量与遥感大会,不仅为我国科技工作者提供了了解国际摄影测量与遥感及相关领域最新进展和发展动向的极佳机会,也提供了向国际同行展示我国在地理空间信息领域取得的巨大成就、全面展示中国和平利用地理空间技术造福人类的学术平台,必将有效促进中国与国际同行的广泛交流和深度合作。

值《摄影测量与遥感在中国》(中英文版)出版发行之际,特向为我国摄影测量与遥感科学技术作出贡献的中外专家致以崇高的敬意,祝第 21 届国际摄影测量与遥感大会圆满成功!

国土资源部副部长、国家测绘局局长

第 21 届国际摄影测量与遥感大会国家指导委员会主席



二〇〇八年六月十八日

Foreword II

Surveying and mapping is a kind of Infrastructure work for socio-economic development and national defense. It is an important means for accurately mastering the conditions and strength of a nation and for improving decision-making levels. Photogrammetry and remote sensing is an important part of surveying and mapping technology. Since the 1970s when Prof. WANG Zhizhuo (Academician of Chinese Academy of Science and honorary President of Wuhan Technical University of Surveying and Mapping) put forward the concept of fully digital mapping, the State Bureau of Surveying and Mapping (SBSM) has been devoted to the modernization revolution in surveying and mapping technology in China. Through unremitting efforts by Chinese scientists, a range of surveying and mapping products have been developed, such as digital photogrammetric work station, digital mapping system, digital aerial camera, and GIS software platform. During the period of the 10th Five-Year Plan, a historical leap of transforming surveying and mapping technology systems from analogue to digital was realized.

At the same time, Chinese surveying and mapping professionals are by means of photogrammetry and remote sensing, GPS and GIS technology making efforts on the development of geographic information infrastructure and on the applications of surveying and mapping technology and surveying results. The national fundamental geographic information databases at 1 : 1,000,000, 1 : 250,000, and 1 : 50,000, provincial databases at 1 : 10,000 and city/county databases at larger scales have been build up. New and high surveying and mapping technology and basic surveying and mapping results have played an important role in strengthening and improving macro-scale economic control, promoting coordinated regional development, building a resource-saving and an environment-friendly society and developing an innovation-oriented country.

During the mitigation and relief of recent earthquake in Wenchuan (on May 12th 2008), the SBSM has swiftly built up a system for monitoring the disaster-hit areas, which is based on airborne, aerial and low-altitude platforms; speeded up the image acquisition and processing; and integrated these images with other pre- and post-earthquake geospatial information resources (earthquake and socio-economic information) to produce special maps, orthophoto maps, and three-dimension geo-information service systems. These products satisfy the timely requirements for the disaster assessment, relief, and monitoring and for the reconstruction of disaster-hit areas.

With the acceleration of informatization process and increasingly prominence of outstanding problems associated with population, resources, environment and disasters, we must vigorously strengthen the capacity-building of China's surveying and mapping and upgrade our services for China's modernization drive. Currently the SBSM is making every effort to ensure the successful execution of some major projects like 1 : 50,000 topographic mapping for China's western areas, China-Brazil Earth Resources Satellite 3, and the establishment and updating of fundamental geographic information databases at different levels, to increase the quantity, improve the quality and optimize the structure of China's fundamental geographic information resources. We are making every effort to promote the development of IT-based surveying and mapping technology systems to achieve geographic information acquisition in real-time, processing with automation, services on-line and applications to the general public.

The ISPRS, since its foundation in 1910, has played an active role in strength of basic research on spatial information science, and promotion of exchange and applications of photogrammetry and remote sensing technology. The SBSM always attaches great importance to the technical exchange and cooperation with international colleagues in the field of photogrammetry and remote sensing. The holding of the 21st ISPRS Congress in China will not only provide a good opportunity for Chinese scientists to have a close-up view on the latest development in the fields of photogrammetry and remote sensing, but offer a platform to showcase China's development and achievements in the field of spatial information system and to demonstrate China's peaceful use of spatial information to benefit human beings. It will greatly promote the broad exchange and in-depth collaboration between Chinese scientists and their colleagues in the world.

On the occasion of publishing the book 'Photogrammetry and Remote Sensing in China', I'd like to take this opportunity to pay high tribute to all the scientists who have made contributions to the development of photogrammetry and remote sensing of China and to wish the 21st ISPRS Congress a great success.

LU Xinshe

Vice Minister, Ministry of Land and Resources

Director General, State Bureau of Surveying and Mapping

Co-Chairman, National Steering Committee of ISPRS 2008 Beijing

前 言

摄影测量与遥感是从影像和其他传感器系统中获取地球及其环境的可靠信息,并对其进行记录、量测、分析与表达的科学和技术。改革开放以来,中国摄影测量与遥感在科学研究、技术发展、教育普及、产业化应用等方面取得了长足进步,在国家经济建设、社会发展、资源研究、环境保护、防灾减灾、国防建设、国家安全、人民生活等方面有着十分广泛的应用,同时中国在积极参与摄影测量与遥感的国际学术交流与合作活动方面也作出了应有的努力。这为中国 2004 年成功获得第 21 届国际摄影测量与遥感大会(ISPRS Congress)举办权打下了良好的基础,经国务院批准,此次国际学术盛会将于 2008 年 7 月 3 日至 11 日在北京国际会议中心举行。

为了便于参加第 21 届国际摄影测量与遥感大会的代表及国内外同行更好地了解中国该领域的发展与应用情况,我们在大会国家指导委员会的指导与支持下,发动和组织全国本领域高水平专家、学者,编写了这本旨在反映中国摄影测量、遥感与空间信息系统领域主要成就的《摄影测量与遥感在中国》。该书重点介绍了中国在空间信息的获取、处理、管理与分析、应用、产业化各个阶段的主要成就,以及在该领域的学科教育和国际合作情况。全书分为九章,第一章和第九章由李德仁院士编写,第二章由田国良研究员组织编写,第三章由袁修孝教授组织编写,第四章由周成虎研究员和方裕教授组织编写,第五章由金奕名研究员组织编写,第六章由钟耳顺研究员组织编写,第七章由刘耀林教授组织编写,第八章由白泊编审组织,来自全国 30 多个单位近 50 名专家参加了编写工作或提供了素材。全书中文稿由田国良研究员、陈军教授、何超英博士统稿。张景雄教授、杨崇俊研究员、詹庆明教授、刘闯研究员、李志林教授、孙保武编审、代强玲女士、袁金国博士等负责了

有关章节的英文翻译,全书英文稿由周启鸣教授统稿与审定。

国家测绘局、国家自然科学基金委员会、中国测绘学会等对本书的编写与出版给予了多方面的支持与帮助;第21届国际摄影测量与遥感大会国家指导委员会主席徐冠华院士、鹿心社局长对本书的编写与出版工作高度重视,亲自为本书做序;国家指导委员会常务副主席宋超智副局长为本书的编写作了具体指导;国家指导委员会副主席李德仁院士和杨凯理事长担任了本书编委会主任委员,并直接参与了本书大纲的讨论与主要内容的审定。在此一并向他们和所有对本书编写、翻译、出版作出贡献的人士与朋友们表示衷心的感谢。

由于编写时间仓促,加上组织水平有限,本书难免挂一漏万,定存在着不妥及不足之处,恳请同行与读者批评指正。

陈 军 金奕名 何超英

2008年5月31日