

风云纵览

Magnificent Wind And Cloud

风云一号 C 星图集

FY-1C Satellite Imagery And Applications

国家卫星气象中心

National Satellite Meteorological Center

上海航天技术研究院

Shanghai Academy of Spaceflight Technology

气象出版社

PDG

献给为卫星气象事业做出贡献的人们

For all those

who contribute to the cause of satellite meteorology ...



主 编：董超华 张文建

副 主 编：范天锡 孟执中 卢乃锰

编 委：方宗义 徐博明 刘玉洁 高火山 黄 签

英文翻译：罗东风 唐闻生

图像美工：黄 签

美术设计：杨玉华

基础数据：朱小祥 张里阳 马 刚 郑照军 刘瑞霞

师春香 游 然 许 徽 郭 炜 樊昌尧

产品制作：江吉喜 黄 签 朱小祥 闫 静 师春香

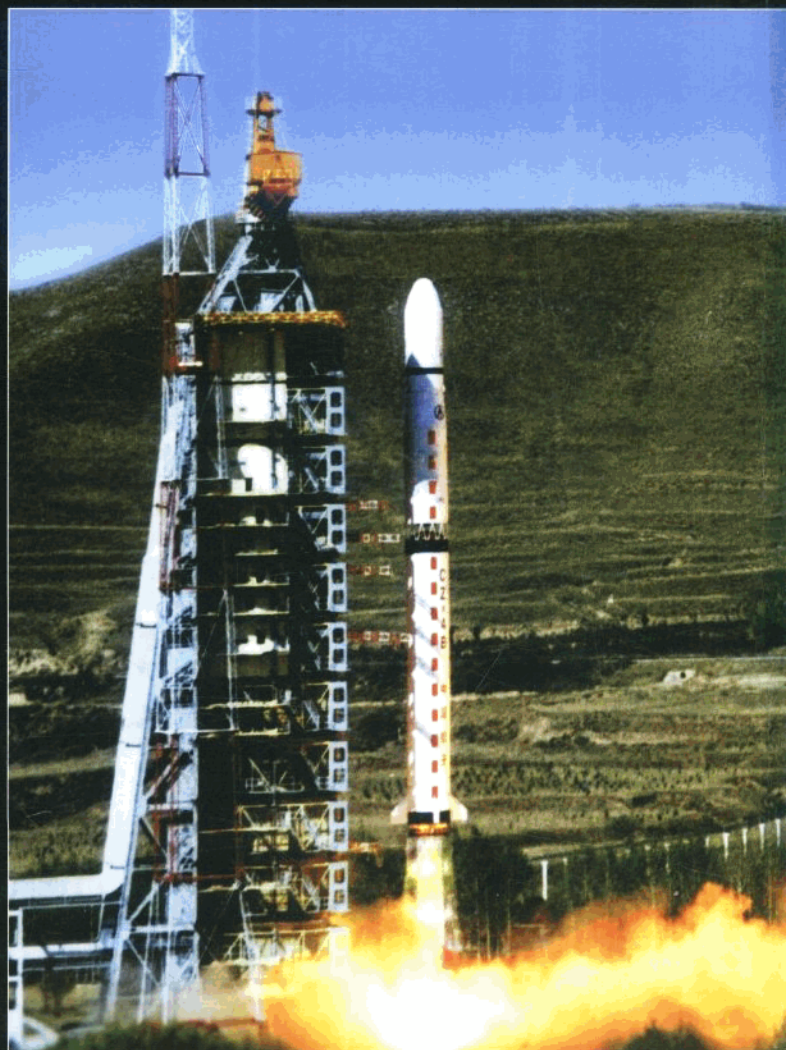
陈金娥 陈维英 肖乾广 刘 健 刘玉洁

郑照军 罗敬宁 刘 诚 孙安来 杨忠东

谷松岩 赵洪森 胡秀清 邱 红 吴 晓

徐 磊 张畔萍 赵长海 闫 华 李亚君

张 鹏



1999.5.10.9:33 风云一号C气象卫星由长征四号乙运载火箭在中国山西太原卫星发射中心发射升空。





FY-1C meteorological satellite, carried by Long March-4B Rocket, is lifting off for the journey in the space, 09:33BT, May 5, 1999, Taiyuan Launch Center, Shanxi Province.





(模拟图)

1999年5月10日北京时间9时33分，在太原卫星发射中心，用长征四号乙火箭，成功发射了风云一号C气象卫星（简称FY-1C）。这是继1988年和1990年FY-1A和FY-1B后，我国发射的第三颗极轨气象卫星。卫星入轨后第二圈，由地面遥控打开了扫描辐射计的7个可见光、近红外和短波红外通道。6月10日又打开了其余3个热红外通道，地面站在星上播放遥感信号后立即进行接收和处理，图像质量良好。1999年6月24日至7月18日对FY-1C星进行了在轨测试，测试结果表明：卫星性能符合设计要求。FY-1C气象卫星从发射至今工作状态良好。

轨道特征： 太阳同步轨道
轨道高度： 863公里
轨道倾角： 98.79°
轨道偏心率： 0.00188
轨道周期： 102.332分钟
轨道回归周期： 10.61天
轨道降交点地方时： 08:34（1999年7月4日）
卫星总体技术参数
重量： 950公斤
峰值功率： 295瓦
平均功率： 229瓦
高度： 2.115米
总长度： 10.556米（含太阳帆板）
星体尺寸： 1.42米×1.42米×1.20米（柱型六面体）
姿态： 三轴稳定
设计寿命： 二年
遥感仪器
 两台10通道的可见光和红外扫描辐射计，互为备份
主要特性为
扫描率： 6条扫描线/秒
对地扫描角： ±55.4°
星下点地面分辨率： 1.1公里
数据量化等级： 10比特
定标精度： 可见光、近红外10%(反射率)红外1K(300K)
10个通道的波长：

通道	波长(μm)	通道	波长(μm)
1	0.58-0.68	6	1.58-1.64
2	0.84-0.89	7	0.43-0.48
3	3.55-3.93	8	0.48-0.53
4	10.3-11.3	9	0.53-0.58
5	11.5-12.5	10	0.900-0.965

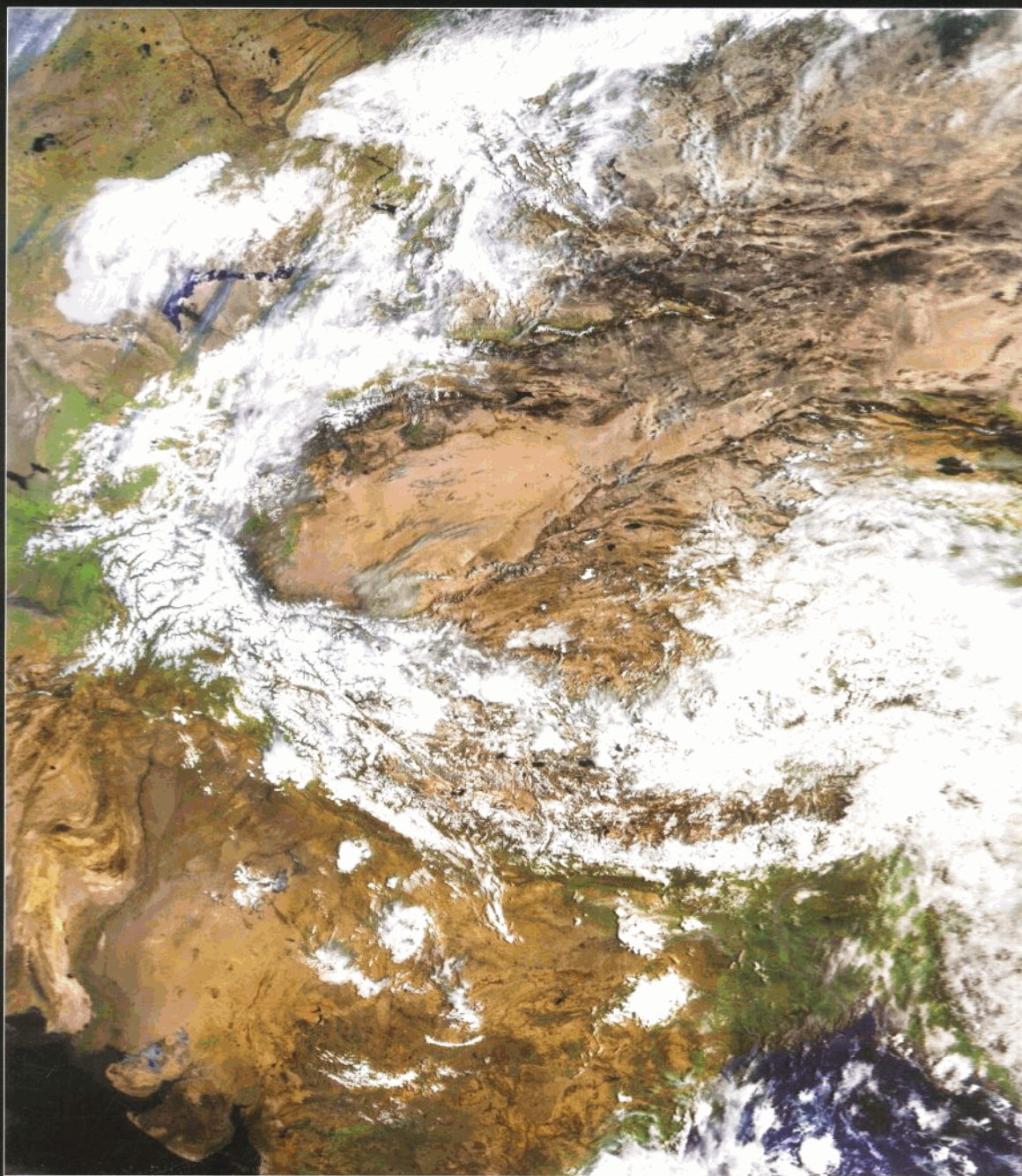
The FY-1C meteorological satellite was launched successfully at 09:33BT on May 10, 1999, Taiyuan Launch Center with a Long March-4B Rocket. FY-1C is the third Chinese polar orbiting meteorological satellite in a sequence following FY-1A and FY-1B launched in 1988 and 1990, respectively. On its second circle flying around the globe after entering the orbit, the on-board radiometer opened 7 channels of the visible, near-infrared and shortwave infrared by the ground instruction. On the tenth of June, the remaining 3 channels of long-wave infrared started to work. Upon capturing the transmission signal, the ground station immediately began to receive and process the data, and the first image of FY-1C was produced with good quality. The in-orbit test for the satellite conducted from June 24 to July 18, 1999 showed that the design requirements were satisfied. The satellite is now in good operational status.

Orbit parameters:

Orbit: sun-synchronous
Altitude: 863 km
Inclination: 98.79°
Eccentricity: 0.00188
Period: 102.332min
Satellite weight: 950kg
Height: 2.115m
Length(including solar panel): 10.556m
Size: 1.42m × 1.42m × 1.20m
Designed life time: 2 years
Real time picture transmission: CHRPT format
Delayed picture transmission: GDPT format(Global)
 LDPT format(Local)
Global recording capacity: 300 min
Local recording capacity: 20 min
Attitude stabilization: three-axis stabilization
Satellite power supply: 295W(peak value)
Average power supply: 229W

10-channel scan radiometer:

Channel	Wave length(μm)	Channel	Wave length(μm)
1	0.58-0.68	6	1.58-1.64
2	0.84-0.89	7	0.43-0.48
3	3.55-3.93	8	0.48-0.53
4	10.3-11.3	9	0.53-0.58
5	11.5-12.5	10	0.900-0.965



1999年5月10日北京时间11时17分FY-1C气象卫星发射后的第一条轨道区域地貌图像，图中绿色为植被，浅蓝色及白色为云或积雪，黑色为水体，黄色和褐色为荒漠地带。

(制作：黄签)

The first FY-1C visible image at 03:17GMT on May 10, 1999. The geographic features in Xinjiang are shown vividly.

前言

2001年5月10日是我国自行研制生产的风云一号C星发射后成功运行两周年，达到设计寿命的日子。这是值得纪念的一天，也是在我国气象卫星发展史上有深远影响的一个里程碑。它记载着我们失败后的崛起，磨难后的成功，辛勤劳动的回报，勤奋耕耘的收获。

风云一号C星是一颗业务应用气象卫星。自卫星发射成功后，国家卫星气象中心就肩负着卫星连续运行（实时接收、处理、产品分发和服务等）的重任。两年多来，由三站（北京、广州和乌鲁木齐气象卫星地面站）和数据处理中心组成的运行和存档系统保持了稳定运行和数据存档的完整性，为应用服务工作打下了良好基础。

业务应用卫星系统的成功与否还要体现在应用方面。自风云一号C星投入业务运行以来，国家卫星气象中心的科技人员针对风云一号C星十通道辐射计的特点，在应用方面做了大量的工作。例如，独立自主地研制了复杂的数据处理系统；将卫星数据实时处理成区域各通道图像、彩色合成图像和全球拼图等；开发研制了诸如植被指数、海面温度、晴空亮温、云分类图、水汽分布图、积雪覆盖分布图、各类专题图像等多种卫星定量遥感产品；为多种应用提供产品服务。

图集分为五大部分，集中反映了各应用领域的主要成果。第一章“锦绣山河”，汇集了风云一号C星的经典图像，其中既有中国区域春夏秋冬四季晴空影像，也有全球多通道彩色合成图像；既有深入浅出的GDPT成像原理图，也有经过复杂定量计算而得到的全球陆表晴空辐射亮温数值产品。第二章“气象万千”，收录了风云一号C星在天气分析方面的应用实例，从中小尺度的暴雨云团到大尺度的温带锢囚气旋，从沙尘暴监测到水汽含量的定量反演，各种天气分析应用产品尽收其中。第三章“斑斓大地”，反映了风云一号C星资料在地表分析方面的应用成果，例如内蒙古的雪灾、蒙古的大火、华北的干旱、长江的洪水等，各种产品充分显示了风云一号C星在环境遥感和灾害监测中的无限神威。第四章“沧海掠影”，展示的是风云一号C星水色通道在海洋环境遥感中的特有本领。河口泥沙、近海赤潮、海冰演变、海温反演等一系列海洋遥感应用产品一览无余。第五章“异域风光”，撷取了风云一号C星资料在全球环境变化监测方面的应用产品和风云一号C星HRPT资料在国外直接接收应用的实例。冰峰雪原的南极洲、广袤浩瀚的北冰洋、澳大利亚的飞机尾迹、美国西部清晰的海岸，各种绮丽影像尽在其中。

尽管本书是一本图集，然而，它记载的决不仅仅是一颗气象卫星的图像和产品，中国的气象卫星和卫星气象事业从无到有、从小到大，是几代人孜孜不倦上下求索缔造起来的系统工程。许多人没有能亲眼看到今天的成功，他们用生命托起了我们的气象卫星；许多人今天已不再年轻，他们的青春已化为气象卫星艳丽的画卷。气象卫星的发展是一个由五大系统通力协作组成的系统工程，其中中国气象局国家卫星气象中心承担着应用系统建设和运行，上海航天技术研究院是卫星和火箭研制的总体单位。在风云一号C星业务运行两周年的今天，我们谨以此图集，献给为我国气象卫星和卫星气象事业做出贡献的五大系统的全体人员，并向所有为发展中国气象卫星和卫星气象事业做出贡献的人们表示崇高的敬意。

中国气象局国家卫星气象中心
中国航天科技集团公司上海航天技术研究院

PREFACE

The Chinese meteorological satellite and its applications take a great leap forward into the 21st century with the FY-1C satellite operating successfully for two years by the day May 10, 2001, reaching the life time designed. It is a day to remember and a milestone event to celebrate, the impact of which is sure to be far reaching in the Chinese history of developing the space science and technology.

FY-1C is an operational meteorological satellite. The National Satellite Meteorological Center (NSMC) is in charge of real-time data receiving, processing, dissemination, and application service. The operational and archiving system, including one data processing center and three ground stations, has been working well since the satellite was launched, making it possible for preservation of a complete data archive, critical and fundamental for applications and service.

Application is an important aspect for an operational satellite system. To make the best use of FY-1C satellite that is characterized by a ten-channel radiometer, NSMC has developed a state-of-the-art application system to process real-time satellite data, to create the channel image, color composite and global mosaic image. Quantitative remote sensing products such as vegetation index, sea surface temperature, cloud classification, water vapor distribution and snow coverage, and so on and so forth, have been developed for various application purposes.

The pictures in this five-section book cover various application fields. In the first section "Many-splendoured Views", there are some fine pictures from FY-1C, including the cloud-free images of China in different seasons, the color composite images of the world; the primitive GDPT data displayed to explain how the global observation is obtained, and the quantitative products that need careful calculation to make. Section two "Ever-changing Weather" gives examples of FY-1C images in analyzing small or mesoscale thunderstorm, large scale temperate occluded cyclone, sandstorm; and product of retrieved water vapor amount. The third section "Colourful Mother Land" shows the pictures of FY-1C in use for monitoring environment and natural hazards, such as snowstorm, grass fire, drought, flood and so on. Section four "Over the Vast Waters" exhibits the pictures of FY-1C in monitoring silt, red tide, sea ice, and sea surface temperature. The ocean color channel of FY-1C is useful for ocean environment study. Section five "Foreign Lands and Seas" gives some cases in monitoring the global change. There are interesting overseas images, some of which come from the GDPT of FY-1C, and some from foreign contributors who directly receive FY-1C HRPT data.

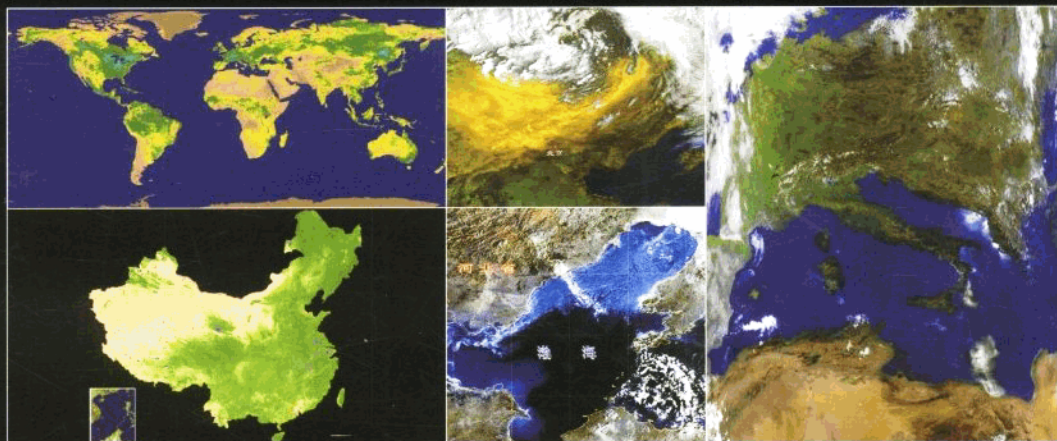
A picture album as this, the book not only records the products of a mere meteorological satellite, but also exhibits the progress in developing the Chinese meteorological satellite that has involved effort of people for generations. Though many of them are no longer young today, and some even unable to see the success, they left behind a splendid and glorious picture of a great cause they drew with life and youth.

Meteorological satellite development and application is an integrated engineering project that requires coordination between various aspects involved. The National Satellite Meteorological Center is responsible for the construction and operation of ground application subsystem, the Shanghai Academy of Spaceflight Technology is in charge of developing and manufacturing the satellite and launch vehicles. We publish this book to commemorate this day, and to present it as our gift, as well as our respect to all those who contribute to the achievement in developing the Chinese meteorological satellites.

National Satellite Meteorological Center
China Meteorological Administration

Shanghai Academy of Spaceflight Technology
China Aerospace Science and Technology Corporation

目录 CONTENTS



锦绣山河 Many-splendoured Views

1

气象万千 Ever-changing Weather

21

斑斓大地 Colourful Mother Land

45

沧海掠影 Over the Vast Waters

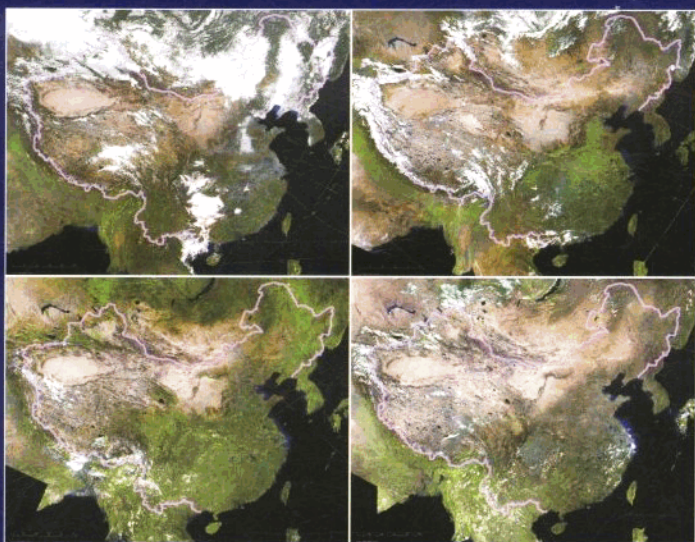
63

异域风光 Foreign Lands and Seas

71

锦绣山河

Many-splendoured Views







◀ FY-1C 晴空影像镶嵌图

采用1999年8月底至10月初期间的高分辨率图像传输数据(CHRPT),融合数字高程模型(DEM)信息产生的具有地形渲染效果的晴空影像镶嵌图。影像彩色合成方式为: FY-1C的通道1、2、8分别赋予红、绿、蓝色。兰勃托等角圆锥投影,象元分辨率为1000米。

(制作: 黄益)

FY-1C Cloud-free Image Mosaic

The topographic rendering image created with CHRPT data from the end of August to early October, 1999 and fused with terrain shaded relief from a Digital Elevation Model (DEM). CH1, 2, 8 (RGB); Lambert projection with pixel resolution of 1000 meters.

FY-1C 中国四季影像镶嵌图

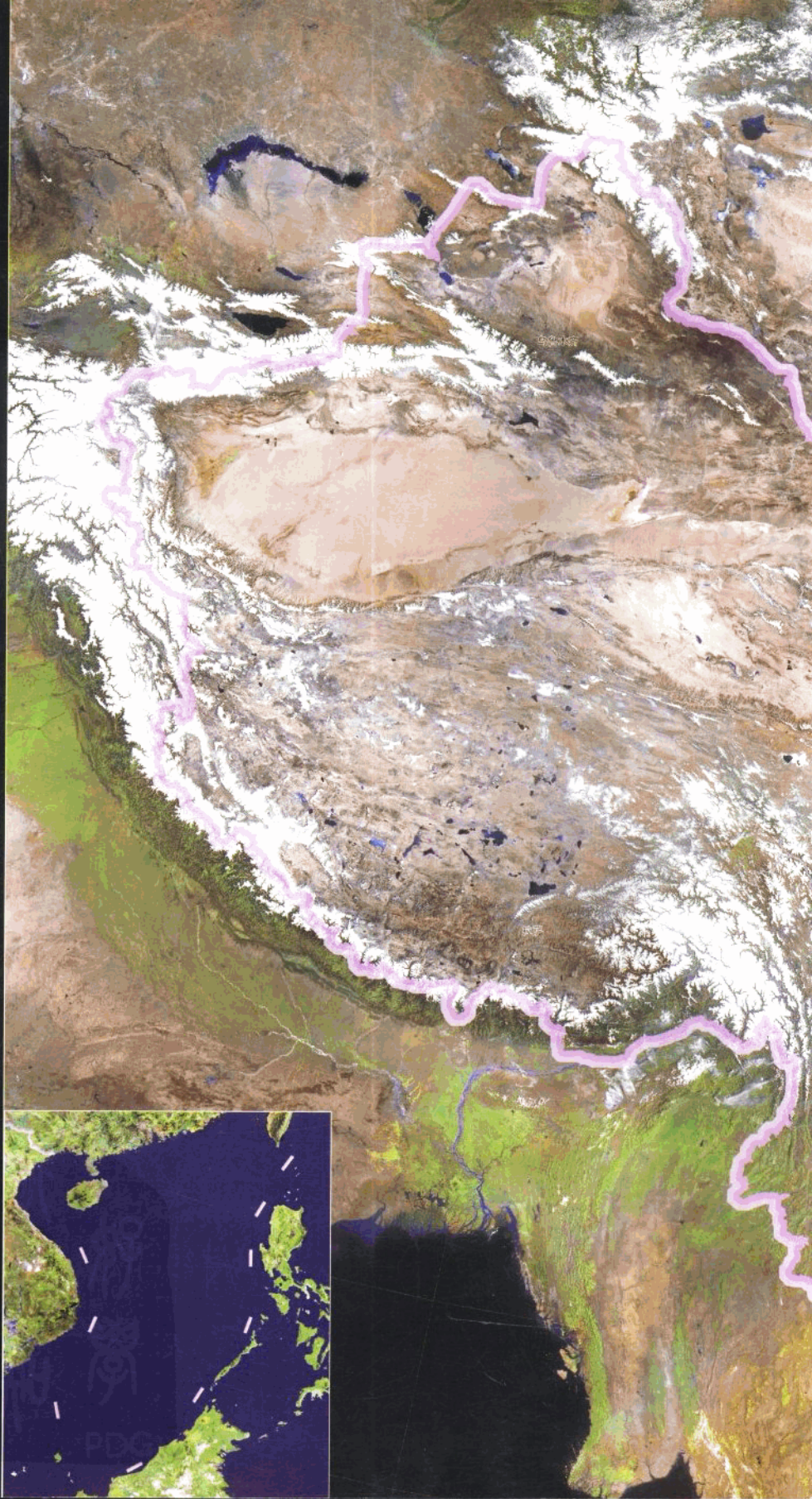
采用 FY-1C/CHRPT 数据制作的中国 2000 年春、夏、秋、冬四个季节的最低云量影像镶嵌图。各季节分别采用其代表月份，即 1 月、4 月、7 月和 10 月的数据，经多时相晴空数据提取、几何配准和数据融合构成。仿自然色的彩色合成方式为：通道 6、2、1 分别赋予红、绿、蓝色。阿尔伯斯等积圆锥投影，象元分辨率为 1000 米。

(制作：黄笠)

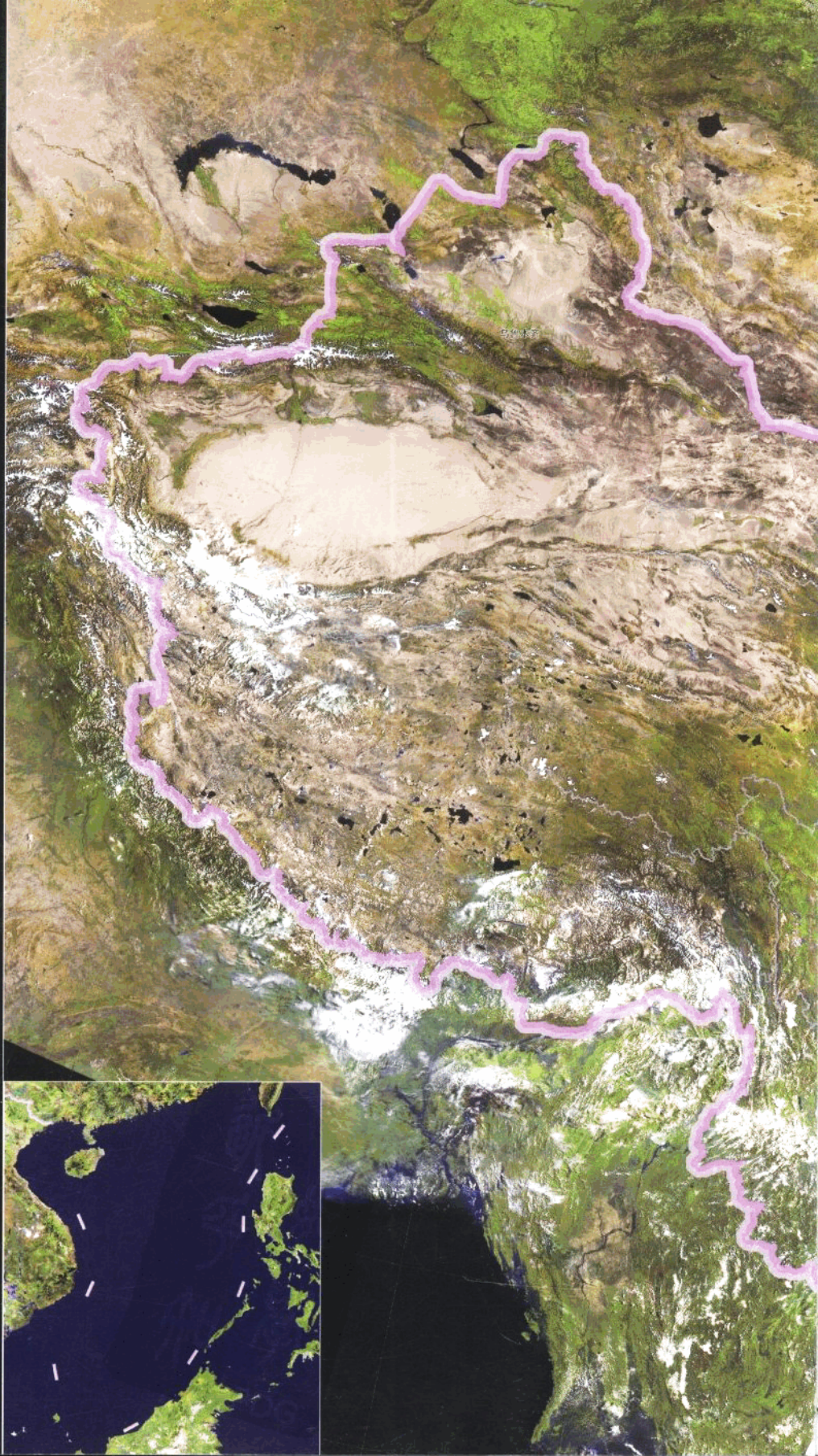
FY-1C Seasonal Image Mosaic

The seasonal image mosaic series created with multi-temporal CHRPT data from January (winter), April (spring), July (summer) and October (autumn), 2000 with cloud-free data extraction, registration and data fusion. The simulated natural color composition is made from CH6, 2, 1(RGB). Albers projection with pixel resolution of 1000 meters.

► 春 Spring







▶ 夏 Summer

